

**St. James Civic Centre**  
**Phase 2 – Building Systems Upgrades**  
2055 Ness Avenue  
Winnipeg, Manitoba

For:  
The City of Winnipeg  
185 King Street  
Winnipeg, MB R3B 1J1

**Specifications**  
(Architectural, Structural, Mechanical, Electrical)

**ISSUED FOR CONSTRUCTION**  
**NOVEMBER 2019**

Set No. \_\_\_\_\_

Tender No. 1176-2019

**PUBLICCITY**

**Public City Architecture Inc**  
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R3G 2X6 204 475 9323  
publiccityarchitecture.com

# St. James Civic Centre Phase 2 Building Systems Upgrades

Located at: 2055 Ness Avenue, Winnipeg, Manitoba R3J 0Z2

## **OWNER**

**City of Winnipeg**  
4<sup>th</sup> Floor - 185 King Street  
Winnipeg, MB R3B 1J1

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**Part 1 GENERAL**

**1.1 EXAMINATION**

- .1 The Bidder, either personally or through a representative, shall examine the place of Work before submitting a Bid, and shall satisfy himself as to the nature and location of the Work and local conditions at the site of the Work, the equipment and facilities needed preliminary to and during the execution of the Work, the means of access to the site, onsite accommodation, all necessary information as to risks, contingencies and circumstances which may affect this Bid, and all other matters which can in any way affect the Work. The Bidder is fully responsible for obtaining all information required for the preparation of the Bid.
- .2 Claims for additional costs will not be entertained with respect to conditions which would reasonably have been ascertained by an inspection of the site prior to the Bid closing date.

**1.2 APPENDIX A – HAZARDOUS BUILDING MATERIALS ASSESSMENT**

- .1 Hazardous Building Materials Assessment (Revision #02) prepared by PINCHIN dated the 4<sup>th</sup> of October, 2018.
- .2 Any information pertaining to hazardous building materials is furnished by the Contract Administrator as a matter of general information only and is not to be interpreted as descriptive of conditions at locations other than those described therein.
- .3 The survey provides information on the types and locations of asbestos containing materials and was prepared primarily for the use of the City. The report, by its nature, cannot reveal all conditions that exist or can occur on the site. The Contractor may use this information to draw his own conclusions therefrom.

**1.3 APPENDIX B – BUILDING CONDITION ASSESSMENT REPORT**

- .1 St. James Civic Centre – 2055 Ness Avenue – Building Condition Assessment, prepared by Crosier Kilgour & Partners Ltd., dated June 14, 2019 (CKP File No. 2019-0374)

**1.4 APPENDIX C – GEOTECHNICAL – TEST HOLE LOGS**

- .1 St. James Civic Centre – Appendix C – Geotechnical – Test Hole Logs, prepared by Trek Geotechnical, dated May 9, 2019 (Trek Project Number 0015 024 00).

**1.5 APPENDIX D – TOPOGRAPHICAL SURVEY**

- .1 Topographical survey prepared by Barnes and Duncan, dated November 20<sup>th</sup>, 2018.

**END OF SECTION**

**Part 1            General**

1.1            OWNER

- .1            The Owner is: City of Winnipeg.

1.2            DRAWINGS AND SPECIFICATIONS

- .1            The Work is to be executed in conformance with the Drawings and Specifications, which are to form a part of the Contract. The Drawings and Specifications are complimentary, and what is called for in one is to be considered called for by both.
- .2            The arrangement and compilation of the Drawings and Specifications under the several Sections and Divisions is purely arbitrary and is intended to relate and clarify the Work and shall be interpreted as a whole. The responsibility for the arrangement of the supply of the several and varied Materials and Labour wherever they may appear shall rest solely with the Contractor.
- .3            In the event of discrepancy between Drawings and Specifications, the Contractor is to assume the product, Material, or method which is the more costly, unless such conflict is resolved by addendum.
- .4            The Contractor is held responsible for the delivery of a completely weatherproof building. If for any reason the Contractor questions the weather tightness of any portion of the building as drawn or specified, he shall so state to the Contract Administrator prior to performing that portion of the Work. Failure to do so shall not relieve the Contractor from taking whatever subsequent remedial action may be necessary to weatherproof the building, and paying for same.

1.3            WORK BY THE CITY

- .1            Work of Project which will be executed after completion of Work of this Contract, and which is specifically excluded from this Contract:
  - .1            Furniture
  - .2            Final keying and cores.

**END OF SECTION**

**Part 1**

**General**

- 1.1 RELATED WORK
- .1 Division 01 – General Requirements
  - .2 Division 02 – Existing Conditions
  - .3 Division 03 – Concrete
  - .4 Division 07 – Thermal and Moisture Protection
  - .5 Division 10 – Specialities
- 1.2 REFERENCES
- Not Used
- 1.3 CASH ALLOWANCES
- .1 Include in Contract Price, cash allowances stated herein.
  - .2 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation and other authorized expenses incurred in performing Work.
  - .3 The Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
  - .4 The Contract Price will be adjusted by written order to provide for an excess or deficit to each cash allowance.
  - .5 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in Contract Documents.
  - .6 Progress payments on accounts of Work authorized under cash allowances shall be included in monthly certificate for payment.
  - .7 A schedule shall be prepared jointly by Contract Administrator and Contractor to show when items called for under cash allowances must be authorized by Contract Administrator for ordering purposes so that progress of Work will not be delayed.
  - .8 The amount of each allowance item is as follows: (to be carried by the Contractor, including Retail Sales Tax, but excluding GST)
    - .1 Building permit \$ 25,000
    - .2 Concrete testing \$ 2,500
    - .3 Compaction testing \$ 2,500
    - .4 Roofing inspections \$ 15,000
    - .5 Interior Signage \$ 5,000
    - .6 Painting Inspections \$ 7,500
    - TOTAL \$ 57,500

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 45 00 – Quality Control
- .3 Section 01 52 00 – Construction Facilities
- .4 Section 01 56 00 – Temporary Barriers and Enclosures
- .5 Section 01 78 00 – Closeout Submittals

**1.2 ADMINISTRATIVE**

- .1 Contractor will schedule and administer project meetings throughout the progress of the Work as required.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting five (5) Working Days in advance of meeting date to all parties required to attend.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record accurate and complete meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within three (3) Working Days after meetings and transmit to meeting participants and, affected parties not in attendance.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

**1.3 PRECONSTRUCTION MEETING**

- .1 Within fifteen (15) Working Days after award of Contract, request a meeting of parties in Contract to discuss and resolve administrative procedures and responsibilities.
- .2 Contractor, major Subcontractors, Contract Administrator and the City will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum of five (5) days before meeting.
- .4 Agenda to include:
  - .1 Appointment of official representative of participants in the Work
  - .2 Schedule of submission of Shop Drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .3 Requirements for temporary facilities, Site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
  - .4 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
  - .5 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
  - .6 City provided products.
  - .7 Record Drawings in accordance with Section 01 33 00 - Submittal Procedures.

- .8 Maintenance manuals in accordance with Section 01 78 00 – Closeout Submittals.
  - .9 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
  - .10 Monthly progress claims, administrative procedures, photographs, and hold backs.
  - .11 Appointment of inspection and testing agencies or firms in accordance with Section 01 45 00 – Quality Control.
  - .12 Insurances, and transcript of policies.
  - .5 Comply with Contractor's allocation of mobilization areas of Site; for field offices and sheds, for access, traffic, and parking facilities.
  - .6 During construction co-ordinate use of Site and facilities through Contractor's procedures for intra-project communications: Submittals, reports and records, schedules, coordination of Drawings, recommendations, and resolution of ambiguities and conflicts.
  - .7 Comply with instructions of Contractor for use of temporary utilities and construction facilities.
  - .8 Coordinate field engineering and layout Work with Contractor.
- 1.4 PROGRESS MEETINGS
- .1 During course of Work and two weeks prior to project completion, schedule progress meetings monthly as required.
  - .2 Contractor, major Subcontractors involved in Work, Contractor, Contract Administrator and the City are to be in attendance. Include costs for execution, preparation and reproduction of schedule submittals in Bid documents.
  - .3 Notify parties minimum five (5) Working Days prior to meetings.
  - .4 Contractor will record accurate and complete minutes of meetings and circulate to attending parties and affected parties not in attendance within three (3) Working Days after meeting.
  - .5 Agenda to include the following:
    - .1 Review, approval of minutes of previous meeting.
    - .2 Review of Work progress since previous meeting.
    - .3 Field observations, problems, conflicts.
    - .4 Problems which impede construction schedule.
    - .5 Review of Off-Site fabrication delivery schedules.
    - .6 Corrective measures and procedures to regain projected schedule.
    - .7 Revision to construction schedule.
    - .8 Progress schedule, during succeeding Work period.
    - .9 Review submittal schedules: expedite as required.
    - .10 Maintenance of quality standards.
    - .11 Review proposed changes for affect on construction schedule and on completion date.
    - .12 Other business.
  - .6 Review of progress and status of critical path activities.

**PART 2        PRODUCTS**

2.1            NOT USED

    .1        Not Used.

**PART 3        EXECUTION**

3.1            NOT USED

    .1        Not Used.

**END OF SECTION**

**PART 1 GENERAL REQUIREMENTS**

1.1 GENERAL

- .1 Provide construction photographs in accordance with procedures and submission requirements specified in this Section.
- .2 Photographs shall be colour, in digital format.
- .3 Provide electronic copies of photos to the Contract Administrator, bi-weekly.

**PART 2 EXECUTION**

2.1 PRE-CONSTRUCTION PHOTOGRAPHS

- .1 Viewpoints: interior and exterior locations of the existing building, prior to any demolition Work.
- .2 Number of viewpoints:
  - .1 Each side of building exteriors
  - .2 Interior of all existing rooms and finishes

2.2 PROGRESS PHOTOGRAPHS

- .1 Viewpoints: interior and exterior locations of the Work as determined by Contract Administrator, minimum 40 photographs per month.

2.3 FINAL PHOTOGRAPHS

- .1 Number of viewpoints:
  - .1 Each side of building.
  - .2 Interior of rooms and finishes.

**END OF SECTION**



**PART 1 GENERAL**

1.1 SECTION INCLUDES

- .1 Shop Drawings and product data.
- .2 Samples.
- .3 Certificates and transcripts.

1.2 RELATED SECTIONS

- .1 Section 01 45 00 – Quality Control
- .2 Section 01 78 00 – Closeout Submittals

1.3 PRECONSTRUCTION SUBMITTALS

- .1 Submit for approval prior to first application for payment, a Contract breakdown indicating amounts for individual portions of the Work. This breakdown shall be detailed enough to provide progress claim evaluations and shall total to the amount of the Contract Price. Application for payment will not be processed until the Contract breakdown is approved by the Contract Administrator.
- .2 Submit contact sheet with phone numbers, addresses, fax numbers, emails and contact Person for all trades and suppliers working on this project.
- .3 Submit Project Construction Schedule within five (5) Working Days of Contract Award and prior to commencement of Work on Site.

1.4 ADMINISTRATIVE

- .1 Submit to Contract Administrator submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present Shop Drawings, product data, samples and mock-ups in units consistent with Drawings.
- .4 The Contractor is to review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.
- .5 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .6 Verify field measurements and affected adjacent Work are coordinated.

.7 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.

.8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.

.9 Keep one reviewed copy of each submission on Site.

#### 1.5 CONSTRUCTION SCHEDULE

.1 Submit a construction schedule prior to the first application of payment that indicates the timing of major activities of the Work and provides sufficient detail of the critical events and their inter-relationship to demonstrate the Work will be performed in conformity with the Contract Time. Contract Administrator will review schedule and return reviewed copy within ten (10) days after receipt. Resubmit finalized schedule within seven (7) days after return of reviewed copy.

.2 Include copies of letters from all Subcontractors and major suppliers, confirming completion dates for their respective trades in the allotted schedule.

.3 The Contractor shall monitor the progress of the Work relative to the construction schedule and update the schedule on a monthly basis, at minimum.

.4 The Contractor shall advise the Contract Administrator of any revisions required to the schedule as a result of extensions of the Contract Time as provided in C7 Changes in Work of the General Conditions of Construction.

.5 Format:

.1 Prepare schedule in form of horizontal bar chart.

.2 Provide separate bar for each trade or operation

.3 Provide horizontal time scale identifying first Work Day of each week.

.4 Format for listings: Chronological order of start of each item of Work.

#### 1.6 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "Shop Drawings" means Drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of the Work.

.2 Indicate Materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design Drawings and Specifications.

.3 The Contractor shall provide Shop Drawings to the Contract Administrator to review in an orderly sequence and sufficiently in advance so as to cause no delay in the Work or in the Work of Subcontractors.

- .4 Allow ten (10) Working Days for Contract Administrator's review of each submission.
- .5 Adjustments made on Shop Drawings by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
- .6 Make changes in Shop Drawings as Contract Administrator may require, consistent with Contract Documents. When resubmitting, notify Contract Administrator in writing of any revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each Shop Drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions shall include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.

- .10 Relationship to adjacent Work.
  - .9 After Contract Administrator's review, distribute copies.
  - .10 Submit electronic Shop Drawings for each requirement requested in Specification Sections and as Contract Administrator may reasonably request.
  - .11 Submit 6 hardcopy or electronic copies of product data sheets or brochures for requirements requested in Specification Sections and as requested by Contract Administrator where Shop Drawings will not be prepared due to standardized manufacture of product.
  - .12 Colour and Material sample to be submitted as physical copies
  - .13 Delete information not applicable to project.
  - .14 Supplement standard information to provide details applicable to project.
  - .15 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and resubmission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
  - .16 The Contract Administrator will review and return Shop Drawings in accordance with the schedule agreed upon, or, in the absence of such schedule, with reasonable promptness so as to cause no delay to the performance of the Work.
- 1.7 SAMPLES & MOCK-UPS
- .1 Submit for review samples in duplicate as requested in respective Specification Sections. Label samples with origin and intended use.
  - .2 Construct field samples and mock-ups requested in the Specifications at locations acceptable to Contract Administrator.
  - .3 Construct each sample or mock-up complete, including Work of all trades required to finish Work.
  - .4 Deliver samples prepaid to Contract Administrator's business address.
  - .5 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of Contract Documents.
  - .6 Where colour, pattern or texture is criterion, submit full range of samples.
  - .7 Adjustments made on samples by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
  - .8 Make changes in samples which Contract Administrator may require, consistent with Contract Documents.
  - .9 Reviewed and accepted samples or mock-ups will become standards of workmanship and Material against which installed Work will be verified.

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- 1.8 INSURANCE POLICIES
- .1 Submit transcription of insurance immediately after award of Contract.
- 1.9 CASH FLOW FORECAST
- .1 Submit to the Contract Administrator immediately after award of Contract, a cash flow forecast of approximate costs of the Work compiled on the monthly basis over the term of the Contract.
- 1.10 WORKERS' COMPENSATION BOARD
- .1 After award of Contract, submit to the Contract Administrator, in writing, with reasonable promptness, current financial status with the Workers' Compensation Board.
- 1.11 ROOF COMPONENT DECLARATION
- .1 Refer to the roofing Section 07 53 50 and submit written declaration that components of the roofing system are compatible.
- 1.12 RECORD DRAWINGS
- .1 Upon award of the Contract, Contract Administrator will provide a set of prints, which shall be used solely for the purpose of maintaining record Drawings. Accurately and neatly record deviations from Contract Documents resulting from negotiated Contract changes, Site conditions, and changes ordered by Contract Administrator, including Work Orders and Supplementary Instructions.
- .2 "Record" Drawings to be maintained on a weekly basis to ensure they are up-to-date and accurate.
- .3 Record the locations of concealed components of mechanical and electrical services.
- .4 Identify Drawings as "Project Record Copy". Maintain in new conditions and make available for inspection on Site by Contract Administrator.
- .5 Pay costs to have information transferred to digital format, in AutoCAD 2000 format, through Contract Administrator. Contractor to submit marked-up set of Drawings to Contract Administrator showing information to be included on record Drawings at least fifteen (15) Working Days prior to Substantial Performance of the Work.
- .6 Submit one (1) hard copy, and one (1) USB with copies in AutoCAD format and PDF format.
- 1.13 INSTRUCTION TO CITY'S PERSONNEL
- .1 In addition to start-up supervision and instruction to the City's Personnel required of individual equipment manufacturers and systems noted, instruct the City's Personnel in operation and maintenance of all equipment and systems.
- .2 Review instructions with the City's representative to ensure a thorough understanding of equipment and its operation.
- .3 Submit to the Contract Administrator a copy of written documentation that instruction has been provided, signed by the City's representative.

**END OF SECTION**

**Part 1 GENERAL**

1.1 RELATED SECTION

- .1 Section 01 51 00 – Temporary Utilities
- .2 Section 01 52 00 – Construction Facilities
- .3 Section 01 74 00 – Cleaning
- .4 Section 02 07 20 – Selective Site Demolition

1.2 EXISTING CONDITIONS

- .1 The existing building will be closed during the majority of the period that Work is in progress. Cooperate with the City so as to cause the least inconvenience and carry out all Work to maintain a suitable and safe environment.
- .2 Do not remove from the building, without the consent of the City, any of the City's furniture, equipment, tools, or non-building components.
- .3 The City will remove all loose furniture and portable equipment required to give free working space as required.

**Part 2 PRODUCTS**

Not used.

**Part 3 EXECUTION**

3.1 SCHEDULING OF WORK – GENERAL

- .1 Upon award of the Contract, Contractor can begin work on site.

3.2 ACCESS AND EXITING

- .1 Contractor shall maintain exiting for the building as Authorities having Jurisdiction may reasonably require during the period when it is open. The Contractor shall review temporary means of Egress with the Authority Having Jurisdiction.
- .2 Provide temporary ramps, railings, and hoarding from existing exit across construction Site, if required by the authority.
- .3 Do not interfere with use of adjacent building areas. Maintain free and safe passage to and from.

3.3 TEMPORARY HEAT

- .1 Provide temporary heat to protect existing building spaces when permanent service is interrupted.

3.4 UTILITIES

- .1 Do not make changes to utility services until reasonably convenient for the City, and as allowed by scheduling of the Work.

**END OF SECTION**

**Part 1 GENERAL**

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures

1.2 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .3 Material Safety Data Sheets (MSDS).
- .4 Province of Manitoba
  - .1 Workplace Safety and Health Act, R.S.M. 1987 or latest.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work.

1.4 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning Site Work and continue to implement, maintain, and enforce plan until final demobilization from Site. Health and Safety Plan must address project Specifications.
- .2 Contract Administrator may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.
- .3 Volatile Products and Waste
  - .1 Store flammable or combustible liquids or gases used on the construction Site in ULC approved containers.
  - .2 Store volatile wastes in covered metal containers, and remove from premises daily.
  - .3 Provide adequate ventilation during use of volatile or noxious substances.
- .4 Overloading
  - .1 Ensure no part of Work is subjected to a load that will endanger its safety or will cause permanent deformation.
- .5 Falsework
  - .1 Design and construct falsework in accordance with CSA S269.1-1975 or latest.

**END OF SECTION**



**Part 1 GENERAL**

**1.1 ASSOCIATIONS**

- .1 AA - Aluminum Association, 900 19th Street N.W., Washington, D.C., U.S.A. 20006 URL <http://www.aluminum.org>
- .2 AASHTO - American Association of State Highway and Transportation Officials, 444 N Capitol Street N.W., Suite 249, Washington, D.C., U.S.A. 20001 URL <http://www.aashto.org>
- .3 ACEC Association of Consulting Engineers of Canada, 130 Albert Street, Ottawa, ON. K1P 5G4 URL <http://www.acec.ca>
- .4 AHA - American Hardboard Association, 1210W Northwest Hwy., Palatine, Illinois, U.S.A. 60067 URL : <http://www.ahaa.com>
- .5 AITC - American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, Colorado, U.S.A. 80112 URL <http://www.aitc-glulam.org>
- .6 AMCA - Air Movement and Control Association Inc., 30 West University Drive, Arlington Heights, Illinois, U.S.A. 60004-1893 URL <http://www.amca.org>
- .7 ANSI - American National Standards Institute, 11 West 42nd Street, New York, New York, U.S.A. 10036 URL <http://www.ansi.org>
- .8 APA - The Engineered Wood Association, P.O. Box 11700, Tacoma, Washington, U.S.A. 98411-0700 URL <http://www.apawood.org>
- .9 API - American Petroleum Institute, 1220 L St. Northwest, Washington, D.C., U.S.A. 20005-4070 URL <http://www.api.org>
- .10 ARI - Air Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425, Arlington, Virginia, U.S.A. 22203 URL <http://www.ari.org>
- .11 ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, Georgia, U.S.A. 30329 URL <http://www.ashrae.org>
- .12 ASME - American Society of Mechanical Engineers, United Engineering Centre, Three Park Avenue, New York, New York, U.S.A. 10016-5990 URL <http://www.asme.org>
- .13 ASPT Association for Asphalt Paving Technologists, 400 Selby Avenue, Suite 1, St. Paul, MN 55102 U.S.A. URL <http://www.asphalt.org>
- .14 ASTM - American Society for Testing and Materials, 100 Barr Harbor Drive West, Conshohocken, Pennsylvania 19428-2959 URL <http://www.astm.org>
- .15 AWCI - Association of the Wall and Ceiling Industries International, 803 West Broad Street, Suite 600, Falls Church, VA, U.S.A. 22046 URL <http://www.awci.org>
- .16 AWMAC - Architectural Woodwork Manufacturers Association of Canada, 516 4 Street West, High River, Alberta T1V 1B6 URL <http://www.awmac.com>
- .17 AWWA - American Wire Producer's Association, 6232 Roudsby, Alexandria, VA U.S.A. 22315-5285 URL <http://www.awpa.org>
- .18 AWWA - American Wood Preservers' Association, P.O. Box 5690, Grandbury Texas, U.S.A. 76049-0690 URL <http://www.awap.com>
- .19 AWS - American Welding Society, 550 N.W. LeJeune Road, Miami, Florida U.S.A. 33126 URL <http://www.amweld.org>
- .20 AWWA - American Water Works Association, 6666 W. Quincy Avenue, Denver, Colorado, U.S.A. 80235 URL <http://www.awwa.org>
- .21 CCA Canadian Construction Association, 75 Albert St., Suite 400 Ottawa, Ontario, K1P 5E7 URL <http://www.cca-acc.com>

- .22 CITC Canadian Institute of Timber Construction, 200 Cooper Street, Ottawa, Ontario K2P 0G1
- .23 CFFM - Canadian Forces Fire Marshal, 101 Colonel By Drive, 8NT MGen George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2
- .24 CGA - Canadian Gas Association, 20 Eglinton Avenue West, Suite 1305, Toronto, Ontario M4R 1K8 URL <http://www.cga.ca>
- .25 CGSB - Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 URL <http://w3.pwgsc.gc.ca/cgsb>
- .26 CISC - Canadian Institute of Steel Construction, 201 Consumers Road, Suite 300, Willowdale, Ontario M2J 4G8 URL <http://www.buildingweb.com/CISC>
- .27 CLA - Canadian Lumbermen's Association, 27 Goulburn Avenue, Ottawa, Ontario, K1N 8C7 URL <http://www.cla.ca.ca>
- .28 CNLA - Canadian Nursery Landscape Association, RR #4, Stn. Main, 7856 Fifth Street, Milton, Ontario. L9T 2X8 URL <http://www.canadanursery.com>
- .29 CRCA - Canadian Roofing Contractors Association, 155 Queen Street, Suite 130C, Ottawa, Ontario K1P 6L1 URL <http://www.roofingcanada.com>
- .30 CSA - Canadian Standards Association International, 178 Rexdale Blvd., Toronto, Ontario M9W 1R3 URL <http://www.csa-international.org>
- .31 CSC - Construction Specifications Canada, 100 Lombard Street, Suite 200, Toronto, Ontario M5C 1M3 URL <http://www.csc-dcc.ca>
- .32 CSDFMA - Canadian Steel Door and Frame Manufacturing Association One Yonge Street, Suite 1400, Toronto, Ontario M5E 1J9
- .33 CSPI - Corrugated Steel Pipe Institute, 201 Consumers Road, Suite 306, Willowdale, Ontario M2J 4G8
- .34 CSSBI - Canadian Sheet Steel Building Institute, 652 Bishop St. N., Unit 2A, Cambridge, Ontario N3H 4V6 URL <http://www.cssbi.ca>
- .35 CUFCA Canadian Urethane Foam Contractor's Association
- .36 CWC - Canadian Wood Council, 1400 Blair Place, Suite 210, Ottawa, Ontario K1J 9B8 URL <http://www.cwc.ca>
- .37 EC - Environment Canada, Conservation and Protection, Ottawa, Ontario KIA 0H3 URL <http://www.ec.gc.ca>
- .38 EEMAC - Electrical and Electronic Manufacturers' Association of Canada, 5800 Explorer Drive, Suite 200, Mississauga, Ontario L4W 5K9 URL <http://www.electrofed.ca>
- .39 EIMA EIFS Industry Manufacturer's Association, 3000 Corporate Center Drive, Suite 270, Morrow, Georgia U.S.A. 30260 URL <http://www.eifsfacts.com>
- .40 FCC - Fire Commissioner of Canada, Place du Portage, Phase II, 165 rue Hotel de Ville, Hull Quebec K1A 0J2 URL <http://www.hrdc-drhc.gc.ca>
- .41 IEEE - Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, New York U.S.A. 10017 URL <http://www.ieee.org>
- .42 MPI - The Master Painters Institute, 4090 Graveley Street, Burnaby, BC V5C 3T6 URL <http://www.paintinfo.com>
- .43 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, Virginia U.S.A.22180
- .44 NAAMM - National Association of Architectural Metal Manufacturers, 8 South Michigan Avenue, Suite 1000, Chicago, Illinois U.S.A. 60603 URL <http://www.naamm.org>
- .45 NABA - National Air Barrier Association, 400-283 Bannatyne Avenue, Winnipeg, Manitoba R3B 3B2

- .46 NEMA - National Electrical Manufacturers Association, 1300 N. 17th Street, Suite 1847, Rosslyn, Virginia 22209 URL <http://www.nema.org>
- .47 NFPA - National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101 Quincy, Massachusetts, U.S.A. 02269-9101 URL <http://www.nfpa.org>
- .48 NFSA - National Fire Sprinkler Association, 40 Jon Barrett Road, P.O. Box 1000, Patterson, New York, U.S.A. 12563 URL <http://www.nfsa.org>
- .49 NHLA - National Hardwood Lumber Association, P.O. Box 34518, Memphis, Tennessee, U.S.A 38184-0518 URL <http://www.natlhardwood.org>
- .50 NLGA - National Lumber Grades Authority, 406 First Capital Place, New Westminster, B.C. V3M 6G2
- .51 NRC - National Research Council, Montreal Road, Ottawa, Ontario K1A 0S2 URL <http://www.nrc.gc.ca>
- .52 NSPE National Society of Professional Engineers, 1420 King Street, Alexandria, VA U.S.A. 22314-2794 URL <http://www.nspe.org>
- .53 QPL - Qualification Program List, c/o Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 URL <http://www.pwgsc.gc.ca/cgsb>
- .54 RAIC Royal Architectural Institute of Canada, 55 Murray Street, Suite 330, Ottawa, Ontario, K1N 5M3 URL <http://www.raic.org>
- .55 SCC - Standards Council of Canada, 200 Albert Street, Suite 2000, Ottawa, Ontario K1P 6N7 URL <http://www.scc.ca>
- .56 SSPC - The Society for Protective Coatings, 40 24th Street, Pittsburgh, Pennsylvania 15222-4656 URL <http://www.sspc.org>
- .57 TPI - Truss Plate Institute, 583 D'Onofrio Drive, Suite 200, Madison, WI, U.S.A. 53719 URL <http://www.tpinst.org>
- .58 UL - Underwriters' Laboratories, 333 Pfingsten Road, Northbrook, Illinois, U.S.A. 60062 URL <http://www.ul.com>
- .59 ULC - Underwriters' Laboratories of Canada, 7 Crouse Road, Toronto, Ontario M1R 3A9 URL <http://www.ulc.ca>

**END OF SECTION**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Tests and mix designs.
- .3 Mock-ups.
- .4 Mill tests.
- .5 Equipment and system adjust and balance.

**1.2 RELATED SECTIONS**

- .1 Section 01 42 00 – References
- .2 Section 01 78 00 – Closeout Submittals

**1.3 INSPECTION**

- .1 Allow Contract Administrator access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Contract Administrator instructions, or law of Place of Work.
- .3 The Contractor shall furnish promptly to the Contract Administrator two (2) copies of certificates and inspection reports relating to the Work.
- .4 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .5 The Contractor shall pay the cost of making any test or inspection, including the cost of samples required for such test or inspection, if such test or inspection is designated in the Contract Documents to be performed by the Contractor or is designated by the laws or ordinances applicable to the Place of the Work.
- .6 Contract Administrator may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such Work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Contract Administrator shall pay cost of examination and replacement.

**1.4 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by Contract Administrator for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by the City.
- .2 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .3 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Contract Administrator at no cost to Contract Administrator. Pay costs for re-testing and re-inspection.

**1.5 ACCESS TO WORK**

- .1 Allow inspection/testing agencies access to Work, off Site manufacturing and fabrication Plants.
- .2 Co-operate to provide reasonable facilities for such access.

- 1.6 PROCEDURES
- .1 Notify appropriate agency and Contract Administrator in advance of requirement for tests, in order that attendance arrangements can be made.
  - .2 Submit samples and/or Materials required for testing, as specifically requested in Specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
  - .3 Provide labour and facilities to obtain and handle samples and Materials on Site. Provide sufficient space to store and cure test samples.
- 1.7 REJECTED WORK
- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Contract Administrator as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
  - .2 Make good other Contractor's Work damaged by such removals or replacements promptly.
  - .3 If in opinion of Contract Administrator, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the City may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Contract Administrator.
- 1.8 REPORTS
- .1 Submit 2 copies of inspection and test reports to Contract Administrator.
  - .2 Provide copies to Subcontractor of Work being inspected or tested or manufacturer or fabricator of Material being inspected or tested.
- 1.9 TESTS AND MIX DESIGNS
- .1 Furnish test results and mix designs as may be requested.
  - .2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Contract Administrator and may be authorized as recoverable.
- 1.10 MOCK-UPS
- .1 Prepare mock-ups for Work specifically requested in Specifications. Include for Work of all Sections required to provide mock-ups.
  - .2 Prepare mock-ups for Contract Administrator's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
  - .3 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
  - .4 If requested, Contract Administrator will assist in preparing a schedule fixing dates for preparation.
  - .5 Remove mock-up at conclusion of Work or when acceptable to Contract Administrator.
  - .6 Mock-ups may remain as part of Work, at discretion of Contract Administrator.
- 1.11 MILL TESTS
- .1 Submit mill test certificates as required of Specification Sections.

- 1.12 EQUIPMENT AND SYSTEMS
  - .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

**END OF SECTION**

- Part 1**            **General**
- 1.1                SECTION INCLUDES
- .1            Temporary utilities.
- 1.2                RELATED SECTIONS
- .1            Section 01 35 30 – Health and Safety Requirements
- .2            Section 01 52 00 – Construction Facilities
- .3            Section 01 56 00 – Temporary Barriers and Enclosures
- 1.3                INSTALLATION AND REMOVAL
- .1            Provide temporary utilities controls in order to execute Work expeditiously.
- .2            Remove from Site all such Work after use.
- 1.4                DEWATERING
- .1            Provide temporary drainage and pumping facilities to keep excavations and Site free from standing water.
- 1.5                WATER SUPPLY
- .1            Contractor to arrange for connection with appropriate utility company and pay all costs for installation, maintenance and removal. Include water costs in the base construction tender.
- 1.6                TEMPORARY HEATING AND VENTILATION
- .1            Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2            Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3            Provide temporary heat and ventilation in enclosed areas as required to:
- .1            Facilitate progress of Work.
- .2            Protect Work and products against dampness and cold.
- .3            Prevent moisture condensation on surfaces.
- .4            Provide ambient temperatures and humidity levels for storage, installation and curing of Materials.
- .5            Provide adequate ventilation to meet health regulations for safe working environment.
- .4            Maintain temperatures of minimum 10 °C in areas where construction is in progress.
- .5            Ventilating:
- .1            Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
- .2            Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3            Dispose of exhaust Materials in manner that will not result in harmful exposure to Persons.
- .4            Ventilate storage spaces containing hazardous or volatile Materials.
- .5            Continue operation of ventilation and exhaust system for time after cessation of Work process to assure removal of harmful contaminants.

- .6 Permanent heating system of building may be used when available. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, replace filters as per manufacturer's directions.
- .8 Ensure Date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Contract Administrator.
- .9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform with applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services.
  - .4 Prevent damage to finishes.
  - .5 Vent direct-fired combustion units to outside.
- .10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.
- 1.7 TEMPORARY POWER AND LIGHT
  - .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts 30 amps.
  - .2 Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance and removal.
  - .3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
  - .4 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Contract Administrator provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.
- 1.8 TEMPORARY COMMUNICATION FACILITIES
  - .1 Provide and pay for temporary telephone and fax hook up, lines and equipment necessary for own use and use of Contract Administrator.
- 1.9 FIRE PROTECTION
  - .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.
  - .2 Burning rubbish and construction waste Materials is not permitted on Site.
- 1.10 SECURITY
  - .1 The provision of security to Site and buildings at nights, weekends and non-work periods is the sole responsibility of the Contractor.
  - .2 Provide plywood covers to all windows after installation and before full time occupancy.

**END OF SECTION**



- Part 1**            **General**
- 1.1                SECTION INCLUDES
- .1                Construction aids.
  - .2                Office and sheds.
  - .3                Parking.
  - .4                Project identification.
- 1.2                RELATED SECTIONS
- .1                Section 01 56 00 – Temporary Barriers and Enclosures
- 1.3                REFERENCES
- .1                Canadian Construction Association (CCA)
  - .2                Canadian Standards Association (CSA)
    - .1                CAN3-A23.1-/A23.2-94, Concrete Materials and Methods for Concrete Construction/Method of Test for Concrete or latest.
    - .2                CSA-0121-M1978, Douglas Fir Plywood or latest.
    - .3                CAN/CSA-Z321-96, Signs and Symbols for the Occupational Environment or latest.
- 1.4                INSTALLATION AND REMOVAL
- .1                Provide construction facilities in order to execute Work expeditiously.
  - .2                Remove from Site all such Work after use.
- 1.5                SCAFFOLDING
- .1                Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs as required.
- 1.6                SITE STORAGE/LOADING
- .1                Confine Work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
  - .2                Do not load or permit to load any part of Work with a weight or force that will endanger the Work.
- 1.7                CONSTRUCTION PARKING
- .1                Parking will be permitted on Site as defined on Site plans provided it does not disrupt performance of Work and any damage to property is repaired.
  - .2                Provide and maintain adequate access to project Site – front and rear entrances as per Site plan.
  - .3                Provide snow removal during period of Work as required.
- 1.8                OFFICES
- .1                Provide a heated Site trailer for on-Site supervisor and Contract Site meetings as required.
  - .2                Provide a clearly marked and fully stocked first aid case in a readily available location.
  - .3                Subcontractors may provide their own offices as necessary. Contractor is to coordinate the locations of these offices.

- 1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE
- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and Materials.
  - .2 Locate Materials not required to be stored in weatherproof sheds on Site in a manner to cause least interference with Work activities.
- 1.10 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.
  - .3 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of Contract Administrator.
- 1.11 CONSTRUCTION SIGNAGE
- .1 No other signs or advertisements, other than warning signs, are permitted on Site without the permission of the Contract Administrator.

**END OF SECTION**

- Part 1 GENERAL**
- 1.1 SECTION INCLUDES
- .1 Barriers
  - .2 Environmental Controls
- 1.2 RELATED SECTIONS
- .1 Section 01 51 00 – Temporary Utilities
  - .2 Section 01 52 00 – Construction Facilities
- 1.3 REFERENCES
- .1 Canadian General Standards Board (CGSB)
    - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel or latest.
    - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood or latest.
  - .2 Canadian Standards Association (CSA International)
    - .1 CSA-O121[M1978(R2003), Douglas Fir Plywood or latest.
- 1.4 INSTALLATION AND REMOVAL
- .1 Provide temporary controls in order to execute Work expeditiously.
  - .2 Remove from Site all such Work after use.
- 1.5 HOARDING
- .1 Erect temporary Site enclosures using wire fencing to 1800m height.
  - .2 Provide one lockable truck entrance gate and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.
  - .3 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.
  - .4 Site enclosure shall be erected so as to maintain public access and use of the recycling and garbage bins on the west side of the existing parking lot.
- 1.6 GUARD RAILS AND BARRICADES
- .1 Provide secure, rigid guardrails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
  - .2 Provide as required by governing authorities.
- 1.7 WEATHER ENCLOSURES
- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
  - .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior Work for temporary heat.
  - .3 Design enclosures to withstand wind pressure and snow loading.
- 1.8 DUST TIGHT SCREENS
- .1 Provide dust tight screens to localize dust generating activities, and for protection of workers, finished areas of Work and public.
  - .2 Maintain and relocate protection until such Work is complete.
- 1.9 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.
- 1.10 PUBLIC TRAFFIC FLOW
  - .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.
- 1.11 FIRE ROUTES
  - .1 Maintain access to property including overhead clearances for use by emergency response vehicles.
- 1.12 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY
  - .1 Protect surrounding private and public property from damage during performance of Work.
  - .2 Be responsible for damage incurred.
- 1.13 PROTECTION OF BUILDING FINISHES
  - .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
  - .2 Provide necessary screens, covers, and hoardings.
  - .3 Confirm with Contract Administrator locations and installation schedule three (3) days prior to installation.
  - .4 Be responsible for damage incurred due to lack of or improper protection.

**END OF SECTION**

- Part 1 GENERAL**
- 1.1 SECTION INCLUDES
- .1 Product quality, availability, storage, handling, protection, and transportation.
  - .2 Manufacturer's instructions.
  - .3 Quality of Work, coordination and fastenings.
  - .4 Existing facilities.
- 1.2 RELATED SECTIONS
- .1 Section 01 42 00 – References
  - .2 Section 01 45 00 – Quality Control
- 1.3 REFERENCE STANDARDS
- .1 Within text of Specifications, reference may be made to reference standards contained in Section 01 42 00 – References.
  - .2 Conform to these standards, in whole or in part as specifically requested in Specifications.
  - .3 If there is question as to whether any product or system is in conformance with applicable standards, Contract Administrator reserves right to have such products or systems tested to prove or disprove conformance.
  - .4 The cost for such testing will be borne by the City in event of conformance with Contract Documents or by Contractor in event of non-conformance.
  - .5 Conform to latest date of issue of referenced standards in effect on date of Bid Submission, except where specific date or issue is specifically noted.
- 1.4 QUALITY
- .1 Products, Materials, equipment and articles (referred to as Products throughout Specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with Specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.
  - .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
  - .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Contract Administrator based upon requirements of Contract Documents.
  - .4 Unless otherwise indicated in Specifications, maintain uniformity of manufacture for any particular or like item throughout building.
  - .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.
- 1.5 AVAILABILITY
- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify Contract Administrator of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

- .2 In event of failure to notify Contract Administrator at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Contract Administrator reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.
- 1.6 STORAGE, HANDLING AND PROTECTION
- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar Materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet Materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from Site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.
- .9 Touch-up damaged factory finished surfaces to Contract Administrator's satisfaction. Use touch-up Materials to match original. Do not paint over name plates.
- 1.7 TRANSPORTATION
- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by the City will be paid for by Contractor. Unload, handle and store such products.
- 1.8 MANUFACTURER'S INSTRUCTIONS
- .1 Unless otherwise indicated in Specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Contract Administrator in writing, of conflicts between Specifications and manufacturer's instructions, so that Contract Administrator may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and re-installation at no increase in Contract Price or Contract Time.
- 1.9 QUALITY OF WORK
- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Contract Administrator if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Contract Administrator reserves right to require dismissal from Site, workers deemed incompetent or careless.

- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Contract Administrator, whose decision is final.
- 1.10 CO-ORDINATION
  - .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
  - .2 Be responsible for coordination and placement of openings, sleeves and accessories.
- 1.11 CONCEALMENT
  - .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise. Advise Contract Administrator of any potential conflict areas prior to construction.
  - .2 Before installation, inform Contract Administrator if there is interference. Install as directed by Contract Administrator.
- 1.12 REMEDIAL WORK
  - .1 Perform remedial Work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
  - .2 Perform remedial Work by specialists familiar with Materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.
- 1.13 LOCATION OF FIXTURES
  - .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
  - .2 Inform Contract Administrator of conflicting installation. Install as directed.
- 1.14 FASTENINGS
  - .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent Materials, unless indicated otherwise.
  - .2 Prevent electrolytic action between dissimilar metals and Materials.
  - .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior Work, unless stainless steel or other Material is specifically requested in affected Specification Section.
  - .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic Material plugs are not acceptable.
  - .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
  - .6 Fastenings which cause spalling or cracking of Material to which anchorage is made are not acceptable.
- 1.15 FASTENINGS - EQUIPMENT
  - .1 Use fastenings of standard commercial sizes and patterns with Material and finish suitable for service.
  - .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
  - .3 Bolts may not project more than one diameter beyond nuts.
  - .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.
- 1.16 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Contract Administrator.
- 1.17 EXISTING UTILITIES
- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and pedestrian and vehicular traffic.
  - .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**END OF SECTION**



**Part 1**

**General**

1.1

**PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by the City or its Subcontractors.
- .2 Remove waste Materials from Site at regularly scheduled times or dispose of as directed by Contract Administrator. Do not burn waste Materials on Site.
- .3 Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide On-Site dump containers for collection of waste Materials and debris.
- .6 Provide and use clearly marked separate bins for recycling. Refer to Section 02 07 20 – Selective Site Demolition for waste management.
- .7 Remove waste Material and debris from Site and deposit in waste container at end of each Working Day.
- .8 Clean interior areas prior to start of finish Work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each Working Day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning Materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning Material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .13 Replace heating, ventilating and air conditioning filters if units were operated during construction.

1.2

**FINAL CLEANING**

- .1 When Work is Substantially Performed, remove surplus products, tools, and machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by the City or its Subcontractors.
- .5 Remove waste Materials from Site at regularly scheduled times or dispose of as directed by Contract Administrator. Do not burn waste Materials on Site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

- .8 Remove stains, spots, marks and dirt from decorative Work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus Materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

**END OF SECTION**

- Part 1            General**
- 1.1            SECTION INCLUDES
- .1            Administrative procedures preceding preliminary and final review of Work.
- 1.2            RELATED SECTIONS
- .1            Section 01 78 00 – Closeout Submittals
- 1.3            REVIEW AND DECLARATION
- .1            Contractor's Review: Contractor and all Subcontractors shall conduct a review of the Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
- .1            Notify Contract Administrator in writing of satisfactory completion of Contractor's Review and that corrections have been made.
- .2            Request Contract Administrator's Review.
- .2            Contract Administrator's Review: Contract Administrator and Contractor will review Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- .3            Substantial Performance: submit written certificate that following have been performed:
- .1            Work has been completed and inspected for compliance with Contract Documents.
- .2            Defects have been corrected and deficiencies have been completed.
- .3            Equipment and systems have been tested, adjusted and balanced and are fully operational.
- .4            Certificates required by Fire Commissioner and Utility companies have been submitted.
- .5            Operation of systems have been demonstrated to the City's Personnel.
- .6            Work is complete and ready for Final Review.
- .4            Final Review: when items noted above are completed, request final review of Work by Contract Administrator, and Contractor. If Work is deemed incomplete by Contract Administrator, complete outstanding items and request subsequent review.
- .5            Declaration of Substantial Performance: when Contract Administrator consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance.
- .6            Commencement of Lien and Warranty Periods: date of the City's acceptance of submitted declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of place of Work.
- .7            Provide warranties and bonds fully executed and notarized.
- .8            Execute transition of Performance and Labour and Materials Payment Bond to warranty period requirements.
- .9            Final Payment: When Contract Administrator consider final deficiencies and defects have been corrected and as-built Drawings and operation and maintenance manuals have been submitted, and it appears requirements of Contract have been totally performed,

- make application for final payment. If Work is deemed incomplete by Contract Administrator, complete outstanding items and request subsequent review.
- .10 Payment of Holdback: After issuance of certificate of Substantial Performance of Work, submit an application for payment of holdback amount.

**END OF SECTION**

- PART 1            General**
- 1.1            SECTION INCLUDES
- .1            As-built drawings, samples, and specifications.
  - .2            Equipment and systems.
  - .3            Product data, materials and finishes, and related information.
  - .4            Operation and maintenance data.
  - .5            Spare parts, special tools and maintenance materials.
  - .6            Warranties and bonds.
  - .7            Final site survey certificate.
- 1.2            RELATED SECTIONS
- .1            Section 01 45 00 - Quality Control.
  - .2            Section 01 77 00 - Closeout Procedures
- 1.3            SUBMISSION (OPERATIONS AND MAINTENANCE MANUAL)
- .1            Prepare instructions and data by personnel experienced in maintenance and operation of described products.
  - .2            Two weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, two (2) final hard copies of operating and maintenance manuals in English and one digital copy on USB flash drive.
  - .3            Copy will be returned after Substantial Performance review, with Contract Administrator's comments.
  - .4            Revise content of documents as required prior to final submittal. Final O&M Manuals are required to achieve Total Performance.
  - .5            Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
  - .6            If requested, furnish evidence as to type, source and quality of products provided.
  - .7            Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
  - .8            Pay costs of transportation.
- 1.4            FORMAT
- .1            Organize data in the form of an instructional manual.
  - .2            Binders: vinyl, hard covered, 3 'D' ring, loose leaf with spine.
  - .3            When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
  - .4            Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
  - .5            Arrange content by systems under Section numbers and sequence of Table of Contents.
  - .6            Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
  - .7            Text: Manufacturer's printed data, or typewritten data.

- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Digital format to be arranged in folders, by Division.
- 1.5 CONTENTS - EACH VOLUME
  - .1 Table of Contents: provide title of project;
    - .1 date of submission; names,
    - .2 addresses, and telephone numbers of Contract Administrator and Construction Manager with name of responsible parties;
    - .3 schedule of products and systems, indexed to content of volume.
  - .2 For each product or system:
    - .1 list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
  - .3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
  - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
  - .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01450 - Quality Control.
- 1.6 AS-BUILTS AND SAMPLES
  - .1 All As-Builts, (Architectural, Structural, Mechanical, Electrical): Contractor to submit 1 set of red line marked up drawings to Contract Administrator for transfer of information to CADD format for delivery to City. Contractor is responsible for associated cost. Final Progress Certificate will not be released until this condition is complete. In addition to requirements in General Conditions, maintain at the site for Contract Administrator one record copy of:
    - .1 Contract Drawings (As built).
    - .2 Specifications.
    - .3 Addenda.
    - .4 Change Orders and other modifications to the Contract.
    - .5 Reviewed shop drawings, product data, and samples.
    - .6 Field test records.
    - .7 Inspection certificates.
    - .8 Manufacturer's certificates.
  - .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
  - .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
  - .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
  - .5 Keep record documents and samples available for inspection by Contract Administrator.
- 1.7 RECORDING ACTUAL SITE CONDITIONS
  - .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Contract Administrator.

- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
  - .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
  - .4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
    - .1 Measured depths of elements of foundation in relation to finish first floor datum.
    - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
    - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
    - .4 Field changes of dimension and detail.
    - .5 Changes made by change orders.
    - .6 Details not on original Contract Drawings.
    - .7 References to related shop drawings and modifications.
  - .5 Specifications: legibly mark each item to record actual construction, including:
    - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
    - .2 Changes made by Addenda and change orders.
  - .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- 1.8 FINAL SURVEY
- .1 Contractor to provide Building Location Certificate and Survey of all exterior Work at project completion.
- 1.9 EQUIPMENT AND SYSTEMS
- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
  - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
  - .3 Include installed colour coded wiring diagrams.
  - .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
  - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
  - .6 Provide servicing and lubrication schedule, and list of lubricants required.
  - .7 Include manufacturer's printed operation and maintenance instructions.
  - .8 Include sequence of operation by controls manufacturer.
  - .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
  - .10 Provide installed control diagrams by controls manufacturer.

- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
  - .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
  - .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
  - .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control.
  - .15 Additional requirements: As specified in individual specification sections.
- 1.10 MATERIALS AND FINISHES
- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
  - .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
  - .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
  - .4 Additional Requirements: as specified in individual specifications sections.
- 1.11 SPARE PARTS
- .1 Provide spare parts, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site; place and store.
  - .4 Receive and catalogue all items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- 1.12 MAINTENANCE MATERIALS
- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site; place and store in locations as directed by Construction Administrator.
  - .4 Receive and catalogue all items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- 1.13 SPECIAL TOOLS
- .1 Provide special tools, in quantities specified in individual specification section.
  - .2 Provide items with tags identifying their associated function and equipment.
  - .3 Deliver to site; place and store.
  - .4 Receive and catalogue all items. Submit inventory listing to Contract Administrator. Include approved listings in Maintenance Manual.
- 1.14 STORAGE, HANDLING AND PROTECTION
- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.



- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.

1.15 WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
- .4 Except for items put into use with City's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

**END OF SECTION**

- Part 1**            **General**
- 1.1                RELATED WORK
- .1            Related Sections.
- .1        Section 01 33 00 - Submittal Procedures.
- .2        Section 01 35 00 – Special Procedures
- .3        Section 01 35 30 - Health and Safety Requirements.
- .4        Section 01 52 00 – Construction Facilities
- .5        Section 01 56 00 – Temporary Barriers and Enclosures
- .6        Division 02 – Existing Conditions
- .7        Mechanical and Electrical specifications – services removal
- .8        Reconstruction by trades affected by demolition
- 1.2                REFERENCE STANDARDS
- .1            Canadian Standards Association (CSA)
- .1        CSA-S350 – Code of Practice for Safety in Demolition of Structures.
- .2        Carry out demolition Work in accordance with standard safety practice and applicable laws and codes.
- 1.3                EXAMINATION
- .1            Carefully examine drawings and Site conditions to determine the full extent of demolition and renovation Work to be performed and Materials and conditions encountered.
- .2            Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .3            After uncovering, inspect conditions affecting performance of Work.
- .4            Beginning of cutting or patching means acceptance of existing conditions.
- 1.4                EXISTING CONDITIONS
- .1            Take over elements to be demolished generally based on their condition during the Bid Period.
- .2            Prevent damage to existing concealed, hidden, poured-in, or buried utilities, service lines, structural rebar, conduits, cables or mechanical equipment in or under the floor slabs, or exterior surfaces. Carry out all investigation necessary to confirm location of such utilities, service lines, structural rebar, conduits, cables or mechanical equipment, which may or may not include scanning the floor. Repair to existing utilities, service lines, structural rebar, conduits, cables or mechanical equipment damaged during the course of the Work is the responsibility of the Contractor and at the Contractor's expense.
- .3            Arrange and pay for disconnecting, removing and capping utility services within areas of demolition as required. Notify affected utility company prior to commencing.
- .4            Place markers to indicate location of disconnected services. Identify service lines and capping locations on Record drawings.
- .5            Demolition of asbestos containing Materials (ACM) and mould-contaminated components (MCC) can be hazardous to health. Should Material resembling ACM or MCC be

encountered in the course of demolition Work, stop Work, and notify Contract Administrator immediately. Do not proceed until written instructions have been received from the Contract Administrator.

1.5 DEMOLITION INFORMATION

- .1 Where required by authorities having jurisdiction, submit for approval, drawings, diagrams, or details showing sequence of disassembly Work, supporting structures and underpinning.
- .2 Provide information in form set out by Authorities Having Jurisdiction, including stamp of qualified Professional Engineer registered in the Province of Manitoba.

1.6 PROTECTION

- .1 Prevent movement or settlement of structures. Provide and place bracing or shoring and be responsible for safety and structure. Be liable for any such movement or settlement and any damage or injury caused.
- .2 If safety of structure appears to be endangered, cease operations, and notify the Contract Administrator immediately. Take all precautions to properly support structure. Do not resume operations until acceptable to the Contract Administrator.
- .3 Erect access resistant and weatherproof enclosures as required to close-off exterior openings. Maintain exit requirements.
- .4 Erect and maintain dustproof partitions as required to prevent spread of dust, fumes and smoke to other parts of the building. Provide plastic tarps to protect furniture, fixed millWork, and bookcases, from dust and debris. On completion, remove partitions and tarps, and make good damaged surfaces to match adjacent surfaces.
- .5 Prevent dust from entering the air handling system. Inspect air filters and clean or replace during period system is in use, and prior to turnover.
- .6 Prevent debris from blocking surface drainage inlets and systems, or mechanical and electrical systems, which must remain in operation.
- .7 During the removal of the existing building elements, provide proper protection from falling objects.
- .8 Post warning signs, which are clearly visible.
- .9 Carry out demolition Work in a manner to cause minimal inconvenience to the adjacent occupied areas.

**Part 2 PRODUCTS**

Not used.

**Part 3 EXECUTION**

3.1 APPROVALS

- .1 Submit written request in advance of cutting or alteration which affects:
  - .1 Structural integrity of any element of Project.
  - .2 Integrity of weather-exposed or moisture resistant elements.
  - .3 Efficiency, maintenance, or safety of any operational element.

- .4 Visual qualities of sight-exposed elements.
- .5 Work of City, or separate contractor.

### 3.2 DEMOLITION

- .1 Perform demolition of existing Work necessary to accommodate new and remedial Work indicated on the drawings, and/or described in the specifications. This shall include all necessary demolition Work and all miscellaneous cutting required for the installation or extension of services.
- .2 Repair all demolition in excess of that indicated or required, to the approval of the Contract Administrator, at no cost to the City.
- .3 Remove existing construction, millWork, fixtures, equipment, services, and obstacles where required for new Work, refinishing, or making good of existing surfaces, and replace same as Work progresses.
- .4 At the end of each day's Work, leave building, Site and Work in a safe condition. Protect interiors or parts not to be demolished from exterior elements.
- .5 Demolish to minimize dusting. Keep Materials wetted, as directed by the Contract Administrator.
- .6 Cut rigid Materials using power saw or core drill. Pneumatic or impact tools not allowed.

### 3.3 RENOVATION

- .1 Carefully remove, store, protect and reinstall in building, using qualified tradesmen, Materials and equipment as required.
- .2 Patch and make good existing surfaces to provide neat, uniform finish.
- .3 Patch and make good existing surfaces to match existing adjacent Work. Leave finished, neat, to Contract Administrator's approval. For continuous surfaces, refinish to nearest intersection. For an assembly, refinish entire unit.
- .4 Prepare existing surfaces to receive patching and finishing.
- .5 Patch surfaces with Materials similar to existing, to maintain fire and acoustic ratings, and structural integrity.
- .6 At penetration of fire-rated wall, ceiling or floor construction, completely seal voids with fire-rated Material, full thickness of construction element.
- .7 Neatly perform patching Work to blend smoothly with surrounding surfaces.
- .8 Infill of masonry openings shall be "toothed-in".
- .9 Fit Work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

### 3.4 DISPOSAL

- .1 Dispose of demolished Materials, except where noted otherwise, in accordance with local authorities having jurisdiction.
- .2 Selling or burning Materials on Site is not permitted.
- .3 Remove contaminated or dangerous Materials from WorkSite, and dispose of in safe manner to minimize danger at site and during disposal.
- .4 Deliver all refuse Materials to a registered landfill Site and pay all costs of disposal.
- .5 Employ rodent and vermin exterminators as required to comply with health regulation.

- .6 Leave Site in condition acceptable to the Contract Administrator.
- 3.5 SALVAGE TO CITY
  - .1 Carefully remove Materials and fixtures designated to be removed and not reused, and turn over to the City.
  - .2 Generally:
    - .1 Hollow metal and wood doors and hardware
    - .2 Hollow metal frames where possible
    - .3 Light fixtures, heating units, plumbing fixtures
    - .4 Motors, pumps, fans
    - .5 Chalkboards, whiteboards and tack boards
    - .6 Counters, cupboards, shelving, etc.
    - .7 Metal window screens
    - .8 Equipment and appliances
  - .3 If the City does not want removed Materials, then dispose as noted above.

**END OF SECTION**

## **PART 1 GENERAL**

### **General and Related Work**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Related work specified elsewhere:
  - .1 Section 02 82 10 Asbestos Abatement – Low Risk Precautions
  - .2 Section 02 82 10 Asbestos Abatement – Low Risk Precautions
  - .3 Section 02 82 13 Asbestos Abatement – Glove Bag Method
  - .4 Section 02 83 10 Lead Abatement – Minimal Precautions
  - .5 Section 02 83 11 Lead Abatement – Intermediate Precautions
- .3 Site Conditions identifies all known hazardous building materials within the Project Area. The information provided is for general reference only.
  - .1 The specification fulfils the requirements of Part 36 and 37 of Manitoba Workplace Safety and Health Regulation 217/2006.
- .4 The Outline of Work identifies the location, condition and quantities of hazardous building materials to be removed as part of this project.
  - .1 It is the intent that work prescribed this Section will result in the removal of all hazardous materials as outlined and the decontamination of all surfaces or materials which may have been or become contaminated by hazardous materials either during or prior to work of this Contract.

### **Site Conditions**

- .1 Refer to the report entitled “Hazardous Building Materials Assessment St. James Civic Centre 2055 Ness Avenue Winnipeg, Manitoba”, dated October 4, 2018, prepared by Pinchin Ltd, file number 220300 for locations and quantities of hazardous. Building materials
- .2 General Building Conditions
  - .1 Heat and smoke detectors to remain live throughout work.
  - .2 Sprinklers to remain live throughout work.

### **Outline of Work**

- .1 Using procedures prescribed in Section 02 82 10 Asbestos Abatement – Low Risk perform the following;
  - 1 Duct insulation scheduled for removal within the South Crawlspace is jacketed with either paper or foil face. Asbestos-containing tar mastic is present on the jacketing. Reference line items 4 and 9 in the Basement Demolition HVAC Plan Drawing MH2.0 for location of ducting scheduled for removal.
  - 2 9” x 9” Vinyl floor present on the Second Floor contain asbestos. Reference locations 61, 63, 65, 66, and 67 in Appendix I Drawings in the report entitled “Hazardous Building Materials Assessment St. James Civic Centre 2055 Ness Avenue Winnipeg, Manitoba”, dated October 4, 2018, prepared by Pinchin Ltd, file number 220300. There are approximately 3,350 SF of asbestos-containing floor tiles scheduled for removal
  - 3 Mechanical, electrical and plumbing equipment will be anchored into hollow core walls which have been confirmed to contain vermiculite. Vermiculite is present within hollow core wall cavities within the Arena and second floor.
- .2 Using procedures prescribed in Section 02 82 13 Asbestos Abatement – Glove Bag Method Remove the following materials;
  - 1 Parging cement, containing chrysotile asbestos, is present on pipe fittings (elbows, valves, tees) on the domestic (DW), hot water heating (HWH), steam, and rain water leader system. There are approximately 280 fittings present. Reference locations and quantities in Section 3.1.3.1 in the report entitled “Hazardous Building Materials Assessment St. James Civic Centre 2055 Ness Avenue Winnipeg, Manitoba”, dated October 4, 2018, prepared by Pinchin Ltd, file number 220300
- .3 Using procedures prescribed in Section 02 83 10 Lead Abatement – Minimal Precautions perform the following;
  - 1 Remove loose/flaking paint from surfaces scheduled to be painted as identified during the mandatory site walkthrough.
- .4 Using procedures prescribed in Section 02 83 11 Lead/Silica Abatement – Intermediate Precautions perform the following;
  - .1 Containment Required: Crystalline silica is a presumed component of poured or pre-cast concrete, masonry, mortar, and stone. Various levels of lead are known to be present in

paint covering throughout the building. Therefore; demolition of wall and ceilings identified in the architectural demolition drawings will be performed following procedures outlined in this section.

- .2 No Containment Required - Anchoring/fastening into wall and ceiling finishes with lead-containing paint finishes and presumed silica using HEPA filtered power tools (various locations to be determined)
- .5 Coordinate site inspection and air monitoring services specified herein as required with Hazardous Materials Consultant (Pinchin).
- .6 Refer to Specification Sections identified in the Related Work for specified personnel protective measures for the safe handling, removal, clean-up, enclosure, or repair of hazardous materials in each phase or work area.
- .7 Visit the site prior to tender close to confirm the location and extent of any hazardous building materials or materials contaminated by hazardous materials.
- .8 Protect surfaces, building fabrics and items remaining within the Abatement Work Area.
- .9 Isolate the Abatement Work Area from adjoining Occupied and Non-Occupied Areas whether present at an interior or exterior location.
- .10 Maintain emergency and fire exits from Abatement Work Area, or establish alternative exits satisfactory to Provincial Fire Marshall and local authorities having jurisdiction. Maintain extra routes from occupied areas. Place emergency exit signs at locations to clearly mark exit route. Seal emergency exit doors so as not to impede use of door during emergency evacuation.
- .11 Remove and dispose of as appropriate waste, building components, materials and items contaminated by hazardous materials that cannot be effectively cleaned.
- .12 Encapsulate remaining hazardous materials at locations where removal is deemed impractical by the Abatement Consultant.
- .13 Final clean work area to remove visible signs of asbestos and other hazardous materials, other debris or settled dust.
- .14 Unless otherwise specified, the handling, removal, clean-up or repair of hazardous materials or surfaces contaminated with hazardous materials is to be performed following wet removal techniques.

## Schedule

- .1 Provide necessary manpower, supervision, equipment and materials to maintain and complete the project on schedule.
- .2 Work Hours:



- .1 Normal Work Hours: 08:00 through 17:00 (Mon. - Fri.).
- .3 Provide 48 hours written notice to the Abatement Consultant of any request to work outside normal working hours. Obtain written approval before proceeding.

## Definitions

- .1 Abatement Consultant: Owner's Representative providing inspection and air monitoring.
- .2 Abatement Contractor: Contractor or sub-contractor performing work of this section.
- .3 Abatement Work Area: Area where work takes place which will, or may, disturb hazardous materials.
- .4 Amended Water: Water with wetting agent added for the purpose of reducing surface tension to allow thorough wetting of materials.
- .5 Asbestos: Any of the fibrous silicates defined in Regulation 278/05 including: actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite.
- .6 Asbestos-Containing Material (ACM): Material identified under Site Conditions including any debris, overspray, fallen material and settled dust.
- .7 Authorized Visitors: Building Owner, Abatement Consultant, or designated representative, and persons representing regulatory agencies.
- .8 Competent Worker: A worker who is qualified because of knowledge, training and experience to perform the work, is familiar with Regulation 278/05 and the Occupational Health and Safety Act, and has knowledge of the potential or actual danger to health and safety in the work.
- .9 Contaminated Waste: Material identified under Site Conditions, including fallen material, settled dust, other debris and materials or equipment deemed to be contaminated by the Abatement Consultant.
- .10 Curtained Doorway: Doorway consisting of two (2) overlapping flaps of rip-proof polyethylene arranged to permit ingress and egress from one room to another while permitting minimal air movement between rooms.
- .11 DOP Test: A testing method used to determine the integrity of the Negative Pressure unit or vacuum using a Dispersed Oil Particulate (DOP) or Poly Alpha Olefin (PAO) HEPA filter leak test. This test is to be conducted on site where units are to be installed.
- .12 Fitting: Individual segments or pieces of a mechanical service line which may include but is not limited to the hangers, tees, elbows, joints, valves, unions, etc.
- .13 Friable Material: Material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.

- .14 HEPA Filter: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.
- .15 Lead-Containing: The Manitoba Workplace Safety and Health (WSH) has not established a lower limit for concentrations of lead in paint, below which precautions do not need to be considered during construction projects. In the absence of a provincial standard, Pinchin follows the Federal Surface Coating Materials Regulations, SOR/2005-109, Hazardous Products Act. criteria of 0.009% (90 ppm) for lead in paint.
- .16 Lead Waste: Waste generated from removal of lead-containing materials, or the substrate and paint finish where left intact.
- .17 Mercury Waste: Equipment, materials or items containing mercury or contaminated with mercury.
- .18 Milestone Inspection: Inspection of the Abatement Work Area at a defined point in the abatement operation.
- .19 Negative Pressure: A reduced pressure within the Abatement Work Area (> 0.02 inches of water column) established by extracting air directly from Abatement Work Area and discharging it to exterior of building.
- .20 Non-Friable Material: Material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .21 Occupied Area: Any area of the building or adjoining space outside the Abatement Work Area.
- .22 Personnel: All Contractor's employees, sub-contractors employees, supervisors.
- .23 PCBs: Monochlorinated or Polychlorinated Biphenyls (or any mixture of both).
- .24 PCB Material: means solid material containing PCBs at a concentration of more than fifty milligrams per kilogram (mg/kg) or 50 parts per million (ppm), or liquid with greater than 2 mg/kg or ppm.
- .25 PCB Waste: PCB Equipment, PCB Material, PCB Liquids and materials or items contaminated with PCBs.
- .26 PCM: Phase Contrast Microscopy.
- .27 Remove: Remove means remove and dispose of (as applicable type of waste) unless followed by other instruction (e.g. remove and turn over to Owner).
- .28 Toxicity Characteristic Leachate Procedure (TCLP): Laboratory analysis to determine leachable parameters in lead waste.
- .29 TEM: Transmission Electron Microscopy.

## Regulations and Guidelines

- .1 Regulations and Guidelines include but are not limited to the following:
  - .1 Workplace Safety and Health Act W210.
  - .2 Workplace Safety and Health Regulation M.R. 217/2006
  - .3 The Dangerous Goods Handling and Transportation Act C.C.S.M c. D12.
  - .4 Hazardous Waste Regulation, M.R. 195/2015.
  - .5 Dangerous Goods Handling and Transportation Regulation, M.R. 55/2003.
  - .6 Transportation of Dangerous Goods Regulation (SOR 219/2019-101).
  - .7 PCB Regulations, SOR 2008-273.
  - .8 PCB Storage Site Regulation M.R. 474/88.
  - .9 Environmental Abatement Council of Ontario (EACO), Lead Guideline For Construction, Renovation, Maintenance or Repair, October 2014.

### **Quality Assurance**

- .1 Removal and handling of hazardous materials is to be performed by persons trained in the methods, procedures and industry practices for Abatement.
- .2 Ensure work proceeds to schedule, meeting all requirements of this Specification.
- .3 Complete work so that at no time airborne dust, visible debris, or water runoff contaminate areas outside the Abatement Work Area.
- .4 Any contamination of surrounding area (indicated by visual inspection or air monitoring) shall necessitate the clean-up of affected area, and in the same manner applicable to an Abatement Work Area at no cost to the Owner.
- .5 All work of this Section involving electrical, mechanical, carpentry, glazing, etc., shall be performed by licensed persons experienced and qualified for the work required.

### **Supervision**

- .1 Provide on site for each work shift, a Shift Superintendent(s), who has authority regarding all aspects related to manpower, equipment and production.
- .2 Supervisory personnel must hold a recognized certificate proving attendance at an asbestos removal training course (3 day minimum duration) and have performed supervisory functions on at least five (5) other asbestos abatement projects of similar size and complexity.
- .3 At all times during work, the Shift Superintendent(s) must be on site. Failure to comply with this requirement will result in a stoppage of all work, at no cost to the Owner.

- .4 Replace supervisory personnel, with approved replacements, within three (3) working days of a written request from the Owner. Owner reserves the right to request replacement of supervisory personnel without explanation.
- .5 Do not replace supervisory personnel without written approval from the Owner.

#### **Notification**

- .1 landfill site as per local requirements..
- .2 Inform all trades on site of the presence and location of hazardous materials identified in the Contract documents.
- .3 Notice of Project to Work Place Safety and Health Division.

#### **Submittals**

- .1 Submit prior to starting work:
  - .1 Provincial Workers' Compensation Board Clearance Certificate.
  - .2 Insurance certificates.
  - .3 Copy of Company Health and Safety Policy and applicable programs.
  - .4 Ministry of Labour or other Provincial Regulator Notice of Project form.
  - .5 Pre-removal damage survey of the Abatement Work Area(s), waste transport routes, and bin storage areas.
- .2 Submit the following information regarding personnel prior to starting work:
  - .1 Resumes of the supervisory personnel.
  - .2 Written statement that personnel have had instruction on hazards of exposure to hazardous materials identified within this scope, the use of respirator, protective clothing, worker and waste decontamination procedures, and all aspects of work procedures and protective measures.
  - .3 Written statement that personnel have had instruction on hazards of exposure to hazardous materials identified within this scope, the use of respirator, protective clothing, worker and waste decontamination procedures, and all aspects of work procedures and protective measures.
  - .4 WHMIS training certificates for all personnel.
  - .5 Certificate proving that each worker on site has been fit tested for the respirator appropriate for the work being performed.

- .3 Submit the following information regarding HEPA filtered devices prior to construction of enclosure or asbestos abatement:
  - .1 Performance data on HEPA filtered vacuums including DOP tests no more than 3 months old.
  - .2 DOP tests to be performed by an independent testing company.
    - .1 DOP testing company is required to submit a detailed technical report of testing protocol, including Introduction, Methodology, Results, Conclusions, and Recommendations, including results of the Air-Aerosol Mixing Uniformity test as per ASME N510-1989 (1995).
    - .2 DOP testing company must also provide calibration certificates from an independent calibration firm or from the manufacturer of the testing equipment for both the aerosol photometer and the pressure gauge on the aerosol generator dated within 1 calendar year from the on-site testing date.
    - .3 DOP testing company must also provide the National Sanitation Foundation (NSF) certification name and number of the on-site technician performing the testing.
  - .3 Proof of calibration of DOP testing equipment.
- .4 Submit the following prior to isolating the work area:
  - .1 Safety Data Sheets for chemicals or material used in the course of the Abatement Project.
- .5 Submit the following upon completion of the work.
  - .1 Manifests, waybills, bills of lading etc. as applicable for each type of waste.

#### **Insurance**

- .1 Maintain a Commercial General Liability Policy with an insurance company acceptable to OWNER. The intent of this policy is to hold OWNER harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Commercial General Liability insurance shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period.
- .2 Maintain an Automobile or Fleet Policy, and Non-owned Automobile Policy with an insurance company acceptable to OWNER. The intent of these policies is to hold OWNER harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract.

- .3 Maintain a Pollution Liability Policy (or asbestos/lead liability policy or specific coverage under the CGL for asbestos/lead abatement) with an insurance company acceptable to OWNER. The intent of this policy is to hold OWNER harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Pollution Liability shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period. Without limiting the generality of the foregoing, the policy shall insure the operations of abatement and shall not contain any environmental and/or health hazard exclusions relating to remediation operations.
- .4 Forward all certificates to OWNER before work is commenced, showing OWNER as additional insured as their interest may appear.
- .5 OWNER may request a certified true copy of the policies.
- .6 The limits will not be less than:
  - .3 Commercial General Liability \$5,000,000.00
  - .4 Automobile \$2,000,000.00
  - .5 Pollution Policy \$5,000,000.00

### **Inspection**

- .1 From commencement of work until completion of clean-up operations, the Abatement Consultant is empowered by the Owner to inspect for compliance with the requirements of governing authorities, adherence to specified procedures and materials, and to inspect for final cleanliness and completion.
- .2 The Abatement Consultant is empowered by the Owner to order a shutdown of work when leakage of asbestos from the controlled work area has occurred or is likely to occur.
- .3 Any deviation from the requirements of the Specifications or governing authorities that is not approved in writing may result in a stoppage of work, at no cost to the Owner.
- .4 Additional labour or materials expended by the Contractor to rectify unsatisfactory conditions and to provide performance to the level specified shall be at no additional cost to the Owner.
- .5 Inspection and air monitoring performed as a result of Contractor's failure to perform satisfactorily regarding quality, safety, or schedule, shall be back-charged to the Contractor.
- .6 Facilitate inspection and provide access as necessary. Make good work disturbed by inspection and testing at no cost to the Owner.
- .7 Refer to the Sections identified in Related Work for specified milestone inspections which are to take place at defined points throughout the abatement operation specific to each phase or work area.

- .8 Provide 24 hours written notice to the Abatement Consultant of any request for scheduling of milestone inspections or transportation of waste through Occupied Areas.
- .9 The following Milestone Inspections may take place, at the Owner's cost, as outlined in each related specification section:
  - .1 Milestone Inspection - Clean Site Preparation
    - .1 Inspection of preparations and set-up prior to contaminated work in the Abatement Work Area.
  - .2 Milestone Inspection – Bulk Removal Inspection
    - .1 Inspection during asbestos/lead/silica removal, monitoring removal methods, site deficiencies, performing occupied air monitoring for asbestos, etc.
  - .3 Milestone Inspection - Visual Clearance
    - .1 Inspection of Abatement Work Area after completion of all abatement, but prior to application of lock-down agents or dismantling of enclosure.
  - .4 Milestone Inspection – Clearance Sampling for Asbestos
    - .1 Air monitoring performed following removal of asbestos.
- .10 Refer to the Sections identified in Related Work for specified milestone inspections which are to take place at defined points throughout the abatement operation specific to each phase or work area.
- .11 Do not proceed with next phase of work until written approval of each milestone is received from the Abatement Consultant.

#### **Air Monitoring - Asbestos**

- .1 Air monitoring will be performed using Phase Contrast Microscopy (PCM) following the National Institute for Occupational Safety and Health Method 7400.
- .2 Co-operate in the collection of air samples, including providing workers to wear sample pumps for up to full-shift periods. Contractor will be responsible for the cost of testing equipment repairs or resampling resulting from the actions of the Contractor's forces.
- .3 Results of PCM samples of 0.05 fibres per cubic centimeter of air (fibre/cc) or greater, outside an Abatement Work Area, or from within the Abatement Work Area during or following Glove Bag Work, will indicate asbestos contamination of these areas. Respond as follows:
  - .1 Suspend work within the adjoining Abatement Work Area until written authorization to resume work has been received from the Abatement Consultant.
  - .2 Isolate and clean area in the same manner applicable to the Abatement Work Area.

- .3 Maintain work area isolation, and repeat clean-up operations until visual inspection and air monitoring results are at a level equal to that specified.
  - .4 At the discretion of the Abatement Consultant provide additional negative air units at locations specified in response to elevated fibre levels being detected in the Occupied Areas.
  - .5 Maintain work area isolation and re-clean entire work area. Then apply another acceptable coat of lock-down agent to exposed surfaces throughout the work area.
  - .6 Repeat above measures until visually inspected and air monitoring results are at a level equal to that specified.
- .4 exceed 50% of maximum use concentration for the respirator being used within the work area respond as follows:
- .1 Immediately stop work within the Abatement Work Area.
  - .2 Instruct workers to exit the Abatement Work Area via the Worker Decontamination Facility while observing specified personnel exiting procedures.
  - .3 Contractor's forces shall not re-enter the Abatement Work Area for a period of 8 hours or until authorized by the Abatement Consultant.
  - .4 Upon re-entry to the Abatement Work Area, mist the air, any fallen debris or exposed surfaces with amended water using an airless sprayer.
- .5 Additional labour or materials expended by the Contractor to rectify unsatisfactory conditions and to provide performance to the level specified shall be at no additional cost to the Owner.
- .6 Cost of additional inspection and sampling performed as a result of elevated fibre levels in areas outside the Abatement Work Area or from within the work area following completion of work, will be back-charged to the Contractor.

### **Worker Protection**

- .1 Instruct workers before allowing entry to the Abatement Work Area. Instruction shall include training in use of respirators, dress, entry and exiting from an Abatement Work Area, and all other aspects of work procedures and protective measures.
- .2 Workers shall not eat, drink, chew gum or tobacco, or smoke in the Abatement Work Area.
- .3 Workers shall be fully protected at all times when possibility of disturbance of hazardous materials exists.



- .4 Provide soap, towels and facilities for washing of hands and face, which shall be used by all personnel when leaving the Abatement Work Area.
- .5 Respiratory Protection
  - .1 Refer to each particular Section of the Specification for specified type of respiratory equipment specific to each phase or work area.
  - .2 Respirators shall be:
    - .1 Certified by the National Institute of Occupational Safety and Health (NIOSH) or other testing agency acceptable to the Ministry of Labour or other Provincial regulator.
    - .2 Fitted so that there is an effective seal between the respirator and the worker's face. Ensure that no person required to enter an Abatement Work Area has facial hair which affects the seal between respirator and face.
    - .3 Assigned to a worker for their exclusive use.
    - .4 Maintained in accordance with manufacturer's specifications.
    - .5 Cleaned, disinfected and inspected by a competent person after use on each shift, or more often if required.
    - .6 Repaired or have damaged or deteriorated parts replaced.
    - .7 Stored in a clean and sanitary location.
    - .8 Provided with new filters as necessary, according to manufacturer's instructions.
    - .9 Worn by personnel who have been fit checked by qualitative or quantitative fit-testing.
    - .10 Instruction on proper use of respirators must be provided by a competent person as defined by the Occupational Health and Safety Act.
  - .3 Provide protective clothing, to all personnel which:
    - .1 Is made of a material that does not readily retain nor permit penetration of asbestos fibres or lead/silica dust.
    - .2 Consists of head covering and full body covering that fits snugly at the ankles, wrists and neck.
    - .3 Once coveralls are worn, treat and dispose of as contaminated waste.
    - .4 Is replaced or repaired if torn or ripped.
  - .4 Use hard hats, safety footwear and other protective equipment and apparel required by applicable construction safety regulations.

### **Visitor Protection**

- .1 Provide clean protective clothing and equipment to Authorized Visitors.
- .2 Instruct Authorized Visitors in the use of protective clothing and Abatement Work Area entry and exit procedures.

## Signage

- .3 Asbestos Abatement Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:
  - .1 There is an asbestos dust hazard.
  - .2 Access to the work area is restricted to persons wearing protective clothing and equipment.
- .4 Lead/Silica Abatement Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:
  - .1 There is a lead/Silica dust, fume or mist hazard.
  - .2 Access to the work area is restricted to authorized persons.
  - .3 Respirators must be worn in the work area.
- .5 Vehicles, Bins and Asbestos Waste Containers: Post signs on both sides of every vehicle used for the transportation of asbestos waste and on every asbestos waste container. Signs must display thereon in large, easily legible letters that contrast in colour with the background the word “CAUTION” in letters not less than ten centimetres in height and the words:
  - .1 CONTAINS ASBESTOS FIBRES
  - .2 Avoid Creating Dust and Spillage
  - .3 Asbestos May be Harmful To Your Health
  - .4 Wear Approved Protective Equipment.
- .6 Place placards in accordance with Transportation of Dangerous Goods Act.

## Differential Pressure Monitoring

- .1 Provide and install differential pressure monitors as specified in each section.
- .2 Replace damaged or non-functional equipment at the request of the Abatement Consultant.
- .3 Record at minimum twice daily, and when damage to the enclosure is identified and repaired, the following information:
  - .1 Name of inspector.
  - .2 Date and time.
  - .3 Pressure reading.
  - .4 Repairs completed, if applicable.
- .4 Maintain specified differential pressure.

- .5 Stop contaminated work and take corrective action if pressure differential drops below the specified level. Notify the Abatement Consultant immediately.

### **Waste and Material Handling**

- .1 Waste bins must be placed on grade or in receiving.
- .2 All bins for hazardous materials must be covered and locked when waste transfer is not being performed.
- .3 Ensure redundant non-ACM, rubble, debris, etc. removed during contaminated work are treated, packaged, transported and disposed of as appropriate waste.
- .4 Clean, wash and apply Post Removal Sealant to metal waste prior to removal from Abatement Work Area. Recycle metals.
- .5 Clean, wash and apply Post Removal Sealant to non-porous materials prior to disposal as clean waste. Obtain prior written approval from the Abatement Consultant for each individual type of material.
- .6 Clean and wash equipment prior to removal from Abatement Work Area if removed prior to completion.
- .7 Place all equipment, tools and unused materials that cannot be cleaned in Abatement Waste Containers.
- .8 As work progresses, and at regular intervals, transport the sealed and labelled waste containers from the Abatement Work Area to waste bin.
- .9 Place items in bins according to waste classification. Place asbestos waste, lead waste, metals, non-asbestos waste, etc. in separate bins.
- .10 Removal of waste containers and decontaminated tools and materials from the Abatement Work Area shall be performed as follows:
  - .1 Remove any visible contamination from the surface of non-porous or cleanable waste being removed from the Abatement Work Area. If the item can be cleaned, remove it from the site as clean waste.
  - .2 Place waste or item in Waste Container and seal closed.
  - .3 Wet wipe outside of Waste Container.
  - .4 Within Decontamination Facility, Transfer Room or at the perimeter of the Abatement Work Area, place in second Waste Container. Seal closed.
  - .5 Remove waste containers and transport to appropriate bin.

- .11 Transport waste and materials via the predetermined routes and exits. Arrange waste transfer route with Owner. Use a closed, covered cart to transport through Occupied Areas.
- .12 Provide workers transporting waste with means to access full personal protective equipment and all tools required to properly clean up spilled material in the case of a rupture of a Waste Container.
- .13 Pick-up and drop off of garbage bin shall be at pre-approved times, and must not interfere with the Owners operations.
- .14 Transport hazardous waste to landfill or waste transfer station licensed by the provincial Ministry of the Environment.
- .15 Cooperate with the provincial Ministry of the Environment inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the Owner.

## **PART 2 PRODUCTS AND FACILITIES**

### **Materials and Equipment**

- .1 Refer to the Sections identified in Related Work for specified materials, equipment or facilities specific to each phase or work area.
- .2 Materials and equipment must be in good condition and free of debris and fibrous materials. Disposable items must be of new materials only.
- .3 Airless Sprayer: AC powered pressure washer that allows wetting agent to mix with water, uses no air or compressed air, and has a nozzle to regulate power and pressure.
- .4 Amended Water: Water with wetting agent added for purpose of reducing surface tension to allow thorough wetting of materials.
- .5 Asbestos Waste Container: A container acceptable to disposal site, Ministry of the Environment comprised of the following:
  - .1 Dust tight.
  - .2 Suitable for the type of waste.
  - .3 .Impervious to asbestos.
  - .4 Identified as asbestos waste.
- .6 Differential Pressure Monitor: a high precision instrument for measuring and controlling pressure differences in the low range, between the Abatement Work Area and Occupied Area. Calibrate regularly to manufacturer's instructions.

- .7 Discharge Ducting: Polyethylene Tubing. Reinforced with wire. Diameter to equal negative pressure machine discharge. Not to be longer than required, or so long that negative pressure is compromised.
- .8 Ground Fault Panel: Electrical panel as follows:
  - .1 Ground fault circuit interrupters of sufficient capacity to power temporary electrical equipment and lights in Asbestos Work Area.
  - .2 Interrupters to have a 5 mA ground fault protection.
  - .3 Necessary accessories including main switch disconnect, ground fault interrupter lights, test switch to ensure unit is working, and reset switch.
  - .4 Openings sealed to prevent moisture or dust penetration.
  - .5 Inspected by the Electrical Safety Authority.
  - .6 Panel uses CSA approved parts and been constructed, inspected and installed by a licensed electrician.
  - .7 Provide one Ground Fault Panel for each 5,000 square feet (500 square metres) of Abatement Work Area.
- .9 HEPA Filtered Negative Pressure Machine: Portable air handling system which extracts air directly from the Abatement Work Area and discharges the air to the exterior of the building. Equipped as follows:
  - .1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.
  - .2 Pressure differential gauge to monitor filter loading.
  - .3 Auto shut off and warning system for HEPA filter failure.
  - .4 Separate hold down clamps to retain HEPA filter in place during change of prefilter.
- .10 HEPA Vacuum: Vacuum with necessary fittings, tools and attachments. Discharged air must pass through a HEPA filter.
- .11 Hose: Leak-proof, minimum bursting strength of 500 PSI or greater if required, abrasion resistant covering, reinforcing, and machined-brass couplings. Maintained and tested. Hose to be temperature resistant if it is to carry domestic hot water.
- .12 Lead Waste Container: An impermeable container acceptable to disposal site and Ministry of the Environment, that is:
  - .1 Dust tight.
  - .2 Suitable for the type of waste.

- .3 Evaluated for leachable lead content, and disposed of in accordance with applicable regulations.
  - .1 Where lead waste exceeds 5.0 mg/L of lead in the TCLP analysis, label as lead waste and dispose of as leachate toxic hazardous waste.
  - .2 Where lead waste is below 5.0 mg/L of lead in the TCLP analysis, disposed of as construction waste.
- .13 OSB: Oriented Strand Board.
- .14 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.
- .15 Post Removal Sealant (or Lockdown): Sealant that when applied to surfaces serves the function of trapping residual asbestos fibres or other dust. Product must have flame spread and smoke development ratings both less than 50. Product shall leave no stain when dry. Post Removal Sealant shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate. Apply to manufacturer's instructions.
- .16 Protective Clothing: Disposable coveralls complete with head covering and full body covering that fits snugly at the ankles, wrists and neck.
- .17 Rip-Proof Polyethylene Sheeting: 8 mil (0.20 mm) fabric made up from 5 mil (0.13 mm) weave and two (2) layers of 1.5 mil (0.05 mm) poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps.
- .18 Shower Hose: Water lines for supply of hot & cold water to shower facilities to be rated for use at 200 PSI (1380 kPa) or twice the working pressure whichever is greater. Supply lines to be continuous and free of fittings, joints or couplings.
- .19 Sprayer: Garden type portable manual sprayer or water hose with spray attachment if suitable.
- .20 Tape: Duct tape or tape suitable for sealing polyethylene to surfaces under both dry and wet conditions in the presence of Amended Water.
- .21 Wetting Agent: Non-sudsing surfactant added to water to reduce surface tension and increase wetting ability.

### **PART 3 EXECUTION**

- .1 Refer to the Sections identified in Related Work for specified procedures for work area preparation, maintenance, site dismantlement, application of lock-down agent and all other procedures for the safe handling, removal and clean-up of hazardous materials specific to each phase or work area.

### **END OF SECTION**



## **PART 1 GENERAL**

### **1.1 General and Related Work**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
  - .1 Section 02 81 00 Hazardous Materials – General Provisions
  - .2 Section 02 82 11 Asbestos Abatement – Moderate Precautions
  - .3 Section 02 82 13 Asbestos Abatement – Glove Bag Method
  - .4 Section 02 83 10 Lead Abatement – Minimal Precautions
  - .5 Section 02 83 11 Lead Abatement – Intermediate Precautions

### **1.2 Outline of Work**

- .1 Refer to Basement Demolition HVAC Plan Drawing MH2.0 in the tender package and Appendix I Drawings in the report entitled “Hazardous Building Materials Assessment St. James Civic Centre 2055 Ness Avenue Winnipeg, Manitoba”, dated October 4, 2018, prepared by Pinchin Ltd, file number 220300. for the extent of Abatement Work Areas.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Low Risk procedures, and Pinchin and Owner specific requirements.
- .3 Using Low Risk procedures of this section, remove and dispose of the following:
  - .1 9” x 9” asbestos-containing vinyl floor tiles and mastic are present on the Second Floor. Reference locations 61, 63, 65, 66, and 67 in Appendix I Drawings in the report entitled “Hazardous Building Materials Assessment St. James Civic Centre 2055 Ness Avenue Winnipeg, Manitoba”, dated October 4, 2018, prepared by Pinchin Ltd, file number 220300. There are approximately 3,350 SF of asbestos-containing floor tiles scheduled for removal:
  - .2 Duct insulation scheduled for removal within the South Crawlspace is jacketed with either paper or foil face. Asbestos-containing tar mastic is present on the jacketing. Reference line items 4 and 9 in the Basement Demolition HVAC Plan Drawing MH2.0 for location of ducting scheduled for removal:

### **1.3 Instruction and Training**

- .1 Provide instruction and training to all workers including the following:
  - .1 Hazards of asbestos.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 Measures and procedures prescribed in the regulation and decontamination of the worker.



- .2 Instruction and training must be provided by a competent person.

#### **1.4 Personal Protection**

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
  - .1 Provide non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters when requested by personnel.
  - .2 When requested by personnel, provide protective clothing.

#### **1.5 Inspections**

- .1 Refer to Part 1.12 Inspections in Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
  - .1 Milestone Inspection - Visual Clearance

### **PART 2 PRODUCTS AND FACILITIES**

- .1 Refer to Section 02 81 00.

### **PART 3 EXECUTION**

#### **3.1 Site Preparation**

- .1 Remove stored or non-fixed items from the Abatement Work Area including but not limited to equipment, furniture, waste etc. Store in area provided by Owner.
- .2 Moving of equipment, tools, supplies, and stored materials that can be performed without disturbing ACM will be performed by others.
- .3 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .4 Install polyethylene drop sheets below areas of work.
- .5 Install signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .6 Shut down HVAC systems serving the Abatement Work Area.
  - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
  - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
  - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
  - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .7 Provide amended water for wetting ACM, and adequate method of wetting (garden sprayers, airless sprayers, etc).

#### **3.2 Maintenance of Abatement Work Area**

- .1 Maintain Abatement Work Area in tidy condition.
- .2 Remove any standing water on polyethylene/floor at the end of every shift.

#### **3.3 Asbestos Removal - General**

- .1 Do not use powered tools or non-hand held tools.

- .2 Do not use compressed air to clean or remove dust or debris.
- .3 Do not break, cut, drill, abrade, grind, sand or vibrate ACM if it cannot be wetted. Type 2 procedures would be required if the material cannot be wetted due to hazard or damage.
- .4 Wet ACM prior to work and keep ACM wet throughout the removal process.
- .5 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .6 Frequently and at regular intervals, place all waste in asbestos waste containers.
- .7 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

### **3.4 Asbestos Removal - Vinyl Asbestos Tile**

- .1 Wedge a heavy duty scraper in seam of two adjoining tiles and gradually force edge of one tile up and away from floor. Do not break off pieces of tile, but continue to force balance of tile up.
- .2 Place tile, without breaking into smaller pieces, into Asbestos Waste Container.
- .3 Force scraper through tightly adhered areas by striking scraper handle with a hammer.
- .4 Heat tile thoroughly with a hot air gun until heat penetrates through tile and softens adhesive in areas where scraper will not remove tile.
- .5 Scrape up adhesive remaining on floor with a hand scraper until only a thin smooth film remains.
- .6 Use a hot air gun where deposits are heavy or difficult to scrape.
- .7 Deposit scrapings into asbestos waste disposal bag.
- .8 HEPA vacuum floor on completion of work in area.

### **3.5 Asbestos Removal - Removal of Asbestos-Containing Tar Mastic from Ducting**

- .1 Use the procedures described above under Site Preparation –No Enclosure Required.
- .2 Wet all material to be disturbed.
- .3 Undo fasteners if necessary to remove material.
- .4 Remove effected insulation including fibreglass, foil face jacketing and paper from ducting and mastic
- .5 Break material only if unavoidable, and wet material if broken during work.
- .6 Use only non-powered hand-held tools to remove ACM.
- .7 Scrape to remove material adhered to substrate.
- .8 Place removed insulation effected by ACM directly into an asbestos waste container.

### **3.6 Abatement Work Area Dismantling**

- .1 Wash or HEPA vacuum equipment and tools used in contaminated Abatement Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior to being removed from Abatement Work Area.
- .2 Place tools and equipment used in contaminated work site but not cleaned in polyethylene bags prior to removal from Abatement Work Area.

- .3 Clean polyethylene sheeting and drop sheets which with HEPA vacuum or wet cleaning methods at completion of work.
- .4 Wet drop sheets and polyethylene sheeting.
- .5 Carefully roll polyethylene sheeting and drop sheets toward the centre. As polyethylene is rolled away, immediately remove visible debris beneath with a HEPA vacuum.
- .6 Remove remaining polyethylene sheeting and tape.
- .7 Place polyethylene sheeting, drop sheets, tape, disposal clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.

### **3.7 Waste and Material Handling**

- .1 Refer to Section 02 81 00.

### **END OF SECTION**

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## **PART 1 GENERAL**

### **1.1 General and Related Work**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
  - .1 Section 02 81 00 Hazardous Materials – General Provisions
  - .2 Section 02 82 10 Asbestos Abatement – Low Risk Precautions
  - .3 Section 02 82 13 Asbestos Abatement – Glove Bag Method
  - .4 Section 02 83 10 Lead Abatement – Minimal Precautions
  - .5 Section 02 83 11 Lead Abatement – Intermediate Precautions

### **1.2 Outline of Work**

- .1 Parging cement, containing chrysotile asbestos, is present on pipe fittings (elbows, valves, tees) on the domestic (DW), hot water heating (HWH), steam, and rain water leader system. There are approximately 280 fittings present. Reference locations and quantities in Section 3.1.3.1 in the report entitled “Hazardous Building Materials Assessment St. James Civic Centre 2055 Ness Avenue Winnipeg, Manitoba”, dated October 4, 2018, prepared by Pinchin Ltd, file number 220300. This section will be used for removal of less than 1 Square Meter of parging cement when glovebag procedures cannot be used.
- .2 Vermiculite is present within hollow core wall cavities within the Arena and second floor. This section will be used to facilitate anchoring of Mechanical, electrical and plumbing equipment into hollow core walls which have been confirmed to contain vermiculite.
- .3 Using Moderate Risk procedures of this section, perform the following:
  - .1 Minor amounts (<1 sq m) of asbestos-containing parging cement when glovebag methods are not achievable.
  - .2 Anchoring of Mechanical, electrical and plumbing equipment with HPEA filtered power tools into hollow core walls which have been confirmed to contain vermiculite:

### **1.3 Instruction and Training**

- .1 Provide instruction and training to all workers including the following:
  - .1 Hazards of asbestos.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 The measures and procedures prescribed by this section including decontamination of the worker.

.5 Instruction and training must be provided by a competent person.

#### **1.4 Personal Protection**

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
  - .1 Provide workers, at a minimum, with non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters.
  - .2 Provide protective clothing, to all personnel entering the Abatement Work Area.

#### **1.5 Inspections**

- .1 Refer to Part 1.12 Inspections in Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
  - .1 Milestone Inspection - Clean Site Preparation
  - .2 Milestone Inspection – Bulk Removal Inspection
  - .3 Milestone Inspection - Visual Clearance
  - .4 Milestone Inspection – Clearance Sampling

### **PART 2 PRODUCTS AND FACILITIES**

- .1 Refer to Section 02 81 00.

#### **2.2 Hoarding Walls**

- .1 Hoarding Wall: 38 mm x 89 mm wood or metal studs at 400 mm o/c with continuous sill and top plate, covered with one layer of rip-proof polyethylene sheeting on each side of wall.

#### **2.3 Transfer Room**

- .1 Transfer Room to be generally 2000 mm x 2000 mm x 2200 mm high. Increase size accordingly to accommodate number of workers.
- .2 Install walls as follows:
  - .1 Install 38 x 89 mm wood framing at 610 mm o/c with continuous top and sill plates.
  - .2 Install one layer rip-proof polyethylene sheeting on interior walls of Transfer Room.
- .3 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting beneath entire Transfer Room.
- .4 Install one layer rip-proof polyethylene sheeting over roof.
- .5 Turn 600 mm of polyethylene down the sides over polyethylene on the perimeter walls.
- .6 Install a fire extinguisher, mount to wall.

#### **2.4 Curtained Doorways**

- .1 Construct as follows:
  - .1 Install two flap doors, full width and height of door opening at all doors to Abatement Work Area and both ends of Transfer Room.
  - .2 Construct each flap door of two layers of polyethylene sheeting with all edges reinforced with tape. Use wood strapping to securely fasten flap doors to head

and alternate jambs.

- .3 Install weights attached to bottom edge of each door flap.
- .4 Provide direction arrows on flaps to indicate opening.

### **PART 3 EXECUTION**

#### **3.1 Site Preparation - General**

- .1 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .2 Isolate, at panel, and disconnect existing power supply to Abatement Work Area. Power supply to remaining areas of building must not be disrupted during work of this section.
  - .1 Lock-out/tag-out power at electrical panels.
  - .2 Mark/tag any items within or passing through the Abatement Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc.
- .3 Shut down HVAC systems serving the Abatement Work Area.
  - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
  - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
  - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
  - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .4 Provide power from ground fault interrupt circuits.
- .5 Provide amended water for wetting ACM, and adequate method of wetting (garden sprayers, airless sprayers, etc).

#### **3.2 Site Preparation –Enclosure Required**

- .1 Install polyethylene enclosure at Abatement Work Areas in which the abatement of friable asbestos-containing materials (less than 1 square metre) is performed, and the removal of a false ceiling (or part of) where asbestos-containing material is presumed or known to be present on the surface.
- .2 Install Transfer Room.
- .3 Construct Hoarding Walls between Abatement Work Area perimeter and occupied areas.
- .4 Install Curtained Doorways.
- .5 Install polyethylene sheeting on floors of Abatement Work Area. Use sufficient layers to provide adequate protection for carpeting and equipment.
  - .1 Minimum requirement over carpet is one layer of 6 mil polyethylene under one layer of rip-proof polyethylene.
  - .2 Cover floors first so that polyethylene on walls is overlapped by at least 305 mm.
- .6 Install polyethylene sheeting at openings in walls (as required) and seal.
- .7 Install 6 mil polyethylene sheeting on walls within the Abatement Work Area., including existing walls that make up, or are within, the Abatement Work Area.

- .8 Install one layer of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged. Items to remain include but are not limited to:
  - .1 Millwork.
  - .2 Doors.
  - .3 Bulkheads.
  - .4 Toilet Partitions.
  - .5 Plumbing fixtures.
  - .6 Electrical Equipment.
  - .7 Mechanical Equipment.
  - .8 Kitchen Equipment.
- .9 Provide a completely sealed polyethylene top for free standing enclosures.
- .10 Extend to underside of ceiling system, enclosures for access into ceilings.
- .11 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .12 Establish negative pressure in Abatement Work Areas as follows:
  - .1 Provide sufficient HEPA filtered negative pressure machines to exchange a volume of air equivalent to that of the Abatement Work Area a minimum of every 20 minutes.
  - .2 Provide additional HEPA filtered negative pressure machines as required to ensure air flow from Occupied Area into Abatement Work Area.
  - .3 Arrange negative air units to maximize the distance between units and decontamination facilities.
  - .4 Operate HEPA filtered negative pressure machines continuously from first disturbance of ACM until completion of dismantling.
  - .5 Replace prefilters to maintain specified flow rate.
  - .6 Replace HEPA filter as required to maintain flow rate and integrity of unit.
  - .7 Discharge HEPA filtered negative air machines as follows:
    - .1 To building exterior.
      - .1 Remove existing glazing where necessary and replace with a 19 mm plywood panel.
      - .2 Install panel securely in window frame so that it cannot be pushed into the building and make weather-tight with caulking.
      - .3 For each negative pressure unit, provide a 300 mm diameter, screened, duct opening through panel.
      - .4 Direct discharge away from building access points.
      - .5 Reinstall glazing to match existing upon completion of work.
    - .2 Into Occupied Areas as required.
      - .1 Install and make airtight all negative air discharge ducting.
      - .2 Use metal reinforced polyethylene discharge ducting in locations where the ducting must be protected from damage or collapse.
- .13 Place required tools to complete the abatement with the Abatement Work Area.

- .14 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.

### **3.3 Site Preparation – No Enclosure Required**

- .1 Install polyethylene drop sheeting below areas of work.
- .2 Install polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged. Items to remain include but are not limited to:
  - .1 Millwork.
  - .2 Doors.
  - .3 Bulkheads.
  - .4 Toilet Partitions.
  - .5 Plumbing fixtures.
  - .6 Electrical Equipment.
  - .7 Mechanical Equipment.
  - .8 Kitchen Equipment.
- .3 Install caution tape around work area where existing walls are not present.
- .4 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .5 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .6 Place HEPA vacuum in Abatement Work Area.
- .7 Place water sprayer in Abatement Work Area.
- .8 Place can of spray foam in Abatement Work Area
- .9 Place required tools to complete the abatement with the Abatement Work Area.

### **3.4 Maintenance of Abatement Work Area**

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Abatement Work Area.
- .3 Inspect HEPA filtered negative pressure machines including discharge ducting at the beginning and end of each working period. Inspection must be performed by competent person.
- .4 Maintain Abatement Work Area in tidy condition.
- .5 Remove standing water on polyethylene/floor at the end of every shift.
- .6 Turn off water supply to any hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.

### **3.5 Asbestos Removal - General**

- .1 Do not use compressed air to clean or remove dust or debris.
- .2 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.



- .3 Frequently and at regular intervals, place all waste in asbestos waste containers.
- .4 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

### **3.6 Asbestos Removal – Parging Insulation (less than 1 Square Metre)**

- .1 Construct an enclosure around Abatement Work Area and use the procedures described above under *Site Preparation – Enclosure Required*.
- .2 Adequately wet exterior of the ACM with amended water to suppress dust.
- .3 Remove asbestos-containing parging insulations in layers, maintaining all exposed surfaces of insulation in a wet condition.
- .4 Remove wetted ACM directly into waste containers. Do not allow ACM to fall to the floor of the Abatement Work Area.
- .5 Clean all surfaces from which ACM has been removed with scouring pads, vacuuming or wet-sponging to remove all visible material after completion of removal of ACM.
- .6 Remove visible dust and debris.
- .7 HEPA vacuum or wet clean entire Abatement Work Area, including any surfaces not covered with polyethylene sheeting. Any materials removed to access ACM that are to be re-used, and any abatement equipment, must be wet cleaned or HEPA vacuumed prior to completion.
- .8 Apply Post Removal Sealant to all surfaces within the Abatement Work Area including those from which ACM has been removed. Do not apply post removal sealant to materials that will be damaged by its application
- .9 Schedule Visual Inspection and Air Sampling with abatement contractor prior to proceeding with dismantlement of hoarding.

### **3.7 Asbestos Removal - Anchoring of Mechanical, electrical and plumbing equipment into hollow core walls containing Vermiculite with HEPA Filtered Power Tools**

- .1 Use the procedures described above under *Site Preparation – No Enclosure Required*.
- .2 If necessary undo fasteners to prep for new anchors to be installed using either HEPA Filtered Power Tools or hand-held tools.
- .1 Seal anchoring points where fasteners have been removed with spray foam
- .2 If vermiculite is dislodged from wall during removal of fasteners stop immediately, seal openings with spray foam, HEPA vacuum and wet wipe debris.
- .3 Use hand held powered tools with a HEPA filtered dust collection device to install new anchored points.
- .4 If vermiculite is dislodged from wall during installation of anchor points stop immediately, seal openings with spray foam, HEPA vacuum and wet wipe debris.
- .5 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not covered with polyethylene sheeting. Any materials or equipment removed to access ACM that are to be reused, must be wet cleaned or vacuumed prior to reinstatement.

### **3.8 Abatement Work Area Dismantling**

- .1 Wash or HEPA vacuum equipment and tools used in contaminated Abatement Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior

- to being removed from Abatement Work Area.
- .2 Place tools and equipment used in contaminated work site but not cleaned in polyethylene bags prior to removal from Abatement Work Area.
  - .3 Clean polyethylene sheeting and drop sheets which with HEPA vacuum or wet cleaning methods at completion of work.
  - .4 Wet drop sheets and polyethylene sheeting.
  - .5 Carefully roll polyethylene sheeting and drop sheets toward the centre of enclosure. As polyethylene is rolled away, immediately remove visible debris beneath with a HEPA vacuum.
  - .6 Remove remaining polyethylene sheeting and tape, and dispose of as asbestos waste.
  - .7 Place polyethylene sheeting, drop sheets, tape, disposal clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.
  - .8 Remove remaining site isolation, seals, tape, etc.
  - .9 Remove Transfer Room.
  - .10 Remove seals, tape, Signage etc.
  - .11 Immediately upon shutting down negative air units, seal air inlet grill and exhaust vent with polyethylene and tape.
  - .12 Seal openings in HEPA vacuums.
  - .13 Remove and dispose of the pre-filters from HEPA filtered negative pressure machines as asbestos waste.
  - .14 Remove HEPA filtered negative pressure machines and discharge ducting or HEPA vacuums.
  - .15 Remove temporary lights.
  - .16 Remove ground fault panels.
  - .17 Place contaminated materials including polyethylene sheeting, drop sheets, seals, tape, disposable coveralls, and other contaminated waste in asbestos waste containers.

### **3.9 Waste and Material Handling**

- .1 Refer to Section 02 81 00.

### **END OF SECTION**

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**PART 1 GENERAL**

**1.1 General and Related Work**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
  - .1 Section 02 81 00 Hazardous Materials – General Provisions
  - .2 Section 02 82 10 Asbestos Abatement – Low Risk Precautions
  - .3 Section 02 82 11 Asbestos Abatement – Moderate Precautions
  - .4 Section 02 83 10 Lead Abatement – Minimal Precautions
  - .5 Section 02 83 11 Lead Abatement – Intermediate Precautions

**1.2 Outline of Work**

- .1 De-activate steam and condensate, and hot water heating pipe systems prior to work.
- .2 Using Glove Bag procedures of this section, remove and dispose of asbestos-containing mechanical insulations in the following locations:
  - .1 Parging cement, containing chrysotile asbestos, is present on pipe fittings (elbows, valves, tees) on the domestic (DW), hot water heating (HWH), steam, and rain water leader system. There are approximately 280 fittings present. Reference locations and quantities in Section 3.1.3.1 in the report entitled “Hazardous Building Materials Assessment St. James Civic Centre 2055 Ness Avenue Winnipeg, Manitoba”, dated October 4, 2018, prepared by Pinchin Ltd, file number 220300
  - .3 If for reasons of pipe geometry, temperature or access, Glove Bag procedures cannot be used, remove and dispose of asbestos-containing insulations as per Section 02 82 11 for less than 1 square meter.

**1.3 Instruction and Training**

- .1 Provide instruction and training to all workers including the following:
  - .1 Hazards of asbestos.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 The measures and procedures prescribed by this section and decontamination of the worker.
  - .5 Instruction and training must be provided by a competent person.

**1.4 Personal Protection**

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
  - .1 Provide workers, at a minimum, with non-powered half-face respirators with

P100 high efficiency (HEPA) cartridge filters.

- .2 Provide protective clothing, to all personnel entering the Abatement Work Area.

## **1.5 Inspections**

- .1 Refer to Part 1.12 Inspections in Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
  - .1 Milestone Inspection - Visual Clearance
  - .2 Milestone Inspection – Clearance Sampling

## **PART 2 PRODUCTS AND FACILITIES**

### **2.1 Materials and Equipment**

- .1 Refer to Section 02 81 00.
- .2 Single Use Glove Bag: Prefabricated bag which provides a completely sealed envelope surrounding a given section of piping to permit the removal of asbestos-containing insulation from within the bag while maintaining the integrity of the bag and preventing the spread of airborne asbestos fibres. The glove bag shall be equipped with,
  - .1 sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period,
  - .2 valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure,
  - .3 a tool pouch with a drain,
  - .4 a seamless bottom and a means of sealing off the lower portion of the bag, and
  - .5 a high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.
- .3 Knife: Knife with fully retractable blade for use inside Glove Bag.
- .4 Securing Straps: For some types of Glove Bag, reusable nylon straps at least 25mm wide with metal tightening buckle for sealing ends of bags around pipe and/or insulation.

## **PART 3 EXECUTION**

### **3.1 Site Preparation - General**

- .1 Remove to the extent necessary to access piping, stored or non-fixed items from the Abatement Work Area including but not limited to equipment, furniture, waste etc. Store in area provided by Owner.
- .2 Moving of equipment, tools, supplies, and stored materials that can be performed without disturbing ACM will be performed by others.
- .3 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping using Type 2 or Moderate Risk Procedures.
- .4 Shut down HVAC systems serving the Abatement Work Area.
  - .1 Install polyethylene sheeting over openings in ducts and at diffusers and seal.
  - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
  - .3 System shall remain inoperative until completion of work, unless ducts can be

effectively capped.

- .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .5 Install caution tape around work area where existing walls are not present.
- .6 Cover walls, floors, finishes, millwork, equipment and furnishings below the pipe to be worked on in the Abatement Work Area with polyethylene sheets before disturbing ACM. Drop sheets shall extend a minimum of 1,800 mm from pipe.
- .7 Use existing lighting or install temporary lighting to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .8 Provide Amended Water for wetting ACM, in garden sprayers. Provide one garden sprayer for each worker.
- .9 Do not use compressed air to clean or remove dust or debris when completing work of this section.
- .10 Place HEPA Vacuum in Abatement Work Area for each worker.
- .11 Place required tools to complete the abatement within the Abatement Work Area.
- .12 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .13 Post Notice of Project.

### **3.2 Maintenance of Abatement Work Area**

- .1 Maintain Abatement Work Area in tidy condition.

### **3.3 Glove Bag Removal**

- .1 Do not use Glove Bags on hot pipes that may damage Glove Bag. Refer to manufacturers limitations.
- .2 Prior to use of Single Use Glove Bag on damaged or unjacketed insulation:
  - .1 Spray any areas of damaged insulation jacketing with mist of Amended Water.
  - .2 Tape over damaged insulation to provide temporary repair.
  - .3 Mist areas of insulation with no jacketing and wrap with polyethylene sheeting and seal with tape.
- .3 Place any tools necessary to remove insulation in tool pouch built into Glove Bag.
- .4 Inspect the Glove Bag for damage and defects immediately before it is attached to the pipe or duct.
  - .1 If damage or defects are observed, dispose of Glove Bag.
- .5 Install Single Use Glove Bag as per manufacturer's instructions.
- .6 Remove metal jacketing or banding carefully. Do not damage the Glove Bag.
- .7 Remove insulation from pipe as per manufacturer's directions.
  - .1 Volume and weight of insulation must not exceed capacity of the Glove Bag or supports.
  - .2 Arrange insulation in the Single Use Glove Bag to maximize use of the Glove Bag.

- .8 Only glove bags designed to be moved may be re-used on other sections of pipe or moved down same section of pipe (e.g. Safe-T-Strip).
- .9 At regular intervals during its use, if damage or defects are observed during the use of the Glove Bag, which cannot be readily repaired with tape and not affect the integrity or strength of the glove bag.
  - .1 Discontinue use of Glove Bag.
  - .2 Wash inner surface of Glove Bag.
  - .3 Wet insulation.
  - .4 Pull an Asbestos Waste Container over Glove Bag before removing from pipe.
  - .5 Remove Glove Bag and Asbestos Waste Container, seal with tape.
  - .6 Place in a second Asbestos Waste Container and seal with tape.
  - .7 Clean immediate area with a HEPA Vacuum prior to resuming work.
- .10 If bag is to be moved along pipe for use on adjacent section of insulation:
  - .1 Wash inner surface of Glove Bag.
  - .2 Wash tools and place tools in pouch.
  - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
  - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
  - .5 Seal closure strip.
  - .6 Loosen securing straps to maintain a loose seal of Glove Bag to insulation or pipe.
  - .7 Use double throw zipper as necessary to pass hangers.
  - .8 Tighten straps once bag is in new position and continue insulation removal until Glove Bag is full, work is completed on the pipe or an obstruction prevents further movement of the bag.
- .11 If bag is to be removed from a pipe for use on a new section of pipe, perform the following:
  - .1 Wash inner surface of Glove Bag.
  - .2 Wash tools and place tools in pouch.
  - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
  - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
  - .5 Seal valve cover on valve Glove Bags.
  - .6 Seal closure strip.
  - .7 Wash top section of Glove Bag and tool pouch thoroughly.
  - .8 Undo securing straps, unfasten zipper and carefully move bag to new section of pipe.
- .12 To remove bag after completion of insulation removal operation:
  - .1 Wash inner surface of Glove Bag.
  - .2 Wash and place all tools in one hand (glove), pull hand out inverted, twist to create a separate pouch, tape inverted hand at two separate locations 25 mm apart so as

to seal pouch.

- .1 Remove inverted hand and tools by cutting between the two tape seals.
- .2 Place inverted hand pouch and tools into the next clean Glove Bag to be used or into a water bucket, open pouch underwater and clean tools.
- .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
- .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
- .5 Seal valve cover on valve Glove Bags.
- .6 Seal closure strip if equipped with one. Twist bag at tapered point and secure with tape.
- .7 Pull an Asbestos Waste Container over Glove Bag before removing from pipe.
  - .1 Undo straps and unzipper, or cut upper portion of single-use Glove Bag.
  - .2 Seal Asbestos Waste Container with tape.
- .8 Ensure pipe is clean of all residue after removal of Glove Bag. If necessary, after removal of each section of asbestos, vacuum all surfaces of pipe, using HEPA vacuum or wipe with wet cloth.
- .13 Seal all surfaces of freshly-exposed pipe with Post Removal Sealer.
- .14 Cover exposed ends of any remaining asbestos insulation with canvas and lagging using Type 2 or Moderate Risk Procedures.

### **3.4 Clean-Up and Dismantling**

- .1 Remove equipment and tools.
- .2 Remove temporary lighting if used.
- .3 Remove polyethylene seals from HVAC systems.
- .4 Place polyethylene sheeting, drop sheets, seals, tape, clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.
- .5 Clean Abatement Work Area with HEPA vacuums or wet wiping/mopping.
- .6 Seal openings in HEPA vacuums.
- .7 Proceed with the dismantlement of all barricades, etc. following receipt of authorization to proceed from the Asbestos Abatement Consultant.
- .8 Remove barricades, fencing, caution tape, signs, etc.

### **3.5 Waste and Material Handling**

- .1 Refer to Section 02 81 00.

### **3.6 Re-Establishment of Items**

- .1 Upon completion of work:
  - .1 Move all items that were removed from Abatement Work Area prior to work, back into same location within Abatement Work Area.
  - .2 Remove tags and locks from electrical panels and re-energize equipment and items.
  - .3 Enable building air handling systems.

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.4 Clean and vacuum Abatement Work Area.

**END OF SECTION**

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## **PART 1 GENERAL**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
  - .1 Section 02 81 00 Hazardous Materials – General Provisions
  - .2 Section 02 82 10 Asbestos Abatement – Low Risk Precautions
  - .3 Section 02 82 11 Asbestos Abatement – Moderate Precautions
  - .4 Section 02 83 10 Lead Abatement – Minimal Precautions
  - .5 Section 02 83 11 Lead Abatement – Intermediate Precautions

### **1.2 Outline of Work**

- .1 Comply with requirements of this Section when performing following Work:
  - .1 Removal of loose/flaking lead paint, using non-powered hand scrapers.

### **1.3 Instruction and Training**

- .1 Provide instruction and training to all workers including the following:
  - .1 Hazards of lead.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 The measures and procedures prescribed by this section including decontamination of the worker.
  - .5 Instruction and training must be provided by a competent person.

### **1.4 Personal Protection**

- .1 Provide the following respiratory protection to all personnel, at minimum:
  - .1 Non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters.
- .2 Provide protective clothing, when requested by personnel, entering the Abatement Work Area, including:
  - .1 Disposable protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.

- .3 Provide protective clothing, to all personnel entering the Abatement Work Area, including:
  - .1 Dust impermeable gloves appropriate for the work being completed.
- .4 Lead-specific soaps and hygiene indicators are recommended to be provided for hand-wash stations.

### **1.5 Inspections**

- .1 Refer to Part 1.12 Inspections in Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
  - .1 Milestone Inspection - Visual Clearance

## **PART 2 PRODUCTS AND FACILITIES**

- .1 Refer to Section 02 81 00.

## **PART 3 EXECUTION**

### **3.1 Site Preparation - General**

- .1 Provide washing facilities consisting of a wash basin, clean water, soap and towels.
  - .1 Workers are to use washing facilities each time leaving the Abatement Work Area.
- .2 Stored or non-fixed items, including but not limited to equipment, furniture, waste etc., shall be removed from the Abatement Work Area prior to abatement work.
- .3 Shut down HVAC systems serving the Abatement Work Area.
  - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
  - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
  - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
  - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .4 Remove visible dust from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .5 Provide amended water for wetting materials, and adequate method of wetting (garden sprayers, airless sprayers, etc.).
- .6 Provide electrical power and shut off for operation of powered tools and equipment. Provide ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard.
  - .1 Ensure safe installation of electrical lines and equipment.
- .7 Do not use compressed air to clean or remove dust or debris.
- .8 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.

- .9 Frequently and at regular intervals, place all waste in waste containers.
- .10 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

### **3.2 Site Preparation – No Enclosure Required**

- .1 Isolate Abatement Work Area with barrier tape.
- .2 Protect floor surfaces covered from wall to wall with polyethylene sheets.
- .3 Maintain Abatement Work Area in tidy condition.
- .4 Remove waste and debris frequently.
- .5 Remove standing water on polyethylene/floor at the end of every shift.

### **3.3 Lead-Containing Paint Abatement**

- .1 Removal methods minimizing dust generation should be used wherever possible.
  - .1 Wet methods are to be used to reduce dust generation.
  - .2 Wetting agents should be used where possible.
  - .3 Wet method not be used if it creates a hazard or cause damage to equipment or to project.
- .2 Provide drop sheets below all lead operations that may produce dust, chips or debris containing lead.
- .3 Waste water from cleaning or removal operations must be contained, for treatment or disposal.
- .4 Remove loose/flaking lead paint with hand scrapers and pack as it is being removed in sealable lead waste containers.
- .5 After completion of work, wet sponge surface from which lead based paint has been removed to remove visible material. During this work keep surfaces wet.
- .6 After wet sponging to remove visible lead based paint, wet clean entire work area, and equipment used in process.
  - .1 Compressed air or dry sweeping not be used to clean up lead-containing dust or waste.
  - .2 Ensure all waste is cleaned and packaged.
- .7 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to staging area. Clean external surfaces thoroughly again by wet sponging. Wash containers thoroughly pending removal to outside.

### **3.4 Waste Management and Disposal**

- .1 Per Section 02 81 00.

### **3.5 Final Cleaning**

- .1 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum.
- .2 Place polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .3 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

### **END OF SECTION**

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**PART 1 GENERAL**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
  - .1 Section 02 81 00 Hazardous Materials – General Provisions
  - .2 Section 02 82 10 Asbestos Abatement – Low Risk Precautions
  - .3 Section 02 82 11 Asbestos Abatement – Moderate Risk Precautions
  - .4 Section 02 82 13 Asbestos Abatement – Glove Bag Method
  - .5 Section 02 83 10 Lead Abatement – Minimal Precautions

**1.2 Outline of Work**

- .1 Removal and disposal of clean waste prior to abatement work to be performed by others without disturbing lead/Silica containing materials:
- .2 Comply with requirements of this Section when performing following Work:
  - .1 Containment Required - Demolition of concrete, masonry and drywall wall and ceiling finishes will be performed following procedures outlined in this section. Refer to Demolition Drawings for the extent of the Abatement Work Areas
  - .2 No Containment Required - Anchoring/fastening into concrete, masonry and drywall wall and ceiling finishes with lead-containing paint finishes and or presumed silica using HEPA filtered power tools (various locations to be determined)

**1.3 Instruction and Training**

- .1 Provide instruction and training to all workers including the following:
  - .1 Hazards of lead and Silica.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 The measures and procedures prescribed by this section including decontamination of the worker.
  - .5 Instruction and training must be provided by a competent person.

**1.4 Personal Protection**

- .1 Provide the following respiratory protection to all personnel, at minimum:
  - .1 Non-powered full-face respirators with P100 high efficiency (HEPA) cartridge filters.

- .2 Provide protective clothing, to all personnel entering the Abatement Work Area, including:
  - .1 Dust impermeable gloves appropriate for the work being completed.
  - .2 Disposable protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.
- .3 Lead-specific soaps and hygiene indicators are recommended to be provided for shower and hand-wash stations.

## **1.5 Inspections**

- .1 Refer to Part 1.12 Inspections in Section 02 81 00 – General Provisions.

## **PART 2 FACILITIES**

### **2.1 Hoarding Walls**

- .1 38 mm x 89 mm wood or metal studs at 400 mm o/c with continuous sill and top plate, covered with one layer of rip-proof polyethylene sheeting on each side of wall.

### **2.2 Transfer Room**

- .1 Transfer Room to be generally 2000 mm x 2000 mm x 2200 mm high. Increase size accordingly to accommodate number of workers.
- .2 Install walls as follows:
  - .1 Install 38 x 89 mm wood framing at 610 mm o/c with continuous top and sill plates.
  - .2 Install one layer rip-proof polyethylene sheeting on interior walls of Transfer Room.
- .3 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting beneath entire Transfer Room.
- .4 Install one layer rip-proof polyethylene sheeting over roof.
- .5 Turn 600 mm of polyethylene down the sides over polyethylene on the perimeter walls.
- .6 Install a fire extinguisher, mount to wall.

### **2.3 Curtained Doorways**

- .1 Construct as follows:
  - .1 Install two flap doors, full width and height of door opening at all doors to Abatement Work Area and both ends of Transfer Room.
  - .2 Construct each flap door of two layers of polyethylene sheeting with all edges reinforced with tape. Use wood strapping to securely fasten flap doors to head and alternate jambs.
  - .3 Install weights attached to bottom edge of each door flap.
  - .4 Provide direction arrows on flaps to indicate opening.

## **PART 3 EXECUTION**

### **3.1 Site Preparation - General**

- .1 Workers are to use washing facilities each time leaving the Abatement Work Area .
- .2 Stored or non-fixed items, including but not limited to equipment, furniture, waste etc., shall be removed from the Abatement Work Area prior to abatement work.
- .3 Isolate, at panel, and disconnect existing power supply to Abatement Work Area. Power supply to remaining areas of building must not be disrupted during work of this section.
  - .1 Lock-out/tag-out power at electrical panels.
  - .2 Mark/tag any items within or passing through the Abatement Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc.
- .4 Shut down HVAC systems serving the Abatement Work Area.
  - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
  - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
  - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
  - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .5 Remove visible dust from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .6 Provide amended water for wetting materials, and adequate method of wetting (garden sprayers, airless sprayers, etc.).
- .7 Provide electrical power and shut off for operation of powered tools and equipment. Provide ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard.
  - .1 Ensure safe installation of electrical lines and equipment.
- .8 Do not use compressed air to clean or remove dust or debris.
- .9 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .10 Frequently and at regular intervals, place all waste in waste containers.
- .11 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

### **3.2 Site Preparation for Demolition –Enclosure Required**

- .1 Demolition of concrete, masonry and drywall wall and ceiling finishes will be performed Under containment within enclosure described in this section. Refer to Demolition Drawings for the extent of the Abatement Work Areas
  - .1 Install Transfer Room where duration of work is to last longer than one 8 hour shift.

- .2 Install Curtained Doorways.
- .3 Install polyethylene sheeting at openings in walls (as required) and seal.
- .4 Seal openings in floor using tape, caulking, polyethylene, etc. Floor openings are to be sealed independently prior to installation of floor polyethylene.
- .5 Install polyethylene sheeting on floors of Abatement Work Area. Use sufficient layers to provide adequate protection for carpeting and equipment.
- .6 Cover floors first so that polyethylene on walls is overlapped by at least 305 mm.
- .7 Install 6 mil polyethylene sheeting on walls to remain, within the Abatement Work Area., including existing walls that make up, or are within, the Abatement Work Area.
- .8 Install one layer of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged.
- .9 Place required tools to complete the abatement within the Abatement Work Area.
- .10 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .11 Establish negative pressure in Abatement Work Areas as follows:
- .12 Provide sufficient HEPA filtered negative pressure machines to exchange a volume of air equivalent to that of the Abatement Work Area a minimum of every 20 minutes.
- .13 Provide additional HEPA filtered negative pressure machines as required to ensure air flow from Occupied Area into Abatement Work Area.
- .14 Operate HEPA filtered negative pressure machines continuously from first disturbance of ACM until completion of dismantling.
- .15 Replace prefilters to maintain specified flow rate.
- .16 Replace HEPA filter as required to maintain flow rate and integrity of unit.
- .17 Discharge HEPA filtered negative air machines to building exterior, where possible.
- .18 Direct discharge away from building access points.
- .19 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of lead/Silica hazard, where appropriate.

### **3.3 Site Preparation – No Enclosure Required**

- .1 Anchoring/fastening into concrete, masonry and drywall wall and ceiling finishes with lead-containing paint finishes and or presumed silica will be performed using HEPA filtered power tools under isolation as described in this section (various locations to be determined)
  - .1 Cover materials to remain in the Abatement Work Area with polyethylene sheeting before disturbing lead/silica to control the spread of dust.
  - .2 Install caution tape around work area where existing walls are not present.
  - .3 Ensure lighting to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
  - .4 Place HEPA vacuum in Abatement Work Area.



- .5 Place required HEPA Filtered tools to complete the Anchoring/fastening within the Abatement Work Area.
- .6 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of a lead/Silica dust hazard.

### **3.4 Maintenance of Abatement Work Area**

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Abatement Work Area.
- .3 Inspect HEPA filtered negative pressure machines including discharge ducting at the beginning and end of each working period. Inspection must be performed by competent person.
- .4 Maintain Abatement Work Area in tidy condition.
- .5 Remove standing water on polyethylene/floor at the end of every shift.
- .6 Turn off water supply to any hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.

### **3.5 Silica and Lead Handling**

- .1 Use the procedures described above under *Site Preparation – Enclosure Required*.
  - .1 Non-powered Hand tool demolition of concrete, masonry and drywall wall and ceiling finishes Refer to Demolition Drawings for the extent of the Abatement Work Areas
- .2 Use the procedures described above under *Site Preparation – No Enclosure Required*.
  - .1 Anchoring/fastening using HEPA filtered power tools into concrete, masonry and drywall wall and ceiling finishes with lead-containing paint finishes and or presumed silica.
- .3 Provide washing facilities consisting of a wash basin, clean water, soap and towels.
  - .1 Workers are to use washing facilities each time leaving the Abatement Work Area.
- .4 Removal methods minimizing dust generation should be used wherever possible.
  - .1 Wet methods are to be used to reduce dust generation.
    - .1 Wetting agents should be used where possible.
    - .2 Wet method not be used if it creates a hazard or cause damage to equipment or to project.
- .5 Waste water from cleaning or removal operations must be contained, for treatment or disposal.
- .6 Waste generated should be maintained wet until cleaned and packaged.
- .7 Compressed air or dry sweeping not be used to clean up lead/Silica-containing dust or waste.

- .8 Ensure all waste is cleaned and packaged.
- .9 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to staging area. Clean external surfaces thoroughly again by wet sponging. Wash containers thoroughly pending removal to outside. Ensure containers are removed by workers who have entered from uncontaminated areas dressed in clean coveralls.
- .10 The Abatement Work Area is not to be dismantled until visual inspection is performed by abatement consultant.
  - .1 Obtain Abatement Consultant's written permission to proceed.

### **3.6 Waste Management and Disposal**

- .1 Per Section 02 82 00.

### **3.7 Final Cleaning**

- .1 Following specified cleaning procedures proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Clean visible lead/Silica containing particles observed during cleanup, immediately, using HEPA vacuum.
- .3 Place polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and seal. Dispose of in accordance with waste materials generated.
- .4 Clean Work areas and Transfer Room, where present.
- .5 Remove sealed waste containers and equipment used in Work and remove from work areas at appropriate time in cleaning sequence.
- .6 Conduct final check to ensure no dust or debris remain on surfaces as result of dismantling operations.

## **END OF SECTION**

- Part 1            General**
- 1.1            RELATED SECTIONS
- .1            Section 03 30 00 – Cast-In-Place Concrete
  - .2            Section 03 20 00 – Concrete Reinforcing
  - .3            Section 03 35 00 – Concrete Finishing
- 1.2            WORK INCLUDED
- .1            Provide all labour, Materials, equipment and services necessary to supply, erect, and strip all formwork and falsework for poured-in-place concrete shown or indicated on the Contract Drawings and Specifications.
- 1.3            REFERENCE STANDARDS
- .1            Do concrete formwork and falsework to:
    - .1            Provincial Building Code - current edition.
    - .2            CSA Standard CSA-A23.1-94 (CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION).
    - .3            CSA Standard CSA-A23.2-94 (METHODS OF TEST FOR CONCRETE).
    - .4            CSA Standards S269.1 - 1975 (FALSEWORK FOR CONSTRUCTION PURPOSES).
    - .5            ACI SP4 Chapter 5 (FORMWORK FOR CONCRETE).
    - .6            ACI Standard 347 (RECOMMENDED PRACTICE FOR CONCRETE FORMWORK).
- 1.4            TOLERANCES
- .1            The tolerances for all concrete Work shall conform to the requirements of CSA Standard CSA-A23.1-94 Section 10.
- 1.5            PRODUCT HANDLING
- .1            Protect formwork Materials before, during and after installation and protect installed Work and Materials of other trades.
  - .2            In the event of damage, immediately make required repairs or replacements necessary at no extra cost to the City.
- Part 2            Products**
- 2.1            MATERIALS
- .1            Form Material:
    - .1            Exposed surfaces - metal, plywood or plywood lined. Plywood to CSA Standard O121-M1978 or CSA Standard O153-M1980.
    - .2            Unexposed surfaces - metal, plywood to CSA Standard O121-M1978 or CSA Standard O153-M1980, or wood lumber to CSA Standard CAN/CSA O86.1-94 (ENGINEERING DESIGN IN WOOD - LIMIT STATES DESIGN).
    - .3            Plywood and wood formwork Materials shall conform to CSA Standard S269.1, be free from warp and sawn straight so that lines and shapes will be accurately retained.
    - .4            Unlined forms for unexposed surfaces shall be made with a good grade of

- lumber or plywood and fitted so that there will be no leakage of mortar.
- .5 Use metal forms, plywood lined forms or plywood forms of sufficient structural strength for exposed surfaces. Plywood for lining shall be GIS exterior grade fir plywood with waterproof glue.
- .2 Ties and Spreaders:
  - .1 Use metal form ties, which are adjustable in length to permit tightening of forms. Use only the snap-off type of form, which will permit no metal within 25mm of the concrete surface after removal. Twisted wire form ties will not be accepted.
- .3 Form Release Agent:
  - .1 Form release agent shall be a pre-approved chemical agent, not an oil.
- .4 Void Form:
  - .1 Void form shall be of a deteriorating Material that will result in a total void thickness as noted on the Drawings. If a non-biodegradable Material is used the thickness must be adjusted to insure the required void volume is achieved. Contractor to submit technical data on void Material for approval.

### **Part 3 Execution**

#### **3.1 FORMWORK**

- .1 Lines and Levels:
  - .1 Verify lines, levels and column centres before proceeding with Work and ensure that dimensions agree with Drawings.
  - .2 Coordinate and cooperate with all other trades in forming and setting of recesses, chases, sleeves, inserts, bolts and hangers.
- .2 Design:
  - .1 Build forms sufficiently strong and rigid to sustain the weight or fluid pressure of the concrete without noticeable deflection. Ensure forms are sufficiently tight to prevent leakage or mortar.
  - .2 The Contractor shall be responsible for design and construction of falsework. The method and scheduling of reshoring shall be submitted to the Contract Administrator for review prior to fabrication.
- .3 Construction:
  - .1 Construct forms so that the finished concrete will conform to the shape and dimensions specified.
  - .2 Construct forms so that they may be dismantled and removed without damaging the concrete.
  - .3 Set shores on wedges or use adjustable shores so they may be removed without causing undue strains in the concrete.
  - .4 Provide temporary openings at the bottom of column and wall forms to facilitate cleaning and inspection. Use water to flush out debris and close the openings with patch, flush on the inside.
- .4 Treatment of Forms:
  - .1 Use a non-staining form release agent free from volatile constituents for treating forms.
  - .2 Place form release agent prior to placing metal reinforcement.
  - .3 Untreated forms shall be kept wetted down to prevent shrinkage prior to placing concrete and shall be surface wetted at time of placing.

- .5 Alignment:
  - .1 Provide suitable means for checking the alignment and elevation of forms during placing. Check these items frequently during placing.
  - .2 Carry out corrective wedging as required until concrete is in place.
  - .3 The Contract Administrator shall have the right to order concrete removed which has become misaligned during placing.
  - .4 Align forms to ensure that movements and deflections of the finished product are confined within the following Specifications and tolerances.
    - .1 The tolerances for all concrete Work shall conform to the requirements of CSA Standard CSA-A23.1-94.
    - .2 Variation in sizes and locations of sleeves, floor openings and wall openings -- 10mm.
    - .3 Variation for steps in a flight of stairs - rise 4mm, tread 8mm in consecutive steps - rise 2mm, tread 4mm.
  - .5 Formwork for slabs and beams shall be cambered as shown on the Drawings. For calculation of such cambers, allowance for settlement, closure of form joints, elastic shortening of forms and shoring, must be made and added to camber requirements.
  - .6 Stripping:
    - .1 Formwork shall not be removed until the concrete has gained sufficient strength to carry dead loads and all possible construction loads liable to be imposed upon it. Notify the Contract Administrator before removing any formwork.
    - .2 Remove forms in a manner to prevent spalling and other damage to the concrete surface. Forms shall be removed without hammering or prying against the concrete. Completely remove the forms from under steps and similar spaces, through temporary openings if necessary.
    - .3 Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.
  - .7 Re-use of Formwork:
    - .1 Forms may be re-used after adequate cleaning, providing the faces have not cracked or become roughened. Such formwork shall be trimmed and properly patched.

### 3.2 INSERTS

- .1 All sleeves, openings, etc., shown on Structural Drawings must be checked with the Architectural, Mechanical and Electrical Drawings. Sleeves, openings, etc., not shown on the Structural Drawings must be approved.
- .2 Set ties, anchor bolts, pipe hangers and other inserts, openings and sleeves, in concrete floors and walls, as required by other trades.
- .3 No sleeves, ducts, pipes or other openings shall pass through beams or columns, except where detailed on the Structural Drawings.

**END OF SECTION**

<b>Part 1</b>	<b>General</b>
1.1	SECTION INCLUDES
.1	Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.
1.2	RELATED SECTIONS
.1	Section 03 10 00 – Concrete Formwork
.2	Section 03 30 00 – Cast-in-place Concrete
.3	Section 03 35 00 – Concrete Finishing
1.3	REFERENCES
.1	ACI 301 - Structural Concrete.
.2	ACI 318 - Building Code Requirements For Structural Concrete and Commentary.
.3	ACI SP-66 - American Concrete Institute - Detailing Manual.
.4	ASTM A82 - Steel Wire, Plain, for Concrete Reinforcement.
.5	ASTM A184/A184M - Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
.6	ASTM A185 - Steel Welded Wire Reinforcement, Plain, for Concrete.
.7	ASTM A496 - Steel Wire, Deformed, for Concrete Reinforcement.
.8	ASTM A497/A497M - Steel Welded Wire Reinforcement, Deformed, for Concrete.
.9	ASTM A615/A615M - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
.10	ASTM A704/A704M - Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
.11	ASTM A706/A706M - Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
.12	ASTM A767/A767M - Zinc-Coated (Galvanized) Bars for Concrete Reinforcement.
.13	ASTM A775/A775M - Epoxy-Coated Reinforcing Steel Bars.
.14	ASTM D3963D3963M - Fabrication and jobsite handling of Epoxy-Coated Steel Reinforcing Bars.
.15	AWS (American Welding Society) D1.1 - Structural Welding Code -Steel.
.16	AWS (American Welding Society) D12.1 - Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete Construction.
.17	CRSI - Concrete Reinforcing Steel Institute - Manual of Practice.
.18	CRSI 63 - Recommended Practice For Placing Reinforcing Bars.
.19	CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature.
.20	CAN/CSA-A23.1 - Concrete Materials and Methods of Concrete Construction.
.21	CAN3-A23.3 - Design of Concrete Structures.
.22	CSA G30.3 - Cold-Drawn Steel Wire for Concrete Reinforcement.
.23	CSA G30.5 - Welded Steel Wire Fabric for Concrete Reinforcement.
.24	CSA G30.14 - Deformed Steel Wire for Concrete Reinforcement.
.25	CSA G30.15 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
.26	CAN/CSA-G30.18 - Billet-Steel Bars for Concrete Reinforcement.
.27	CAN/CSA-G40.21 - Structural Quality Steels.
.28	CAN/CSA-G164 - Hot Dip Galvanizing of Irregularly Shaped Articles.
.29	CSA W186 - Welding of Reinforcing Bars in Reinforced Concrete Construction.

- .30 RSIC (Reinforcing Steel Institute of Canada) - Reinforcing Steel Manual of Standard Practice.
- 1.4 SUBMITTALS FOR REVIEW
  - .1 Section 01 33 00 – Submittal Procedures
  - .2 Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules.
  - .3 Prepare reinforcement Drawings in accordance with [Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada,] [ACI 315 and ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure].
  - .4 Detail lap lengths and bar development lengths to CAN3-A23.3. Provide Type [A] [B] [C] tension lap splices.
- 1.5 SUBMITTALS FOR INFORMATION
  - .1 Section 01 33 00 – Submittal Procedures
  - .2 Submit certified copies of mill test report of reinforcement Materials analysis.
- 1.6 QUALITY ASSURANCE
  - .1 Perform Work in accordance with ACI 318.
  - .2 Design reinforcement under the seal of a Professional Registered in the Province of Manitoba experienced in design of this Work and licensed at the place where the Project is located.
  - .3 Welders' Certificates: Submit to Section 01 45 00 – Quality Control, certifying welders employed on the Work, verifying CSA qualification within the previous 12 months.
- Part 2 Products**
- 2.1 REINFORCEMENT
  - .1 Reinforcing Steel: CAN/CSA-G30.18, billet steel, Grade 400, deformed bars, weldable low alloy bars,
  - .2 Reinforcing Steel Mat: ASTM A704, ASTM A615, 414 MPa yield grade; steel bars or rods, unfinished.
  - .3 Stirrup Steel: ASTM A82, unfinished.
  - .4 Welded Steel Wire Fabric: CSA G30.14 - Deformed steel wire.
- 2.2 ACCESSORIES
  - .1 Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions
  - .2 Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Stainless steel] type; size and shape as required.
- 2.3 FABRICATION
  - .1 Fabricate concrete reinforcing in accordance with:
    - .1 CAN/CSA-A23.1.
  - .2 Weld reinforcement in accordance with CSA W59
  - .3 Galvanized Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with manufacturer's instructions.
  - .4 Locate reinforcing splices not indicated on Drawings, at point of minimum stress.

**Part 3**

**Execution**

3.1

PLACEMENT

- .1 Place, support and secure reinforcement against displacement. Do not deviate from required position to CAN/CSA A23.1.
- .2 Do not displace or damage vapour barrier.
- .3 Accommodate placement of formed openings.
- .4 Maintain concrete cover around reinforcing as per Structural Drawings.

3.2

FIELD QUALITY CONTROL

- .1 Section 01 45 00 – Quality Control. Provide a schedule when differing reinforcement types or finishes are required.
- .2 Reinforcement For Foundation Wall Framing Members and Slab-on-Grade: Deformed bars and wire fabric, galvanized finish.

**END OF SECTION**



**Part 1**

**General**

1.1

RELATED SECTIONS

- .1 Section 03 10 00 – Concrete Formwork
- .2 Section 03 20 00 – Concrete Reinforcing
- .3 Section 03 35 00 – Concrete Finishing
- .4 Section 07 13 00 – Sheet Waterproofing

1.2

REFERENCES

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM C109/C109M-95, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50mm or 2" Cube Specimens) or latest.
  - .2 ASTM C260-94, Specification for Air-Entraining Admixtures for Concrete or latest.
  - .3 ASTM C309-94, Specification for Liquid Membrane-Forming Compounds for Curing Concrete or latest.
  - .4 ASTM C332-87(1991), Specification for Lightweight Aggregates for Insulating Concrete or latest.
  - .5 ASTM C494-92, Specification for Chemical Admixtures for Concrete or latest.
  - .6 ASTM C827-95a, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures or latest.
  - .7 ASTM C939-94a, Test Method for Flow of Grout for Preplaced-Aggregate Concrete or latest.
  - .8 ASTM D412-92, Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension or latest.
  - .9 ASTM D624-91 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer or latest.
  - .10 ASTM D1751-83(1991), Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) or latest.
  - .11 ASTM D1752-84(1992), Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction or latest.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings or latest.
  - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction or latest.
  - .3 CGSB 81-GP-1M-77, Flooring, Conductive and Spark Resistant or latest.
- .3 Canadian Standards Association (CSA)
  - .1 CAN/CSA-A5-93, Portland Cement or latest.
  - .2 CAN/CSA-A23.1-94, Concrete Materials and Methods of Concrete Construction or latest.
  - .3 CAN/CSA-A23.2-94, Methods of Test for Concrete or latest.
  - .4 CAN/CSA-A23.5-M86(R1992), Supplementary Cementing Materials or latest.
  - .5 CAN/CSA A363-M88(R1996), Cementitious Hydraulic Slag or latest.

- 1.3 SAMPLES
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 At least 4 weeks prior to commencing Work inform Contract Administrator of proposed source of aggregates and provide access for sampling.
- 1.4 CERTIFICATES
  - .1 Submit certificates in accordance with Section 01 33 00 - Submittal Procedures
  - .2 A Minimum 4 weeks prior to starting concrete Work, submit to Contract Administrator manufacturer's test data and certification by qualified independent inspection and testing laboratory that following Materials will meet specified requirements:
    - .1 Portland cement.
    - .2 Blended hydraulic cement.
    - .3 Supplementary cementing Materials.
    - .4 Grout.
    - .5 Admixtures.
    - .6 Aggregates.
    - .7 Water.
    - .8 Waterstops.
    - .9 Waterstop joints.
    - .10 Joint filler.
  - .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1 or latest.
  - .4 Provide certification that Plant, equipment, and Materials to be used in concrete comply with requirements of CAN/CSA-A23.1 or latest.
- 1.5 QUALITY ASSURANCE
  - .1 Minimum 4 weeks prior to starting concrete Work, submit proposed quality control procedures in accordance with Section 01 45 00 - Quality Control for Contract Administrator's approval for following items:
    - .1 Falsework erection.
    - .2 Hot weather concrete.
    - .3 Cold weather concrete.
    - .4 Curing.
    - .5 Finishes.
    - .6 Formwork removal.
    - .7 Joints.
- 1.6 WASTE MANAGEMENT AND DISPOSAL
  - .1 Separate and recycle waste Materials in accordance with Section 02 07 20 – Selective Site Demolition.
  - .2 Use excess concrete for: additional paving, post footing anchorage, flowable fill, retaining wall footing ballast, storm structure covers, underground utility pipe kickers, storm pipe flared end section, toe wash protection.
  - .3 Use trigger operated spray nozzles for water hoses.
  - .4 Designate a cleaning area for tools to limit water use and runoff.
  - .5 Carefully coordinate the specified concrete Work with weather conditions.

- .6 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .7 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible Material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .8 Choose the least harmful, most appropriate cleaning method, which will perform adequately.

## Part 2 Products

### 2.1 MATERIALS

- .1 Portland cement: to CAN/CSA-A5 or latest.
- .2 Supplementary cementing Materials: to CAN/CSA-A23.5 or latest.
- .3 Water: to CAN/CSA-A23.1 or latest.
- .4 Aggregates: to CAN/CSA-A23.1 or latest. Coarse aggregates to be high density. All aggregate to be used in concrete mix for concrete slabs that are to receive a polished concrete floor finish are to be from one supplier and one batch.
- .5 Air entraining admixture: to CAN3-A266.1 or latest.
- .6 Chemical admixtures: to CAN3-A266.2 or latest. Obtain approval for accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete retarders: to ASTM C494 or latest water based, low VOC, solvent free. Do not allow moisture of any kind to come in contact with the retarder film.
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
  - .1 Compressive strength: 50 MPa at twenty-eight (28) days.
- .9 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 50 MPa at twenty-eight (28) days.
- .10 Curing compound: to CAN/CSA A23.1 or latest. white and to ASTM C309 or latest, Type 1 chlorinated rubber.
- .11 Premoulded joint fillers:
  - .1 Bituminous impregnated fiber board: to ASTM D1751 or latest.
- .12 Dovetail anchor slots: minimum 0.6mm thick galvanized steel with insulation filled slots.
- .13 Ribbed waterstops: extruded PVC of sizes indicated:
  - .1 Tensile strength: to ASTM D412 or latest, method A, Die "C", minimum 11.4 MPa.
  - .2 Elongation: to ASTM D412 or latest, method A, Die "C", minimum 275%.
  - .3 Tear resistance: to ASTM D624 or latest, method A, Die "B", minimum 48 kN/m.

### 2.2 MIXES

- .1 Cement:
  - .1 Type 10 Portland cement unless noted.
- .2 Minimum compressive strength at twenty-eight (28) days: as indicated on Drawings.
- .3 Nominal size of coarse aggregate: 20mm.
- .4 Slump at time and point of discharge: 90 to 110mm.
- .5 Air content: 5 to 7 % all exterior locations and where indicated.

- .6 Chemical admixtures: following admixtures in accordance with ASTM C494, type, quantity, water reducing strength increasing, air entraining, super plasticizers.

### 2.3 DELIVERY AND STORAGE

- .1 Concrete hauling time: deliver to Site of Work and discharge within 120 minutes maximum after batching.

## Part 3 Execution

### 3.1 PREPARATION

- .1 Obtain Contract Administrator's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing concrete, obtain approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 In locations where new concrete is dowelled to existing Work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with shrinkage compensating grout or epoxy grout to anchor and hold dowels in positions as indicated.
- .7 Do not place load upon new concrete until authorized.

### 3.2 COLD WEATHER REQUIREMENTS

- .1 In the event "Possutec 20" as manufactured by Master Builders is used, relaxation of the following will be considered.
- .2 When the air temperature is at or below 5°C or when there is a probability of it falling to that limit during the placing or curing period, cold weather requirements shall be applicable.
- .3 Provide heating equipment or heating Plant on the job ready for use when concrete is being placed during cold weather. Such equipment shall be adequate for the purpose of maintaining the required temperature during the placing and curing of the concrete. The methods used for heating shall be acceptable to the Contract Administrator. Equipment inducing carbon monoxide gas free to come into contact with concrete Work shall not be acceptable.
- .4 Concrete shall not be placed on or against reinforcing, form Work, ground or any surface that is at a temperature less than 5°C.
- .5 When being placed the concrete shall have a temperature of not less than 10°C nor more than 30°C.
- .6 The temperature of the concrete at all surfaces shall be maintained at not less than 20°C for three (3) days, or at not less than 10°C for five (5) days after placing.
- .7 Means shall be provided to humidify the air within enclosures and to keep the concrete and form Work continuously moist if dry heat is used.
- .8 The concrete shall be kept above freezing temperature for a period of seven (7) days and shall be kept from alternate freezing and thawing for at least fourteen (14) days after placement.

- .9 At the end of the specified protection period, the temperature of the concrete shall be reduced gradually at a rate not exceeding that shown in Table 17 of CSA CAN3-A23.1-M77.
- .10 Accelerator or so-called antifreeze compounds shall not be permitted unless otherwise approved by Contract Administrator.
- .11 All protective coverings shall be kept clear of the concrete and form surfaces to permit free circulation of air and shall be maintained intact for at least twenty-four hours after the artificial heat is disconnected.
- .12 On slip formed Work, newly poured surfaces exposed to exterior weather conditions shall be protected to avoid exposure to adverse effects of wind, rain and low temperatures.

### 3.3 CONSTRUCTION

- .1 Do cast-in-place concrete Work in accordance with CAN/CSA-A23.1.
- .2 Sleeves and inserts.
  - .1 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved.
  - .2 Where approved, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100mm not indicated on Drawings, must receive approval.
  - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications before placing of concrete.
  - .4 Check locations and sizes of sleeves and openings shown on Drawings.
  - .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts.
  - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
  - .2 With approval, grout anchor bolts in preformed holes or holes drilled after concrete has set. Formed holes to be minimum 100mm diameter. Drilled holes to be to manufacturers' recommendations.
  - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
  - .4 Set bolts and fill holes with epoxy grout.
  - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .4 Drainage holes and weep holes:
  - .1 Form weep holes and drainage holes in accordance with Section 03 10 00 – Concrete Formwork. If wood forms are used, remove them after concrete has set.
  - .2 Install weep hole tubes and drains as indicated.
- .5 Dovetail anchor slots:
  - .1 Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.
  - .2 Install continuous vertical anchor slots at 800mm oc where concrete walls are masonry faced.
- .6 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

- .7 Finishing: refer to Section 03 35 00 – Concrete Finishing for requirements above and beyond those listed below.
  - .1 Finish concrete in accordance with CAN/CSA-A23.1 or latest.
  - .2 Use procedures acceptable to Contract Administrator and those noted in CAN/CSA-A23.1 or latest to remove excess bleed water. Ensure surface is not damaged.
  - .3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that any compounds used are compatible.
  - .4 Finish concrete floors to CGSB 81-GP-1M Class A or latest.
  - .5 Provide swirl-trowelled finish where floor tile is to be applied.
  - .6 Provide smooth, swirl-trowelled finish for interior floor surfaces, unless otherwise noted.
  - .7 Provide light sandblast finish with no frames for exterior slabs, unless otherwise noted.
  - .8 Rub exposed sharp edges of concrete with carborundum to produce 3mm radius edges, unless otherwise noted.
- .8 Waterstops.
  - .1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing waterstops. Use equipment to manufacturer's requirements to field splice waterstops. Tie waterstops rigidly in place.
  - .2 Use only straight heat-sealed butt joints in field. Use factory welded corners and intersections unless otherwise approved.
- .9 Joint fillers.
  - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
  - .2 Locate and form isolation, construction, expansion joints as indicated on the Drawings. Install joint filler.
  - .3 Use 12mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12mm of finished slab surface unless indicated otherwise.
- 3.4 CURING
  - .1 Cure and protect concrete in accordance with CAN/CSA A23.1.
- 3.5 SITE TOLERANCE
  - .1 Concrete tolerance in accordance with CAN/CSA-A23.1 or latest straight edge method.
- 3.6 FIELD QUALITY CONTROL
  - .1 Inspection and testing of concrete and concrete Materials will be carried out by a Testing Laboratory in accordance with CAN/CSA-A23.1 or latest and Section 01 45 00 - Quality Control.
  - .2 The City will pay for costs of tests as specified.
  - .3 Testing Laboratory may take additional test cylinders during cold weather concreting. Cure cylinders on Site under same conditions as concrete in which they represent.
  - .4 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2 or latest.

- .5 Inspection or testing by Contract Administrator on the City will not augment or replace Contractor quality control nor relieve the Contractor's contractual responsibility.

**END OF SECTION**

**Part 1            General**

1.1            RELATED WORK

- .1            Section 01 45 00 – Quality Control
- .2            Section 03 30 00 – Cast-In-Place Concrete

1.2            REFERENCES

- .1            American Society for Testing and Materials:
  - .1            ASTM-C779, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces or latest.
  - .2            ASTM G23-81, Ultraviolet Light & Water Spray or latest.
  - .3            ASTM C805, Impact Strength or latest.
  - .4            Curing compounds shall conform to ASTM C309 – “Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete”.
  - .5            American Concrete Institute
  - .6            ACI 302. 1R-89, Guide for Concrete Floor and Slab Construction or latest.
- .2            CAN/CSA
  - .1            Do concrete floor finishing to CAN/CSA-A23.1, except where specified otherwise.
  - .2            Concrete curing shall comply with CAN/CSA-A23.1, except where specified otherwise.

1.3            SUBMITTALS

- .1            Comply with pertinent provisions of Section 01 60 00 - Basic Product Requirements.
  - .1            Provide submittal information within thirty-five (35) Working Days after the Contractor has received the City's notice to proceed.
- .2            Product data:
  - .1            Submit concrete finishes manufacturer's Specifications and test data.
  - .2            Submit concrete finishes describing product to be provided, giving manufacturer's name and product name for the specified Material proposed to be provided under this Section.
  - .3            Submit special concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.
  - .4            Submit concrete finishes manufacturer's Material Safety Data Sheet (MSDS) and other safety requirements.

**Part 2            Products**

2.1            2.1            MATERIALS AND MANUFACTURERS

- .1            Curing: use clean, potable water, which shall not contain impurities, which would cause staining.
- .2            Curing compounds: AR-30 by Meadows, Ritecure by Sternson, CPD Clear Cure, and Elsro #705 Clear Curing Compound.



- .3 Cure and seal: SealTight CS-309 by Meadows, Florseal by Sternson, CPD Acrylic Cure and Seal, Elsro #702 Clear Acrylic Sealer.
- .4 Bonding agent: Daraweld "C" by Grace, or SCP AcriStix latex bonding agent.

### **Part 3 Execution**

#### **3.1 WORKMANSHIP**

- .1 Concrete slabs, which are to receive bonded toppings, shall be cleaned free of dirt, oil, loose Material and laitance.
- .2 Concrete slabs to receive toppings, quarry tile, or ceramic tile, to be screeded off to true lines and levels shown and left ready to receive finish. Depress slabs to accommodate finish.
- .3 Steel trowel all concrete slabs to be left exposed, or receiving carpeting, resilient flooring and applied floor finishes.

#### **3.2 FLOOR DRAINS**

- .1 In area where floor drains are installed, grade the entire floor surface (or as indicated on plans) towards the drain.
- .2 Floors to be level around walls and have a minimum 5mm/m uniform pitch to drains, unless indicated otherwise.
- .3 The slope shall be such that water on all areas of the floor surface will drain by gravity, without leaving pools or puddles on the floor surface.

#### **3.3 PLAIN FLOOR FINISH**

- .1 Spread and vibrate concrete to force coarse aggregate into concrete mix, and then screed.
- .2 Float surface with wood or metal floats, or with power finishing machine, and bring surface to true grade.
- .3 Steel trowel in accordance with CAN/CSA-A23.1. Trowel to level, even surface, to within 6mm (1/4") tolerance when measured in any direction using a 3m (10ft) straight edge.
- .4 Continue steel trowelling to produce smooth burnished surface.
- .5 Sprinkling of dry cement, or dry cement and sand mixture over concrete surfaces is not acceptable.
- .6 Apply cure and seal compound to all interior floor surfaces, unless specified otherwise. Do not apply cure and seal to concrete receiving epoxy finishes.
- .7 Apply curing compound to all exterior concrete such as exterior paving, curbs and sidewalks. Note: Cure and seal compounds may not be used until twenty-eight (28) days after placement.
- .8 Wet curing: wet cure exposed concrete floors using polyethylene sheeting and wet burlap over entire floor area, weighted down and taped on all edges for total sealing of wetted down concrete, and keep in place a minimum of seven (7) days. Protect the surface from direct sunlight to avoid overheating.

- 3.4            **SIDEWALK PAVINGS**
- .1            Use full depth pre-molded isolation joints at building, stairs, ramps, changes in paving thickness, at existing paving, and at property lines.
  - .2            Place sidewalks to provide a slope for drainage of 6mm/300mm (1/8"/12") minimum, in direction of Site drainage and in conformance with the instructions describing the Work on the Drawings.
  - .3            Spread and vibrate concrete to force coarse aggregate into concrete mix, and then screed.
  - .4            Level concrete with straight edge. Darby or bull-float immediately.
  - .5            Float surface, then apply slightly roughened surface by means of a light stiff broom stroke in one direction across width of sidewalk.
  - .6            Saw cut 5mm (0.2") saw cut to depth of 1/5 paving thickness at intervals shown but not more than 2500mm (8'-4") each way, once the concrete has set or as identified by Drawings which will be read to supersede this instruction.
  - .7            Thickness: refer to Drawings
  - .8            In addition to the above requirements, sidewalks on Municipal property shall also meet the Municipal requirements.

**END OF SECTION**

- Part 1            General**
- 1.1            REFERENCES
- .1            Canadian Standards Association (CSA International).
- .1            CSA-A165 Series-94(R2000), Standards on Concrete Masonry Units.
- .2            CSA A179-94(R1999), Mortar and Grout for Unit Masonry.
- .3            CSA-A371-94 (R1999), Masonry Construction for Buildings.
- 1.2            QUALIFICATION ASSURANCE
- .1            Applicator: Company specializing in commercial masonry Work with five years experience and approved by the Materials manufacturer.
- .2            Installation of Masonry Work: CAN3-A371M, except where specified otherwise.
- 1.3            REPOINTING/REPAIR SCOPE OF WORK
- .1            Refer to demolition and renovation Drawings for the scope of Work required for repair and repointing of existing concrete masonry unit (CMU) masonry.
- Part 2            Products**
- 2.1            NEW CONCRETE MASONRY UNITS (CMU)
- .1            Thickness 200mm (8”), 140mm (6”) and 90mm (4”) non-load bearing units, type H/15/A/M, as noted on Drawings.
- .2            Colour: grey.
- .3            Provide square units with bull-nose corners for all exposed 90 degree corners, including fin walls and door openings.
- .4            Provide purpose made shapes for lintels and bond beams.
- 2.2            MORTAR MATERIALS
- .1            All mortar for masonry shall be Type “S” mortar having a minimum strength of 13mPa @ 28 days. Mortar to be in accordance with the latest edition of CSA A179.
- Part 3            Execution**
- 3.1            CONSTRUCTION
- .1            Cutting.
- .1            Refer to Structural Drawings for sequence of masonry removals, steel installations, masonry reconstruction, and grout filling required for new openings.
- .2            Cut out for electrical device boxes, and other recessed or built-in objects.
- .3            Make cuts straight, clean, and free from uneven edges.
- .4            Ease exposed edges to match existing.
- .2            Building-In.
- .1            Build in items required to be built into masonry.
- .2            Prevent displacement of built-in items during construction.
- .3            Fill spaces between door jambs and masonry with mortar.

- .3 Interface with other Work.
  - .1 Cut openings in existing Work as indicated.
  - .2 Openings in walls for duct and piping penetrations:
    - .1 All piping penetrations through exposed masonry walls are to be cored to suit pipe diameter, and sealed all around.
    - .2 Re-use existing piping penetrations where possible – new penetrations are to be cored, and penetrations sealed all around.
  - .3 Make good existing Work. Use Materials to match existing.
- 3.2 REPOINTING/REPAIR
  - .1 Cut out damaged CMU units and replace with new CMU units to match existing. .
  - .2 Fill all voids between masonry wythes with mortar and provide with smooth flush surface all around opening.
  - .3 Where existing CMU is to remain exposed around openings, cut out loose or disintegrated mortar in joints to a 12mm depth
  - .4 Utilize power tools only after test cuts determine no damage to masonry units will result.
  - .5 Do not damage existing masonry units. Replace damaged units with new masonry units.
  - .6 When cutting is complete, remove dust and loose Material with water jet.
  - .7 Pre-moisten joints and apply mortar specified in this Section. Pack tightly in maximum 6mm layers. Leave a smooth, compact joint to match existing.
  - .8 Moist cure for 72 hours.
- 3.3 SITE TOLERANCES
  - .1 Tolerances in notes to Clause 5.3 of CSA-A371 apply.
- 3.4 CLEANING
  - .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
  - .2 Upon completion of installation, remove surplus Materials, rubbish, tools and equipment barriers.
- 3.5 PROTECTION
  - .1 Protect masonry and other Work from marking and other damage. Protect completed Work from mortar droppings. Use non-staining coverings.

**END OF SECTION**

## **Part 1 General**

### **1.1 GENERAL REQUIREMENTS**

- .1 Division One – General Requirements is a part of this Section and shall apply as if repeated here.

### **1.2 WORK INCLUDED**

- .1 The Work included under this Section shall conform to the industry standard and be accepted by the local construction and trade associations.

### **1.3 RELATED SECTIONS**

- .1 Division 3 – Concrete
- .2 Division 4 – Masonry
- .3 Section 05 50 00 – Metal Fabrications
- .4 Section 09 90 00 – Painting
- .5 Refer to Structural Drawings for all other corresponding structural steel Specifications. Contractor shall notify Contract Administrator of any conflicts.

### **1.4 QUALITY ASSURANCE**

- .1 Fabricator: Company specializing in fabricating structural steel in accordance with CAN3-S16.1M or latest with documented experience.
- .2 Welder: Company specializing in welding structural steel components in accordance with CSA W47.1 or latest, CSA W55.3 or latest, and CSA W59 or latest with documented experience.
- .3 Design structural Work under direct supervision of a professional experienced in design of the Work of this Section and registered in the Province of Manitoba.
- .4 Submit 3 certified copies of Material mill reports upon Contract Administrator's request.

### **1.5 SHOP DRAWINGS**

- .1 Submit Shop Drawings and product data to requirements of Section 01 33 00 – Submittal Procedures.
- .2 Indicate on Shop Drawings, profiles, sizes, spacing, and locations of structural members, connections, attachments, fasteners, cambers, and loads.
- .3 Structural steel Shop Drawings for both review and fabrication are to bear the signature and seal of professional registered in the Province of Manitoba.

## **Part 2 PRODUCTS**

### **2.1 MATERIALS**

- .1 Structural Steel Members: CAN3-G40.20M or latest and CAN3-G40.21M or latest, All rolled or steel structural sections shall be G40.21-50W unless otherwise noted on Structural Drawings. All angles, channels and plates shall be G40.21 44W, shop primed.
- .2 Structural H.S.S. Tubing: CAN3-G40.21M or latest, Grade 350 W, shop primed.
- .3 Bolts, Nuts, and Washers: ASTM A325 or latest.
- .4 Welding Materials: CSA W59 or latest, type required for Materials being welded.
- .5 Primer: CGSB 85-GP-10M or latest for plain steel surfaces and CGSB 85-GP-16M or latest for galvanized surfaces.

- .6 All Materials are to be new.
- 2.2 2.2 FABRICATION
  - .1 Fabricate structural steel members in accordance with CAN3-S16.1 or latest.
  - .2 Verify all Drawing dimensions prior to commencing fabrication.
  - .3 Design details and connections to requirements of CAN3-S16-1 or latest to resist forces, moments, and shears indicated on Drawings.
  - .4 All shop connections are to be welded as shown on Drawings.
  - .5 Accurately cut and mill column ends and bearing plates to assure full contact of bearing surfaces prior to welding.
  - .6 Close and weatherproof all gaps, butt joints and connections exposed to exterior of building. Grind all exposed welds flush with surface of welded members.
- 2.3 2.3 SHOP PAINTING
  - .1 Clean all members, remove loose mill scale, rust, oil, dirt and other foreign matter.
  - .2 Apply one coat of prime paint in the shop to all steel surfaces.
  - .3 Apply paint under cover, on dry surfaces only when surface and air temperatures are above 5 °C.
  - .4 Maintain dry conditions and 5 °C minimum temperature until paint is thoroughly dry.
  - .5 Patch paint bolts, nuts, sharp edges and corners one coat before full prime coat is applied.
  - .6 Apply paint by brush or spray to a dry film thickness of 0.05 mm minimum.

### **Part 3 EXECUTION**

- 3.1 EXAMINATION
  - .1 Before starting erection, take field measurements and examine other Work that may affect this Work.
  - .2 Notify the Contract Administrator of any conditions that prejudice proper installation of this Work.
  - .3 Commencement of this Work implies acceptance of existing conditions.
- 3.2 DAMAGED MEMBERS
  - .1 Repair or replace members damaged during transit or erection, before securing in position.
  - .2 Report serious bends, twists or other damage immediately.
- 3.3 ERECTION
  - .1 Erect structural steel in accordance with CSA S16.1 or latest, and Drawings.
  - .2 Do not field weld surfaces during rain unless under cover.
  - .3 Do not weld at temperature below 5 °C except with express permission.
  - .4 Conform to the requirements of CSA W59 or latest, for minimum preheat and inter pass temperatures.

- .5 Make adequate provision for all erection loads, and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection and installation of necessary permanent bracing.
- .6 Set column bases and other vertical members to design elevations.
- .7 Use only light drifting to draw parts together. Enlarge holes for bolted connections with reamers or twist drill only. Do not burn to form holes, enlarge holes or match unfair holes.
- .8 Erection error is not to exceed requirements of CSA S16.1 or latest.
- .9 Obtain written permission prior to field cutting or altering structural members.
- .10 After erection, field prime welds, nuts, bolts, washers and touch up abrasions and damage to shop primed surfaces.

#### 3.4 GROUTING

- .1 Grout underside of steel column base plates with non-shrinking grout to manufacturer's specifications and where indicated on Drawings.

**END OF SECTION**

**Part 1**

**General**

1.1

RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 60 00 – Basic Product Requirements
- .3 Section 03 30 00 – Cast-in-Place Concrete
- .4 Division 04 – Masonry
- .5 Section 05 12 00 – Structural Steel
- .6 Division 06 – Wood Plastics and Composites
- .7 Division 08 – Openings
- .8 Section 09 90 00 – Painting

1.2

REFERENCES

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM A53/A53M-99b, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless or latest.
  - .2 ASTM A269-98, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service or latest.
  - .3 ASTM A307-97, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength or latest.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer or latest.
  - .2 CAN/CGSB-1.108-M89, Bituminous Solvent Type Paint. or latest
  - .3 CAN/CGSB-1.181-92, Ready-Mixed, Organic Zinc-Rich Coating or latest.
- .3 Canadian Standards Association (CSA)
  - .1 CAN/CSA-G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel or latest.
  - .2 CAN/CSA-G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles or latest.
  - .3 CAN/CSA-S16.1-94, Limit States Design of Steel Structures or latest.
  - .4 CSA W48.1-M1991(R1998), Carbon Steel Covered Electrodes for Shielded Metal Arc Welding or latest.
  - .5 CSA W48.2-M1992(R1998), Chromium-Nickel Steel Covered Electrodes for Shielded or latest.
  - .6 CSA W48.3-M1993(R1998), Low Alloy Steel Covered Electrodes for Shielded Metal Arc Welding or latest.
  - .7 CSA W48.4-95, Solid Carbon Steel Filler Metals for Gas Shielded Arc Welding.
  - .8 CSA W48.5-M1990(R1996), Carbon Steel Electrodes for Flux- and Metal-Cored Arc Welding or latest.
  - .9 CSA W48.6-96, Fluxes and Carbon Steel Electrodes for Submerged Arc Welding or latest.
  - .10 CSA W59-M1998, Welded Steel Construction (Metal Arc Welding) or latest.



- 1.3 SHOP DRAWINGS
- .1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate Materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - .3 Miscellaneous steel Shop Drawings for Work of this Section are to meet all necessary Codes and regulations and bear the signature and seal of a Professional registered in the Province of the Work.
- 1.4 PROTECTION
- .1 Deliver, store, handle and protect Materials in accordance with Section 01 60 00 - Basic Product Requirements.
  - .2 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job Site.
  - .3 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.
- Part 2 Products**
- 2.1 MATERIALS
- .1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 350 W.
  - .2 Steel pipe: to ASTM A53/A53M standard weight black finish.
  - .3 Welding Materials: to CSA W59.
  - .4 Welding electrodes: to CSA W48 Series.
  - .5 Bolts and anchor bolts: to ASTM A307.
  - .6 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.
  - .7 Shop coat primer: to CGSB 1-GP-40d.
  - .8 Galvanized primer: zinc rich, ready to mix to CGSB 1-GP-181M.
  - .9 Sulphur: commercial grade for setting metal posts.
- 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 round headed screws on items requiring assembly by screws or as indicated.
  - .3 Where possible, fit and shop assemble Work, ready for erection.
  - .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.
- 2.3 FINISHES
- .1 Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
  - .2 Do not prime surfaces in direct contact bond with concrete or where field welding is required.

- .3 Apply coatings in shop and before assembly. Where size permits, galvanize components after assembly.
  - .4 Prime paint items with one coat.
  - .5 Hot dip galvanize components where indicated after fabrication in accord with requirements of CSA Standard G164-M1981.
  - .6 Apply one coat of bituminous enamel to contact surfaces of metal components in contact with cementitious Materials and dissimilar metals.
- 2.4 MISCELLANEOUS STEEL SECTIONS
- .1 Supply all miscellaneous steel angles, plates, brackets, lintels, etc., as indicated and noted on the Drawings. Size according to loads, set plumb and true and securely fix. Continuously weld and grind smooth exposed connections. Also refer to Structural Drawings for connections.
- 2.5 ISOLATION COATING
- .1 Isolate aluminum from following components, by means of bituminous paint:
    - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
    - .2 Concrete, mortar and masonry.
    - .3 Wood.
- 2.6 SHOP PAINTING
- .1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
  - .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C.
  - .3 Clean surfaces to be field welded; do not paint.
- 2.7 STEEL STAIRS, RAILINGS AND GUARDS
- .1 Supply and install steel stairs and railings where shown on Drawings.
  - .2 Method of construction left to discretion of fabricator, but shall be in accordance with best standard practice and shall meet with the Contract Administrator's approval. Stairs shall safely support a 100 lb. Live load per sq. ft. (4.79 kN/sq. m). Structural members shall be positively and securely attached to the building structure. Weld all connections where possible, where not possible, bolted connections shall be cut off flush with nuts and made as inconspicuous as possible.
  - .3 Stringers and landing supports shall be of size and shapes as noted on Drawings. All pan construction and metal framing of stairs and landings by stair supplier.
  - .4 Railings shall be plumb, true and rigid and of standard steel pipe, solid rods and flat bars of sizes indicated on Drawings. Unless shown otherwise on Drawings, close ends of tubes, joints and intersecting members welded and ground smooth; where rails return to walls or other vertical faces, cut off and grind smooth 6mm from vertical face. All corners shall be curved to a 75mm face.
  - .5 Prime all metal Work for stairs, handrails and railings, ready for painting at interior areas. All exterior stairs and railings to be hot dipped galvanized after fabrication.
  - .6 NOTE: Railings shall resist a horizontal load of 103 lb./lin. ft. (1.5 kN/lin.m.) applied at the top of the rail and as required by Code.
- 2.8 MASONRY OPENING LINTELS

- .1 Provide lintels as per structural lintel schedule
  - .2 Provide all hot-dipped galvanized steel loose lintels at exterior openings and prime painted at interior openings.
  - .3 Provide lintels for all openings including windows, doors, ductwork, etc.
  - .4 Provide minimum 102x102x8mm, back to back, with steel plate connector (refer to Structural Drawings), with minimum 150mm minimum bearing at each end.
- 2.9 LATERAL SUPPORT FOR MASONRY
- .1 Provide deflection and lateral support angles for non-loadbearing masonry walls as detailed on Structural Drawings.
- 2.10 MISCELLANEOUS ITEMS, STEEL BRACKETS, SUPPORTS AND ANGLES
- .1 Supply for installation by respective trades steel brackets, supports, and angles as indicated on Drawings. Drill for countersunk screws and anchor bolts. Prime paint for interior, galvanize for exterior.
  - .2 Supply for installation by respective trades all steel sections, brackets, and angles as indicated on Drawings for interior and exterior benches, counters, vanities, etc.
- 2.11 MISCELLANEOUS STEEL SUPPORT CHANNELS FOR ELECTRICAL EQUIPMENT
- .1 Steel support channels for electrical equipment shall be Unistrut metal framing system, model P2000, 1 5/8" x 1 5/8" x 16 gauge with concrete inserts and all related accessories required. Refer to Drawings for lengths and locations, and coordinate with Electrical.
- 2.12 STAINLESS STEEL SUPPORTS FOR BENCHES
- .1 Stainless steel flat bars, 2 1/2" wide x 3/8" thick, per Drawings.
- 2.13 STEEL PLATE PANELS
- .1 Steel plate: 1/4" thick folded steel panels c/w custom laser-cut lettering pattern.
  - .2 Edges and seams to be radiused and polished, min. 1/8". Some site welding is expected to allow for installation over site-built millwork.
  - .3 Refer to Drawings for typical details and dimensions.
  - .4 Allow for high-gloss enamel paint finish after installation, field applied.
- 2.14 STEEL ACCESS LADDERS
- .1 All access ladders shall be constructed to comply with local government and maintenance union regulations, and in accordance w/ ANSI 14.3 Safety Requirements for Fixed Ladders (latest edition).
  - .2 Access ladders to be vertical, constructed of 1/2" x 2 1/2" flat bar stringers with 3/4" x 3/4" solid steel used for rungs, rungs spaced no more than 12" apart. Provide angles for floor anchoring and wall anchoring to suit loads.
  - .3 Cages to be constructed of steel flat bar to suit dimensions shown on drawings, and ANSI 14.3 requirements. Cage shall be designed so as not to be climable.
3. All components to be hot-dipped galvanized.

**Part 3**

**Execution**

3.1

**ERECTION**

- .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 Contract Administrator 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 building into Work by other sections in accordance with Shop Drawings and schedule.
- .6 Make field connections with bolts to CAN/CSA-S16.1, or weld.
- .7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 01 56 00 – Temporary Barriers and Enclosures
- .2 Section 03 10 00 – Concrete Formwork
- .3 Section 06 20 00 – Finish Carpentry
- .4 Section 06 40 00 – Architectural Woodwork
- .5 Section 07 21 00 – Thermal Insulation
- .6 Section 07 53 50 – Modified Bitumen Roofing
- .7 Section 07 62 00 – Sheet Metal Flashing and Trim
- .8 Section 07 84 00 – Firestopping
- .9 Section 07 92 00 – Joint Sealing
- .10 Section 08 11 00 – Steel Doors and Frames
- .11 Section 09 29 00 – Gypsum Board
- .12 Section 09 51 30 – Acoustic Ceiling Panels
- .13 Division 10 – Miscellaneous Specialties

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI A208.1-1999, Particleboard, Mat Formed Wood or latest.
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM A 36/A 36M-94, Specification for Structural Steel or latest.
  - .2 ASTM A 653/A 653M-94, Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot Dip Process or latest.
  - .3 ASTM D 1761-88, Standard Test Methods for Mechanical Fasteners in Wood or latest.
  - .4 ASTM D 5055-94a, Prefabricated Wood I-Joists or latest.
  - .5 ASTM D 5456-96, Evaluation of Structural Composite Lumber Products or latest.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-11.3-M87, Hardboard or latest.
  - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type or latest.
  - .3 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction or latest.
  - .4 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems or latest.
- .4 Canadian Standards Association (CSA)
  - .1 CAN/CSA-A82.27-M91, Gypsum Board or latest.
  - .2 CSA-B111-1974, Wire Nails, Spikes and Staples or latest.
  - .3 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles or latest.
  - .4 CSA-O112 Series-M1977, CSA Standards for Wood Adhesives or latest.
  - .5 CSA O121-M1978, Douglas Fir Plywood or latest.
  - .6 CAN/CSA-O122-M89, Structural Glued-Laminated Timber or latest.
  - .7 CAN/CSA-O141-91, Softwood Lumber or latest.

- .8 CSA-O151-M1978, Canadian Softwood Plywood or latest.
- .9 CSA-O153-M1980, Poplar Plywood or latest.
- .10 CAN/CSA-O325.0-92, Construction Sheathing or latest.
- .11 CAN3-O437 Series-93, Standards on OSB and Waferboard or latest.
- .5 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 1991 or latest.
- .6 'Truss Design and Procedures for Light Metal Connected Wood Trusses', Truss Plate Institute of Canada
- .7 Forest Stewardship Council Canada (FSC)
  - .1 Forest Management Standards
  - .2 Controlled Wood Standards

### **1.3 QUALITY ASSURANCE**

- .1 Lumber identification: 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.

### **1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Set aside damaged wood and dimensional lumber off-cuts for approved alternative uses (e.g. bracing, blocking, cripples, bridging). Store this separated reusable wood waste convenient to cutting station and area of Work.
- .2 Separate metal, plastic, wood and corrugated cardboard-packaging in accordance with the Waste Management Plan and place in designated areas for recycling.
- .3 Do not burn scrap at the project Site.
- .4 Remove from Site and dispose of packaging Materials at appropriate recycling facilities.
- .5 Divert unused wood Materials from landfill to recycling reuse composting facility approved by the Contract Administrator.
- .6 Do not dispose of preservative treated wood through incineration.
- .7 Do not dispose of preservative treated wood with Materials destined for recycling or reuse.
- .8 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by the Contract Administrator.
- .9 Dispose of unused wood preservative Material at official hazardous Materials collections Site.
- .10 Do not dispose of unused preservative Material into sewer system, into streams, lakes, onto ground or in other locations where they will pose health or environmental hazard.
- .11 Fold up metal banding, flatten, and place in designated area for recycling.

## **PART 2 Products**

### **2.1 FRAMING AND STRUCTURAL MATERIALS**

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
  - .1 CAN/CSA-O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Glued end-jointed (finger-jointed) lumber NLGA Special Products Standard.

- .3 Glulam in accordance with Structural Glued-Laminated Timber CAN/CSA-O122.
- .4 Wood I-Joists and I-Joist blocking in accordance with Prefabricated Wood I-Joists ASTM D 5055.
- .5 Structural Composite Lumber (SCL) in accordance with Evaluation of Structural Composite Lumber Products ASTM D 5456.
- .6 Framing and board lumber: in accordance with most current edition of the NBC and Drawings.
- .7 Furring, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
  - .1 Board sizes: "Standard" or better grade.
  - .2 Dimension sizes: "Standard" light framing or better grade.
  - .3 Post and timbers sizes: "Standard" or better grade.
- 2.2 PANEL MATERIALS
  - .1 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.0.
  - .2 Douglas fir plywood (DFP): to CSA-O121, standard construction.
  - .3 Canadian softwood plywood (CSP): to CSA-O151, standard construction.
  - .4 Poplar plywood (PP): to CSA-O153, standard construction.
  - .5 Interior mat-formed wood particleboard: to ANSI 208.1.
  - .6 Mat-formed structural panelboards (OSB wafer): to CAN3-O437.0.
- 2.3 ACCESSORIES
  - .1 Exterior wall sheathing paper: to CAN/CGSB-51.32 laminated type as indicated.
  - .2 Refer to Section 07 25 00 – Air & Vapour Membrane.
  - .3 Air seal: closed cell polyurethane or polyethylene.
  - .4 Refer to Section 07 92 00 – Joint Sealers
  - .5 Subflooring adhesive: to CGSB-71.26, cartridge loaded.
  - .6 General purpose adhesive: to CSA-O112 Series.
  - .7 Nails, spikes and staples: to CSA-B111.
- 2.4 FASTENER FINISHES
  - .1 Galvanizing: to CAN/CSA-G164, use hot-dipped galvanized fasteners for exterior Work, interior highly humid areas, pressure-preservative, fire-retardant, treated lumber.
- 2.5 WOOD PRESERVATIVE
  - .1 ACQ or Borate treated lumber only. No chromium or arsenic allowed, including CCA or ACA treated wood.
- 2.6 CEMENT BOARD
  - .1 Wonder-Board glass-mesh mortar units, 11mm (7/16") thick, noncombustible in accordance with CAN4-S114.

### **PART 3 Execution**

#### **3.1 PREPARATION**

**.1 Store wood products.**

**3.2 INSTALLATION**

- .1 Comply with requirements of the most current NBC supplemented by following paragraphs.
- .2 Install members true to line, levels and elevations, square and plumb.
- .3 Construct continuous members from pieces of longest practical length.
- .4 Install spanning members with "crown-edge" up.
- .5 Select exposed framing for appearance. Install lumber and panel Materials so that grade-marks and other defacing marks are concealed or are removed by sanding where Materials are left exposed.
- .6 Install subflooring with panel end-joints located on solid bearing, staggered at least 600 mm.
- .7 In addition to mechanical fasteners, floor panels secure floor subflooring to floor joists using glue and screws. Place continuous adhesive bead in accordance with manufacturer's instructions, single-bead on each joist and double-bead on joists where panel ends butt.
- .8 Install wall sheathing in accordance with manufacturer's printed instructions.
- .9 Install roof sheathing in accordance with requirements of NBC.
- .10 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding, electrical equipment mounting boards, and other Work as required.
- .11 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.
- .12 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .13 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other Work.
- .14 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.
- .15 Install sleepers as indicated.
- .16 Use caution when working with particle board. Use dust collectors and high quality respirator masks.

**3.3 ELECTRICAL EQUIPMENT BACKBOARD**

- .1 Provide backboards for mounting electrical equipment as indicated. Use 19mm (3/4") thick plywood on 19mm x 38mm (3/4" x 1-1/2") furring around perimeter and at maximum 300mm (12") intermediate spacing.

**3.4 FIREWALL COPING**

- .1 Install steel studs, insulation and cement board coping construction at firewalls.

**END OF SECTION**



**Part 1**

**General**

- 1.1 RELATED SECTIONS
  - .1 Section 01 33 00 – Submittal Procedures
  - .2 Section 06 10 11 – Rough Carpentry
  - .3 Section 06 40 00 – Architectural Woodwork
  - .4 Section 08 14 00 – Wood Doors
  - .5 Division 09 – Finishes
  - .6 Section 09 90 00 – Painting
  - .7 Section 10 99 90 – Miscellaneous Specialties
- 1.2 REFERENCES
  - .1 American National Standards Institute (ANSI)
    - .1 ANSI A208.1-1989, Particleboard, Matformed Wood or latest.
    - .2 ANSI A208.2-1994, Medium Density Fibreboard (MDF) or latest.
  - .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
    - .1 AWMAC Quality Standards for Architectural Woodwork 2014 or latest.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-11.3-M87, Hardboard or latest.
  - .4 Canadian Standards Association (CSA)
    - .1 CSA B111-1974, Wire Nails, Spikes and Staples or latest.
    - .2 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles or latest.
    - .3 CSA O115-M1982, Hardwood and Decorative Plywood or latest.
  - .5 National Hardwood Lumber Association (NHLA)
    - .1 Rules for the Measurement and Inspection of Hardwood and Cypress January 1986 or latest.
  - .6 National Lumber Grades Authority (NLGA)
    - .1 Standard Grading Rules for Canadian Lumber 1996 or latest.
  - .7 South Coast Air Quality Management District
    - .1 SCAQMD Rule #1168, Adhesives & Sealants
- 1.3 SUBMITTALS
  - .1 Section 01 33 00 – Submittal Procedures.
  - .2 Shop Drawings: Indicate Materials, component profiles and elevations, assembly methods, surface graining elevations of sheet paneling, joint details, fastening methods, accessory listings, hardwood locations and schedule of finishes.
  - .3 Products must not contain formaldehydes.
  - .4 Cut Sheets: Provide cutsheets, material safety data, signed attestations or other official literature clearly identifying product emission rates. All Materials must not exceed maximum VOC values listed in SCAQMD Rule #1168 for product type.
- 1.4 SAMPLES
  - .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.

- 1.5 DELIVERY, STORAGE, AND HANDLING
  - .1 Deliver, handle, store and protect Materials in accordance with Section 01 60 00 – Basic Product Requirements.
  - .2 Protect Materials against dampness during and after delivery.
  - .3 Store Materials in ventilated areas, protected from extreme changes of temperature or humidity.
- 1.6 WASTE MANAGEMENT AND DISPOSAL
  - .1 Separate and recycle waste Materials to maximum extent economically possible.
  - .2 Separate wood waste and place in designated areas in categories as follows for recycling: Solid wood/softwood/hardwood, composite wood, treated, painted, or contaminated wood.
  - .3 Separate wood waste and place in designated areas in categories as follows for re-use on Site: sheet Materials larger than 4'-0" x 4'-0", framing members larger than 4'-0", multiple offcuts of any large size.
  - .4 Set aside damaged wood for acceptable alternative uses (e.g. bracing, blocking, cripples, bridging, finger-joining, or ties). Store separated reusable wood waste convenient to cutting station and area of Work.
  - .5 Separate corrugated cardboard and place in designated areas for recycling.
  - .6 Do not burn scrap at project Site.
  - .7 Fold up metal banding, flatten, and place in designated area for recycling.
- Part 2 Products**
- 2.1 LUMBER MATERIAL
  - .1 Hardwood lumber: moisture content 6 % or less in accordance with following standards:
    - .1 National Hardwood Lumber Association (NHLA).
    - .2 AWMAC custom grade, moisture content as specified.
  - .2 Manufacturing process must adhere to Lifecycle Assessment (LCA) Standards as per ISO 14040/14041 LCA Standards.
- 2.2 PANEL MATERIAL
  - .1 All panel Materials to be FSC Certified wood products.
  - .2 Hardwood plywood (oak veneer): to CSA O115 or latest.
  - .3 Manufacturing process must adhere to Lifecycle Assessment Standards as ISO 14040/14041 LCA Standards
- 2.3 INTERIOR TRIM
  - .1 Miscellaneous wood trim, caps: clear, grade A, white maple, sizes and finishes as noted on Drawings.
- 2.4 WOOD BENCHES
  - .1 Clear, Grade A White Maple for transparent finish
  - .2 Size: 1 ½" x 3 ½", laminated on edge, mounted to stainless steel flat bar support brackets.
  - .3 Radiused edges and corners, min. 1/8".

2.6 ACCESSORIES

- .1 Nails and staples: to CSA B111 or latest; galvanized to CAN/CSA-G164 or latest for exterior Work, interior humid areas and for treated lumber; plain finish elsewhere.
- .2 Wood screws: to CSA B35.4 or latest plain, type and size to suit application.
- .3 Splines: wood.
- .4 Adhesive: recommended by manufacturer such that formaldehyde emissions do not exceed 0.05 ppm.
- .5 Use least toxic sealants, adhesives, sealers, and finishes necessary to comply with requirements of this section.

**Part 3 Execution**

3.1 INSTALLATION

- .1 Do finish carpentry to Quality Standards of the Architectural Wood Manufacturers Association of Canada (AWMAC), except where specified otherwise.
- .2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.
- .3 Form joints to conceal shrinkage.

3.2 CONSTRUCTION

- .1 Fastening
  - .1 Position items of finished carpentry Work accurately, level, plumb, true and fasten or anchor securely.
  - .1 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
  - .2 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match Material being secured.
  - .3 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.
- .2 Hardware
  - .1 Verify that door and frame components are ready to receive Work and dimensions are as indicated on Shop Drawings.
  - .2 Verify that appropriate power supply is available to power operated devices.
  - .3 Beginning of installation means acceptance of existing conditions.
  - .4 Install hardware in accordance with manufacturer's instructions and requirements of Canadian Steel Door and Frame Manufacturers Association.
  - .5 Use the templates provided by hardware item manufacturer.

**END OF SECTION**

**Part 1            General**

1.1            WORK INCLUDED

- .1            The Work included under this Section shall conform to the industry standard and be accepted by the local construction and trade associations.

1.2            RELATED SECTIONS

- .1            Section 01 33 00 – Submittal Procedures
- .2            Section 05 50 00 – Miscellaneous Metal
- .3            Section 06 10 00 – Rough Carpentry
- .4            Section 06 20 00 – Finish Carpentry
- .5            Section 06 61 16 – Solid Surface Fabrications
- .6            Section 09 90 00 – Painting
- .7            Section 10 99 90 – Miscellaneous Specialties
- .8            Division 21 – Mechanical General Requirements
- .9            Division 26 – Electrical

1.3            REFERENCES

- .1            AWMAC (Architectural Woodwork Manufacturers' Association of Canada) - Quality Standards for Architectural Woodwork.
- .2            South Coast Air Quality Management District
  - .1            SCAQMD Rule #1168, Adhesives & Sealants

1.4            QUALITY ASSURANCE – AWMAC GUARANTEE & INSPECTION SERVICES (GIS)

- .1            Perform Work to "Custom" quality standards as set out by AWMAC.
- .2            Lumber Grading: NLGA.
- .3            Architectural woodwork shall be manufactured and installed to the current AWMAC Architectural Woodwork Standards and shall be subject to an inspection at the factory and Site by an appointed AWMAC Certified Inspector. Inspection costs shall be included in the tender price for this project. (Contact the Manitoba AWMAC Chapter for details of inspection costs). Shop Drawings shall be submitted to the AWMAC Chapter office for review before Work commences. Work that does not meet the AWMAC Architectural Woodwork Standards, as specified, shall be replaced, reworked and/or refinished by the architectural woodwork Subcontractor, to the approval of AWMAC, at no additional cost to the City.
- .4            If the woodwork Subcontractor is an AWMAC Manufacturer member in good standing, a two (2) year AWMAC Guarantee Certificate will be issued. The AWMAC Guarantee shall cover replacing, reworking and/or refinishing deficient architectural woodwork due to faulty workmanship or defective Materials supplied and/or installed by the woodwork Subcontractor, which may appear during a two (2) year period following the date of issuance.
- .5            If the woodwork Subcontractor is *not* an AWMAC Manufacturer member they shall provide the City with a two (2) year maintenance bond, in lieu of the AWMAC Guarantee Certificate, to the full value of the architectural woodwork Contract. Costs for the bond are to be included in the Contract Price for this project.
- .6            Laminated plastic Work shall include a three (3) year warranty against warpage or delamination from substrate.

- 1.5            **MOCK-UP**
- .1            Construct mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .2            Mock-ups to include the following:
    - .1            Typical solid surface mitred corner detail at Reception Desk
      - .1            Orthogonal and angled corner
  - .3            Allow 48 hours for inspection of mock-up by Contract Administrator before proceeding with this Work.
  - .4            When accepted, mock-up will demonstrate minimum standard for this Work.
- 1.6            **SUBMITTALS**
- .1            Submit Shop Drawings to requirements of Section 01 33 00 – Submittal Procedures.
  - .2            Indicate on Shop Drawings Materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.
  - .3            Submit samples to requirements of Section 01 33 00 – Submittal Procedures.
- Part 2            Products**
- 2.1            **WOOD MATERIALS**
- .1            Hardwood Lumber: 'Custom' grade in accordance with AWMAC; max. moisture content of 6 percent.
- 2.2            **SHEET MATERIALS**
- .1            Hardwood Plywood: CSA O115; 'Good' grade in accordance with AWMAC; G1S where not exposed or where one side is exposed to view; G2S where both sides are exposed to view. Where oak veneer plywood is noted or specified, a 'Natural' appearance designation is required with 0% formaldehyde content refers to added content in addition to naturally occurring formaldehydes in these Materials.
  - .2            Medium Density Fibreboard (MDP) ANSI A-208.2 2-198, minimum density 700 kg/m<sup>3</sup> (84 psf), factory pre-sanded faces of thickness indicated – with 0% formaldehyde content refers to added content in addition to naturally occurring formaldehydes in these Materials.
  - .3            Melamine Panels: Melamine resin impregnated decorative sheet thermally fused to a rigid particle board substrate. Standard of Acceptance: cabinet grade, standard white colour with 0% formaldehyde content refers to added content in addition to naturally occurring formaldehydes in these Materials.
  - .4            Hardboard: CGSB 11-GP-3M; Type 2, Tempered grade with 0% formaldehyde content refers to added content in addition to naturally occurring formaldehydes in these Materials.
- 2.3            **LAMINATE MATERIALS**
- .1            Plastic Laminate to CAN3-A172 or latest: Commercial Grade to suit application. 1.1m thickness for countertop and .75m for vertical surfaces. Standard of Acceptance: Wilsonart, Formica, Arborite, Pionite, Nevamar, or approved equal in accordance with B7. Colour and finish to be selected from full range available.
  - .2            Laminate Backing Sheet to CAN3-A172-M79 or latest; undecorated plastic laminate to same thickness as facing sheet. Colour to be selected from range available.

## 2.4 ACCESSORIES

- .1 Adhesive: Water base contact type.
- .2 Fasteners: Size and type to suit application.
- .3 Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application.
- .4 Door Bumpers: self-stick rubber bumpers at back of cabinet doors typical.
- .5 Wall Bumpers: wall-mounted self-stick rubber bumpers typical on door handles where they open against a wall.
- .6 Edge Banding: 0.5mm PVC as manufactured by Canada woodtape hc in standard stock colour range.
- .7 Steel Members: 1-1/2" x 1-1/2" HSS tube and plate for countertop support (where anchoring exclusively to millwork (and not other building elements). Other steel supports to be provided by Section 05 50 00 Miscellaneous Metal where anchoring to building elements.

## 2.5 HARDWARE - CASEWORK

- .1 Finish: All hardware to have dull chrome finish unless otherwise noted.
- .2 Pilaster supports: pre-drilled at 1-1/4" (32mm) o.c. with 5mm diameter steel support w/ block pin with non-tip feature. Richelieu #2282G dual pin shelf support.
- .3 Door Pulls: by Mockett DP212B. Finish: by Contract Administrator from standard range.
- .4 Drawer Pulls: by Mockett DP140E. Finish: by Contract Administrator from standard range.
- .5 Hinges: 110° opening, heavy duty, concealed hinge, full overlay type. Hettich Intermat 9943 110° self-closing (c/w steel cover cap), Blum Clip Top +110°, Hafele 200 Series 120° Model C2P9A99, or acceptable "as Equal" in accordance with B7. Nickel finish, steel construction. Use 3 hinges on doors over 500mm x 810mm (20" x 32").
- .6 Cabinet Locks: removable core, disk tumbler, cam style with strike. Standard of acceptance: CCL cabinet lock 02066 x 26D for drawer, 02067 x 26D for door or similar. Keyed alike or differently as required. Provide each lock with two (2) keys. 180 key changes.
- .7 Elbow Cabinet Catch: Ives 2MB 26D/Richelieu 3675-26.
- .8 Case door silencers: 3M model SJ5032 bump-ons rubber, clear/Richelieu HP 303-11 supply to mechanical room.
- .9 Steel Support Braces: speedbraces, sized to suit countertop depth and spans, A&M, Richelieu or equivalent.

## 2.6 FABRICATION - CASEWORK

- .1 Fabricate casework to AWMAC 'Custom' grade designation.
- .2 Shop assembles casework for delivery to Site in units easily handled and to permit passage through building openings.
- .3 Fit shelves, doors, and exposed edges with matching veneer edging unless otherwise noted.
- .4 Cabinet toe spaces shall be finished same as cabinet faces. All toe spaces to have rubber base as specified unless otherwise noted.
- .5 Door and Drawer Fronts, Gables, Shelves: 3/4" (19mm) thick.

- .6 When necessary to cut and fit on Site, provide Materials with ample allowance for cutting. Provide trim for scribing and Site cutting.
- .7 Apply plastic laminate finish in full, uninterrupted sheets consistent with manufactured sizes. Make corners and joints hairline. Locate counter butt joints minimum 600mm from sink cutouts, where applicable.
- .8 Apply laminate backing sheet to reverse side of plastic laminate finished surfaced.
- .9 Fabricate countertops to sizes required for base cabinets. At right angle corners provide 45 degree joint in counter top. At end walls, return backsplash to front of counter.
- .10 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures and fittings. Verify locations of cutouts from On-Site dimensions.
- .11 Sand Work smooth and set exposed nails and screws. Apply wood filler in exposed nail and screw indentations. On items to receive transparent finishes, use wood filler which matches surrounding surfaces and of types recommended for applied finishes. Install rubber bumpers on doors.
- .12 Seal surfaces in contact with cementitious Materials.
- .13 Install millwork with open gables to the floor on top of finished flooring – coordinate installation with Contractor.
- .14 Secure all backsplashes to the countertop and leave side splashes loose.

## 2.7 FABRICATION DETAILS:

All cabinetry to AWMAC standards, 'Custom' grade quality, flush overlay construction. Coordinate cabinet location and construction with Drawings as follows:

- .1 **Door and drawer fronts:**
  - .1 Typical: 3/4" particle core with plastic laminate finish.
- .2 **Drawer carcass:** 3/4" melamine component panel.
- .3 **Cabinet carcass:**
  - .1 Typical: 3/4" plywood core with plastic laminate finish (where exposed) – coordinate w/ Drawings.
  - .2 Reception Desk: refer to Drawings.
- .4 **Cabinet backs:**
  - .1 Typical: 1/2" plywood core with plastic laminate finish, set into case body 5/8".
- .5 **Cabinet base and blocking:** 3/4" plywood core with plastic laminate finish to match doors and drawers.
- .6 **Shelves:**
  - .1 Typical: 3/4" particle core with plastic laminate finish.
  - .2 Where shelf span exceeds 36", provide 1" thick material, to prevent sagging.
- .7 **Countertops, backsplashes, vanity tops, aprons:**
  - .1 Solid surface fabrication. Refer to Section 06 61 16 and Drawings.

## Part 3 Execution

### 3.1 INSPECTION

- .1 Verify that surfaces are ready to receive Work and field measurements are as shown on Shop Drawings.

- .2 Verify mechanical, electrical and building items affecting Work of this Section are placed and ready to receive this Work.
- .3 Beginning of installation means acceptance of existing conditions.

### 3.2 PREPARATION

- .1 Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious Materials.

### 3.3 INSTALLATION

- .1 Install Work in accordance with AWMAC 'Custom' quality standard.
- .2 Set and secure all Materials and components in place, rigid plumb and square.
- .3 Provide heavy-duty fixture attachments for wall mounted cabinets.
- .4 Use draw bolts in countertop joints.
- .5 Carefully scribe cabinetwork which is against other building components leaving gaps of 1.5mm (0.06") maximum.
- .6 Apply small beads of sealant at junction of countertops, backsplash, gables and shelves to adjacent wall finish.
- .7 Apply water resistant building paper or bituminous coating over wood framing members in contact with masonry or cementitious construction.
- .8 Apply cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .9 After installation, fit and adjust operating hardware for wood and laminated plastic cabinet doors, drawers, and shelves.
- .10 Touch up paint and/or stain once installation is complete for mouldings, paneling and veneer.
- .11 Install banding with countersunk finishing screws; fill all holes and sand.
- .12 Install steel reinforcement where indicated, or as required to accommodate countertop spans, and secure anchoring of all millwork items to adjacent floors, wall, or other construction.

### 3.4 PROTECTION

- .1 Protect finish installation under provisions of Section 01 60 00 – Basic Product Requirements.

**END OF SECTION**



- Part 1            General**
- 1.1            REFERENCES
- .1            ISSFA-2, "Classification and Standards Publication of Solid Surfacing Material".
  - .2            ANSI Z124-3 for vanities and Z124-6 for kitchen sinks.
  - .3            NSF Standard 51 for use in both splash and food service areas.
  - .4            Canadian Standards Association (CSA).
  - .5            ASTM G21 "Fungal Resistance", Method [A] [B], no growth.
  - .6            ASTM G22 "Bacterial Resistance", no growth.
  - .7            Stain Resistance, ANSI Z124-6-5.2 19
- 1.2            DESIGN REQUIREMENTS
- .1            Design Load: Deflection limited to 1/360.
  - .2            Design items with sufficient strength for handling stresses.
- 1.3            SUMMARY
- .1            This Section includes the following horizontal and trim solid surface product types:
    - .1            Countertops as indicated, including trim and Material needed for a complete installation.
- 1.4            DEFINITION
- .1            Solid surface is defined as nonporous, homogeneous Material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.
- 1.5            SUBMITTALS
- .1            In accordance with 01 33 00 – Submittal Procedures
  - .2            Shop Drawings: Indicate design parameters, adjacent construction, Materials, dimensions, thickness, fabrication details, tolerances, jointing methods, method of support, anchorages, integration with plumbing fixtures and connections, and colors.
  - .3            Samples: Submit two, 2" x 2" (50mm x 50mm) samples representative of colors, patterns, textures, finishes and edge treatments. Approved samples will be retained as a standard for the Work.
- 1.6            DELIVERY, STORAGE AND HANDLING
- .1            Protect against dampness and damage during and after delivery.
  - .2            Store in ventilated areas, protected from extreme changes of temperature or humidity.
- 1.7            QUALITY ASSURANCE
- .1            Fabricator/Installer Qualifications: Company specializing in fabricating and installing solid surfacing fabrications similar in complexity to those required in this project, including specific requirements indicated.

- .2 Source Limitations: Obtain solid surfacing fabrications through one source.
  - .3 Fire-Test-Response Characteristics: Provide solid surfacing fabrications with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL 723 or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - .4 Flame-Spread Index: 25 or less.
  - .5 Smoke-Developed Index: 450 or less.
- 1.8 DELIVERY, STORAGE AND HANDLING
- .1 A. Deliver, store, handle, and protect Materials in accordance with manufacturer's written instructions.
  - .2 Provide protective coverings of suitable Material. Take special precautions at corners.
- 1.9 PROJECT CONDITIONS
- .1 Environmental Limitations: Do not deliver or install solid surfacing fabrications until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at design levels during the remainder of the construction period.
  - .2 Field Measurements: Verify that field measurements are as indicated on Shop Drawings.
- 1.10 SEQUENCING
- .1 Sequence Work to permit installation of adjacent affected construction, plumbing rough-in.
  - .2 Coordinate sizes and locations of plumbing, cut-outs and other related Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated
- 1.11 WARRANTY
- .1 Warranty: Provide manufacturer's 10 year limited warranty covering replacement of the Material except for non-covered conditions as follows:
    - .1 Minor stains, scratches, water spots, and burns which may be corrected by techniques covered in the manufacturer's Use and Care Guide.
    - .2 Failure of solid surfacing joint Material.
    - .3 Failure due to structural failure of base cabinets or other solid surfacing substrate construction.
    - .4 Use for purposes other than indoor finish Material.
    - .5 See manufacturer's warranty for complete details.

**Part 2 Products**

2.1 ACCEPTABLE MANUFACTURER AND PRODUCTS

- .1 Corian® solid surfaces by Dupont Canada, P.O. Box 2200, Streetsville, Mississauga, Ontario, Canada L5M 2H3, Tel: 1 (800) 387-2122.

- .2 Formica Solid Surface by Formica.
- .3 Wilsonart Solid Surface by Wilsonart.
- 2.2 SUBSTITUTIONS:
  - .1 Approved equal in accordance with B7. Refer to Section 01 33 00 – Submittal Procedure
- 2.3 MATERIALS
  - .1 Solid polymer components
    - .1 Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.
    - .2 Superficial damage to a depth of 0.010" (.25mm) shall be repairable by sanding and/or polishing.
  - .2 Thickness: ½" (13mm), on 2 layers of ¾" plywood.
  - .3 Edge treatment: As indicated.
  - .4 Backsplash: Coved
- 2.4 ACCESSORIES
  - .1 Joint adhesive:
    - .1 Manufacturer's standard one- or two-part adhesive kit to create inconspicuous, nonporous joints
    - .2 Sealants
      - .1 Manufacturer's standard mildew-resistant, UL-listed silicone sealant in colors matching components.
    - .3 Sink/lavatory mounting hardware:
      - .1 Manufacturer's standard bowl clips, panel inserts and fasteners for attachment of undermount sinks/lavatories.
    - .4 Conductive tape:
      - .1 Manufacturer's standard aluminum foil tape, with required thickness, for use with cutouts near heat sources.
    - .5 Insulating felt tape:
      - .1 Manufacturer's standard for use with conductive tape in insulating solid surface Material from adjacent heat source.
- 2.5 FABRICATION
  - .1 Assemble Work at shop following manufacturer's printed fabrication instructions and deliver to job ready for installation. Manufacture in largest practical pieces for handling and shipping without seams.
  - .2 Shop assembly
    - .1 Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and manufacturer's printed instructions and technical bulletins.
    - .2 Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.

- .1 Reinforce with strip of solid polymer Material, 2" (50mm) wide.
- .3 Provide factory cutouts for plumbing fittings and bath accessories as indicated on the Drawings.
- .4 Rout and finish component edges with clean, sharp returns.
  - .1 Rout cutouts, radii and contours to template.
  - .2 Smooth edges.
  - .3 Repair or reject defective and inaccurate Work.

## 2.6 FINISHES

- .1 Color: to be selected by Contract Administrator from *price group 5* of manufacturer's available colours.
- .2 Finish:
  - .1 Provide surfaces with a uniform finish.
  - .2 To be determined by Contract Administrator from standard range of finishes.

## Part 3 Execution

### 3.1 EXAMINATION AND PREPARATION

- .1 Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.
- .3 Preparation: Take field measurements

### 3.2 INSTALLATION

- .1 Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved Shop Drawings and product data.
  - .1 Provide product in the largest pieces available.
  - .2 Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished Work.
    - .1 Exposed joints/seams shall not be allowed.
  - .3 Reinforce field joints with solid surface strips extending a minimum of 1" (25mm) on either side of the seam with the strip being the same thickness as the top.
  - .4 Cut and finish component edges with clean, sharp returns.
  - .5 Rout radii and contours to template.
  - .6 Anchor securely to base cabinets or other supports.
  - .7 Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
  - .8 Carefully dress joints smooth, remove surface scratches and clean entire surface.
  - .9 Install countertops with no more than 1/8" (3mm) sag, bow or other variation from a straight line.
- .2 Coved backsplashes and applied sidesplashes:

- .1 Install applied sidesplashes using manufacturer's standard color-matched silicone sealant.
  - .2 Adhere applied sidesplashes to countertops using manufacturer's standard color-matched silicone sealant.
  - .3 Coved backsplashes and sidesplashes:
    - .1 Provide coved backsplashes and sidesplashes at all walls and adjacent millwork.
    - .2 Fabricate radius cove at intersection of counters with backsplashes to dimensions shown on the Drawings.
    - .3 Adhere to countertops using manufacturer's standard color-matched Joint Adhesive.
- 3.3 REPAIR
- .1 Repair or replace damaged Work which cannot be repaired to Contract Administrator's satisfaction.
- 3.4 CLEANING AND PROTECTION
- .1 Cleaning:
    - .1 Clean and polish fabrications in accordance with manufacturer's instructions.
    - .2 Promptly remove excessive mastic and seam adhesive.
    - .3 Clean tops and splashes in accordance with manufacturer's recommendations.
  - .2 Protection:
    - .1 Do not permit construction near unprotected surfaces.

**END OF SECTION**

**PART 1**

**General**

- 1.1 RELATED SECTIONS
  - .1 Section 07 25 00 – Air/Vapour Barrier Membrane
  - .2 Section 07 53 33 – EPDM Membrane Roofing
  - .3 Section 07 62 00 – Sheet Metal Flashing and Trim
- 1.2 REFERENCES
  - .1 American Society for Testing and Materials (ASTM)
    - .1 ASTM E96-96, Test Methods for Water Vapour Transmission of Materials or latest.
    - .2 ASTM C208-95, Standard Specification for Cellulosic Fiber Insulating Board or latest.
    - .3 ASTM C591-94, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation or latest.
    - .4 ASTM C726-93, Standard Specification for Mineral Fiber Roof Insulation Board or latest.
    - .5 ASTM C728-97, Standard Specification for Perlite Thermal Insulation Board or latest.
    - .6 ASTM C1126-98, Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation or latest.
    - .7 ASTM C1289-98, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board or latest.
    - .8 ASTM C 665-98, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing, or latest.
    - .9 ASTM C 1320-99, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction, or latest.
  - .2 Canadian Gas Association (CGA)
    - .1 CAN/CGA-B149.1-M95, Natural Gas Installation Code or latest.
    - .2 CAN/CGA-B149.2-95, Propane Installation Code or latest.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CGSB 71-GP-24M-77, Adhesive, Flexible, for Bonding Cellular polystyrene Insulation or latest.
  - .4 Underwriters Laboratories of Canada (ULC)
    - .1 CAN/ULC-S701-97, Thermal Insulation, Polystyrene, Boards and Pipe Coverings or latest.
    - .2 CAN/ULC-S702-97, Thermal Insulation, Mineral Fibre, for Buildings or latest.
    - .3 CAN/ULC-S705.1 – Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Material Specification
    - .4 CAN/ULC-S705.2 – Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Installer’s Responsibilities – Specification.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
  - .1 Remove from Site and dispose of packaging Materials at appropriate recycling facilities.
  - .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging Material for recycling.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 Apply foamed-in-place insulation only when surfaces and ambient temperatures are within manufacturer's recommended limits.

**PART 2 Products**

2.1 BLANKET INSULATION

- .1 Batt and blanket mineral fibre: to ASTM C 665, Type 1, CFC and formaldehyde free to R-Value/thickness and locations indicated on Drawings:
- .2 Mineral wool, thermal/acoustic – exterior assemblies:
- .1 Unfaced, friction fit, batts, to CAN/ULC-S702: ROCKWOOL ComfortBatt®, Johns Manville or Owen's Corning equivalent, or approved alternative with 3<sup>rd</sup> party testing data to support and confirm thermal/acoustic performance.
- .3 Mineral wool, fire-resistant/acoustic – interior assemblies:
- .1 Unfaced, friction fit, batts to CAN/ULC-S702: ROCKWOOL Safe'n'Sound®, Johns Manville or Owen's Corning equivalent, or approved alternative with 3<sup>rd</sup> party testing data to support and confirm thermal/acoustic performance.
- .4 Mineral wool, fire-resistant – perimeter fire containment / fireblocking / firestopping:
- .1 Mineral fibre block, semi-rigid, fireblocking: ROXUL Safe 45 by ROCKWOOL, "Thermafiber Safing" Mineral Wool Insulation by Owen's Corning, or Johns Mansville equivalent.

2.2 RIGID INSULATION

- .1 Rigid board:
- .1 Exterior walls above grade: Extruded polystyrene to CAN/ULC-S701, Type 3 or 4, RSI = 0.87/25mm (R5/in.), shiplap or butt edges to suit. Standard of acceptance: Styrofoam CavityMate by Dow Chemical Inc., Foamular 250 by Owen's Corning
- .2 Exterior walls below grade: Extruded polystyrene to CAN/ULC-S701, Type 4, RSI = 0.87/25mm (R5/in.), ship-lap edges. Standard of acceptance: Styrofoam SM by Dow Chemical Inc., or Foamular 250 by Owen's Corning.

2.3 FOAMED-IN-PLACE INSULATION

- .1 Spray-foam insulation: Type 2, closed-cell, spray polyurethane to CAN/ULC-S705.1
- .2 Standard of Acceptance: Icynene ProSeal (MD-C-200v3) Polyurethane Spray Foam Insulation, as manufacturer by Icynene Inc., or approved equal.
- .1 Medium-density, closed cell
- .2 Thermal Resistance: R6/in.
- .3 Air Permeance: 0.0005 L/slm<sup>2</sup>
- .4 Water Vapour Permeance (at 50mm (2")): 0.6 perm
- .5 Flame Spread Rating: 340
- .6 Smoke Developed Classification: 325
- .7 Compressive Strength: 38 psi
- .8 Tensile Strength: 41 psi

- .3 Primer (if required): in accordance with manufacturer's recommendations for surface conditions.
- 2.4 ADHESIVE
  - .1 Adhesive (for polystyrene): to CGSB 71-GP-24 or latest, Type Bulldog Wetstick/Bulldog Grip PL 200.
- 2.5 FASTENERS
  - .1 Insulation clips: impale type, perforated 2" x 2" cold rolled carbon steel 1/32" thick, adhesive back, spindle of 1/4" (2.5mm) diameter annealed steel, length to suit insulation, 1" diameter washers of self locking type.
  - .2 Performance requirements for installed insulation fasteners:
    - .1 Pullout Resistance: minimum 200N, perpendicular to applicable substrates and within temperature range of -30C to +40C.
    - .2 Corrosion Resistance: carbon steel components shall show not more than 15% of the surface rusted, and coatings shall not blister, peel or crack, when tested to Corrosion Test Procedure of Factory Mutual Research Approval Standard, Class I Roof Covers (4470)

**PART 3 Execution**

3.1 WORKMANSHIP

- .1 Install insulation after building substrate Materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 3" from heat emitting devices such as recessed light fixtures, and minimum 2" from sidewalls of CAN4-S604 type A chimneys or as required by code, whichever is more stringent.
- .5 Cut and trim insulation neatly to fit all spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not cover insulation until it has been inspected and approved by Contract Administrator.

3.2 EXAMINATION

- .1 Examine substrates and immediately inform Contract Administrator of defects in writing.
- .2 Prior to commencement of Work ensure that substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.3 BLANKET INSULATION INSTALLATION

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .3 Do not compress insulation excessively to fit into spaces.



- .4 Use mineral fibre fire-resistant insulation where required to maintain fire separations.
- .5 In all sound rated walls, ensure that acoustic batt insulation is installed snugly to all penetrations and that acoustic separation is not compromised.
- .6 Do not enclose insulation until it has been inspected and approved by Contract Administrator.

#### 3.4 RIGID INSULATION INSTALLATION

- .1 Where required, imbed insulation boards into vapour barrier type adhesive, using type and method as recommended by insulation manufacturer.
- .2 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150mm wide 0.15mm polyethylene strip over expansion and control joints using compatible adhesive before application of insulation.

#### 3.5 FOAMED-IN-PLACE INSULATION INSTALLATION

- .1 Install spray-foam insulation to clean surfaces in accordance with CAN/ULC-S705.2, and manufacturer's written recommendations. Use primer where recommended by manufacturer.
- .2 Foam insulate all gaps between insulation and envelope, and at penetrations through the building envelope.

**END OF SECTION**

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- Part 1            General**
- 1.1            SECTION INCLUDES
- .1            Materials and installation methods providing continuous air/vapour barrier materials and assemblies.
  - .2            Air/vapour barrier materials to provide continuous seal between components of building envelope and building penetrations.
- 1.2            RELATED SECTIONS
- .1            Section 06 10 00 – Rough Carpentry
  - .2            Section 07 21 00 – Thermal Insulation
  - .3            Section 07 62 00 – Sheet Metal Flashing and Trim
  - .4            Section 07 42 13 – Metal Wall Panels
  - .5            Section 07 92 00 – Joint Sealants.
- 1.3            REFERENCES
- .1            Canadian General Standards Board (CGSB)
    - .1            CAN/CGSB-19.13M-M(latest), Sealing Compound, One Component, Elastomeric Chemical Curing or latest.
    - .2            CAN/CGSB-19.18M-M(latest), Sealing Compound, One Component, Silicone Base Solvent Curing or latest.
    - .3            CAN/CGSB-19.24M-M(latest), Multi-Component, Chemical Curing Sealing Compound or latest.
    - .4            CGSB 19-GP-14M-(latest), Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing or latest.
  - .2            Canadian Construction Materials Centre (CCMC), Technical Guide for Air Barrier Systems for Exterior Walls of Low-Rise Buildings
  - .3            CSA S478 – “Guideline on Durability in Building”
  - .4            Most recent edition of the NBCC or Provincial Code as applicable to place of work; Part 5 - Environmental Separation or latest.
  - .5            Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification or latest.
  - .6            National Air Barrier Association (NABA)
- 1.4            QUALITY ASSURANCE
- .1            Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.
  - .2            Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.
  - .3            Maintain one copy of documents on site.

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- 1.5 FIELD QUALITY CONTROL
- .1 Inspection and testing of air/vapour barrier membrane application will be carried out by an independent Building Envelope Commissioning Agent at the discretion of the Contract Administrator, and will be paid for by Owner.
  - .2 Notify agency minimum 48 hours prior to commencement of air/vapour barrier membrane application to arrange inspection. Permit agency full access to all portions of Work.
  - .3 Inspections shall include inspections prior to, during, and upon completion of the installation, including air leakage testing of the installed membrane.
  - .4 Submit two (2) original copies of each inspection report, complete with photographs, to the Consultant. Submit one (1) copy to the General Contractor.
- 1.6 PRE-INSTALLATION CONFERENCE
- .1 A pre-installation conference between General Contractor, Air/Vapour Barrier Contractor, Consultant, manufacturer's representative, Air/Vapour Barrier Inspection Agency, and any other trades affected by installation of the air barrier membrane must be held prior to the start of the installation of the air barrier membrane system, with the exception of the job mock-up.
- 1.7 MANUFACTURER'S APPLICATION GUIDELINES
- The membrane manufacturer shall provide "application guidelines" for their materials. Copies of these guidelines shall be provided to the Consultant and to the applicators. Copies shall be kept on site during AVB installation for reference.
- 1.8 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 60 00 - Basic Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions. Provide raised platforms, waterproof coverings and interior storage as necessary to protect materials from direct sunlight, chemicals, solvents, precipitation, ground moisture and temperature extremes, as per manufacturer's recommendations.
  - .3 Do not double stack pallets of air/vapour barrier membrane. Protect rolls from direct sunlight until ready for use.
  - .4 Adhesives and primers contain solvents and are flammable. Do not store or use near open flame or spark.
- 1.9 PROJECT ENVIRONMENTAL REQUIREMENTS
- .1 Do not install solvent curing sealants or vapour release adhesive materials in enclosed spaces without ventilation.
  - .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
  - .3 Maintain temperature and humidity recommended by materials manufacturer before, during and after installation. Except as explicitly permitted by the membrane manufacturer, no installation Work shall be performed on walls exposed to inclement weather or on frost covered or wet surfaces.
  - .4 Substrate shall be protected from exposure to moisture following application until building envelope is complete.
  - .5 Concrete block assemblies shall be cured a minimum of seven (7) days and be free of surface moisture. Allow a minimum of 24 hours drying period following precipitation.

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- .6 Prior to installation, inspect those areas to receive the air/vapour barrier membrane to ensure that they are clean, dry, sound, smooth and continuous.
- 1.10 SEQUENCING
- .1 Sequence work to permit installation of materials in conjunction with related materials and seals. Coordinate with roofing air/vapour barrier membrane installations to ensure specified laps, connections, intersections, etc. are achieved to ensure continuity of the overall building air/vapour barrier.
  - .2 Work shall be scheduled to provide an airtight seal at the end of each working day on the area worked upon during the day.
- 1.11 WARRANTY
- .1 Provide a three 3 year warranty under provisions of Section 01 78 00 - Closeout Submittals.
  - .2 Warranty: Include coverage of installed sealant and sheet materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or failure to cure, in accordance with GC 12.3, for a period of three (3) years.
- 1.12 SUBMITTALS
- .1 Submit certified copy of test data from recognized independent testing laboratory confirming performance properties of air/vapour barrier membrane.
  - .2 Submit 12" x 12" samples of air/vapour barrier membrane.
  - .3 Provide data on material characteristics, performance criteria, and limitations.
  - .4 Submit manufacturer's installation instructions, indicating preparation and installation requirements and techniques.
- 1.13 DURABILITY
- .1 Product manufacturers shall certify their products will meet all characteristics required by CSA S478.
- Part 2 Products**
- 2.1 AIR/VAPOUR BARRIER MEMBRANE (AVB) & WATERPROOFING (WP) MEMBRANE
- .1 Acceptable products:
    - .1 AquaBarrier AVB, as manufactured by IKO Industries
    - .2 Blueskin SA, as manufactured by Henry
    - .3 Sopraseal Stick 1100, as manufactured by Soprema
  - .2 Ensure compatibility with other building membrane components.
  - .3 Roll width to suit tie locations, where used in cavity wall locations.
  - .4 Provide suitable primer for substrate to manufacturer's recommendations.
  - .5 Provide suitable mastic membrane and sealants to seal end laps, terminations, and around protrusions such as masonry ties, as recommended by specific membrane manufacturer.
- 2.2 AIR/VAPOUR BARRIER MEMBRANE ACCESSORY PRODUCTS AND MATERIAL COMPATIBILITY
- .1 Accessory products including caulks, sealants, primers, etc., which are in direct contact with, or form part of, the air/vapour barrier systems must be chemically and physically compatible with the materials to which they are applied and must be approved for that

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- use/application by their manufacturer and the manufacturers of the air/vapour barrier materials they contact.
- .2 Bridging membrane: flexible butyl sheet, standard of acceptance: Firestone Rubbergard Form Flash, or acceptable "as Equal".
  - .3 Transition membrane:
    - .1 AquaBarrier AVB, as manufactured by IKO Industries
    - .2 Sopraseal Stick 1100, as manufactured by Soprema
    - .3 Blueskin SA, as manufactured by Henry
  - .4 Membrane backer: Galvanized steel sheet, minimum 0.015" Nominal Base Steel Thickness (NBST), commercial quality, with Z275 designation zinc coating.
- 2.3 VAPOUR BARRIER (VB)
- .1 Poly vapour barrier, CMHC approved; CAN CG SB 51.34-M86. Thickness as indicated on Drawings.
  - .2 Underslab Vapour Barrier
    - .1 High-density, cross-laminated polyethylene, 15 mil thick, c/w taped joints or sealant as recommended by manufacturer.
    - .2 Standard of acceptance: Permalon Ply X-150, as manufactured by Reef Industries, and as distributed by Brock White Company.
- Part 3 Execution**
- 3.1 EXAMINATION
- .1 Verify that surfaces and conditions are ready to accept the Work of this section.
  - .2 Ensure all surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
  - .3 Report any unsatisfactory conditions to the Contract Administrator in writing.
  - .4 Do not proceed with application of air/vapour barrier membrane when rain is expected within 24 hours.
  - .5 Do not start work until deficiencies have been corrected. Commencement of Work implies acceptance of conditions.
- 3.2 SURFACE PREPARATION
- .1 Remove loose or foreign matter which might impair adhesion of materials.
  - .2 Ensure all substrates are clean of oil or excess dust; all masonry joints struck flush, and open joints filled; and all concrete surfaces free of large voids, spalled areas or sharp protrusions.
  - .3 Ensure all substrates are free of surface moisture prior to application of self-adhesive membrane and primer.
  - .4 Ensure metal closures are free of sharp edges and burrs.
  - .5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.
  - .6 Cast-In-Place Concrete:
    - .1 Ridges at the frame work joints shall not exceed 197 mils in height.
    - .2 Surface to be flat, remove any lumps of concrete.

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- .3 All surfaces must be clean and dry, free from laitance, release form oils etc.
  - .4 Tie holes are to be filled with appropriate material.
  - .5 Ensure concrete is cured and dried for a minimum of 14 days.
  - .7 Sheathing:
    - .1 Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.
    - .2 Gaps/voids between material sheets, around penetrations, and between different substrates to be filled with bridging materials/backer sheets as recommended by membrane manufacturer.
  - .8 Examine work of other trades for defects and discrepancies and report them to the Consultant in writing. Do not proceed with work until surfaces are satisfactory.
- 3.3 INSTALLATION - PRIMER
- .1 Install materials in accordance with manufacturer's instructions.
  - .2 Apply self-adhered membrane primers using a short nap roller or spray equipment. Masks and safety glasses must be worn if spray methods are utilized on the project.
  - .3 Apply primers at the manufacturer's recommended rate (litres/sq. m.) depending on the surface porosity.
  - .4 Allow primer to be dry to touch before commencing membrane application. Drying time will depend on ambient temperature.
  - .5 Primed surfaces not covered by air/vapour barrier membrane during the same working day must be re-primed.
- 3.4 INSTALLATION – SELF-ADHERED AIR/VAPOUR/MOISTURE/WATERPROOFING MEMBRANES
- .1 Install self-adhered membranes at all locations noted in the Contract Documents and/or Architectural Drawings.
  - .2 Orientation of membrane may depend on substrate type and ease of accessibility. On precast concrete the membrane may be installed either vertically or horizontally.
  - .3 Install air/vapour barrier membrane to substrate in manageable lengths, approximately 8 feet. Install in an overlapping shingle fashion and in accordance with manufacturer's recommendations and written instructions. Stagger all vertically joints.
  - .4 Position membrane for installation and begin installation at the base of the wall. Remove protective film and press firmly into place, where applicable. Apply sufficient hand pressure and use a roller to ensure adhesion to the primed substrate.
  - .5 Install successive courses of membrane ensuring that all end laps are 150 mm (6 inches), and all side laps are 3". All end and side laps shall be rolled with a counter top roller to ensure seal.
  - .6 Apply a trowel coat of modified mastic around all ties, penetrations,
  - .7 Continue membrane installation onto the horizontal and vertical planes to tie into all door frames and windows sills.
  - .8 Seal inside and outside corners of sheathing boards with a strip of self-adhering

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- air/vapour barrier membrane extending a minimum of 3" on either side of the corner detail.
- .9 Tie-in to structural members, floor slabs, parapets, foundation walls, and at the interface of dissimilar materials as indicated in drawings as indicated with self-adhering air/vapour barrier membrane.
  - .10 Install all flashing membranes/transition membranes as indicated on drawings. Where transition/flashing membranes lap onto wall membrane in reverse-shingle fashion, seal the top edge of the membrane using termination sealant, and trowel-apply a feathered edge to seal termination to shed water.
  - .11 Seal top edge of the membrane to the substrate with modified mastic at the end of each workday.
  - .12 Prior to installation of the insulation, inspect membrane for punctures or tears. Any location where the membrane's integrity has been breached, repairs are mandatory. The repair patch must extend at least 6" beyond the damaged area on all sides. Seal the perimeter edges of the repair patch with a bead of modified mastic.
  - .13 Do not allow membrane to come in contact with coal tar products such as creosote, EPDM membrane or polysulphide based sealants.
  - .14 Do not install the insulation or otherwise cover the air/vapour barrier membrane until the approval of the air/vapour barrier installation by the Consultant and Inspection Agency.
- 3.5 **INSTALLATION – UNDERSLAB VAPOUR BARRIER**
- .1 Install materials in accordance with manufacturer's instructions.
  - .2 Ensure all seams are taped with manufacturer's recommended compatible products.
- 3.6 **INSTALLATION – POLY VAPOUR BARRIER**
- .1 Install poly vapour barrier in strict accordance with CMHC guidelines.
- 3.7 **PROTECTION**
- .1 Protect finished Work in accordance with Section 01 50 00, Temporary Facilities. Do not permit adjacent Work to damage Work of this section.
  - .2 Close up all exposed air/vapour/waterproofing/moisture barrier membranes as soon as possible after application to protect the membranes from weather, sunlight and damage by other trades.
  - .3 Do not install membrane, and leave un-insulated, on the cold side of a building shell, which is being heated from the inside.
  - .4 Insulate over the membrane (where applicable) immediately after installation or install within heated enclosure and maintain heat until insulation is installed, if expected range of environmental conditions on either side of the membrane could result in dew point temperatures occurring within the wall.

**END OF SECTION**

**PART 1            General**

1.1            DESCRIPTION

.1            General Requirements

.1            Division 1, General Requirements, is part of this specification and shall apply as if repeated here.

.2            Work finished and included:

.1            Supporting sub-grits.

.2            Cladding profile.

.3            Accessories including associated flashing, closures, and sealants.

1.2            STANDARDS

.1            Design of cladding system, and installer shall demonstrate at least five years experience in projects similar in scope.

.1            CSA – S136 for design of Cold Formed Steel Structural Members.

.2            Canadian Sheet Steel Building Institute Standards 20M.

.3            National Building Code of Canada.

1.3            QUALITY ASSURANCE

.1            Manufacturer of wall system, and installer shall demonstrate at least five years experience in projects similar in scope.

.2            This sections establishes the standard of quality required for the complete metal wall system. Proposed substitutions must meet this standard, and will be considered as follows:

.1            A written request for approval of a substitution is received at least ten (10) days prior to tender closing.

.2            The request includes a complete item-by-item description comparing the proposed substitution to the specified system, together with manufacturer's literature, samples, test data, engineering standards and performance evaluation indicating comparable standards to those specified.

1.4            DESIGN REQUIREMENTS

.1            Design wall system to resist:

.1            Wind loads: Refer to Structural drawings.

.2            Deflection of wall system is not to exceed 1/180<sup>th</sup> of the span for the wind load based on serviceability limit states.

.3            Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.

.1            Temperature Change (Range): 20°C, ambient; 40°C, material surfaces

.4            Design expansion joints to accommodate movement in cladding and between cladding and structure to prevent permanent distortion or damage to the cladding.

.5            Design wall system to maintain the following erection tolerances:

.1            Maximum variation from plane or locations shown on shop drawings: 20mm/10m (3/4 inch/30ft)

.2            Maximum offset from true alignment between two adjacent members abutting end to end in line: 1mm (0.04 inches)

1.5            SAMPLES

.1            Submit samples of standard coloured metal cladding profile for review by the consultant, prior to fabrication.



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- 1.6 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
    - .1 Indicate arrangement of cladding system, including dimensions, location of joints, profiles of inner and outer skin, types and locations of supports, fasteners, flashing, closures and all metal components related to the cladding installation.
    - .2 Drawings shall be signed and sealed by a Professional Engineer, attesting to the ability of the metal panels assembly to withstand the specified loads.
- 1.7 MAINTENANCE DATA
- .1 Provide maintenance data for cleaning and maintenance of panel finishes for incorporation into manual.
- 1.8 PRODUCT DELIVERY, HANDLING AND STORAGE
- .1 Store components and materials in accordance with panel manufacturer's recommendations and protect from elements.
  - .2 Protect prefinished steel during fabrication, transportation, site storage and erection, in accordance with CSSBI Standards.
- 1.9 GUARANTEE
- .1 For work in this section, warranty by installer against defects or deficiencies in materials or workmanship shall be for a period of one year from date of substantial completion.
- 1.10 WARRANTY
- .1 Provide a manufacturer's written warranty: Furnish panel manufacturer's written warranty covering failure of factory-applied exterior finish within the warranty period. Warranty period for finish: 40 years after the date of Substantial Completion. The values below are based on normal environments and exclude any aggressive atmospheric conditions.
- PART 2 Products**
- 2.1 MATERIALS
- .1 Metal Wall System:
    - .1 Sub-Structural System:
      - .1 Thermal Clips: 6" deep, G90 galvanized finish spaced at 4'-0" O.C., mechanically fastened into back-up wall.
      - .2 Continuous Hat Channels: 1" deep, G90 galvanized finish, mechanically fastened to thermal clips.

- .2 Steel Cladding by Agway, Vicwest, Behlen, or equal approved in accordance with B7 Substitutes:
  - .1 Profile: Site verify to match existing.
  - .2 Fabricated from Z275 galvanized sheet steel conforming to ASTM A653M Grade 230 or AZ150 Galvalume, sheet steel conforming to ASTM A792M Grade 230. having a nominal core thickness of 0.64mm (24 ga.)
  - .3 Fasteners: Stainless Steel with exposed fasteners colour matched to cladding.
- 2.2 PANEL FINISHES
  - .1 Cladding coating: Pre-painted with WeatherX™ on interior face.
- 2.3 COLOUR
  - .1 Prefinished cladding colour to be Site verified to match existing.
- 2.4 ACCESSORIES
  - .1 Flashing: In accordance with Section 07 62 00. Material to match cladding in exposed locations, galvanized material in concealed locations. Custom fabricated to suit architectural details as required. Use performed corner pieces only. Double back exposed edges.
  - .2 Closures: Metal closures to suit profiles selected, to manufacturer's recommendations.
  - .3 Sealants:
    - .1 Concealed: Tape or compound, non-skinning, non-drying, butyl rubber.
    - .2 Exposed: (Acrylic co-polymer to CGSB 19GP-5M) (One part silicone to CGSB CAN2-19.13).
- 2.5 FABRICATION
  - .1 Fabricate roof components to comply with dimensions, profiles, gauges, and details as shown on the shop drawings, including fascia and soffit panels and all companion flashing.
  - .2 Fabricate all components of the system in the factory, ready for field installation.
  - .3 Provide metal liner and cladding and all accessories in longest practicable length to minimize field lapping of joints.
- PART 3 Execution**
- 3.1 EXAMINATION
  - .1 Examine work of other Sections upon which work of this Section depends.
  - .2 Report all discrepancies to consultant before beginning work on the roof system.
- 3.2 INSTALLATION
  - .1 Sub-grit framing system:
    - .1 Install sub-grits. Frame all openings in the cladding.
  - .2 Flashing
    - .1 Install starter flashing, drip and other flashing, and corners, edgings, window and door flashing as shown on the drawings.
  - .3 Exterior Cladding:
    - .1 Install exterior cladding in accordance with manufacturer's standard installation procedures, providing proper laps and detailing to ensure a weathertight face.
    - .2 Install finishing flashing and cap flashing.
  - .4 Sealants:
    - .1 Install sealants at junctions with adjoining work, and where shown on the drawings, in accordance with Section 07 92 00.
- 3.3 CLEAN-UP
  - .1 Clean exposed panel surfaces in accordance with manufacturer's instructions.

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- .2 Repair and touch up with colour matching high grade enamel minor surface damage, only where permitted by the Architect and only where appearance after touch-up is acceptable to Architect.
  - .3 Replace damaged panels and components that, in opinion of the Architect, cannot be satisfactorily repaired.

**END OF SECTION**

**PART 1 General**

1.1 WORK INCLUDED

- .1 The work included under this section shall conform to the industry standard and be accepted by the local construction and trade associations.

1.2 RELATED WORK

- .1 **Section 05 30 00 – Structural Steel Deck**
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 07 13 00 – Sheet Waterproofing
- .4 Section 07 21 13 – Board Insulation
- .5 Section 07 25 00 – Air/Vapour Barrier Membrane
- .6 Section 07 62 00 – Sheet Metal and Flashing
- .7 Division 22 – Plumbing Penetrations.
- .8 Division 23 – HVAC Penetrations
- .9 Division 26 – Electrical Penetrations

1.3 REFERENCES & STANDARDS

- .1 CGSB 37-GP-56M.
- .2 Do roofing Work to applicable standard in Canadian Roofing Contractors Association (CRCA) Roofing Specifications Manual, except where specified otherwise.

1.4 SYSTEM DESCRIPTION / COMPATIBILITY

- .1 2-ply modified bitumen roof assembly.
- .2 Compatibility between components of roofing system is essential. Bituminous adhesives, insulation, felts, and surface coatings, which are to be incorporated into system, must be compatible with each other.
- .3 Provide written declaration that components of roofing system are compatible.

1.5 FIELD QUALITY CONTROL

- .1 Inspection and testing of roof application will be carried out by a third party inspection agency acceptable to the Contract Administrator.
- .2 Notify agency minimum 48 hours prior to commencement of roofing operations to arrange inspection. Permit agency full access to all portions of Work.
- .3 Inspections shall include: a 'Final Inspection' carried out after all roofing and building exterior is complete, including installation of equipment and openings, and shall be in the presence of the third party, Contract Administrator and the Contractor.
- .4 Submit two (2) original copies of each inspection report, complete with photographs, to the Contract Administrator. Submit one (1) copy to the General Contractor.
- .5 **Costs of inspection and tests will be paid by cash allowance.**

1.6 QUALITY ASSURANCE

- .1 Roofing Contractor shall be a member in good standing of the Roofing Contractors Association of Manitoba (RCAM) Inc., and the Canadian Roofing Contractors Association. Roofing Contractor must be a company specializing in installation of sheet roofing membranes approved by the membrane manufacturer.

- .2 The Roofing Contractor must, during the application of the modified bitumen membrane, have tradesmen on site at all times who have 40 hours of supervised, hands-on training of modified bitumen membrane application. The tradesmen must have in their possession, a current photo identification card identifying the training for that particular product.
- 1.7 REGULATORY REQUIREMENTS
  - .1 ULC (Underwriters Laboratories of Canada) Fire Hazard Classifications.
- 1.8 DELIVERY, STORAGE, AND HANDLING
  - .1 Deliver products to site to requirements of Section 01 60 00.
  - .2 Store and protect products to requirements of Section 01 60 00. Sealants to be stored at +5°C minimum.
  - .3 Store rolls on end with any selvage edge up, one (1) pallet high only, in dry location, with protection from inclement weather.
  - .4 Store materials in weather protected environment clear of ground and moisture. Remove only in quantities required for same day use.
  - .5 Place plywood runways over Work to enable movement of material and other traffic.
- 1.9 ENVIRONMENTAL REQUIREMENTS
  - .1 Do not install roofing when temperature remains below -18°C for torch application
  - .2 Minimum temperature for solvent-based adhesive is -5°C.
  - .3 Install roofing on dry deck, free of snow and ice, use only dry materials, and apply only during weather that will not introduce moisture into the roofing system.
- 1.10 WARRANTY
  - .1 Provide a ten year manufacturer's warranty and a two year CRCA warranty under provisions of CCDC 2 Article GC 12.3 of the General Conditions, covering damage to building and contents resulting from failure of the work of this Section to resist penetration of water under normal service conditions.
- 1.11 WASTE MANAGEMENT AND DISPOSAL
  - .1 Separate waste materials for reuse, and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management.
  - .2 Place materials defined as hazardous or toxic in designated containers.
  - .3 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.
  - .4 Unused paint, coating material must be disposed of at official hazardous material collections site as reviewed by Contract Administrator.
- PART 2 Products**
- 2.1 ROOF MEMBRANE MATERIALS
  - .1 Gypsum sheathing board: fiberglass mat faced, treated gypsum core panel, Georgia Pacific DensDeck, Type 'X', moisture-resistant, thickness as noted, maximum practical lengths.
  - .2 Gypsum board and insulation fasteners: #12 Dekfast screws with Sentri XP coating and 73mm (2.88") hexagonal galvalume steel stress plate for all deck types as manufactured by SFS Stadler, or acceptable "as Equal". Fasteners shall be of sufficient length to penetrate steel decking a minimum of 20mm (3/4").

- .3 Air/vapour barrier membrane (AVB): thermo-fusible membrane composed of glass reinforcement, styrene-butadiene-styrene (SBS) modified bitumen and thermo-fusible plastic film, to CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing".
  - .1 Elastophene Flam 2.2, as manufactured by Soprema
  - .2 Torchflex TF-95-FF-Base 2.2, as manufactured by IKO
- .4 Wood blocking: refer to Section 06 10 00, Carpentry.
- .5 Roofing insulation (to R-35):
  - .1 Rigid board insulation c/w tapered insulation where indicated and required to maintain 2% roof slope in field, 4% at drains:
    - .1 Top layer: "Sopra-Iso" polyisocyanurate insulation w/ fiberglass facer, thermal resistance allowable of RSI – 1.06/25mm (R6/in), or equivalent by IKO. Total thickness as per Drawings.
    - .2 Bottom layer: Type II expanded polystyrene insulation to CAN/CGSB 51.20-M87, tapered for drainage to slopes shown on drawings.
    - .3 Multi-layer insulation to be staggered.
    - .4 Primer: as recommended by the manufacturer for the specific product and application.
- .6 Fibreboard: 2 layers - 13mm (1/2") asphalt-impregnated fibreboard mechanically fastened through to roof deck, c/w joints staggered. Acceptable products: by Soprema, IKO.
- .7 Membrane Roofing:
  - .1 High-density polyisocyanurate board and base sheet membrane (to CGSB 37.56-M):
    - .1 Board composed of SBS 180 mod bit membrane with a non-woven polyester reinforcement, factory laminated on a high density polyisocyanurate insulation board. Surface to be covered with a thermofusible plastic film. Membrane side lap is part self-adhesive, part thermofusible. Thickness = 12mm (1/2"). Acceptable products: Soprasmart ISO HD 180 by Soprema, or equivalent by IKO.
  - .2 Cap sheets: SBS 250 torch-on modified bituminous membrane, conforming to CAN/CGSB 37.56-M. Acceptable products: Sopralene Flam 250 GR by Soprema, or equivalent by IKO.
  - .3 Traffic cap sheets: Soprafix 660 by Soprema, to be utilized for walkways, and roof servicing areas, or equivalent by IKO. Sizes and locations as per Drawings.
- .8 Membrane flashings:
  - .1 Base sheet: self-adhesive SBS elastomeric modified bitumen membrane, conforming to CAN/CGSB 37.56-M. Acceptable products: Sopraflash Flam Stick by Soprema, or equivalent by IKO.
  - .2 Cap sheet: SBS modified bitumen membrane, conforming to CAN/CGSB 37.56-M. Acceptable products: Sopralene Flam 250 GR by Soprema, or equivalent by IKO.
- .9 Pourable sealer: Sonolastic SL 2, two part self levelling pourable polyurethane, complete with Sonneborn Primer 733, as manufactured by Sonneborn and Distributed by Brock White.
- .10 Modified primer: primer as recommended by the manufacturer for the specific product and application.
- .11 Rubberized mastic: Polyroof as manufactured by Tremco Ltd., equivalent by Bakor or acceptable "as Equal".

- .12 Sealant: Tremco Dymonic FC, equivalent by Bakor, or acceptable "as Equal".
- .13 Accessories:
  - .1 Roofing nails: type and size as required to suit application, conforming to CSA B111, "Wire Nails, Spikes and Staples".
  - .2 Screws: purpose made self-drilling of sufficient length to pass through steel decking at least 15mm (5/8").
  - .3 Insulation fasteners as recommended by the insulation manufacturer, long enough to penetrate the decking at least 20-mm.
- .14 Vent stacks: Insulated Stack Jack Flashings with metal cap, SJ-37, as manufactured by Thaler.
- .15 Protection cup (at pipes penetrating roof): pipe flashing sealed to roof and pipe.
- .16 Roof Drains: Refer to Division 22, underdeck clamp models are only acceptable products.
- .17 Metal flashings, vents and pipe sleeves: Refer to Section 07 62 00 "Metal Flashing and Trim".
- .18 Parapet Anti-slip Surfacing
  - .1 Safety-walk anti-slip surfacing, general purpose, as supplied by Safety Supply Canada.

### **PART 3 Execution**

#### **3.1 INSPECTION & WORKMANSHIP**

- .1 Verify that surfaces and site conditions are ready to receive work. Protect surrounding surfaces against damage from roofing Work.
- .2 Ensure all debris, snow, standing water, dust, dirt, etc. is cleaned off deck prior to accepting the surfaces.
- .3 Verify deck is supported and secured, and is clean, smooth, free of depressions, waves, or projections.
- .4 Before application of roofing membrane, ensure surfaces are dry and substrates properly sloped to drains.
- .5 Verify roof openings, curbs, pipes, sleeves, ducts and vents through roof are solidly set, and cant strip, reglets, and nailing strips are in place.
- .6 Beginning of installations means acceptance of substrate.
- .7 Take special care when working with torch-applied roofing materials. Maintain a tidy work area with a fire extinguisher on hand.
- .8 The Roofing Contractor shall maintain a workman on site a minimum of one (1) hour after any torching of modified bitumen is complete, and use an electronic thermometer to check for any hot areas.

#### **3.2 GYPSUM SHEATHING APPLICATION**

- .1 Install each gypsum-board sheet with minimum eight (8) mechanical fasteners and plates per 1200mm x 2400mm (4ft x 8ft) sheet, and as follows:
  - .1 Provide minimum 12 fasteners and plates per 4ft x 8ft sheet at perimeter edges. The perimeter edge distance is defined as the lesser of:
    - .1 Ten percent (10%) of the building width,
    - .2 Forty percent (40%) of the eave height, or
    - .3 1200mm (4ft)

- .2 Provide minimum 14 fasteners and plates per 4ft x 8ft sheet for outside corners.
  - .2 Trim screws through deck to within 1/2" from underside of deck surface (including flutes) at all exposed deck ceilings within 16'-5" of floor.
  - .3 Coordinate with Electrical sub-contractor to ensure fasteners will not penetrate electrical conduit and wiring that is mounted to U/S of roof deck. Sequence work so that roofing fastener installation occurs prior to conduit rough-ins.
- 3.3 AIR/VAPOUR BARRIER (AVB) MEMBRANE APPLICATION
- .1 Apply torch-on air/vapour barrier membrane to CRCA specifications, or to Manufacturer's specifications and as detailed.
  - .2 Extend air/vapour barrier membrane under cant strips, blockings, curbs, and seal around all penetrations to ensure a continuous seal of the air/vapour barrier.
  - .3 The roof air/vapour barrier shall be fully lapped and sealed together with the wall air/vapour barrier to ensure a complete and continuous seal of the air/vapour barrier building envelope. Roof air/vapour barrier should also be lapped out and over wall air/vapour barrier to create shingle effect for proper drainage.
  - .4 Apply a bead of mastic around the base of all plumbing stacks to ensure a continuous seal of the air/vapour barrier.
- 3.4 INSULATION APPLICATION
- .1 Ensure vapour barrier is clean and dry.
  - .2 Lay insulation boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking, around penetrations through roof and at mitred joints.
  - .3 Mechanically fasten the insulation in place through the top layer with minimum 5 screws and plates per 4ft. x 4ft. through to roof deck.
  - .4 Place first layer of boards in one (1) direction, stagger joints.
  - .5 Place second layer of boards perpendicular to first layer, stagger joints.
  - .6 Apply no more insulation than can be sealed with membrane in same day.
- 3.5 FIBREBOARD SHEATHING
- .1 Fibreboard sheathing (protection board) for flat deck: apply over insulation with staggered joints, length parallel to deck flutes. Apply heavy sprinkle coat of cooled asphalt to fibreboard sheathing, then overturn fibreboard to bond in place to insulation (ensure asphalt does not damage insulation). Apply second layer in full coat of asphalt, joints staggered.
- 3.6 BASE SHEET APPLICATION (torch applied membrane)
- .1 Install membrane roofing in strict accordance with manufacturer's instructions and details and ensure min 3" side laps and 6" end laps.
  - .2 Beginning at the drains and perpendicular to the slope, install the base sheet membrane with adhering in parallel strips.
  - .3 Each strip shall overlap the preceding strip by 3" along the side joint (use the blue line to facilitate alignment) and by 6" at the ends.
  - .4 Let the membrane relax at least 15 minutes before installing it, or burn the plastic film in a zigzag fashion using a propane torch to relax it. In cold weather, use the second method.
  - .5 Peel back the silicone release paper to adhere the membrane to the substrate. Use a broom or brush to apply even pressure and ensure good adherence.
  - .6 Remove the paper protecting the selvedge then heat the side joints. Seal the joints using a trowel. A bead of molten bitumen should appear along the joint to ensure a perfect seal.



- .7 Seal the end joints by welding a 12" wide protection band centred on the joint.
- .8 Avoid creating wrinkles, blisters, and fish-mouths.
- .9 The base sheet membrane should end over the cant strip or at the edge of the substrate.
- .10 Install screws and washers every 12" along the edge of the substrate.

### 3.7 BASE SHEET FLASHING APPLICATION

- .1 Install in strict accordance with manufacturer's instructions and details.
- .2 Primer coating must be dry before application of the base sheet flashing.
- .3 Before applying membranes, always remove the plastic film on the section to be covered if there is an overlap (inside and outside corners and field surface).
- .4 Position the pre-cut membrane piece. Peel back 4" to 6" of the silicone release paper to hold the membrane in place at the top of the parapet.
- .5 Then, gradually peel back the remaining silicone release paper, pressing down on the membrane with an aluminium applicator to ensure good adhesion. Use the aluminium applicator to ensure a perfect transition between the up-stand and the field surface. Smooth the entire membrane surface with a roller for full adhesion.
- .6 Cut off corners at end laps to be covered by the next roll.
- .7 Install a reinforcing gusset in all inside and outside corners.
- .8 Always seal overlaps at the end of the workday.

### 3.8 CAP SHEET APPLICATION (torch applied membrane)

- .1 Once base sheet is applied and no defects are apparent, Install cap sheet to the base sheet in strict accordance with manufacturer's instructions and details.
- .2 Begin with double-selvage starter roll. If starter roll is not used, side laps covered in granules must be degranulated by embedding side laps in torch-heated bitumen over a 3" width.
- .3 Unroll cap sheet starting from low point of roof. Carefully align first side lap (parallel to roof edge).
- .4 Weld cap sheet onto base sheet with torch recommended by membrane manufacturer. During application, simultaneously melt both designated contact surfaces so a bead of bitumen is apparent as cap sheet unrolls.
- .5 Avoid overheating.
- .6 Stagger base sheet and cap sheet seams by a minimum of 12".
- .7 Provide cap sheet side laps of 3" and end laps of 6". Cut off corners at end laps to be covered by next roll. Surface granules on end laps must be embedded prior to installation of following sheet.
- .8 After installation of the cap sheet, check all seams.
- .9 Complete perfect welds between two membranes. Leave no zone unwelded. In cold weather, adjust welding time to obtain homogeneous seam (it be necessary to slow down in certain cases.)
- .10 Once cap sheet is installed, carefully check all overlapped joints.
- .11 During installation, take care to avoid excessive bitumen bleed-out at joints.

### 3.9 CAP SHEET FLASHING APPLICATION (heat-welded)

- .1 Install in strict accordance with manufacturer's instructions and details.

- .2 Lay cap sheet stripping in strips 3'-3" wide to the vertical surface, extending onto the flat surface of the roof a minimum of 6". Side joints must overlap by 3" and must be staggered by at least 4" with respect to the joints of the cap sheet on the field surface to avoid areas of excessive membrane thickness.
  - .3 Lay out a straight chalkline on the cap sheet surface, parallel to the roof edge, upstands and parapets, 6" inside the roof from the base of the cant strip.
  - .4 Use a propane torch and round-nose trowel to embed the surface granules in the layer of hot bitumen starting from the chalk line on the field surface to the bottom edge of the upstand or parapet as well as on the granulated vertical surfaces that are to be overlapped.
  - .5 This cap sheet will be heat-welded directly to the base sheet membrane, proceeding from bottom to top. This technique softens both membranes in order to obtain even, continuous weld.
  - .6 During installation, be careful not to overheat the membrane or to create excessive bitumen bleeding at the joints.
- 3.10 REINFORCING MEMBRANE
- .1 Install in strict accordance with manufacturer's instructions and details.
  - .2 Lay 6" wide strip of base sheet at edge of roof so that 50-mm laps onto edge flashing.
- 3.11 TRAFFIC CAP MEMBRANE INSTALLATION
- .1 Install in strict accordance with manufacturer's instructions and details.
- 3.12 FIELD QUALITY CONTROL
- .1 Field inspection and testing will be performed under provisions of Section 01 45 00.
  - .2 Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.
  - .3 Correct identified defects or irregularities.
- 3.13 PROTECTION
- .1 Where Work must continue over finished roofing membrane, protect surface with minimum 1/2" thick plywood sheets. Otherwise, protect finished installation and adjacent work to requirements of Section 01 60 00.

**END OF SECTION**

**Part 1            General**

1.1            WORK INCLUDED

- .1            The Work included under this section shall conform to the industry standard and be accepted by the local construction and trade associations.

1.2            RELATED WORK

- .1            Section 01 33 00 – Submittal Procedures
- .2            Division 04 – Masonry
- .3            Section 06 10 00 – Rough Carpentry
- .4            Section 07 92 00 – Joint Sealing
- .5            Division 21 – General Mechanical Requirements
- .6            Division 26 – Electrical

1.3            EXISTING CONDITIONS/PROTECTION

- .1            Exercise care when working on or about roof surfaces to avoid damage or puncturing membrane or flexible flashings.
- .2            Place plywood panels on roof surfaces to Work of this section and on access routes. Keep in place until completion of Work.

**Part 2            Products**

2.1            SHEET MATERIALS

- .1            Flashings and Bent Closures: 0.6 mm (24 ga.) core steel, shop pre-coated.
- .2            Flashing colour at windows and parapets: as selected by Contract Administrator from standard 8000 series colours.
- .3            Flashings at limestone: Galvalume
- .4            Fascia: shop pre-coated steel to same thickness as .1 above – colour by Contract Administrator.
- .5            Eavestroughs and light gauge downspouts: pre-coated steel of 24 gauge, unless otherwise noted as per Drawings. Colour as selected by Contract Administrator from standard colours.
- .6            Pipe Sleeves: pre-coated steel of 24 gauge as per Drawings. Colour as selected by Contract Administrator from standard colours.
- .7            Vents: pre-coated steel of 24 gauge as per Drawings. Colour as selected by Contract Administrator from standard colours.

2.2            ACCESSORIES

- .1            Fastener:
  - .1            Screws: Prefinished steel with fiberglass reinforced nylon head and soft neoprene washer, at exposed locations. Finish exposed fasteners to be same colour as flashing and fascias.
  - .2            Nails: Of same Material as sheet metal to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing application.
  - .3            Washers: of same Materials as sheet metal, 0.04" (1mm) thick, with rubber packing.

- .2 Sealant: in accordance with Section 07 92 00 – Joint Sealers. Colours to be selected by Contract Administrator.
- .3 Plastic cement: to CGSB 37-GP-5Ma.
- .4 Isolation coating: alkali-resistant bituminous paint.
- .5 Underlay for metal flashing: No. 15 perforated asphalt felt to CAN/CSA-A123.3.
- .6 Cleats: of same Material and temper as sheet metal, minimum 2" (50mm) wide. Thickness same as sheet metal being secured.
- .7 Solder: to ASTM B32, "Standard Specification for Solder Metal", fifty percent (50%) tin and fifty percent (50%) lead.
- .8 Flux: Rosin, cut hydrochloric acid, or commercial preparation suitable for Materials to be soldered.
- .9 Touch-up paint: as recommended by prefinished Material manufacturer.

### 2.3 FABRICATION

- .1 Form sections true to shape, accurate in size, square, and free from distortion or defects.
- .2 Fabricate cleats, clips, and starter strips of same Material as sheet, inter-lockable with sheet.
- .3 Form pieces in longest practical lengths, 8'-0" (2440mm) maximum. Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 1/2" (13mm); miter and seam corners with sealant.
- .5 Form Material with flat lock seam.
- .6 Seal all joints with silicone.
- .7 Fabricate corners from one piece with minimum 18" (450mm) long legs; solder for rigidity, seal with silicone sealant.
- .8 Fabricate vertical faces with bottom edge formed outward 1/4" (6mm) and hemmed to form drip.
- .9 On exposed faces, return drip edge hem back to form interlock with concealed clip. Provide continuous clips at all exposed faces.
- .10 Fabricate flashings to allow toe to extend 2" (50 mm) over roofing. Return and brake edges.
- .11 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .12 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

## Part 3 Execution

### 3.1 INSPECTION

- .1 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
- .2 Verify membrane termination and base flashings are in place, sealed, and secure.
- .3 Beginning of installation means acceptance of existing conditions.

### 3.2 PREPARATION

- .1 Field measure Site conditions prior to fabricating Work.
- .2 Install starter and edge strips, and cleats before starting installation.

### 3.3 INSTALLATION

- .1 Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- .2 Secure flashings in place using concealed continuous clip fasteners at all visible flashings. Use exposed fasteners only in locations not ordinarily visible (e.g. - inside parapet walls). All exposed fasteners must be on vertical surfaces.
- .3 Apply plastic cement compound between metal flashings and felt flashings.
- .4 Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- .5 Seal metal joints watertight.

**END OF SECTION**

## PART 1 – GENERAL

### 1.1 RELATED WORK

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 77 00 – Closeout Procedures
- .3 Section 03 30 00 – Cast-in-place Concrete
- .4 Section 04 05 10 – Common Work Results for Masonry
- .5 Section 05 12 00 – Structural Steel
- .6 Section 07 84 00 – Firestopping
- .7 Section 09 22 16 – Non-Structural Metal Framing
- .8 Section 09 29 00 – Gypsum Board
- .9 Section 09 51 30 – Acoustical Panel Ceilings
- .10 Section 09 90 00 – Painting
- .11 Division 21 – 25 – Mechanical
- .12 Division 26 – Electrical

### 1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM E84, Surface Burning Characteristics of Building Materials
  - .2 ASTM E119, Fire Tests of Building Construction and Materials
  - .3 ASTM E136, (Non-combustibility) Behaviour of Materials in a Vertical Furnace at 750°C
  - .4 ASTM E605, Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members
  - .5 ASTM E736, Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
  - .6 ASTM E759, Effect of Deflection of Sprayed Fire-Resistive Materials Applied to Structural Members
  - .7 ASTM E760, Effect of Impact on the Bonding of Sprayed Fire-Resistive Materials Applied to Structural Members
  - .8 ASTM E761, Compressive Strength of Sprayed Fire-Resistive Materials Applied to Structural Members
  - .9 ASTM E859, Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members
  - .10 ASTM E937, Corrosion of Steel by Sprayed Fire-Resistive Materials Applied to Structural Members
- .2 Underwriters Laboratories of Canada (ULC):
  - .1 ULC/CAN S101, Fire Endurance Tests of Building Construction and Materials
  - .2 ULC/CAN S102, Surface Burning Characteristics of Building Materials and Assemblies
  - .3 ULC/CAN 4-S114, Standard Test Material for Determination of Non-combustibility in Building Materials
  - .4 Underwriters' Laboratories, Inc. (UL) Fire Resistance Directory
  - .5 Underwriters' Laboratories of Canada (ULC) List of Equipment and Materials
- .3 International Code Council, Evaluation Services (ICC-ES)
- .4 National Building Code of Canada (NBCC)
- .5 International Building Code (IBC)
- .6 Uniform Building Code Standard No. 7-6 (current edition): Thickness and Density Determination for Spray-Applied Fire Protection
- .7 National Fireproofing Contractors Association (NFCA)

- .8 AWCI Technical Manual 12-A, 3<sup>rd</sup> Edition, Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials, an Annotated Guide.
- .9 NFCA 100 Standard Practice for the Application of Spray-Applied Fire Resistive Materials
- .10 NFCA 200 Quality Assurance Procedures for Application of Spray-Applied Fire Resistive Materials

### 1.3 QUALITY ASSURANCE

- .1 Work shall be performed by a firm with expertise in the installation of fireproofing or similar Materials. This firm shall be licensed or otherwise approved by the fireproofing Material Manufacturer.
- .2 Before proceeding with the fireproofing work, approval of the proposed Material, thicknesses and densities shall be obtained from the Contract Administrator and other applicable authorities.

### 1.4 QUALIFICATIONS OF APPLICATOR

- .1 Company specializing in fireproofing with 5 years documented experience approved by the Manufacturer.

### 1.5 SAMPLES

- .1 Submit duplicate 300 x 300mm size sample of exposed finish of sprayed fireproofing, in accordance with Section 013300 for each type.

### 1.6 SUBMITTALS

- .1 Product Information: submit Manufacturer's Product data, MSDS, application instructions, special handling criteria, installation sequence and cleaning procedures. Also provide the following Product data on each proposed Product:
  - .1 Technical data on off-gassing and age testing
  - .2 Curing time
  - .3 Chemical compatibility to other construction Materials
- .2 Shop Drawings: submit applicable ULC systems and thickness tables verifying in which fireproofing will be applied for each system referenced in item 2.9.
- .3 Performance Certification: Submit Manufacturer's verification of performance criteria, fire performance, and compliance with applicable standards.
- .4 Fireproofing systems shall show proposed Material, including technical data, reinforcement, anchorage, fastenings, and method of installation. Construction details shall accurately reflect actual job conditions.
- .5 Provide a matrix of Products, identifying the following for each:
  - .1 Product name
  - .2 Shelf life
  - .3 Life expectancy
  - .4 Temperature range for installation
  - .5 Humidity range for installation
  - .6 Curing time

- .6 Submit a set of structural steel framing plans indicating each area that the sprayed fireproofing is applied to, along with the following for each member:
  - .1 ULC system
  - .2 Thickness
  - .3 Type of Material
  - .4 Sequencing concerns
  - .5 Environmental concerns

#### 1.7 PRECONSTRUCTION MEETING

- .1 The “Standard Construction Project Fireproofing Guideline” shall be reviewed in a meeting approximately two weeks after the award of the Project with the Fireproofing Subcontractor and all affected Subcontractors.
- .2 After Fireproofing Systems (Shop Drawings) are reviewed by the Contract Administrator and one week prior to the mock-up installation, the Fireproofing Subcontractor shall request that a mandatory pre-construction meeting be held.
- .3 All Subcontractors that are affected, such as the hollow metal frame, masonry, gypsum board/steel stud, acoustical tile, floor base, painter, mechanical, and electrical shall be in attendance, along with Fireproofing Subcontractor, Intumescent Coating Subcontractor, Contract Administrator(s), and The City’s representative.
- .4 Each Subcontractor shall receive one copy of the Fireproofing Systems (Shop Drawings) as copied and distributed by the Contractor.
- .5 Standard installation procedures shall be reviewed, scheduling / sequencing of other work around or that affects the outcome of the installation, precautions shall be reviewed to ensure that all Subcontractors and the General Contractor understand the full complexity of the fireproofing installation, based on the approved Fireproofing Systems (Shop Drawings).
- .6 Contract Administrator shall be responsible for taking minutes of initial meeting and distributing these minutes to the Fireproofing Subcontractor.
- .7 Project meetings shall be held according to Section 010050, General Project Instructions.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- .1 All Material to be used for fireproofing shall be delivered in original unopened packages bearing the name of the Manufacturer, the brand and proper UL and ULC labels for fire hazard and fire resistance classifications.
- .2 Store Materials off the ground, in a dry location, protected from the weather, moisture and areas of high humidity in compliance with Manufacturer’s requirements. Damaged packages found unsuitable for use should be rejected and removed from the Project.
- .3 Coordinate delivery of Materials with scheduled installation date to allow minimum storage time at the Site.
- .4 Materials to be applied prior to expiration of shelf-life as indicated on packaging.
- .5 Cleaning and waste management in accordance with Section 017400.

#### 1.9 PROJECT / SITE CONDITIONS

- .1 Ensure that an ambient and steel temperature of (5°C) shall be maintained prior to, during and a minimum of 24 hours after application of the fireproofing. If necessary for job progress, Contractor shall provide enclosures with heat to maintain temperatures.
- .2 Ensure that natural ventilation to properly dry fireproofing during and subsequent to its application is provided. Contractor shall provide additional ventilation to allow proper drying of the fireproofing in enclosed areas lacking openings for natural ventilation.
  - .1 Ventilation shall not be less than 4 complete air exchanges per hour until the fireproofing is fully cured. When spraying in enclosed areas such as basements, stairwells, shafts and small rooms, additional air exchanges may be necessary.



#### 1.10 SEQUENCING AND SCHEDULING

- .1 All fireproofing work on a floor shall be completed before proceeding to the next floor.
- .2 Sequence and coordinate application of sprayed fireproofing with other related work specified in other Sections to comply with the following requirements:
  - .1 Provide temporary enclosure (partitions or tarps) for interior applications to prevent deterioration of applied Materials exposed to unfavorable environmental conditions.
  - .2 Avoid exposure of fireproofing to unnecessary damage or abrasion.
  - .3 Do not apply fireproofing to metal roof decking until roofing is complete including installation of air handling systems. Prohibit all roof traffic until application of fireproofing is completed and dry.
  - .4 Do not apply fireproofing until all hangers, clips and other necessary supports are in place, requiring penetration of fireproofing if installed after the application of fireproofing.
  - .5 Ducts, piping and other items that would interfere with the application of fireproofing shall not be installed, until application is completed.

#### 1.11 APPLICATION PARAMETERS

- .1 The Fireproofing Subcontractor shall be allowed to move freely to apply Products as necessary. Materials stored on the floor, shall be protected by the Subcontractor, or relocated if these Materials prevent the proper application of fireproofing.
- .2 Patching, repairing and cleaning of fireproofing, due to damage done by others, shall be performed by the Fireproofing Subcontractor.
- .3 After completion of fireproofing, the fireproofing Subcontractor shall remove all equipment, and broom sweep all floor areas of overspray Materials.
- .4 Application of fireproofing shall not commence until the project is at a stage to allow the applicator to apply Product continuously and efficiently, without undue interference and delay by other trades.
- .5 Conference: Convene a pre-installation conference to establish a procedure to maintain optimum working conditions and to coordinate this work with related and/or adjacent work.
- .6 Spray Applied Fire Resistive Materials (SFRM) shall be installed in accordance with NFCA – 100, “Standard Practice for the Application of Spray-Applied Fire Resistive Materials.”

#### 1.12 PROTECTION

- .1 Provide ventilation in area to receive sprayed fireproofing, introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
- .2 Provide temporary enclosures to prevent spray from contaminating air beyond application area.

#### 1.13 WARRANTY

- .1 General Warranty: Submit a written warranty, executed by the Contractor and cosigned by the Fireproofing Subcontractor, agreeing to repair or replace sprayed fireproofing Materials that fall within the specified warranty period.

- .1 Failures include, but are not limited to cracking, flaking, eroding in excess of specified requirements, peeling and delaminating of sprayed fireproofing from substrates due to defective Materials or installation.
- .2 Not covered in this warranty are failures due to damage by others, such as occupants and the City maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, excessive flexing of floor systems, and work on said roof systems, and other causes not reasonable foreseeable under conditions of normal use.
- .2 Warranty Period: One (1) year, from date of substantial completion.

## PART 2 – PRODUCTS

### 2.1 MATERIALS

- .1 Sprayed fireproofing: ULC labeled and listed cementitious fireproofing qualified for use in ULC Designs specified.
- .2 Assemblies: Provide fireproofing, including auxiliary Materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- .3 Source Limitations: Obtain fireproofing from single source.
- .4 Fire-Resistance Design: Indicated on Drawings, tested according to CAN/ULC S101M, ASTM E 119/UL 263 by a qualified testing agency. Identify Products with appropriate markings of applicable testing agency.
  - .1 Steel members are to be considered load restricted unless specifically noted otherwise. All loads applied on tested assemblies to be calculated using Limit State Design (LSD) methods.
- .5 VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction.
- .6 Low-Emitting Materials: Fireproofing used within the weatherproofing system shall comply with the testing and Product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- .7 Asbestos: Provide Products containing no detectable asbestos.
- .8 SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.
- .9 Product physical properties:
  - .1 Bond Strength: 7.18 kPa cohesive and adhesive strength based on field testing according to ASTM E 736.
  - .2 Density: Not less than 240 kg/m<sup>3</sup> as specified in the approved fire-resistance design, according to ASTM E 605.
  - .3 Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
  - .4 Combustion Characteristics: When tested in accordance with ASTM E 136 shall be noncombustible.
  - .5 Surface-Burning Characteristics: When tested in accordance with ASTM E84 or CAN4-S102, the Material shall exhibit the following surface burning characteristics:
    - .1 Flame Spread Index 0, maximum
    - .2 Smoke Developed 0, maximum
  - .6 Compressive Strength: When tested in accordance with ASTM E761, the Material shall not deform more than 10 percent when subjected to a crushing force of 35.9 kPa.

- .7 Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
- .8 Deflection: No cracking, spalling, or delamination according to ASTM E 759.
- .9 Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
- .10 Air Erosion: Maximum weight loss of 0.270 g/ m<sup>3</sup> in 24 hours according to ASTM E 859.
- .11 Fungal Resistance: When tested in accordance with ASTM G21, the Material shall show resistance to mold growth for a minimum period of 28 days with or without the use of a mold inhibitor.

## 2.2 MIXES

- .1 Mix sprayed fireproofing to manufacturer's instructions.

## 2.3 not used

## 2.4 ACCEPTABLE MATERIALS – CEMENTITIOUS

- .1 CAFCO<sup>®</sup> 300, Isolatek International - CAFCO
- .2 A/D Fireproofing Type 5, A/D Fire Protection Systems - Carboline
- .3 Grace Monokote, W.R. Grace and Co.

## 2.5 MATERIALS SHALL BE APPLIED TO CONFORM TO THE DRAWINGS, SPECIFICATIONS AND FOLLOWING TEST CRITERIA

- .1 Deflection: When tested in accordance with ASTM E759, the Material shall not crack or delaminate when the non-concrete topped galvanized deck to which it is applied is subjected to a one time vertical centre-load, resulting in a downward deflection of 1/120<sup>th</sup> of the span. Note: Roof Deck Ballast must be completed prior to applying fireproofing.
- .2 Bond Impact: When tested in accordance with ASTM E760, the Material shall not crack or delaminate from the concrete topped galvanized deck to which it is applied.
- .3 Cohesion/Adhesion (bond strength): When tested in accordance with ASTM E736, the Material applied over uncoated or galvanized steel shall have an average bond strength of 150 psf (7.2 kPa).
- .4 Air Erosion: When tested in accordance with ASTM E859, the Material shall not be subject to losses from the finished application greater than 0.025 grams per sq. ft. (0.27 grams per square meter).
- .5 Compressive Strength: When tested in accordance with ASTM E761, the Material shall not deform more than 10 percent when subjected to a crushing force of 750 psf (35.9 kPa).
- .6 Corrosion Resistance: When tested in accordance with ASTM E937, the Material shall not promote corrosion of steel.
- .7 Non-combustibility: When tested in accordance with ASTM E136 or CAN4-S114, the Material shall be non-combustible.
- .8 Surface Burning Characteristics: When tested in accordance with ASTM E84 or CAN4-S102, the Material shall exhibit the following surface burning characteristics.
  - .1 Flame Spread – 0
  - .2 Smoke Developed – 0
- .9 Density: When tested in accordance with ASTM E605, the Material shall meet the minimum individual and average density values as listed in the appropriate UL/ULC design or as required by the Authority Having Jurisdiction, or shall have a minimum average of 15 pcf (240 kg/m<sup>3</sup>).

- 2.6 The Material shall have been tested and reported by Underwriters Laboratories, Inc. (UL) or Underwriters Laboratories of Canada (ULC) in accordance with the procedures of UL 263 (ASTM E119) or CAN4-S101.
- 2.7 The Material shall have been evaluated and reported by International Code Council Evaluation Services (ICC-ES). A valid Evaluation Services Report Number shall be provided ensuring code compliance.
- 2.8 Spray-applied fireproofing shall be applied at the required thickness and density to achieve the following ratings:
- .1 Spray-applied fire-resistive Materials to be applied at the required thickness to achieve a 1 hour rating.
  - .2 Schedule of spray-applied fireproofing:
    - .1 Mechanical Room floor structural steel/steel joists floor framing and steel deck. As indicated on Drawings.
  - .3 Submit ULC spray-applied fireproofing systems in accordance with item 1.6 for each scheduled location noted above and as indicated on the bid Drawing documents.
- 2.9 Potable water shall be used for the application of fireproofing.
- 2.10 Fireproofing shall be free of all forms of asbestos, including actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite. Material Manufacturer shall provide certification of such upon request.

### PART 3 – EXECUTION

#### 3.1 EXAMINATION

- .1 Examine steel, areas, and conditions to receive work for compliance, including:
  - .1 Clean steel free of dirt, dust, grease, oil, mill scale, incompatible primers, or other conditions affecting bond or submitted ULC fireproof design systems.
  - .2 Verify that steel surfaces are compatible and ready to receive work. Weld flashes should be ground smooth prior to commencement of application.
  - .3 Verify that all clips, hangers, sleeves and similar devices have been attached. Ensure that items required to penetrate fireproofing are in place.
  - .4 Ensure that ducts, pipes, equipment or other items that would interfere with application of fireproofing are not positioned until fireproofing work is complete.
  - .5 Confirm compatibility of surfaces to receive fireproofing Materials. Structural steel should be unprimed or surfaces should be primed with a compatible primer acceptable by the Manufacturer.
  - .6 All non-suitable steel must be identified and made known to the Contractor and corrected prior to the application of fireproofing.
  - .7 Beginning of installation means acceptance of steel.

#### 3.2 PREPARATION

- .1 Fill voids and cracks in steel, remove projections, and level offsets in locations where fireproofing is exposed to view as finish Material.
- .2 Clean steel of dirt, dust, grease, oil, loose Material, or other matter which would affect bond of fireproofing.
- .3 Verify that primed steel is compatible and have suitable bonding characteristics to receive fireproofing.

- .4 Remove incompatible Materials by sand blasting when scraping, brushing or washing will not remove them.
- .5 Provide masking, drop cloths and other suitable coverings to prevent overspray from coming in contact with surfaces not intended to be sprayed.
- .6 Verify that ambient temperature, steel temperature, and ventilation requirements have been met when required.

### 3.3 APPLICATION

- .1 Apply bonding adhesive or primer to steel if recommended by Manufacturer.
- .2 Apply fireproofing in accordance with Manufacturer's instructions and to correspond with fireproofing systems and thickness tables to provide fire resistance as noted on Drawings and/or finish schedule.
- .3 Equipment mixing and application shall be in accordance with the Manufacturer's written application instructions.
- .4 Apply fireproofing over steel, building up to required thickness with as many passes or stages necessary to cover with monolithic blanket of uniform density and texture.
- .5 Proper temperature and ventilation shall be maintained as specified in.
- .6 Bonding Materials (adhesives, catch coats, metal lath, mesh, stud pins, etc.) shall only be applied as per the appropriate UL/ULC fireproofing system and Manufacturer's written recommendations.
- .7 Topcoat Material, if any, shall be the type recommended and approved by the manufacturer of the fireproofing Material.
- .8 Steel Decks:
  - .1 Do not apply fireproofing to underside of metal deck substrates until concrete topping has been completed.
- .9 Install auxiliary Materials as required, as detailed, and according to fire-resistance design and Fireproofing Manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary Materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- .10 Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by Fireproofing Manufacturer.
- .11 Extend fireproofing in full thickness over entire area of each substrate to be protected.
- .12 Install body of fireproofing in a single course unless otherwise recommended in writing by Fireproofing Manufacturer.
- .13 For applications over encapsulant Materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- .14 Where sealers are used, apply Products that are tinted to differentiate them from fireproofing over which they are applied.
- .15 Provide a uniform finish complying with description indicated for each type of fireproofing Material and matching finish approved for required mockups.
- .16 Cure fireproofing according to Fireproofing Manufacturer's written recommendations.
- .17 Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

### 3.4 REPAIRING AND CLEANING

- .1 All patching of and repair to fireproofing, due to damage by other trades, shall be performed under this section and paid for by the trade responsible for the damage.
- .2 After the completion of the work in this section, equipment shall be removed and all surfaces not to be sprayed shall be cleaned to the extent previously agreed to by applicator and Contractor.

### 3.5 INSPECTION AND TESTING

- .1 Inspection and testing of fireproofing will be carried out by Contract Administrator.
- .2 The fireproofing shall be tested for thickness and density in accordance with one of the following procedures:
  - .1 ASTM E605 – Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members.
  - .2 AWCI – Inspection Procedure for Field-Applied Sprayed Fire-Resistive Materials, Technical Manual 12-A; an annotated guide.
  - .3 UBC Standard No. 7-6 – Thickness and Density Determination for Spray-Applied Fire Protection.
- .3 Test and inspect completed work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- .4 Fireproofing will be considered defective if it does not pass tests and inspections.
  - .1 Remove and replace fireproofing that does not pass tests and inspections, and retest.
  - .2 Apply additional fireproofing, per Manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- .5 Inspection shall be contracted for and paid by cash allowance.

### 3.6 CLEANING, PROTECTING, AND REPAIRING

- .1 Cleaning: Immediately after completing spraying operations in each containable area of project, remove Material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- .2 Protect fireproofing, according to advice of Manufacturer and installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- .3 As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- .4 Repair fireproofing damaged by other work before concealing it with other construction.
- .5 Repair fireproofing by reapplying it using same method as original installation or using Manufacturer's recommended trowel-applied Product.

END OF SECTION

**PART 1**

**General**

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 – Submittal Procedures
  - .2 Section 03 30 00 – Cast-In-Place Concrete
  - .3 Section 09 29 00 – Gypsum Board
  - .4 Division 21 – Mechanical General Requirements
  - .5 Division 26 – Electrical
- 1.2 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION
- .1 Provide fire and smoke stop systems consisting of a Material, or combination of Materials installed to maintain the integrity of the Fire Resistance Rating of the fire separation by maintaining an effective barrier against the spread of flame, smoke, heat and / or hot gases through penetrations, blank openings, construction joints, or at perimeter fire containment in or adjacent to the Fire Separation in accordance with the requirements of the Manitoba Building Code and NFPA 101.
  - .2 All firestop systems must be ULC-approved systems, suitable to the specific application.
  - .3 All firestop systems must be single-source responsibility. Mixing of manufacturer products is not acceptable.
  - .4 All fire separations to have a Fire Resistance Rating to them as indicated on Drawings. All Non-rated Fire Separations to be assigned a 45-minute Fire Resistance Rating or an F-Rating of ¾ hour minimum. Both sides of a non-rated fire separation to have a tested fire and smoke stop system applied, to match or exceed the F-rating, as indicated.
  - .5 All multiple service penetration through a fire separation must have a minimum space equal to the same size of the smallest pipe or greater, minimum 2", between pipes to be considered an individual services penetration. Penetrations where the space between penetrating items is less than 2" will be classified as a multi-penetrations and a square or rectangular opening shall be constructed around the penetrations with a fire and smoke stop system applied to the entire opening.
- 1.3 REFERENCES
- .1 Standard Method of Fire Tests Through Penetration Fire Stops, ULC-S115-M.2005/ CAN4-S115-M.2005 or ASTM E814 Test Requirements or latest.
  - .2 Underwriters Laboratories (UL) ASTM E-814 under their designation of UL 1479, Fire-Tests of Through Penetration Firestops and publishes the results in FIRE RESISTANCE DIRECTORY. UL tests that meet the requirements of ULC-S115-M.2005 are given a cUL listing and are published by UL in Products Certified for Canada (cUL) Directory.
  - .3 Latest edition of the ULC or cUL Listings for Firestop Systems and Components.
  - .4 Standard Test Method for Surface Burning Characteristics of Building Materials, CAN/ULC-S102-M or ASTM E84 or latest.
  - .5 Method for Fire tests of Building Construction and Materials CAN/ULC-S101 or
  - .6 ASTM E119 or latest.
  - .7 International Firestop Council Guidelines (IFC) for Evaluating Firestop Systems Engineering Judgements.
  - .8 International Firestop Council (IFC) Inspection Guideline and ASTM E2174-04, Standard Practice for On-Site Inspection of Installed Firestop Systems and ASTM E2393-04, or

- latest Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- .9 National Building Code and the Provincial Building Code of the Province that the Authority Having Jurisdiction is responsible for.
  - .10 NFPA 101-Life Safety Code
  - .11 Canadian Electrical Code
- 1.4 DESIGN SYSTEM LISTINGS/SHOP DRAWINGS
- .1 Submit Design System Listings, product data and Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures. Also provide the following product data on each proposed product:
    - .1 Technical data on out-gassing; off-gassing and age testing.
    - .2 Curing time.
    - .3 Chemical compatibility to other construction Materials.
  - .2 Provide Certification by the Manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's) and are non-toxic to building occupants.
    - .1 According to ASTM E595.
    - .2 Test Method: Environmental Protection Association, EPA Method 24.
    - .3 Indoor Environmental Quality: Volatile Content: below 250 g/l.
    - .4 **DO NOT** use silicone firestops.
  - .3 Design System Listings shall show proposed Material, including technical data, reinforcement, anchorage, fastenings and method of installation. Construction details shall accurately reflect actual job Site conditions.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- .1 Deliver Materials undamaged in manufacturer's clearly labelled, unopened containers, identified with brand, type, and ULC or cUL label, complete with batch number, manufacturing date and shelf life expiry date.
- 1.6 ENVIRONMENTAL REQUIREMENTS
- .1 Do not install firestopping when ambient or substrate temperatures are outside limits permitted by Manufacturers or when substrates are wet, due to rain, frost, condensation, or other causes.
- 1.7 WARRANTY
- .1 Manufacturers shall warrant Work of this Section against defects and deficiencies in the product Material for a period of two (2) years from date of Substantial Performance, in accordance with General Conditions of Contract. Promptly correct any defects or deficiencies, which become apparent within warranty period at no expense to the City.
  - .2 Fire and smoke stop system Contractor hereby warrants workmanship on Material installation for period of two (2) years from date of Substantial Performance, in accordance with General Conditions of Contract. Promptly correct any defects or deficiencies, which become apparent within warranty period at no expense to the City.



**PART 2**

**Products**

2.1

**MATERIALS**

- .1 Fire-stopping and smoke-seal systems: in accordance with CAN4-S115-M2005 or latest or ASTM E814 or latest.
  - .1 Asbestos-free Materials and systems capable of maintaining an effective barrier against the passage of flame, smoke, water and toxic gases in compliance with requirements of CAN4-S115-M2005 or latest or ASTM E814 or latest, and not to exceed opening sizes for which they are intended, in accordance with ULC or cUL Design Numbers or other Design System Listings acceptable to local Authority Having Jurisdiction.
  - .2 Firestopping Materials/systems shall be flexible to allow for movement of building structure (refer to architectural and structural) and penetrating item(s) without affecting the adhesion or integrity of the system.
- .2 Fire-stop Methods:
  - .1 Method 1: non-combustible, semi-rigid, felt; minimum density 65 kg per cu/m<sup>2</sup>; depth 100mm, length 1200mm; width as required. Blanket type fire-stop to be listed, and labelled in accordance with file Guide 40-U19.13. Impale - clips; galvanized wire or 25mm x 0.65mm thick galvanized steel Z-clips with dimensions to match location of fire stop Material and width of opening being sealed.
  - .2 Method 2: as per Method 1, without impale - clips.
  - .3 Method 3: Hose stream UL/cUL (Underwriters Laboratories USA) labelled.
  - .4 Method 4: Hose stream, fluid, gas and fire resistant elastomeric seal or non-shrink foam cement mortar proprietary certified assembly of a listed manufacturer.
  - .5 Methods 1 to 4: Methods used can be as per manufacturer's instructions, provided that their system employed meets or exceed the requirements of ULC/CAN4-S115-M2005 or ASTM E814 or latest.
- .3 Mechanical or Electrical service: penetration assemblies; certified in accordance with CAN4-S115-M2005 or latest or ASTM E814 or latest and listed in the ULC Guide No. 40 U19.
- .4 Service - penetration fire-stop components: Certified in accordance with CAN4-S115-M95 or latest or ASTM E814 or latest and listed in the ULC Guide No. 40 U19.
- .5 Fire-resistance rating of installed fire-stopping assembly not less than fire-resistance rating of surrounding substrate assembly (floor or wall) in accordance with the NBC.
- .6 Fire-stopping and smoke-seals at openings intended for re-entry such as cables; elastomeric seal or non-shrink foam cement mortar: do not use cementitious or rigid seal at such locations.
- .7 Firestopping and smoke-seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations.
- .8 Primers: to manufacturer's recommendation for specific Material, substrate, and end-use.
- .9 Water (if applicable: portable, clean and free from injurious amounts of deleterious substrates.)

- .10 Damming and back-up Materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
  - .11 Sealants for vertical joints: non-sagging and having a flame-spread of not more than 25 and a maximum smoke development classification of 100 for walls and 50 for ceilings.
- 2.2 PRODUCT SYSTEMS
- .1 Single source responsibility: obtain firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.
    - .1 Materials of different manufacturers shall not be intermixed on the project.
  - .2 Acceptable manufacturers:
    - .1 AD Fire Protection Systems Inc
    - .2 Hilti Fire Stop
    - .3 3M Fire Protection
    - .4 Tremco, Tremstop, Firestop Systems
    - .5 Rectorseal, Biofireshield
- 2.3 ACCEPTABLE FIRE STOP APPLICATORS
- .1 National Firestop Ltd.
  - .2 Total Fire Stop Systems Limited
  - .3 Western Industrial Services Ltd.
  - .4 Groundstar Systems (1987) Ltd.
  - .5 Secure Firestop
- PART 3 Execution**
- 3.1 EXAMINATION
- .1 Verify substrate conditions, previously installed are acceptable for product installation in accordance with manufacturer's instructions and approved design system listings for each condition.
  - .2 Ensure that opening / annular space does not exceed the maximum and minimum size or dimensions that is indicated on the approved Design Listing.
  - .3 Verify that all joints, service penetrating elements and supporting devices/hangers have been properly installed as indicated on Approved Design Listings. All temporary lines and markings have been removed to meet the approved Design System Listings for each condition has been identified.
- 3.2 INSTALLATION
- .1 Protect adjacent Work Areas and finish surfaces from damage during product installation.
  - .2 Install firestopping and smoke-seal Material and components in accordance with manufacturer's instructions and rated system as tested to ULC/CAN4-S115-M2005, and ULC or cUL Design System Listings.
  - .3 Coordinate with other Sub-Trades to assure that all pipes, conduit, cable, and other items, which penetrate fire separations have been permanently installed prior to installation of firestop systems.
  - .4 Schedule the Work to assure that fire separations and all other construction that conceals penetrations are not erected prior to the installation of fire and smoke stop systems.

- .5 Seal holes or voids made by through-penetrations, poke-through termination devices, and un-penetrated openings or joints to ensure that both continuity and integrity of fire-separation are maintained.
- .6 Provide temporary forming as required. Remove forming Material only after firestop system has gained sufficient strength and after initial curing as per manufacturer's instructions.
- .7 Tool or trowel exposed surface to a neat finish and to accepted architectural finishes as approved by the Contract Administrator.
- .8 Remove excess compound promptly as Work progresses and upon completion.
- .9 Refer to Mechanical and Electrical Sections and Drawings for further information.

### 3.3 SCHEDULE OF FIRESTOP LOCATIONS

- .1 Fire stop and smoke-seal includes but not limited, to the following locations:
- .2 Provide appropriate Firestop System when exposed to view, architectural finish as indicated in Finish Schedule, traffic, moisture, heat, movement and physical damage.
- .3 Penetrations through fire-resistance-rated masonry, concrete, and gypsum board partitions/walls, floors and roof assemblies.
- .4 Intersection of fire-resistance-rated masonry, concrete and gypsum board partitions.
- .5 Joints at top and bottom of fire resistance rated concrete masonry and gypsum board partitions. Joints to allow for independent movement.
- .6 Control and sway joints in fire-resistance-rated masonry and gypsum board partitions and walls.
- .7 Penetrations through fire-resistance-rated floor slabs/systems, ceilings and roof.
- .8 Openings and sleeves installed for future use through fire separations and unused openings and sleeves constructed as part of Work.
- .9 Around mechanical and electrical assemblies/devices penetrating fire separations.
- .10 Between edge of fire-resistant floor or roof assemblies and exterior wall assemblies.
- .11 Between floors, walls, ceilings and roof assemblies at horizontal and vertical fire resistant ratings at floor expansion joints.
- .12 Rigid ducts: 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.
- .13 Mechanical and electrical recessed boxes in walls and partitions.
- .14 Where indicated on Working Drawings and Specification detail Drawings.

### 3.4 THIRD PARTY REVIEW

- .1 Third Party reviewer shall be called to perform random observation reviews during the course of construction and prior to closing off any concealed areas. These 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. Contractor shall notify Third Party Reviewer minimum of 48-hours prior to requesting review.

- .2 The Third Party Reviewer shall perform exploratory review (destructive test) based on ASTM E2174, and E2393 where the system will be cut out by the Firestopping Subcontractor as directed by the Third Party Reviewer and removed to ensure the firestop system installed meets or exceeds the Design System Listing as identified.
  - .3 The Firestopping Subcontractor shall do all cutting and removal of the systems for visual review from the Third Party Reviewer. Once the review is completed and accepted, the Firestopping Subcontractor shall replace the firestop system with new. All costs for cutting, removing and replacement shall be paid for by cash allowances. Refer to Section 01 21 00 Allowances.
- 3.5 CLEAN-UP
- .1 Remove equipment, excess Materials and debris and clean adjacent surfaces immediately after application. Use methods and cleaning Materials approved by Manufacturer.
  - .2 Protect firestopping during and after curing period from contact with contaminating substances. If damage caused by others, the Contractor shall instruct the Firestop Subcontractor to make appropriate repairs and charge to appropriate trades.
  - .3 Remove temporary dams after initial set of fire stop and smoke seal Materials.

**END OF SECTION**

- Part 1**                    **General**
- 1.1                    RELATED WORK
- .1                    Division 3 – Concrete
  - .2                    Section 04 05 10 – Common Masonry
  - .3                    Section 06 40 00 – Architectural Woodwork
  - .4                    Division 07 – Thermal and Moisture Protection
  - .5                    Division 08 - Openings
  - .6                    Division 09 – Finishes
- 1.2                    REFERENCES
- .1                    CAN/CGSB-19.1-M87, Putty, Linseed Oil Type or latest.
  - .2                    CAN/CGSB-19.2-M87, Glazing Compound, Nonhardening, Modified Oil Type or latest.
  - .3                    CGSB 19-GP-5M-76, Sealing Compound, One Component, Acrylic Base, Solvent Curing or latest.
  - .4                    CAN/CGSB-19.6-M87, Caulking Compound, Oil Base or latest.
  - .5                    CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing or latest.
  - .6                    CGSB 19-GP-14M-76, Sealing Compound, One Component, Butyl-polyisobutylene Polymer Base, Solvent Curing or latest.
  - .7                    CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound or latest.
  - .8                    CAN/CGSB-19.18-M87, Sealing Compound, One Component, Silicone Base, Solvent Curing or latest.
  - .9                    CAN/CGSB-19.21-M87, Sealing and Bedding Compound Acoustical or latest.
  - .10                    CAN/CGSB-19.22-M89, Mildew Resistant, Sealing Compound for Tubs and Tiles or latest.
  - .11                    CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound or latest.
  - .12                    California South Cost Air Quality Management District Rule #1168 – Adhesive and Sealant Applications (October 2, 2003) – LEED REQUIREMENT
- 1.3                    SAMPLES
- .1                    Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- 1.4                    SUBMITTALS
- .1                    Submit to the City a binder with complete list of joint sealer assemblies with coordinated Site applied stickers.
  - .2                    Provide at each rated assembly a sticker adjacent to the construction detail Site.
- 1.5                    DELIVERY, STORAGE, AND HANDLING
- .1                    Deliver, handle, store and protect Materials in accordance with Section 01 60 00 - Basic Product Requirements.
  - .2                    Deliver and store Materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.
- 1.6                    ENVIRONMENTAL AND SAFETY 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 Material safety data sheets acceptable to Labour Canada.
- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .3 Ventilate area of Work as directed by Contract Administrator by use of approved portable supply and exhaust fans.
- .4 Place used hazardous sealant tubes and other containers in areas designated for Hazardous Materials.
- .5 Apply sealants only to completely dry surfaces.

**Part 2 Products**

**2.1 SEALANT MATERIALS**

- .1 Sealants and caulking compounds must:
  - .1 meet or exceed all applicable governmental and industrial safety and performance standards; and
  - .2 be manufactured and transported in such a manner that all steps of the process, including the disposal of waste products arising therefrom, will meet the requirements of all applicable governmental acts, by laws and regulations including, for facilities located in Canada, the fisheries Act and the Canadian Environmental Protection Act (CEPA).
- .2 Sealant and caulking compounds must not be formulated or manufactured with: aromatic solvents, fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, barium or their compounds, except barium sulfate.
- .3 Sealant and caulking compounds must be accompanied by detailed instructions for proper application so as to minimize health concerns and maximize performance, and information describing proper disposal methods.
- .4 Caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant shall not be used in air handling units.
- .5 When low toxicity caulks are not possible, confine usage to areas which off-gas to the exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off-gas time.
- .6 In the selection of the products and Materials of this Section preference will be given to those with the following characteristics: non-flammable, low Volatile Organic Compound (VOC) content, manufactured without compounds which contribute to ozone depletion in the upper atmosphere, does not contain methylene chloride, does not contain chlorinated hydrocarbons.
- .7 Sealants acceptable for use on this project except CAN/CGSB-19.1 and CAN/CGSB-19.18 must be listed on CGSB Qualified Products List issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

**2.2 SEALANT MATERIAL DESIGNATIONS**

	Type	Ref.	Description	Application	Accepted Material

1	Neoprene or Butyl Rubber.		Round solid rod, Shore A hardness 70		
2	High Density Foam		Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m <sup>3</sup> density, or neoprene foam backer, size as recommended by manufacturer.		
3	Bond Breaker Tape		Polyethylene bond breaker tape which will not bond to sealant.		
4	Polyurethane Sealant.	CAN 19.13-M87	single component, high performance, non-sagging, low modulus, non-staining	to be used at all exterior and interior control / expansion joints and on the exterior side of all window / door frame perimeters. Color as selected by the Contract Administrator.	Tremco Dymonic or Sonolastic NP1
5	Latex Sealant.	CGSB 19-GP-17M	single component, non-sagging, non-staining.	To be used on the interior side of all exterior window / door frame perimeters and at all interior window / door frame perimeters. Color as selected by the Contract Administrator	Tremco Spectrem 2
6	Silicone Sealant.	CGSB 19-GP-9M	single component, fungus resistant, non-sagging, non-staining, non-bleeding, moisture curing.	To be used in all sloped glazing, skylights, and at all joints between vanities, countertops, backsplashes and adjacent wall Materials and at the joint between bathtubs and finish flooring in washrooms. Color as selected by Contract Administrator.	Tremco Proglaze or GE Sanitary SCS 1700
7	Siliconized acrylic latex sealant		single component, pure acrylic latex, fast-setting with minimal shrinkage, white colour	To be used at exposed joints between hollowcore slabs to 1/4" maximum width.	Tremco Tremflex 834 or equal in accordance with B7

2.3 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming Materials and sealant recommended by sealant manufacturer.
- .2 Primer: as recommended by manufacturer.

**Part 3 Execution**

3.1 PROTECTION

- .1 Protect installed Work of other trades from staining or contamination.

3.2 PREPARATION OF JOINT SURFACES

- .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 Cleanup.
  - .1 Clean adjacent surfaces immediately and leave Work neat and clean.
  - .2 Remove excess and droppings, using recommended cleaners as Work progresses.
  - .3 Remove masking tape after initial set of sealant.

**END OF SECTION**

**Part 1**

**General**

- 1.1 RELATED SECTIONS
  - .1 Section 01 33 00 – Submittal Procedures
  - .2 Section 06 10 00 – Rough Carpentry
  - .3 Section 07 92 00 – Joint Sealing
  - .4 Section 08 71 00 – Door Hardware – General
  - .5 Section 08 80 00 – Glazing
  - .6 Section 09 90 00 – Painting
  - .7 Division 26 – Electrical
- 1.2 REFERENCES
  - .1 American Society for Testing and Materials (ASTM).
    - .1 ASTM A 653M-95, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process or latest.
    - .2 ASTM B 29-[92], Specification for Pig Lead or latest.
    - .3 ASTM B 749-85(1991), Specification for Lead and Lead Alloy Strip, Sheet and Plate Products or latest.
  - .2 Canadian General Standards Board (CGSB).
    - .1 CAN/CGSB-1.181-92, Ready-Mixed Organic Zinc-Rich Coating or latest.
    - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors or latest.
    - .3 CAN/CGSB-51.20-M87, Thermal Insulation, Polystyrene, Boards and Pipe Covering or latest.
    - .4 CGSB 51-GP-21M-78, Thermal Insulation, Urethane and Isocyanurate, Unfaced or latest.
  - .3 Canadian Standards Association (CSA).
    - .1 CSA A101-M1983, Thermal Insulation, Mineral Fibre, for Buildings or latest.
    - .2 CAN/CSA-G40.21-M92, Structural Quality Steels or latest.
    - .3 CSA W59-M1989, Welded Steel Construction (Metal Arc Welding) or latest.
  - .4 Canadian Steel Door and Frame Manufacturers' Association, (CSDFMA).
    - .1 CSDFMA, Specifications for Commercial Steel Doors and Frames, 1990 or latest.
    - .2 CSDFMA, Recommended Selection and Usage Guide for Commercial Steel Doors, 1990 or latest.
  - .5 National Fire Protection Association (NFPA).
    - .1 NFPA 80-1992, Fire Doors and Windows or latest.
    - .2 NFPA 252-1990, Door Assemblies, Fire Tests of or latest.
  - .6 Underwriters' Laboratories of Canada (ULC).
    - .1 CAN4-S104M- M80(R1985), Fire Tests of Door Assemblies or latest.
    - .2 CAN4-S105M-M85, Fire Door Frames or latest.
- 1.3 DESIGN REQUIREMENTS
  - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.

- .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
- 1.4 SHOP DRAWINGS
  - .1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate each type of door, Material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazing, louvers, arrangement of hardware and fire rating and finishes.
  - .3 Indicate each type frame Material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing, fire rating, finishes.
  - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on Drawings and door and interior glazing schedule.
  - .5 Submit test and engineering data, and installation instructions.
- 1.5 REQUIREMENTS OF REGULATORY AGENCIES
  - .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104M or latest for ratings specified or indicated.
  - .2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled. Test products in strict conformance with CAN4-S104 or latest, ASTM E 152 or latest or NFPA 252 or latest 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.
- 1.6 SCHEDULE
  - .1 Doors and frames listed on door schedule and interior glazing schedule are furnished as an assistance to the fabricator, and should not be considered as entirely inclusive. Examine Drawings and Specifications, and determine extent and quantity required. Should any door or frame be omitted in the schedule, the fabricator shall supply door or frame as required for similar or same purpose.
- Part 2 Products**
- 2.1 MATERIALS - STEEL
  - .1 Hot dipped galvanized steel sheet: to ASTM A 653M or latest, minimum base steel thickness in accordance with CSDFMA Table 1 - Thickness for Component Parts or latest.
  - .2 Reinforcement channel: to CAN/CSA-G40.21 or latest, Type 44W, coating designation to ASTM A 653M or latest.
  - .3 Cast or rolled pure sheet lead: to ASTM B 29 or latest, weight: 14.6 kg/m<sup>2</sup>, thickness 3/64".
  - .4 Composites: balance of core Materials used in conjunction with lead: in accordance with manufacturers' proprietary design.
- 2.2 DOOR CORE MATERIALS
  - .1 Honeycomb construction:
    - .1 Structural small cell, 1" maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m<sup>3</sup> minimum sanded to required thickness.
  - .2 Stiffened: face sheets welded, insulated core.

- .1 Fibreglass: to CSA A101 or latest, semi-rigid RSI 2.3.
  - .2 Polyurethane: to CGSB 51-GP-21M or latest rigid, modified poly/isocyanurate, closed cell board. Density 32 kg/m<sup>3</sup>.
  - .3 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250°C at 60 minutes. Core to be tested as part of a complete door assembly, in accordance with CAN4-S104 or latest, ASTM E 152 or latest or NFPA 252 or latest, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.
  - .4 Thermal insulation Material must:
    - .1 not require being labelled as poisonous, corrosive, flammable or explosive under the Consumer Chemical and Container Regulations of the Hazardous Products Act;
    - .2 be manufactured using a process that uses chemical compounds with the minimum ozone depletion potential (ODP) available.
- 2.3 ADHESIVES
- .1 Select Adhesives which:
    - .1 do not contain volatile organic compounds in excess of 5 % by weight as measured by EPA Method 24-24A, 40 C.F.R., Part 60, Appendix A (1991), as demonstrated through calculation from records of the amounts of constituents used to make the product;
    - .2 are accompanied by detailed instructions for proper application so as to minimize health concerns and maximize performance;
    - .3 are accompanied by information describing proper disposal methods for containers.
  - .2 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
  - .3 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
  - .4 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.
- 2.4 PRIMERS
- .1 Touch-up prime CAN/CGSB-1.181 or latest.
- 2.5 PAINT
- .1 Steel doors and frames shall be field painted in accordance with Section 09 90 00. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes.
  - .2 Paint: water based, manufactured without compounds which contribute to ozone depletion in the upper atmosphere, does not contain toxic metal pigments.
- 2.6 ACCESSORIES
- .1 Door silencers: single stud rubber/neoprene type.
  - .2 Exterior top and bottom caps: steel.
  - .3 Interior top and bottom caps: steel.
  - .4 Fabricate glazing stops as formed channel, minimum 5/8" height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

- .5 Metallic paste filler: to manufacturer's standard.
- .6 Fire labels: metal riveted.
- .7 Glazing: as per Section 08 80 00.
- .8 Make provisions for glazing as indicated and provide necessary glazing stops.
  - .1 Provide removable stainless steel glazing beads for dry glazing of snap-on type.
  - .2 Design exterior glazing stops to be tamperproof.
- 2.7 FRAMES FABRICATION GENERAL
  - .1 Fabricate frames in accordance with CSDFMA Specifications.
  - .2 Fabricate frames to profiles and maximum face sizes as indicated.
  - .3 Exterior frames: 16 gauge minimum thermally broken type construction.
  - .4 Interior frames: 16 gauge minimum welded type construction.
  - .5 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.
  - .6 Protect mortised cutouts with steel guard boxes.
  - .7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
  - .8 Manufacturer's nameplates on frames and screens are not permitted.
  - .9 Conceal fastenings except where exposed fastenings are indicated.
  - .10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
  - .11 Insulate exterior frame components with polyurethane insulation.
- 2.8 FRAME ANCHORAGE
  - .1 Provide appropriate anchorage to floor and wall construction.
  - .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
  - .3 Provide 2 anchors for rebate opening heights up to 5'-0" and 1 additional anchor for each additional 2'-6" of height or fraction thereof.
  - .4 Locate anchors for frames in existing openings not more than 6" from top and bottom of each jambs and intermediate at 2'-2" o.c. maximum.
  - .5 Frames for installation in stud partitions shall be provided with steel anchors of suitable design. For installation inside each jamb as follows:
    - .1 Frames up to 7'-8" height – four (4) anchors
    - .2 Frames 7'-8" to 8'-2" – five (5) anchors
- 2.9 LABELED FIRE DOORS AND FRAMES
  - .1 Provide labeled fire doors and frames for openings requiring fire protection ratings as scheduled, and generally in the following locations: firewalls and fire separations, corridors, stairwells, and to storage and mechanical rooms. Attach ULC labels to doors and frames.
  - .2 Doors with bottom vertical rods must be sized to provide proper bottom clearance.
- 2.10 FRAMES: WELDED TYPE
  - .1 Welding in accordance with CSA W59 or latest.
  - .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.
- .7 Securely attach lead to inside of frame profile from return to jamb soffit (inclusive) on door side of frame only.

2.11 DOOR FABRICATION GENERAL

- .1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.
- .2 Exterior doors: 16 gauge, Insulated Core construction.
- .3 Interior doors: 16 gauge, honeycomb construction.
- .4 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .5 Doors: manufacturers' proprietary construction, tested and/or engineered as part of a fully operable assembly, including door, frame, gasketing and hardware in accordance with ASTM E 330 or latest.
- .6 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
- .7 Factory prepare holes ½" diameter and larger except mounting and through-bolt holes, on Site, at time of hardware installation.
- .8 Reinforce doors where required, for surface mounted hardware. Provide flush PVC top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
- .9 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .10 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in strict conformance with CAN4-S104 or latest, ASTM E 152 or latest or NFPA 252 or latest 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.
- .11 Manufacturer's nameplates on doors are not permitted.

2.12 DOORS: HONEYCOMB CORE CONSTRUCTION

- .1 Form each face sheet for exterior doors from 16 gauge sheet steel with polyurethane core laminated under pressure to face sheets.
- .2 Form each face sheet for interior doors from 16 gauge sheet steel with temperature rise rated core laminated under pressure to face sheets.

2.13 HOLLOW STEEL CONSTRUCTION

- .1 Form each face sheet for exterior doors from 16 gauge minimum sheet steel.
- .2 Form each face sheet for interior doors from 16 gauge minimum sheet steel.
- .3 Reinforce doors with vertical stiffeners, securely welded to each face sheet at 6" on centre maximum.
- .4 Fill voids between stiffeners of exterior doors with polyurethane core.
- .5 Fill voids between stiffeners of interior doors with temperature rise rated core.

2.14 THERMALLY BROKEN DOORS AND FRAMES

- .1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.
- .2 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma or latest.
- .3 Apply insulation.

**Part 3 Execution**

3.1 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDFMA Installation Guide.

3.2 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 vertical support at centre of head for openings over 4'-0" wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent Material.
- .6 Maintain continuity of air/vapour barrier membrane.

3.3 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Door Schedule.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
  - .1 Hinge side: 3/64".
  - .2 Latchside and head: 3/64".
  - .3 Finished floor, top of carpet, noncombustible sill, and thresholds: 1/2".
- .3 Adjust operable parts for correct function.
- .4 Install louvers as indicated.

3.4 FINISH REPAIRS

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

3.5 GLAZING

- .1 Install glazing for doors in accordance with Section 08 80 00 - Glazing.

**END OF SECTION**

- PART 1      General**
- 1.1            RELATED SECTIONS
- .1            Door Schedule
  - .2            Section 08 71 00 – Door Hardware
  - .3            Section 07 92 00 - Joints Sealants: Caulking of joints between frames and other building components.
  - .4            Division 26 - Electrical
- 1.2            REFERENCES
- .1            Aluminum Association Designation System for Aluminum Finishes-1997 or latest.
  - .2            American Society for Testing and Materials (ASTM)
    - .1            ASTM E 330-97, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference or latest.
  - .3            Canadian General Standards Board (CGSB)
    - .1            CGSB 1.40-M89, Primer, Structural Steel, Oil Alkyd Type or latest.
  - .4            Canadian Standards Association (CSA)
    - .1            CAN/CSA-G40.21-98, Structural Quality Steels or latest.
    - .2            CSA G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles or latest.
- 1.3            DESIGN CRITERIA
- .1            Design frames and doors in exterior walls to:
    - .1            Accommodate expansion and contraction within service temperature range of -35 to 35°C.
    - .2            Limit deflection of mullions to maximum 1/175th of clear span when tested to ASTM E 330 under wind load of 1.2 kpa.
- 1.4            SHOP DRAWINGS
- .1            Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2            Indicate each type of door and frame, extrusion profiles, method of assembly, section and hardware reinforcement, locations of exposed fasteners, finishes and location of manufacturer's nameplates.
  - .3            Submit catalogue details for each type of door and frame illustrating profiles, dimensions and methods of assembly.
- 1.5            CLOSEOUT SUBMITTALS
- .1            Provide maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.6            PROTECTION
- .1            Apply temporary protective coating to finished surfaces. Remove coating after erection. Do not use coatings that will become hard to remove or leave residue.
  - .2            Leave protective covering in place until final cleaning of building.



**PART 2 Products**

2.1 MATERIALS

- .1 Aluminum extrusions: Aluminum Association alloy AA6063-T6 anodizing quality.
- .2 Steel reinforcement: to CAN/CSA-G40.21, grade 300 W.
- .3 Fasteners: stainless steel, finished to match adjacent material.
- .4 Weatherstrip: mohair pile.
- .5 Door bumpers: black neoprene.
- .6 Isolation coating: alkali resistant.
- .7 Glass: Factory sealed double glazing unit to 25mm overall thickness and as specified in Glazing section.
- .8 Sealants: to CAN/CGSB 19.13-M87 or latest.
- .9 Sheet Aluminum to AA6063-T5 alloy, 2mm thick, bonded to substrate where noted.

2.2 ALUMINUM DOORS

- .1 Interior doors, with no centre rail: Kawneer 350 Swing Door, Alumicor Canadiana Medium Stile swing door, or approved equal in accordance with B7 Substitutes.
  - .1 Dual glazing stops: tamperproof type.

2.3 ALUMINUM FRAMES

- .1 Interior storefront framing: Extruded aluminum; Kawneer Trifab VG 451 series (centre glazed), or approved equal in accordance with B7 Substitutes.

2.4 ALUMINUM FINISHES

- .1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes. Natural Anodized Aluminum Finish
- .2 Flashings: refer to Section 07 62 00 and provide isolation coating.

2.5 STEEL FINISHES

- .1 Finish steel clips and reinforcing steel with zinc coating to CSA G164.

2.6 FABRICATION

- .1 Doors and framing to be by same manufacturer.
- .2 Fabricate doors and frames to profiles and maximum face sizes as shown on drawings, with allowance for glazing and spandrel panels.
- .3 Provide structural steel reinforcement as required.
- .4 Fit joints tightly and secure mechanically.
- .5 Conceal fastenings.
- .6 Mortise, reinforce, drill and tap doors, frames and reinforcements to receive hardware using templates provided under Section 08 71 00 - Door Hardware.
- .7 Isolate aluminum from direct contact with dissimilar metals, concrete and masonry.

**PART 3 Execution**

3.1 INSTALLATION

- .1 Set frames plumb, square, level at correct elevation in alignment with adjacent Work.
  - .2 Anchor securely.
  - .3 Install doors and hardware in accordance with hardware templates and manufacturer's instructions.
  - .4 Adjust operable parts for correct function.
  - .5 Make allowances for deflection of structure to ensure that structural loads are not transmitted to frames.
- 3.2 GLAZING
- .1 Glaze aluminum doors and frames in accordance with Section 08 80 00 - Glazing.
- 3.3 CAULKING
- .1 Seal joints to provide weathertight seal at outside and air, vapour seal at inside.
  - .2 Apply sealant in accordance with Section 07 92 00 - Joint Sealing. Conceal sealant within the aluminum Work except where exposed use is permitted by Contract Administrator.

**END OF SECTION**

- Part 1            General**
- 1.1            WORK INCLUDED
- .1            The Work included under this Section shall conform to the industry standard and be accepted by the local construction and trade associations.
- .2            Flush wood doors, non-rated.
- 1.2            RELATED SECTIONS
- .1            Section 01 33 00 – Submittal Procedures
- .2            Section 01 60 00 – Basic Product Requirements
- .3            Section 06 20 00 – Finish Carpentry
- .4            Section 08 11 00 – Steel Doors and Frames
- .5            Section 08 71 00 – Door Hardware
- .6            Section 08 80 00 – Glazing
- .7            Section 09 90 00 – Painting
- 1.3            REFERENCES
- .1            AWMAC (Architectural Woodwork Manufacturers' Association of Canada) - Millwork Standards current edition.
- .2            American Society for Testing and Materials (ASTM)
- .1            ASTM D5456 – Standard Specification for Evaluation of Structural Composite Lumber Products
- .3            Architectural Woodwork Institute (AWI) / Architectural Woodwork Manufacturer's Association of Canada (AWMAC)
- .1            AWI/AWMAC – Quality Standards
- .4            Canadian Standards Association (CSA) International
- .1            CAN/CSA O132.2 Series – Wood Flush Doors
- .5            National Fire Protection Association (NFPA)
- .1            NFPA 80 – Standard for Fire Doors, Fire Windows
- .2            NFPA 252 – Standard Method of Fire Tests of Door Assemblies
- .6            Underwriters' Laboratories (UL)
- .1            UL 10B – Standard for Fire Test of Door Assemblies
- .7            Warnock Hersey Intertek Testing Services (ITS-WH)
- .1            ITS Certification Listings for Fire Doors
- .8            Window and Door Manufacturer's Association (WDMA)
- .1            WDMA 1.S.1A
- 1.4            SUBMITTALS FOR REVIEW
- .1            Section 01 33 00: Submittal Procedures.
- .2            Product Data: Indicate door core Materials and construction; veneer species, type and characteristics.
- .3            Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, identify cutouts for glazing and louvers.

- .4 Cut Sheet, Materials safety data sheets, signed attestations or other official literature clearly identifying product emission rates.
  - .5 Include elevations indicating veneer requirements including veneer grade, cut, species, piece match, face match, appearance of pairs, sets and transoms and aesthetic grade.
- 1.5 SAMPLES
- .1 For factory finished doors, submit two (2) sets of 200mm x 250mm (8" x 10") selected veneer samples with the standard finish colours representing manufacturer's full range of available colours and finishes. Samples shall represent the colour selected on veneer typical of grain patterns and colouration for the specified species and cut selected.
  - .2 Corner sample: submit 216mm x 279mm (8-1/2" x 11") corner sample cut away to show stile, rail, crossbanding, core and face veneer with description and date.
  - .3 Selection samples: for each finish product selected, submit two (2) complete sets of colour chips representing manufacturer's full range of available colours and patterns.
  - .4 Verification samples: for each finish product specified, two (2) samples, minimum size 150mm (6") square, representing actual product, colour and patterns.
- 1.6 REGULATORY REQUIREMENTS
- .1 Conform to applicable code for fire rated doors and panels. All rated doors are to carry the applicable ULC/WH label.
- 1.7 QUALITY ASSURANCE
- .1 Perform Work in accordance with AWI/AWMAC QSI, custom grade.
  - .2 Manufacturer: Company specializing in manufacturing the Products specified in this Section with a minimum three (3) years documented experience.
  - .3 Non-fire-rated doors: provide doors that comply with AWI Section 1300 and WDMA 1.S.1A.
  - .4 Fire-rated doors: provide doors that comply with NFPA 80, NFPA 252, and UL10B, as applicable and as acceptable to authorities having jurisdiction, and that are listed and labeled by ITS-WH or a qualified testing agency. Notify Contract Administrator prior to fabrication if fire doors required cannot qualify for labeling due to design, size, hardware or other requirement.
  - .5 Single source responsibility: where possible, provide doors from a single source to ensure uniformity in quality of appearance, face veneer, finish and construction.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- .1 Deliver products to Site, and store and protect products, to requirements of Section 01 60 00 – Basic Product Requirements.
  - .2 Accept products of this Section on Site in new condition and verify no damage.
  - .3 Protect doors with resilient packaging and sealed with heat shrink plastic.
  - .4 Break seal on Site to permit ventilation.
  - .5 Protect doors from dampness. Arrange for delivery after Work causing abnormal humidity has been completed.
  - .6 Store doors in well ventilated room, off the floor, in accordance with manufacturer's recommendations.
  - .7 Protect doors with resilient packaging. Do not store in damp or wet areas; or in areas where sunlight might bleach the veneer. Seal top and bottom edges if stored more than one week.
- 1.9 ENVIRONMENTAL CONDITIONS

- .1 Maintain environmental conditions including temperature, humidity and ventilation within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Inspect for damage prior to installation.
- 1.10 WASTE MANAGEMENT AND DISPOSAL
  - .1 Remove from Site and dispose of all packaging Materials at appropriate recycling facilities
  - .2 Dispose of all corrugated cardboard polystyrene plastic packaging Material in appropriate On-Site bin for recycling in accordance with Site waste management program.
- 1.11 WARRANTY
  - .1 Provide a five year warranty under provisions of the General Conditions of Construction.
  - .2 Warranty: Include coverage of warpage beyond installation tolerances indicated in this Section, delamination or degradation of veneer.
- Part 2 Products**
- 2.1 FLUSH WOOD INTERIOR DOORS, NON-RATE
  - .1 Standard of acceptance: Model 8500-ME-AF + NAUF/FSC, as manufactured by Baillargeon Doors Inc., with the following characteristics:
    - .1 Construction: 5-ply
    - .2 Stiles: 3mm (1/8") thick veneer, longitudinally laminated by hot pressing with Type 1 structural glue, per ASTM D5456, including a 22mm (7/8") piece of hardwood, matched with faces, for a total width of 107mm (4-3/16")
    - .3 Top and bottom rails: 3mm (1/8") thick veneer, longitudinally laminated by hot pressing with Type 1 structural glue, per ASTM D5456, for a total width of 85mm (3-5/16")
    - .4 Core: Agrifibre (NAUF), Neutral FSC
    - .5 Faces: wood veneer, FSC
    - .6 Lock block: integrated
    - .7 Glue: Type 1 PVA cross-link (NAUF)
    - .8 Door characteristics:
      - .1 Thickness: 44mm (1-3/4"), unless noted otherwise on door schedule
      - .2 Face veneer: Maple, White – Plain Sliced.
      - .3 Finish: factory finish, colour to be selected by Contract Administrator.
  - .2 Refer to Door Schedule for locations, quantities and sizes and fire ratings.
- 2.2 ACCESSORIES
  - .1 Glazing Stops: solid maple with mitered corners; installed with small head countersunk screws.
- 2.3 FABRICATION
  - .1 Fabricate non-rated doors in accordance with AWMAC Quality Standards.
  - .2 Fabricate fire rated doors in accordance with AWMAC Quality Standards and to ULC requirements. Attach fire rating label to door edge.
  - .3 Provide flush doors with 13 mm thick edge strips of wood species to match face veneer.
  - .4 Pre-machine doors for finish hardware.

**Part 3            Execution**

3.1                INSTALLATION

- .1                Installation of doors specified in Section 06 10 00 – Rough Carpentry.

**END OF SECTION**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- .1 Sliding Grille – Side Folding Door and Grille

1.2 RELATED SECTIONS

- .1 Section 05 50 00 – Metal Fabrications
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 09 29 00 – Gypsum Board

1.3 REFERENCES

- .1 ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

- .1 Stacking:
  - .1 Minimum stacking shall be 1.05 inches/linear foot (87.5 mm/meter) of opening plus 3.5 inches (89 mm) for each locking member.
  - .2 Grille support must be designed to carry the weight of a fully stacked door at any point along its length. Support is to carry the total weight / the total stacking and is expressed as lbs./lin. ft.
- .2 Lintel Deflection: Accommodate deflection of lintel to prevent damage to components, deterioration of seals, or movement between door frame and perimeter framing.
- .3 Thermal Movement: Design sections to permit thermal expansion and contraction of components to match perimeter opening construction.

1.5 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00 Submittal Procedures.
- .2 Shop Drawings: Indicate opening dimensions, curves, type of locking posts, elevations and framed opening tolerances.
- .3 Product Data: Manufacturer's data sheets on each Product to be used, including:
  - .1 Preparation instructions and recommendations.
  - .2 Storage and handling requirements and recommendations.
  - .3 Installation methods.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: A company that specializes in the manufacturing of the folding grille Products required for the project with a minimum of 10 years documented experience.
- .2 Installer Qualifications: Contractor that has minimum of two years documented experience installing folding grille Products similar to those specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Store Products in manufacturer's unopened packaging until ready for installation.
  - .2 Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather
  - .3 Protect Materials from exposure to moisture. Do not deliver until after wet Work is complete and dry.
  - .4 Store Materials in a ventilated weather tight location.
- 1.8 COORDINATION
- .1 Coordinate Work with other operations and installation of finish Materials to avoid damage to the Materials.
- 1.9 WARRANTY
- .1 Manufacturers standard limited Product warranty for a period of two years.
- PART 2 PRODUCTS**
- 2.1 SECTION INCLUDES
- .1 Acceptable Manufacturer: Amstel Manufacturing (1993) Inc  
128 Centre Street East, Richmond Hill, Ontario. L4C 1A6. Canada.  
Ph. 1-800-663-6206 or 905-508-0855 Fx. 1-866-525-1304 or 905-508-8487  
E. projects@amstel-doors.com  
W. www.amstel-doors.com.
  - .2 Substitute Products by the following manufacturers are accepted:
    - .1 Cornell Iron Works Inc.
    - .2 The Cookson Company, Inc.
    - .3 McKinlay Door Sales
  - .3 Requests for substitutions will be considered in accordance with B7 Substitutions.
- 2.2 MATERIALS
- .1 AS400 PERFORATED VISTA Sliding Security Grille
    - .1 Curtain:
      - .1 Panels to have full height butt hinges on 7 inches (178 mm) centers.
      - .2 Panels to have 4 inches (102 mm) high truss-like plates at the top and bottom of the closure.
      - .3 Panel Inserts are separated by 1" height aluminum extrusions with "T" shaped ends to fit into full height aluminum extruded channels for added strength.
      - .4 Constructed of 6 inches (152 mm) wide by 0.125 inch (3.2 mm) thick steel panel inserts with perforated round holes set in a staggered pattern
      - .5 Perforated panels are sandwiched between co-extruded neoprene and P.V.C. gaskets



- .2 Weight: AS400 Perforated Vista: 2.2 lbs./sq. ft. (10.7 kg/sq.m).
- .3 Aluminum is to be 6063 aluminum alloy with T-5 temper conforming to ASTM B 221.
- .4 Locking:
  - .1 Lead Posts:
    - .1 Provide (#2) top and bottom post with top rod and bottom ratcheted rod activated by a keyed cylinder. Provide rubber bumper at edge of locking post.
    - .2 Intermediate posts:
      - .1 Provide (#3) intermediate posts with an adjustable manually operated drop bolt with keyed cylinder locks.
    - .3 End Posts:
      - .1 Provide (#2) top and bottom post with top rod and bottom ratcheted rod activated by a keyed cylinder or thumb turn. Provide rubber bumper at the edge of the locking post.
    - .4 Bi-parting Posts:
      - .1 Provide (#5) bi-parting posts for sliding grilles at 30'-0" wide intervals. One lock member will retain a hook-bolt deadlock activated by keyed cylinder or thumb-turn cylinder. A second intermediate locking member is provided with a steel floor bolt and shall include a full height channel to accept the hook-bolt deadlock.
    - .5 Floor Sockets:
      - .1 Supply Stainless Steel dustproof floor sockets for all drop bolts.
    - .6 Keyed Cylinders:
      - .1 Coordinate with Section 08 71 00 Door Hardware and provide keyed cylinders to match building hardware and keyway system.
- .5 5. Track:
  - .1 Overhead track shall be 1.3 inches (33 mm) wide by 1.8 inches (46 mm) high and sized to accept 1-1/8 inches (29 mm) diameter roller trolleys.
  - .2 Rollers bear on 0.27 inch (7 mm) thick aluminum surface within the track.
  - .3 Radius Track: Provide the following where indicated.
    - .1 Provide custom radius track as indicated on the Drawings.
  - .4 Factory Finishes: Use two letter suffix to denote required door finish.
    - .1 Standard: CA Clear Anodized 0.0004 inch (10 micron) clear anodizing.

## 2.3 ACCESSORIES

- .1 Fasteners: Galvanized or corrosion resistant steel.

## 2.4 FABRICATION

- .1 Size and fabricate grille assembly to allow for tolerances of rough framed openings, clearances, shim spacing and shims around perimeter of assemblies.

.2 Ensure joints and connections are flush and hairline.

.3 Accurately and rigidly fit joints and corners.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

.1 Do not begin installation until substrates have been properly prepared.

.2 Verify openings are ready to receive Work and opening dimensions and clearances are as indicated on shop drawings.

.3 Provide full size template or CAD file for custom radius track prior to fabrication.

.4 If openings are the responsibility of another installer, notify Contract Administrator of unsatisfactory preparation before proceeding.

#### **3.2 PREPARATION**

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces as recommended by the manufacturer for achieving the correct installation under the project conditions.

#### **3.3 INSTALLATION**

.1 Install in accordance with manufacturer's instructions.

.2 Attach frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

.3 Use anchorage devices to securely fasten sliding door assembly to wall and ceiling construction without distortion or imposed stresses.

.4 Separate aluminum and other corrodible surfaces from sources of corrosion of electrolytic action at points of contact with other Materials.

.5 Adjust hardware for smooth operation.

#### **3.4 CLEANING**

.1 Remove protective Material from factory finished surfaces.

.2 Remove temporary labels and visible markings

#### **3.5 PROTECTION**

.1 Protect installed Products until completion of project.

.2 Touch-up, repair or replace damaged Products before Substantial Performance.

**END OF SECTION**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

- .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- .1 This section includes the following types of automatic entrance doors:
  - .1 Exterior and interior, single and bi-parting, sliding automatic all glass entrance doors with sidelites.
- .2 Related Sections:
  - .1 Division 7 – Thermal and Moisture Protection
  - .2 Section 08 43 13 – Aluminum Framed Storefronts
  - .3 Section 08 71 00 – Door Hardware
  - .4 Section 08 80 00 - Glazing
  - .5 Division 26 – Electrical
  - .6 Division 28 – Electronic Safety and Security

1.3 REFERENCES

- .1 References: Refer to the version year adopted by the Authority Having Jurisdiction.
  - .1 ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - .2 ICC/IBC - International Building Code.
  - .3 CUL – Approved for use in Canada.
  - .4 NFPA 70 - National Electrical Code.
  - .5 NFPA 101 - Life Safety Code.
- .2 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA).
  - .1 ANSI/BHMA A156.10 American National Standard for Power Operated Pedestrian Doors.
  - .2 ANSI Z97.1 Standards for Safety Glazing Material Used in Buildings. Underwriters Laboratories (UL).
  - .3 UL 325 Standard for Safety for Door, Drapery, Gate, Louver and window Operators and Systems.
- .3 Canadian Standards Association (CSA).
  - .1 CAN/CSA-C22.2 No. 247 – Operators and Systems of Doors, Gates, Draperies, and Louvers.
- .4 American Association of Automatic Door Manufacturers (AAADM).
- .5 American Society for Testing and Materials (ASTM).
  - .1 ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
  - .2 ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .6 American Architectural Manufacturers Association (AAMA).
  - .1 AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.
- .7 National Association of Architectural Metal Manufacturers (NAAMM).
  - .1 Metal Finishes Manual for Architectural Metal Products.

- .8 International Code Council (ICC).
  - .1 IBC: International Building Code Building Code.
  - .2 CBC: California Building Code.
- 1.4 DEFINITIONS
  - .1 Activation Device: Device that, when actuated, sends an electrical signal to the door to activate the operation of the door.
    - .1 Knowing act: Consciously initiating the opening of a power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.
  - .2 Safety Device: A device that detects the presence of an object or person within a zone where contact could occur and provides a signal to stop the movement of the door.
  - .3 AAADM: American Association of Automatic Door Manufacturers.
- 1.5 PERFORMANCE REQUIREMENTS
  - .1 General: Provide doors that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.
  - .2 Compliance:
    - .1 ANSI/BHMA A156.10 American National Standard for Power Operated Pedestrian Doors.
    - .2 UL 325 listed.
  - .3 Automatic door equipment accommodates medium to heavy pedestrian traffic.
  - .4 Automatic Door equipment accommodates up to the following weights for active leaf doors:
    - .1 Bi-part doors: 220 lbs (100 kg) per active breakout leaf.
    - .2 Single doors: 220 lbs (100 kg) per active breakout leaf.
  - .5 Operating Temperature Range: -31° F to 122° F (-35° C to 50° C).
  - .6 Entrapment Force Requirements:
    - .1 Power Operated Sliding Doors: Not more than 30 lbf (133 N) required to prevent stopped door from closing.
    - .2 Sliding doors provided with a breakaway device shall require no more than 50 lbf (222N) applied 1 inch (25 mm) from the leading edge of the lock stile for the breakout panel to open.
- 1.6 SUBMITTALS
  - .1 Comply with Section 01 33 00 - Submittal Procedures.
  - .2 Product Data: Manufacturer's product data sheets including installation details, Material descriptions, dimensions of individual components and profiles, fabrication, operational descriptions and finishes.
  - .3 Shop Drawings: Submit manufacturer's Shop Drawings, including elevations, sections and details, indicating dimensions, Materials, and fabrication of doors, frames, sidelites, operator, motion /presence sensor control device, anchors, hardware, finish, options and accessories.
  - .4 Samples: Submit manufacturer's samples of aluminum finish.
  - .5 Manufacturers Field Reports: Submit manufacturer's field reports from AAADM certified technician of inspection and approval of doors for compliance with ANSI/BHMA A156.10 after completion of installation.

- .6 Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door opening installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include spare parts list.
- .7 Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.7 QUALITY ASSURANCE

- .1 Manufacturers Qualifications: Engage qualified manufacturers with a minimum 10 years of documented experience in manufacturing of doors and equipment of similar to that indicated for this Project and that have a proven record of successful in-service performance.
  - .1 A manufacturer with company certificate issued by AAADM.
- .2 Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing and maintenance of units similar in Material, design, and extent to that indicated for this Project and whose Work has resulted in construction with a record of successful in-service performance.
- .3 Certified Inspector Qualifications: Certified by AAADM.
- .4 Source Limitations for Automatic Entrances: Obtain each type of door, frame, operator and sensor components specified in this Section from a single source, same manufacturer unless otherwise indicated.
- .5 Power-Operated Pedestrian Door Standard: ANSI/BHMA A156.10 (current version).
- .6 Emergency Exit door requirements: Comply with requirements of authorities having jurisdiction for automatic entrance doors serving as a required means of egress.

1.8 PROJECT CONDITIONS

- .1 Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication and indicate on Shop Drawings.

1.9 COORDINATION

- .1 Coordinate sizes and locations of recesses in concrete floors for recessed tracks and thresholds if applicable. Concrete, reinforcement and formwork are specified in Division 03.
- .2 Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access control system as applicable.

1.10 WARRANTY

- .1 General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive the City of other rights the City may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- .2 Automatic Entrance Doors shall be free of defects in Material and Workmanship for a period of One (1) year from the date of substantial completion.
- .3 During the warranty period a factory-trained technician shall perform service and affect repairs. An inspection shall be performed after each adjustment or repair.
- .4 During the warranty period all warranty Work, including but not limited to emergency service, shall be performed during normal business hours.

- .5 Manufacturer shall have in place a dispatch procedure that shall be available 24 hours a Day, 7 Days a week for emergency call back service.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- .1 Manufacturer: ASSA ABLOY Entrance Systems, 1900 Airport Road, Monroe, NC 28110. Toll Free (877) SPEC-123. Phone (704) 290-5520 Fax (704 ) 290- 5555 Website [www.assaabloyentrance.com](http://www.assaabloyentrance.com) contact: [specdesk.na.aaes@assaabloy.com](mailto:specdesk.na.aaes@assaabloy.com)
- .2 Substitutions: per B7.

### **2.2 SLIDING AUTOMATIC ENTRANCES**

- .1 Standard of Acceptance: Besam SL500 sliding automatic doors. (Basis of Design):
  - .1 Aluminum doors and frames with sidelites and active door leaves.
  - .2 Overhead concealed, electro-mechanical, microprocessor controlled, sliding door operator.
  - .3 Operator housing, guide system and door carriers.
- .2 Sliding Automatic Entrance Doors Configuration:
  - .1 Single slide, fixed sidelite, door system.
    - .1 Configuration: Single slide, two equal panel door unit with one operable leaf and one fixed sidelite unit.
    - .2 Traffic Pattern: Two-way
    - .3 Emergency Breakaway Capability: Exterior sliding leaf only.
    - .4 Mounting: Overhead header installed between jambs.

### **2.3 ALUMINUM DOORS AND FRAMES**

- .1 Doors and Frames: Extruded Aluminum, Alloy 6063-T5.
  - .1 Door panels shall have a minimum .125 inch (3.2 mm) structural wall thickness including adjoining horizontal members and perimeter frames where applicable.
  - .2 Door Construction shall be by means of an integrated corner block with 3/8 inch all-thread through bolt from each stile.
  - .3 Glass stops shall be .062 inch (15.8 mm) wall thickness and shall provide security function as a standard by means of a fixed non-removable exterior section with glazing to be performed from the interior only. Glazing stops that allow for glass removal from the exterior shall not be deemed as equivalent.
  - .4 The sliding door system shall include two interlocks securing the leading stile of the sidelite and the butt stile of the sliding door panel together.
  - .5 Vertical Stiles shall be narrow stile 2-1/8 inch (54 mm).
  - .6 Bottom Rails shall be standard 4 inch (102 mm).
  - .7 No intermediate muntin.

- .8 Weather-stripping shall be slide-in type, replaceable pile mohair seals retained by the aluminum extrusions. The following types of weather-stripping are required: complementing weather-stripping on the joining vertical stiles of the sidelite and sliding door panels, complementing weather-stripping on the lead edge of the lock stiles of bi-parting doors, single pile weather-stripping between the carrier and the header, single pile weather-stripping on the lead edge stile of single slide door panels, dual pile weather-stripping on the pivot stile of breakout sidelite panels, and dual pile weather-stripping on the butt stile of fixed sidelite panels. Bottom rails shall be provided with an adjustable nylon sweep.
- .2 Glass: Glazing shall comply with ANSI Z97.1, thickness as indicated.
  - .1 Glazing Active Door Panels: 1/4" (6 mm) tempered, unless otherwise specified.
  - .2 Glazing Sidelite Panels: 1/4" (6 mm) tempered, unless otherwise specified.
  - .3 Glazing Installation: See Division 8 Section Glazing for requirements.
    - .1 All Glazing furnished by glazing contractor.
- .3 Door Carriers: Manufacturer's standard carrier assembly that allows vertical adjustment.
  - .1 Carriage Assembly: Carriage bar with two wheel assemblies. Each assembly shall have tandem roller wheels.
  - .2 Roller Wheels: Two heavy duty Delrin roller wheels per wheel assembly, for a total of four (4) roller wheels, 1-7/16 inch (36.51 mm) diameter, per active door leaf for operation over a replaceable aluminum track. Single journal with sealed oil impregnated bearings.
  - .3 Two (2) heavy duty self-aligning anti-risers per leaf.
- .4 Framing Members: Provide automatic entrances as complete assemblies. Manufacturer's standard extruded aluminum framing reinforced as required to support loads.
  - .1 Vertical jambs shall be 1-3/4 inches (44.5 mm) by 4-1/2 inches (114.3 mm). Coordinate with aluminum storefront specification sections.
- .5 Header: Manufacturer's standard one-piece extruded aluminum header with a replaceable aluminum track extending full width of entrance unit. Header to conceal door operators, carrier assemblies, and roller track; complete with hinged access panel for service of door operator, and controls.
  - .1 Span: Maximum 16'-0" (4.9 m) without intermediate supports when using 1/4-inch glass.
    - .1 Capacity: Capable of supporting active breakout leaves up to maximum of 300 lb (136 kg) per leaf when header is supported per manufacturer's recommendations.
  - .2 Size: 4-1/2 inches (114.3 mm) wide by 7 inches (177.8 mm) high.
    - .1 Header height including the sensor plate cap which spans the clear door opening width is 8-1/2 inches (215.9 mm) high.
  - .3 Hinge Point: Continuous hinge at top of header allows for complete access to operator and internal electronic and mechanical assemblies.
  - .4 Design: Manufacturer's standard closed header.
- .6 Hardware: Provide manufacturer's standard hardware as required for operation indicated.

- .1 Breakaway arms and bottom pivot assemblies shall be supplied by the manufacturer and shall be adjustable to comply with applicable codes.
  - .2 Locking hardware shall be provided as indicated.
    - .1 Mortise type hookbolt latch. (Single slide sliding door system).
      - .1 Interior Side: Thumbturn.
      - .2 Exterior Side: Keyed cylinder.
    - .3 Keyed cylinders shall be provided as indicated.
      - .1 Keyed cylinder by door hardware supplier.
  - .7 Guide Track/Threshold: Manufacturer's threshold as indicated.
    - .1 Aluminum guide track integrated in the bottom of the sidelite portion of the sliding automatic door assembly.
- 2.4 SLIDING DOOR OPERATOR
- .1 Door Operator and Controller:
    - .1 Electro-mechanical controlled unit utilizing a high-efficiency, energy efficient, DC motor requiring a maximum of 3 amp current draw, allowing 5 operators on one 20 amp circuit. The supplied system shall have the capability to operate at full performance well beyond a brown out and high line voltage conditions (85V – 265V) sensing changes and adjusting automatically. The operator shall allow an adjustable hold open time delay of 0 to 60 seconds and have internal software to incorporate a self-diagnostic system.
  - .2 Microprocessor Control Box:
    - .1 Modular control unit to allow for changing technology. Factory-adjusted configuration with opening and closing speeds set to comply with ANSI/BHMA A156.10 requirements and electronic dampening to reduce wear on drive train. Should the drive train operations deviate from design criteria ranges, Watchdog Control Circuit Monitoring will assume command of the system and shut down the automatic function allowing a secondary supervisory circuit to perform as a backup. Control unit shall allow the following functions:
      - .1 Diagnostics with the ability to produce application data.
  - .1 Mode Selector Control:
    - .2 Multi-position rotary knob mode selector switch to be interior jamb mounted and shall allow selection of the indicated functions to be engaged when switch is turned to the appropriate setting.
    - .3 Mode selector control to allow the following functions:
      - .4 "Off"
        - .1 "Exit Only" one way traffic with automatic operation from the interior.
        - .2 "Two Way Traffic" allowing automatic operation from exterior and interior.
        - .3 "Partial Opening" energy saving door position allows door to automatically adjust opening width based on amount of usage, that is, full open during high use and partial open during low use. The control for this setting is programmable allowing adjustment to both the usage setting and the opening width.
        - .4 "Hold Open" doors activated and held in the full open position.



2.5 ACTIVATION AND SAFETY CONTROL DEVICES

- .1 General: Provide the types of activation and safety devices specified in accordance with ANSI/BHMA standards, for the condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.
- .2 Combination Activation Motion Sensor/Safety Presence Sensor:
  - .1 Shall be a sliding door sensor utilizing K-band microwave technology to detect motion and focused active infrared technology to detect presence, combined in a single housing surface mounted on each side of the header.
    - .1 Presence sensor shall remain active at all times.
    - .2 The sensor shall communicate with the automatic door operator through a self-monitoring connection that allows the door to go into a fail safe mode preventing the door from closing in the event of a sensor failure.
  - .2 Motion/presence detecting sensors to be field installed and adjusted.

2.6 ELECTRICAL

- .1 High-Efficiency DC Motor: Maximum of 3 amp current draw, allowing 5 operators to run on one 20 Amp circuit.
- .2 Power: Self-detecting line voltage capable control. 120 VAC through 240 VAC, 50/60 Hz, 3 amp minimum incoming power with solid earth ground connection for each door system.
- .3 Key Impulse Input: Input for card readers or remote activation with independent adjustable hold open delay.
- .4 Wiring: Separate internal channel raceway free from moving parts.
- .5 Brown out / high voltage capability: System has capability to operate at full performance well beyond brown out and high voltage line conditions (85 V – 265 V) sensing changes and adjusting automatically.

2.7 ALUMINUM FINISHES

- .1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- .2 Anodized Finish:
  - .1 AAMA 611, Clear, AA- M12C22A41, Class I, 0.018 mm.

**PART 3 EXECUTION**

3.1 EXAMINATION

- .1 Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance.

.2 Examine roughing-in for electrical source power to verify actual locations of wiring connections.

.3 Proceed only after such discrepancies or conflicts have been resolved.

### 3.2 INSTALLATION

.1 Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

.2 Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

.1 Install surface mounted hardware using concealed fasteners to greatest extent possible.

.2 Set headers, carrier assemblies, tracks, operating brackets and guides level and true to location with anchorage for permanent support.

.3 Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 – Electrical Specification.

.4 Glazing: Glaze sliding automatic entrance door panels in accordance with the Glass Association of North America (GANA) Glazing Manual, published recommendations of glass product manufacturer, and published instructions of automatic entrance system manufacturer.

.5 Sealants: Comply with requirements specified in Section 07 92 00 – Joint Sealing to provide weather tight installation.

.1 Set thresholds, bottom guide and track systems and framing members in full bed of sealants.

.2 Seal perimeter of framing members with sealant.

.6 Signage: Apply signage on both sides of each door and sidelite as required by ANSI/BHMA A156.10 and manufacturers installation instructions.

### 3.3 FIELD QUALITY CONTROL

.1 Manufacturers Field Services:

.1 Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

.2 Before placing doors into operation, AAADM certified technician shall inspect and approve doors for compliance with ANSI/BHMA A156.10. Certified technician shall be approved by manufacturer.

### 3.4 ADJUSTING

.1 Adjust door operators, controls and hardware for smooth and safe operation and for weather tight closure. Adjust doors in compliance with ANSI/BHMA A156.10.

3.5 CLEANING AND PROTECTION

- .1 Clean adjacent surfaces soiled by door installation.
- .2 Clean glass and metal surfaces promptly after installation. Remove excess sealants, compounds, dirt and other substances. Repair damages finish to match original finish.
  - .1 Comply with requirements in Section 08 80 00 – Glazing for cleaning and maintaining glass.

3.6 DEMONSTRATION

- .1 Engage a factory-authorized representative to train the City's maintenance personnel to adjust, operate, and maintain safe operation of the door.

**END OF SECTION**

- Part 1            General**
- 1.1            SUMMARY OF WORK
- .1            This Section specifies glazed, non-thermally broken aluminum-framed storefronts and accessories.
- 1.2            RELATED REQUIREMENTS
- .1            Section 07 62 00 - Metal Flashing and Trim: Flashings.
- .2            Section 07 84 00 – Firestopping.
- .3            Section 07 92 00 - Joint Sealants.
- .4            Section 08 11 17 – Aluminum Doors: Aluminum-framed glazed swing doors.
- .5            Section 08 42 29 – Sliding Automatic Entrances.
- .6            Section 08 44 13 – Glazed Aluminum Curtain Walls.
- .7            Section 08 51 13 – Aluminum Windows.
- .8            Section 08 80 50 – Glazing.
- 1.3            REFERENCE STANDARDS
- .1            Aluminum Association (AA)
- .1            DAF 45 2003, Designation System For Aluminum Finishes.
- .2            American Architectural Manufacturers Association (AAMA).
- .1            AAMA-501-2005, Methods of Test for Exterior Walls.
- .2            AAMA-2603-2013, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- .3            AAMA-2604-2013, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- .4            AAMA-2605-2013, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .5            AAMA CW-10-2012, Care and Handling of Architectural Aluminum From Shop to Site.
- .6            AAMA CW-11-1985, Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing.
- .7            AAMA-TIR A1-2004, Sound Control for Fenestration Products.
- .3            ASTM International (ASTM).
- .1            ASTM A653 / A653M – [09a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2            ASTM B209-2010, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3            ASTM B221-2013, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .4            ASTM C612 – 2014, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

- .5 ASTM E283-2012, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .6 ASTM E331-2009, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .7 ASTM E413 – 04, Classification for Rating Sound Insulation.
- .8 ASTM E1105 – 2008, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .9 ASTM D2240 – 2010, Standard Test Method for Rubber Property—Durometer Hardness.
- .5 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-12.8-97, Insulating Glass Units.
  - .2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.
  - .3 CAN/CGSB-19.13-M87, Sealing Compound, One-Component, Elastomeric, Chemical Curing.
- .6 CSA International (CSA)
  - .1 CAN/CSA-S157-2005, Strength Design in Aluminum.
  - .2 CAN/CSA-S136–2007, North American Specification for the Design of Cold-Formed Steel Structural Members.
  - .3 CAN/CSA W59.2-M1991(R2003), Welded Aluminum Construction.
- .7 Environmental Choice Program (ECP)
  - .1 CCD-45-1995, Sealants and Caulking Compounds.
- .8 Underwriter’s Laboratories of Canada (ULC)
  - .1 CAN/ULC-S710.1 2005, Standard for Thermal Insulation – Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Materials Standard for Thermal Insulation - Bead - Applied One Component Polyurethane Air Sealant Foam, Part 1: Materials.
- 1.4 ADMINISTRATIVE REQUIREMENTS
  - .1 Co-ordination: Co-ordinate Work of this Section with Work of other trades for proper time and sequence to avoid construction delays.
  - .2 Pre-installation Meeting: Convene pre-installation meeting after Award of Contract and one week prior to commencing Work of this Section to verify project requirements, substrate conditions and coordination with other building sub-trades, and to review manufacturer’s written installation instructions.
    - .1 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:
      - .1 The City;
      - .2 Contract Administrator;
      - .3 Glazing subcontractor;
      - .4 Manufacturer’s Technical Representative.

- .2 Ensure meeting agenda includes review of methods and procedures related to glazed aluminum-framed storefront installation including co-ordination with related Work.
- .3 Record meeting proceedings including corrective measures and other actions required to ensure successful completion of Work and distribute to each attendee within 1 week of meeting.

#### 1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Contract Conditions and Section 01 33 00 - Submittal Procedures.
- .2 Products Data: Submit Products data including manufacturer's literature for glazed aluminum aluminum-framed storefront extruded members, panels, components and accessories, indicating compliance with specified requirements and Material characteristics.
  - .1 Submit list on aluminum-framed storefront manufacturer's letterhead of Materials, components and accessories to be incorporated into Work.
  - .2 Include Products names, types and series numbers.
  - .3 Include contact information for manufacturer and their representative for this Project.
- .3 Shop Drawings: Submit Drawings stamped and signed by Professional Engineer registered or licensed in Province of Manitoba, Canada. Include on shop Drawings:
  - .1 Aluminum-framed storefront panel and component dimensions, framed opening requirements and tolerances, adjacent construction, anchor details anticipated deflection under load, affected related Work, weep drainage netWork, expansion and contraction joint location and details, and field welding required.
  - .2 Include details of fasteners between interior and exterior extrusions.
  - .3 Show size and location of seismic restraints. Include seismic design calculations
- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm (12 x 12 inches) sample sections showing prefinished aluminum surface, finish, colour and texture.
  - .2 Submit duplicate 300 x 300 mm (12 x 12 inches) sample sections of insulating glass unit showing glazing Materials and edge and corner details.
- .5 Thermal Performance: Submit verification that Insulating Glass Units used in aluminum-framed storefront system meet RSI (R) values specified.
- .6 Test Reports:
  - .1 Submit test reports showing compliance with specified performance characteristics and physical properties including air infiltration, water infiltration and structural performance.
- .7 Field Reports: Submit manufacturer's field reports within 3 days of manufacturer representatives Site visit and inspection.
- .8 Installer Qualifications:
  - .1 Submit letter verifying installer's experience with Work similar to Work of this Section.

#### 1.6 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: Supply maintenance data for aluminum-framed storefront for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Record Documentation: In accordance with Section 01 78 00 - Closeout Submittals.
  - .1 List Materials used in aluminum-framed storefront Work.

.2 Warranty: Submit warranty documents specified.

1.7 QUALITY ASSURANCE

.1 Mock-up: Co-ordinate mock-up of aluminum-framed storefront with Section 08 44 13 – Glazed Aluminum Curtain Wall

1.8 DELIVERY STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver Material in accordance with Section 01 60 00 - Products Requirements.

.2 Deliver glazed aluminum-framed storefront Materials and components in manufacturer's original packaging with identification labels intact and in sizes to suit project.

.2 Storage and Handling Requirements: Store Materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.9 WARRANTY

.1 Project Warranty: Refer to Contract Conditions for project warranty provisions.

.2 Manufacturer's warranty: Submit, for the City's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights the City may have under Contract Conditions.

.3 Warranty period: [1] year commencing on Date of Substantial Performance of Work.

.1 Insulating glass units: 10 years, on Date of Substantial Performance of Work.

**Part 2 Productss**

2.1 MANUFACTURER

.1 Manufacturer: Kawneer or approved equal

2.2 DESCRIPTION

.1 Aluminum-framed glazed storefront constructed from prefinished aluminum extrusions and including swing type doors.

.2 Storefront Framing:

.1 Centre glazed framing, 114.3 mm (4.5 inches) deep.

.2 50 mm (2 inches) wide profile.

.3 At locations shown on Drawings.

2.3 DESIGN CRITERIA

.1 Design aluminum-framed storefront to AAMA CW-DG-1.

.2 Design aluminum components to CAN/CSA S157.

.3 Design and size aluminum-framed storefront to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of wall using design pressure of 0.95 kPa (20 psf).

.1 Design aluminum-framed storefront system for expansion and contraction caused by cycling temperature range of 95 degrees C (171 degrees F) over 12 hour period without causing detrimental effect to system components.

.2 Thermal expansion: Ensure aluminum-framed storefront system can withstand temperature differential of 85 degrees C (153 degrees F) and is able to accommodate

interior and exterior system expansion and contraction without damage to components or deterioration of seals.

- .3 Design vertical expansion joints with baffled overlaps and compressed resilient air seal laid between mullion ends.
- .4 Ensure system is designed to accommodate:
  - .1 Movement within aluminum-framed storefront assembly.
  - .2 Movement between system and perimeter framing components.
  - .3 Dynamic loading and release of loads.
  - .4 Deflection of structural support framing.
  - .5 Shortening of building concrete structural columns.
  - .6 Creep of concrete structural members.
- .6 Limit mullion deflection to flexure limit of glass 19 mm (0.75 inches) maximum with full recovery of glazing Materials.
- .7 Sound attenuation through storefront system (exterior to interior): STC 33.
- .8 Glass dimensions: Size glass units to CAN/CGSB-12.20.
- .9 Flatness criteria: 6 mm (0.25 inches) maximum in 6 m (20 feet) for each panel.

## 2.4 MATERIALS

- .1 Aluminum-Framed Storefront System and Components:
  - .1 Extruded aluminum: To ASTM B221, 6063 alloy with temper.
  - .2 Sheet aluminum: To ASTM B209, utility grade for unexposed surfaces.
  - .3 Fasteners, screws and bolts: Cadmium plated stainless steel 300 series to meet aluminum-framed storefront requirements and as recommended by manufacturer.
  - .4 Anchors: Ensure anchors have three-way adjustment.
  - .5 Aluminum panels: 3 mm (0.125 inches) thick factory formed panels.
    - .1 Finish after forming to match window system.
  - .6 Vision glass: 6 mm (0.25 inches) clear tempered glass.
  - .7 Doors: In accordance with Section 08 11 16 - Aluminum Doors and Section 08 42 29 Sliding Entrance Doors.
  - .8 Doors: Aluminum-framed swing door with glass insert suitable for inclusion in aluminum-framed storefront system, constructed and finished to match storefront.

## 2.5 ALUMINUM-FRAMED STOREFRONT SYSTEM FABRICATION

- .1 Aluminum welding to CAN/CSA W59.2.
- .2 Fabricate aluminum assemblies of extruded sections to sizes and profiles indicated.
  - .1 Ensure verticals and horizontals are extrusions designed for either shear block or screw spline corner construction.
- .3 Construct units square, plumb and free from distortion, waves, twists, buckles or other defects detrimental to performance or appearance.



- 
- .4 Fabricate aluminum-framed storefront with minimum clearances and shim spacing around panel perimeter and ensure installation and dynamic movement of perimeter seal is enabled.
  - .5 Fabricate infill panels with metal covered edge seals around perimeter of panel assembly, enabling installation and minor movement of perimeter seal.
  - .6 Fabricate aluminum framed doors in accordance with Section 08 11 16– Aluminum Doors and Frames.
  - .7 Accurately fit and secure joints and corners.
    - .1 Ensure joints are flush and hairline.
  - .8 Prepare aluminum-framed storefront to receive anchor devices.
  - .9 Use only stainless steel or zinc plated concealed fasteners
    - .1 Where fasteners cannot be concealed, countersunk screws finished to match adjacent Material may be used upon receipt of written approval from Contract Administrator.
  - .10 Prepare components to receive doors and openings as indicated.
  - .11 Reinforce framing members for exterior imposed loads where required.
  - .12 Visible manufacturer’s labels are not permitted.
- 2.6 FINISHES
- .1 Anodized Finish:
    - 1. Conforming to AA-M12C22A31 and AAMA 611.
    - 2. Architectural Class II, clear anodic coating, Colour #17 Clear.
- 2.7 ACCESSORIES
- .1 Gasketing: To CCD-45 Silicone compatible rubber or extruded silicone gaskets.
  - .2 Setting Blocks: To CCD-45 and ASTM D2240, silicone, 80 - 90 Shore A Durometer hardness.
  - .3 Spacers: To CCD-45 and ASTM D2240, silicone, 50 - 60 Shore A Durometer hardness.
  - .4 Sealant: To CAN/CGSB-19.13, Class 40, one-component, cold-applied, non-sagging silicone.
    - .1 Acceptable Material: Dow Corning 795.
  - .5 Sealant Bond Breaker: Open cell foam backer rod sized to suit project requirements.
  - .6 Flashings: 3 mm (0.125 inches) thick aluminum flashing to profiles indicated and in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.
  - .7 Liquid Foam Insulation: Single component, moisture cure, low expansion rate spray-in-place polyurethane liquid foam insulation to ULC-S710.1 and in accordance with manufacturer’s written recommendations.
- Part 3 Execution**
- 3.1 INSTALLERS
- .1 Use only installers with 2 years minimum experience in Work similar to Work of this Section.
- 3.2 EXAMINATION
- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for aluminum-framed storefront installation in accordance with manufacturer’s written instructions.
    - .1 Visually inspect substrate in presence of Contract Administrator.

- .2 Inform Contract Administrator 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 Contract Administrator.

### 3.3 INSTALLATION

- .1 Install aluminum-framed storefront in accordance with manufacturer's written recommendations.
- .2 Do aluminum welding to CAN/CSA W59.2.
- .3 Attach aluminum-framed storefront assemblies to structure plumb and level, free from warp, and allow for sufficient adjustment to accommodate construction tolerances and other irregularities.
  - .1 Maintain dimensional tolerances and align with adjacent Work.
  - .2 Use alignment attachments and shims to permanently fasten elements to building structure.
  - .3 Clean welded surfaces and apply protective primer to field welds and adjacent surfaces.
- .4 Install smoke sealing where indicated.

### 3.4 FIELD QUALITY CONTROL

- .1 Field Inspection: Coordinate field inspection in accordance with Section 01 45 00 - Quality Control.
- .2 Site Installation Tolerances:
  - .1 Variation from plumb: 12 mm per 30 m (0.5 inches per 100 feet) maximum.
  - .2 Misalignment of two adjacent panels or members: 0.8 mm (0.03 inches) maximum.
  - .3 Sealant space between aluminum-framed storefront and adjacent construction: 13 mm (0.5 inches) maximum.
- .3 Manufacturer's Services:
  - .1 Coordinate manufacturer's services with Section 01 45 00 - Quality Control.
    - .2 Submit to Contract Administrator a written agreement from the manufacturer to perform the manufacturer's services.
    - .3 Schedule manufacturer's review of Work procedures at stages listed:
      1. Products Application.
      2. Fabrication and Handling.
      3. Installation.
  - .4 Submit manufacturer's written reports to Contract Administrator describing:
    - .1 The scope of Work requested.
    - .2 Date, time and location.
    - .3 Procedures performed.
      - .1 Observed or detected non-compliances or inconsistencies with manufacturers' recommended instructions.
      - .2 Limitations or disclaimers regarding the procedures performed.
      - .3 Obtain reports within seven days of review and submit immediately to Contract Administrator.

### 3.5 PROTECTION

- .1 Protect installed Products and components from damage during construction.
- .2 Repair damage to adjacent Materials caused by aluminum-framed storefront installation.

**END OF SECTION**

**Part 1**

**General**

1.1

RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 45 00 – Quality Control
- .3 Section 01 60 00 – Basic Product Requirements
- .4 Section 01 78 00 – Closeout Submittals
- .5 Section 06 10 00 – Rough Carpentry
- .6 Section 06 20 00 – Finish Carpentry
- .7 Section 08 11 00 – Steel Doors and Frames
- .8 Section 08 14 00 – Wood Doors
- .9 Section 08 42 29 – Sliding Aluminum Automatic Entrance - Interior
- .10 Electrical Specifications

1.2

REFERENCES

- .1 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
  - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
  - .2 Canadian General Standards Board (CGSB).
- .2 CAN/CGSB-69.17-M86(R1993), Bored and Preassembled Locks and Latches or latest.
- .3 CAN/CGSB-69.18-M90ANSI/BHMA A156.1-1981, Butts and Hinges or latest.
- .4 CAN/CGSB-69.19-93ANSI/BHMA A156.3-1984, Exit Devices or latest.
- .5 CAN/CGSB-69.20-M90/ANSI/BHMA A156.4-1986 Door Controls (Closers) or latest.
- .6 CAN/CGSB-69.21-M90/ANSI/BHMA A156.5-1984, Auxiliary Locks and Associated Products or latest.
- .7 CAN/CGSB-69.22-M90/ANSI/BHMA A156.6-1986, Architectural Door Trim or latest.
- .8 CAN/CGSB-69.24-M90/ANSI/BHMA A156.8-1982, Door Controls - Overhead Holders or latest.
- .9 CAN/CGSB-69.26-96/ANSI/BHMA A156.10-1991, Power-operated Pedestrian Doors or latest.
- .10 CAN/CGSB-69.28-M90/ANSI/BHMA A156.12-1986, Interconnected Locks and Latches or latest.
- .11 CAN/CGSB-69.29-93/ANSI/BHMA A156.13-1987, Mortise Locks and Latches or latest.
- .12 CAN/CGSB-69.30-93/ANSI/BHMA A156.14-1991, Sliding and Folding Door Hardware or latest.
- .13 CAN/CGSB-69.31-M89/ANSI/BHMA A156.15-1981, Closer/Holder Release Device or latest.
- .14 CAN/CGSB-69.32-M90/ANSI/BHMA A156.16-1981, Auxiliary Hardware or latest.

- .15 CAN/CGSB-69.33-M90/ANSI/BHMA A156.17-1987, Self-closing Hinges and Pivots or latest.
  - .16 CAN/CGSB-69.34-93/ANSI/BHMA A156.18-1987, Materials and Finishes or latest.
  - .17 CAN/CGSB-69.35-M89/ANSI/BHMA A156.19-1984, Power Assist and Low Energy Power Operated Doors or latest.
  - .18 CAN/CGSB-69.36-M90]ANSI/BHMA A156.20-1984, Strap and Tee Hinges and Hasps or latest.
- 1.3 SUBMITTALS
- .1 Product Data:
    - .1 Submit manufacturer's printed product literature, Specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
    - .2 Samples:
      - .1 Submit one of each unique piece of hardware for review by Contract Administrator. For hinges, one hinge is acceptable in lieu of a full set. For kickplates and other items with varying dimensions, one 50mm x 50mm sample showing finish and fasteners is acceptable in lieu of full size. Send in accordance with Section 01 33 00 - Submittal Procedures.
    - .3 Hardware List:
      - .1 Submit Contract hardware list in accordance with Section 01 33 00 - Submittal Procedures.
      - .2 Indicate specified hardware, including make, model, Material, function, size, finish and other pertinent information.
    - .4 Manufacturer's Instructions:
      - .1 Submit manufacturer's installation instructions.
    - .5 Closeout Submittals
      - .1 Provide operation and maintenance data for door closers, locksets, door holders electrified hardware and fire exit hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.4 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 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
    - .3 Certificates: product certificates signed by manufacturer certifying Materials comply with specified performance characteristics and criteria and physical requirements.
    - .4 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
    - .5 Warranties: Provide a 1 year warranty as provided in General Conditions for Construction for all hardware and associated component supplied under this Section, except for the Automatic door operators and their related components shall have a 2 year warranty (including the motor and the operating unit).

- 1.5 DELIVERY, STORAGE, AND HANDLING
  - .1 Packing, Shipping, Handling and Unloading:
  - .2 Deliver, store, handle and protect Materials in accordance with Section 01 60 00 - Basic Product Requirements.
  - .3 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
  - .4 Storage and Protection:
    - .1 Store finishing hardware in locked, clean and dry area.
- 1.6 WASTE DISPOSAL AND MANAGEMENT
  - .1 Remove from Site and dispose of packaging Materials at appropriate recycling facilities.
  - .2 Dispose of corrugated cardboard, polystyrene, plastic packaging Material in appropriate on-site bin for recycling in accordance with Site waste management program.
- 1.7 MAINTENANCE
  - .1 Extra Materials:
    - .1 Provide maintenance Materials in accordance with Section 01 78 00 - Closeout Submittals.
    - .2 Supply two sets of wrenches for door closers, locksets, and fire exit hardware.
- Part 2 Products**
- 2.1 HARDWARE ITEMS
  - .1 Use one manufacturer's products only for similar items.
  - .2 Manufacturer's listed in the door hardware schedule should be taken as the Standard of Acceptance.
  - .3 Door hardware supplier/installer to carefully review existing site conditions for retro-fitting of existing doors outlined in the Door Schedule, and shall provide hardware to suit site conditions and functionality outlined in Door Schedule notes for card reader retrofits.
- 2.2 DOOR HARDWARE (also refer to Hardware Schedule below)
  - .1 Locks and latches:
    - .1 Bored and preassembled locks and latches: to CAN/CGSB-69.17 or latest, with lever handles as stated in Hardware Schedule. Acceptable manufacturer is Best Access Systems & and Schlage ND Series.
    - .2 All locksets/latchsets with levers to have 70mm backset typically.
    - .3 All locksets/latchsets with knobs to have 127mm backset typically.
  - .2 Butts and hinges:
    - .1 Butts and hinges: to CAN/CGSB-69.18 or latest, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.
    - .2 Self-closing hinges and pivots: to CAN/CGSB-69.33 or latest, designated by letter K and numeral identifiers listed in Hardware Schedule, [with suffix letter F indicating listed for used on fire doors].
    - .3 Strap and tee hinges and hasps: to CAN/CGSB-69.36 or latest, designated by letter A and numeral identifiers listed in Hardware Schedule, size [listed in Hardware Schedule] [in accordance with CAN/CGSB 69.36 or latest, table I].

- .4 Provide 1 ½ pair of butts for door up to 914mm (36") wide x 2200mm (84") high and 2 pairs of butts for doors larger than these dimensions.
- .3 Exit devices: to CAN/CGSB 69.19 or latest, as listed in Hardware Schedule. Acceptable manufacturer is Von Duprin 98/99 series.
- .4 Auxiliary item(s): door co-ordinator, type 21, for pairs of doors with overlapping astragals.
- .5 Door Closers and Accessories:
  - .1 Door controls (closers): to CAN/CGSB-69.20 or latest, designated by letter C and numeral identifiers listed in Hardware Schedule, in accordance with CAN/CGSB-69.20, table A1.
  - .2 Door controls - overhead holders: to CAN/CGSB-69.24 or latest, designated by letter C and numeral identifiers listed in Hardware Schedule.
  - .3 Closer/holder release devices: to CAN/CGSB-69.31 or latest, designated by letter C and numeral identifiers listed in hardware schedule.
  - .4 Door co-ordinator: for pairs of doors with overlapping astragal.
- .6 Door Operators:
  - .1 Power-operated pedestrian doors: to CAN/CGSB-69.26 or latest.
  - .2 Power assist and low energy power operated doors: to CAN/CGSB-69.35 or latest.
- .7 Architectural door trim: to CAN/CGSB-69.22 or latest, designated by letter J and numeral identifiers as listed in Hardware Schedule.
  - .1 Door protection plates: kick plate on push side of door unless otherwise noted, 1.27 mm thick aluminum or stainless steel, with countersunk oval head stainless steel screws. Length to be full width of door less 50mm (2").
  - .2 Push plates: 1.27 mm thick stainless steel.
  - .3 Push/Pull units: stainless steel.
  - .4 Acoustic sound seals and door bottom seal: heavy duty, surface mounted, seals of extruded aluminum frame (clear anod. finish) and solid closed cell neoprene seal. Door bottom to have adjustable automatic retract mechanism when door is open.
  - .5 Thresholds: width listed x full width of door opening, extruded aluminum mill finish, serrated surface, with thermal break of rigid PVC and minimal lip to permit barrier free access.
- .8 Weatherstripping:
  - .1 Head and jamb seal:
    - .1 Extruded aluminum frame and solid closed cell neoprene, clear anodized finish.
    - .2 Adhesive backed neoprene Material.
  - .2 Door bottom seal:
    - .1 Extruded aluminum frame and closed cell neoprene, clear anodized.
  - .3 Astragal: adjustable extruded aluminum frame with pile insert, finished to match doors.
- .9 Barrier Free Electric Door Operator: (also refer to Hardware Schedule)

- .1 Heavy duty electric automatic door closer, capable of multi-door operation, complete with actuators, and control boxes, clear anodized aluminum finish. Surface mounted type with provision for adjustment of operative speed.
- .2 Control boxes: complete with electric strike relay.
- .3 Electrical box and actuator: Hardwired low voltage actuator with stainless steel plate, engraved blue filled with handicap symbol. Confirm final locations on Site for Contract Administrator approval.
- .4 Key switch control (on/off/hold open) shall be provided on each handicap operator (option to hold door open, option to keep door closed).
- .5 Provide switched line voltage to control box. Locate bypass switch above housing mechanism and wire so switch will also act as an on-off switch for the door operator.
- .6 Housing for door operators to extend across full door width. For manual doors, provide heavy duty closers behind the housing.
- .7 Provide low voltage wiring to each actuator.

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 HARDWARE SCHEDULE

**Hardware Sets**

**Set: EXTERIOR GATES**

2 Cylinder	20-062 x Cam to Suit	626	SC
1 Balance of Hardware by Door Supplier			OT

Notes: Confirm cylinder type with door supplier prior to ordering. Supply construction and final cores. One cylinder required for the fluid cooler enclosure gate and the other for the roof access ladder enclosure.

**Set: MATERIAL LIFT**



1 Cylinder	20-062 x Cam to Suit	626	SC
1 Balance of Hardware by Door Supplier			OT

Notes: Supply construction and final cores. Cylinders are shown as example only. Supply Schlage large formati IC core cylinders and cores for material lift doors at basement and main level.

**Set: 1.0**

6 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Flush Bolt	2845	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom Lock	ND80 T D RHO	626	SC
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC
1 Coordinator	2600 Series x Filler x Brackets (If Req'd.)	Black	RO
2 Surface Closer	1431 O	EN	SA
2 Kick Plate	K1050 10"	US32D	RO
2 Floor Stop	441/443	US26D	RO
1 Gasketing	S88BL		PE
2 Door Bottom	4131CRL		PE
1 Astragal	By Door Supplier		OT

Notes: Supply construction and final cores.

**Set: 2.0**

8 Hinge	TA2714 NRP 4-1/2" x 4"	US26D	MK
1 Dust Proof Strike	570	US26D	RO
2 Flush Bolt	555	US26D	RO
1 Storeroom Lock	ND80 T D RHO	626	SC
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC
2 Surface Closer	1431 PS	EN	SA
2 Kick Plate	K1050 10"	US32D	RO
1 Gasketing	S88BL		PE
2 Door Bottom	4131CRL		PE
1 Astragal	By Door Supplier		OT

Notes: Supply construction and final cores.

**Set: 3.0**

4 Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1 Fire Rated Rim Exit	98L-F 06 996L(Std)	US26D	VD
1 Cylinder	20-057	626	SC
1 Surface Closer	351 O	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Electromagnetic Holder	998M	689	RF
1 Gasketing	S88BL		PE
1 Door Bottom	420APKL		PE
1 Power Supply	By Electrical		OT

Notes: Power to magnetic holder to release on fire alarm signal. Outside lever can be left in locked or unlocked position by use of key in lever. Supply construction and final cores.

**Set: 4.0**

2 BEST Cylinder and Core	To Suit Existing Hardware		BE
1 Balance of Hardware by Door Supplier			OT

Notes: Confirm cylinder quantity and type with door supplier prior to ordering. One cylinder to turn the auto sensor on/off and the other to lock the door. Key switch supplied by door supplier. Supply construction and final cores.

**Set: 5.0**

4 Hinge	TA2314 NRP 4-1/2" x 4"	US32D	MK
1 Deadlatch	4900	628	AD
1 Paddle Operator	4591	628	AD
1 Cylinder	20-062 x Cam to Suit	626	SC
1 Electric Strike	5000C-LBM	630	HS
1 Push Bar & Pull	BF15747	US28	RO
1 Conc Overhead Stop	2-X36	630	RF
1 Surface Closer	1431 OZ (Confirm Jamb Depth)	EN	SA
1 Mounting Plate	1431B	EN	SA
1 Threshold	171A		PE

1 Weatherstrip and Sweep	By Door supplier	OT
1 Card Reader	By Electrical/Security	OT
1 Power Supply	By Electrical	OT

Notes: Swiping valid card will release the electric strike allowing the door to be pulled open. Free egress by pushing paddle. Supply construction and final cores.

**Set: 6.0**

1 All Hardware by Door Supplier	OT
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**Set: 7.0**

4 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Storeroom Lock	ND80 T D RHO	626	SC
1 BEST Core	To Match Existing	626	BE
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC
1 Electric Strike	5000C-LBM	630	HS
1 Automatic Operator	5710	689	NO
1 Kick Plate	K1050 10"	US32D	RO
1 Floor Stop	441/443	US26D	RO
2 Full Height Actuator	639		NO
1 Restroom Relay Kit	Camden CX-WC11		CA
1 Power Supply	By Electrical		OT

Notes: Outside lever always rigid. Electric strike normally unlocked. Pressing inside "push to lock" button will lock the electric strike, disable the outside actuator and illuminate the "occupied when lit" indicator. Pushing the inside actuator will release the electric strike, power open the door and reset the system. Opening the door manually will also reset the system. Supply construction and final cores.

**Set: 8.0**

4 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Storeroom Lock	ND80 T D RHO	626	SC
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC
1 Electric Strike	5000C-LBM	630	HS
1 Surface Closer	1431 O	EN	SA

1 Kick Plate	K1050 10"	US32D	RO
1 Floor Stop	441/443	US26D	RO
1 Card Reader	By Electrical/Security		OT
1 Power Supply	By Electrical		OT

Notes: Supply construction and final cores.

**Set: 9.0**

1 Cylinder	20-062 x Cam to Suit	626	SC
1 Balance of Hardware by Door Supplier			OT

Notes: All hardware supplied by the glass door supplier. Confirm cylinder type with door supplier prior to ordering. Supply construction and final cores.

**Set: 10.0**

4 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Classroom Lock	ND70 T D RHO	626	SC
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC
1 Surface Closer	DA 1431 O	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Floor Stop	441/443	US26D	RO
1 Gasketing	S88BL		PE
1 Door Bottom	420APKL		PE

Notes: Supply construction and final cores.

**Set: 11.0**

4 Hinge	TA2714 NRP 4-1/2" x 4"	US26D	MK
1 Storeroom Lock	ND80 T D RHO	626	SC
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC
1 Surf Overhead Stop	55-X36	652	RF

**Set: 12.0**

6 Hinge	TA2714 NRP 4-1/2" x 4"	US26D	MK
1 Dust Proof Strike	570	US26D	RO
2 Flush Bolt	557	US26D	RO
1 Storeroom Lock	ND80 T D RHO	626	SC
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC
2 Surf Overhead Stop	55-X36	652	RF
1 Astragal	355CS		PE

Notes: Supply construction and final cores.

**Set: 13.0**

3 Hinge	TA2714 NRP 4-1/2" x 4"	US26D	MK
1 Storeroom Lock	ND80 T D RHO	626	SC
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC
1 Surface Closer	DA 1431 P10	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Wall Stop	406	US32D	RO
1 Gasketing	S88BL		PE
1 Door Bottom	420APKL		PE

**Set: 14.0**

4 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Passage Latch	ND10S RHO	626	SC
1 Surface Closer	1431 P10	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Wall Stop	406	US32D	RO

**Set: 15.0**

4 Hinge	TA2314 NRP 4-1/2" x 4"	US32D	MK
1 Rim Exit Device	98EO	US26D	VD
1 Conc Overhead Stop	6-X36	630	RF
1 Surface Closer	SRI 351 P10	EN	SA
1 Threshold	253x3AFG		PE
1 Gasketing	2891AS		PE

1 Sweep	315CN	PE
1 Astragal	3572SS	PE

Notes: Door is exit only - no trim on exterior.

**Set: 16.0**

3 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Passage Set	AL10S SAT	626	SC
1 Surf Overhead Stop	55-X36	652	RF

**Set: 17.0**

2 Hinge	TA2714 NRP 4-1/2" x 4"	US26D	MK
1 Storeroom Lock	AL80 T D SAT	626	SC
1 Cylinder	23-030 (Confirm Keyway and Keying)	626	SC

Notes: Supply construction and final cores.

**Set: 18.0**

4 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Privacy Set	AL40S SAT	626	SC
1 Surf Overhead Stop	55-X36	652	RF

**Set: 19.0**

6 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Flush Bolt	2845	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Passage Latch	ND10S RHO	626	SC
1 Coordinator	2600 Series x Filler x Brackets (If Req'd.)	Black	RO
2 Surface Closer	1431 P10	EN	SA
2 Kick Plate	K1050 10"	US32D	RO
2 Floor Stop	441/443	US26D	RO
1 Gasketing	S88BL		PE
2 Door Bottom	4131CRL		PE

1 Astragal By Door Supplier OT

**Set: 20.0**

8 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Dust Proof Strike	570	US26D	RO
2 Flush Bolt	555	US26D	RO
1 Passage Latch	ND10S RHO	626	SC
1 Deadbolt	8T37M STK	626	BE
1 Surface Closer	1431 O	EN	SA
2 Kick Plate	K1050 10"	US32D	RO
2 Floor Stop	441/443	US26D	RO
1 Threshold	253x3AFG		PE
1 Gasketing	316AS		PE
2 Door Bottom	217APK		PE
1 Astragal	By Door Supplier		OT

Notes: Closer for use on active leaf only. Deadbolt keyed on both sides of door. Supply construction and final cores.

**Set: 21.0**

3 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Passage Latch	ND10S RHO	626	SC
1 Surface Closer	1431 P10	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Floor Stop	441/443	US26D	RO
1 Gasketing	S88BL		PE
1 Door Bottom	420APKL		PE

**Set: 22.0**

3 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Passage Latch	ND10S RHO	626	SC
1 Surface Closer	1431 P10	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Floor Stop	441/443	US26D	RO

**Set: 23.0**

1 Retrofit Existing	See Note	OT
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Notes: Retrofit existing doors for card reader operation. See notes on door schedule. Supply new electric strike to suit hardware. Allow for new cylinders in hardware. If possible provide either BEST SFIC cylinders/core (exterior/arena doors) or Schlage LFIC cylinders/cores(interior doors).

**Set: 24.0**

2 Cylinder	20-062 x Cam to Suit	626	SC
1 Balance of Hardware by Door Supplier			OT

Notes: Confirm cylinder quantity and type with door supplier prior to ordering. One cylinder to turn the auto sensor on/off and the other to lock the door. Key switch supplied by door supplier. Supply construction and final cores.

**Set: 25.0**

3 Hinge	TA2314 NRP 4-1/2" x 4"	US32D	MK
1 Deadlatch	4900	628	AD
1 Lever Operator	4600 (deadlatches)	US32D	AD
1 Cylinder	20-062 x Cam to Suit	626	SC
1 Electric Strike	5000C-LBM	630	HS
1 Push Bar	47-PB	US28	RO
1 Surface Closer	1431 O	EN	SA
1 Floor Stop	441/443	US26D	RO
1 Card Reader	By Electrical/Security		OT
1 Power Supply	By Electrical		OT

Notes: Lock and lever to be installed at standard lock height. Lever for use on pull side of door. Card reader for use on push side. Swiping valid card will release the electric strike allowing the door to be pushed open. Free egress by turning inside lever. Provide 4 hinges if door is over 36" wide. Supply construction and final cores.

- 2.5 KEYING
- .1 Keying shall be under existing Grand Master Key System as supplied by the Best Lock Company and Schlage C Keyways.
  - .2 Lock cylinders shall accommodate interchangeable/removable LFIC (Schlage) and SFIC (Best) cores as noted on the Hardware Schedule.



- .3 Hardware supplier shall supply the final key cores; the City will complete the final keying and install the keyed cores.
- .4 Hardware supplier shall furnish required number of temporary construction cores and keys to Contractor for security purposes during construction.
- .5 All keys to be stamped "Do Not Duplicate"
- .6 Contractors shall maintain strict control over construction core and keys.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Furnish wood and metal door and frame manufacturers with complete instructions and templates for preparation of their Work to receive hardware.
- .3 Furnish manufacturers' instructions for proper installation of each hardware component.

**3.2 INSTALLATION**

- .1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .2 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .3 Furnish metal/wood door and frame manufacturers with complete instructions and templates for preparation of their Work to receive hardware.
- .4 Furnish manufacturer's instructions for proper installation of each hardware component.
- .5 Use only manufacturer's supplied fasteners. Failure to comply may void manufacturer's warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .6 Mounting heights: unless noted otherwise, use the following heights as a general guideline from the T/O of the finished floor to the C/L (centre line) of the item for compliance with City of Winnipeg Accessibility Guidelines:

- .1 Door Pull – 3'-0"
- .2 Door Bar – 3'- 0"
- .3 Push Plate –4'-7"
- .4 Lockset/Latchset – 3'-0"
- .5 Panic Hardware – 3'-0" or as recommended by manufacturer
- .6 Deadlock – 5'-0"

**3.3 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 provide tight fit at contact points with frames.

- 3.4 CLEANING
- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
  - .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 Upon completion of installation, remove surplus Materials, rubbish, tools and equipment barriers and provide written certification to the Contract Administrator that all hardware has been installed as specified.

**END OF SECTION**

**Part 1**

**General**

- 1.1 RELATED SECTIONS
  - .1 Section 01 33 00 – Submittal Procedures
  - .2 Section 01 45 00 – Quality Control
  - .3 Section 01 78 00 – Closeout Submittals
  - .4 Section 08 11 00 – Steel Doors and Frames
  - .5 Section 08 14 00 – Wood Doors
  - .6 Section 08 41 13 – Aluminum Framed Entrances and Storefronts
  - .7 Section 08 42 29 – Sliding Automatic Entrances - Interior
  - .8 Section 10 99 90 – Miscellaneous Specialties
- 1.2 REFERENCES
  - .1 American National Standards Institute (ANSI).
    - .1 ANSI/ASTM E330-02, Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference. or latest.
  - .2 American Society for Testing and Materials International, (ASTM).
    - .1 ASTM C542-94(1999), Specification for Lock-Strip Gaskets or latest.
    - .2 ASTM D790-02, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials or latest.
    - .3 ASTM D1003-00, Test Method for Haze and Luminous Transmittance of Plastics or latest.
    - .4 ASTM D1929-96(R2001)e1, Test Method for Determining Ignition Temperature of Plastics or latest.
    - .5 ASTM D2240-02b, Test Method for Rubber Property - Durometer Hardness or latest.
    - .6 ASTM E84-01, Test Method for Surface Burning Characteristics of Building Materials or latest.
    - .7 ASTM F1233-98, Test Method for Security Glazing Materials and Systems or latest.
  - .3 Canadian General Standards Board (CGSB).
    - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass or latest.
    - .2 CAN/CGSB-12.2-M91, Flat, Clear Sheet Glass or latest.
    - .3 CAN/CGSB-12.3-M91, Flat, Clear Float Glass or latest.
    - .4 CAN/CGSB-12.4-M91, Heat Absorbing Glass or latest.
    - .5 CAN/CGSB-12.5-M86, Mirrors, Silvered or latest.
    - .6 CAN/CGSB-12.6-M91, Transparent (One-Way) Mirrors or latest.
    - .7 CAN/CGSB-12.8-97, Insulating Glass Units or latest.
    - .8 CAN/CGSB-12.9-M91, Spandrel Glass or latest.
    - .9 CAN/CGSB-12.10-M76, Glass, Light and Heat Reflecting or latest.
    - .10 CAN/CGSB-12.11-M90, Wired Safety Glass or latest.
    - .11 CAN/CGSB-12.12-M90, Plastic Safety Glazing or latest.
    - .12 CAN/CGSB-12.13-M91, Patterned Glass or latest.

- .4 Canadian Standards Association (CSA International).
  - .1 CSA A440.2-98, Energy Performance Evaluation of Windows and Sliding Glass Doors or latest.
  - .2 CSA Certification Program for Windows and Doors 2000 or latest.
- .5 Environmental Choice Program (ECP).
  - .1 CCD-045-95, Sealants and Caulking or latest.
- .6 Flat Glass Manufacturers Association (FGMA).
  - .1 FGMA Glazing Manual – 1997 or latest.
- .7 Laminators Safety Glass Association (LSGA).
  - .1 LSGA Laminated Glass Design Guide 2000 or latest.
- .8 Canadian Insulated Glass Manufacturers Association (CIGMA)
  - .1 IGCC/IGMA Certification Program for the Harmonized Insulating Glass Standard (ASTM E2190)
- 1.3 SYSTEM DESCRIPTION
  - .1 Performance Requirements:
    - .1 Provide 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 Size glass to withstand wind loads, dead loads and positive and negative live loads as measured in accordance with ANSI/ASTM E330 or latest.
    - .3 Limit glass deflection to flexural limit of glass with full recovery of glazing Materials.
- 1.4 SUBMITTALS
  - .1 Product Data:
    - .1 Submit manufacturer's printed product literature, Specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .3 Upon request, submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .4 Submit manufacturer's installation instructions.
  - .5 Provide maintenance data including cleaning instructions for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .6 The window manufacturer must submit a copy of a computer simulation report giving the overall U-value of the standard ASTM test size for each window type used on the project (i.e. fixed, casement, awning, slider). Only reports signed and certified by and independent CWDMA approved Simulation Organizations, and Simulators prepared in accordance with CSA standards A440.2 (latest edition) will be accepted. The report to be submitted with Shop Drawings.
- 1.5 QUALITY ASSURANCE
  - .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties. Conform to IGMAC – Quality Standard Specification and Glazing Recommendations for Sealed Insulated Glass Units for glazing installation methods.

- .1 Provide testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.
  - .2 Provide shop inspection and testing for glass.
  - .3 Window supplier must supply either a test report by an independent technical source tested to CSA A440.2 (1998 to current) or a current NFRC Certified Products Listing.
  - .4 Certificates: product certificates signed by manufacturer certifying Materials comply with specified performance characteristics and criteria and physical requirements.
  - .5 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
  - .6 Warranty: Provide a five year warranty to include coverage of all sealed glass units from seal failure, interpane dusting/misting, and replacement to same quality.
- 1.6 SITE CONDITIONS
- .1 Environmental Requirements:
    - .1 Install glazing when ambient temperature is 10 °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.
- 1.7 WASTE MANAGEMENT AND DISPOSAL
- .1 Divert metal cut-offs from landfill by disposal into On-Site Metal recycling bin.
  - .2 Divert unused caulking and sealant Materials from landfill through disposal at special wastes depot.
  - .3 Unused or damaged glazing Materials are not recyclable and must not be diverted to municipal recycling programs.
  - .4 Remove form Site and dispose of packaging Materials at appropriate recycling facilities.
  - .5 Dispose of corrugated cardboard, polystyrene, plastic packaging Material in appropriate On-Site bin for recycling in accordance with Site waste management program.
- Part 2 Products**
- 2.1 MATERIALS: FLAT GLASS
- .1 Type A: Safety glass: to CAN/CSGB-12.1M, clear, laminated with 1/32" polyvinyl butyral plastic interlayer, 1/4" minimum thickness.
  - .2 Type B: Tempered glass for interior and exterior units: to CAN2-12.1M; Type 2-Tempered, thickness to suit opening size thickness and shall be in accordance with applicable Building Code. Clear. Note: **All exterior outer panes on all glass units are to be tempered.**
  - .3 Type C: Float Glass for exterior units: CAN2-12.3M; glazing quality, thickness to suit opening size thickness and shall be in accordance with applicable Building Code, visible light transmission 91%, approved product PPG Starphire or approved equal.
  - .4 Type D: Ceramic Glass: to CAN/CSGB-12.1 – Firelite, Pyrostop or equal.
  - .5 Type E: Silvered Mirrored Glass: to CAN/CGSB - 12.5, 1/4" thick, Type 1A-float glass for normal use, with special mirrored film.
- 2.2 ACCESSORIES
- .1 Setting blocks: Neoprene, 80-90 Shore A durometer hardness to ASTM D2240 or latest, to suit glazing method, glass lightweight and area.

- .2 Spacer shims: Neoprene, 50-60 Shore A durometer hardness to ASTM D2240 or latest, 75mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face. Continuous bond breaker type, and compatible with silicone sealant, "Thermabond V-2100" by Norton or acceptable "as Equal".
- .3 Seals: extruded elastomeric gaskets, compatible with structural silicone sealant, as recommended by the sealant manufacturer, to the interior, and dense EPDM gaskets to the exterior. Glazing tapes are not acceptable.
- .4 Glazing tape:
  - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240 or latest; on release paper, black colour.
  - .2 Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume 2%, designed for compression of 25%, to effect an air and vapour seal.
- .5 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot.
- .6 Glazing clips: manufacturer's standard type.
- .7 Lock-strip gaskets: to ASTM C542 or latest.

### **Part 3 Execution**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.2 EXAMINATION**

- .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.

#### **3.3 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.

#### **3.4 INSTALLATION: EXTERIOR**

- .1 Perform Work in accordance with IGMAC for glazing installation methods.
- .2 Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- .3 Install removable stops without displacing glazing tape/spline. Exert pressure for full continuous contact.
- .4 Trim protruding tape edge.
- .5 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 9mm below sight line.
- .6 Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.5 INSTALLATION: INTERIOR

- .1 Perform Work in accordance with IGMAC for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6mm above sight line.
- .3 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
- .4 Place glazing tape on free perimeter of glazing in same manner described.
- .5 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .6 Knife trim protruding tape.

3.6 INSTALLATION: MIRROR

- .1 Install mirrors using glazing tape strips vertically at 400mm o.c.
- .2 Apply bead of silicone caulking 50mm from edge around perimeter of mirror and vertically between glazing tape strips prior to setting in mirror in place.

3.7 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking.
- .3 Remove glazing Materials from finish surfaces.
- .4 Remove labels after Work is complete.
- .5 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacture's instructions.
- .6 Upon completion of installation, remove surplus Materials, rubbish, tools and equipment barriers.

3.8 PROTECTION OF FINISHED WORK

- .1 After installation, mark light with an "X" by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

**END OF SECTION**

**PART 1 General**

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 09 29 00 – Gypsum Board

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM C 645-99, Standard Specification for Nonstructural Steel Framing Members or latest.
  - .2 ASTM C 754-98a, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products. or latest
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.40-97, Primer, Structural Steel, Oil Alkyd Type or latest.
- .3 CAN/CGSB-19.21-M87, Sealing and Bedding Compound Acoustical or latest.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert steel scraps from landfill by disposal into the On-Site metal recycling bin or at nearest metal recycling facility.
- .2 Divert reusable Materials for reuse at nearest used building Materials facility or similar type facility.
- .3 Divert unused primer Materials from landfill through disposal at a special wastes depot.

**PART 2 Products**

2.1 MATERIALS

- .1 Non-load bearing channel stud framing: to ASTM C 645 or latest, stud size as indicated on Drawings, roll formed, hot dipped galvanized steel sheet, for screw attachment of gypsum board, with knock-out service holes. Unless otherwise noted, 20 ga. typical thickness for standard interior wall assemblies and 20 ga. thickness for all ceiling and bulkhead assemblies. Refer to Structural Drawings for other gauges.
- .2 Floor and ceiling tracks: to ASTM C 645 or latest, in widths to suit stud sizes, 1 1/4" flange height. Slip tracks to be provided at all interior partitions.
- .3 Metal channel stiffener: size as indicated on Drawings, thickness as indicated on Drawings, cold rolled steel, coated with rust inhibitive coating.
- .4 Acoustical sealant: to CAN/CGSB-19.21 or latest.
- .5 Insulating strip: rubberized, moisture resistant 1/8" thick foam strip, 1/2" wide, with self-sticking adhesive on one face, lengths as required.

**PART 3 Execution**

3.1 ERECTION

- .1 Align partition tracks at floor and ceiling and secure at 24" o.c. maximum.
- .2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .3 Place studs vertically as indicated on Drawings and not more than 2" from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.



- .4 Erect metal studding to tolerance of 1:1000.
- .5 Attach studs to bottom and ceiling track using screws unless indicated otherwise.
- .6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for Work specified in other Sections.
- .8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 2" apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .9 Install double heavy gauge single jamb studs at all openings typically.
- .10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .12 Provide 1 1/2" wood stud secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .13 Install blocking between studs where required for attaching electrical and other boxes.
- .14 Extend partitions to ceiling height except where noted otherwise on Drawings.
- .15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Refer to Drawings for details.
- .16 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .17 Install two continuous beads of acoustical sealant under top and bottom tracks and at end studs, around the perimeter of all sound rated partitions.
- .18 Where steel stud walls meet substrates that are not completely level, the bottom and top tracks shall follow the substrate as snug as possible. Fill all gaps between tracks and substrate with foam insulation or acoustic caulking to suit.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 07 25 00 – Air/Vapour Barriers Membrane
- .2 Section 07 84 00 – Firestopping
- .3 Section 07 92 00 – Joint Sealing
- .4 Section 08 11 00 – Steel Doors and Frames
- .5 Section 09 22 16 – Non-Structural Metal Framing
- .6 Section 09 90 00 – Painting

**1.2 REFERENCES**

- .1 Aluminum Association
  - .1 Designation for Aluminum Finishes-1997 or latest.
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM C 36-95, Specification for Gypsum Wallboard or latest.
  - .2 ASTM C 442-92, Specification for Gypsum Backing Board and Coreboard or latest.
  - .3 ASTM C 475-94, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board or latest.
  - .4 ASTM C 557-93a, Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing or latest.
  - .5 ASTM C 630-93, Specification for Water-Resistant Gypsum Backing Board or latest.
  - .6 ASTM C 840-95, Specification for Application and Finishing of Gypsum Board or latest.
  - .7 ASTM C 954-93, Specification for Steel Drill Screws for the Application of Gypsum Board or latest.
  - .8 ASTM C 1002-93, Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases or latest.
  - .9 ASTM C 1047-94, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base or latest.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction or latest.
  - .2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs or latest.
- .4 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-1988, Building Materials and Assemblies, Standard Method of Test for Surface Burning Characteristics of or latest.

**NOTE: Subcontractors to coordinate with Section 07 84 00 to achieve required fire ratings.**

**1.3 SITE ENVIRONMENTAL REQUIREMENTS**

- .1 Maintain temperature minimum 10°C, maximum 21°C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.

- .2 Apply board and joint treatment to dry, frost free surfaces.

#### 1.4 **DESCRIPTION OF WORK**

- .1 Types of Work: The types of Work herein specified include the following:
  - .1 Gypsum drywall applied to steel stud framing system.
  - .2 Gypsum drywall applied to wood framing.
  - .3 Gypsum drywall backing board as substrate for other finishes.
  - .4 Gypsum drywall applied to solid substrates.
  - .5 Gypsum drywall applied to ceilings.
  - .6 Gypsum drywall finishing including joint tape and compound treatment.
- .2 The Work included under this Section shall conform to the industry standard and be accepted by the local construction and trade associations.

#### 1.5 **QUALITY ASSURANCE**

- .1 Fire-resistance Ratings: Where gypsum drywall assemblies with fire-resistance ratings are indicated, provide Gypsum system that provides the required rating.
  - .1 Provide fire-resistance rated assemblies identical to those indicated by reference to GA File Nos. in GA Fire Resistance Design Manual or to design designations in UL Fire Resistance Directory, Warnock Hersey (WHI) listing, or in listing of other testing and agencies acceptable to authorities having jurisdiction.

#### 1.6 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver Materials in original packages, containers or bundles bearing brand name and identification.
- .2 Store Materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.
- .3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

#### 1.7 **PROJECT CONDITIONS**

- .1 Environmental Requirements General: Comply with requirements of gypsum board application standards for environmental conditions before, during and after application of gypsum board.
- .2 Cold Weather Protection: When outdoor temperature is below 10 °C, maintain building working temperature of not less than 10 °C for a period of 48 hours prior to, during and following application of gypsum board and joint treatment Materials or bonding adhesives.
- .3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment Material immediately after its application.

#### 1.8 **WASTE MANAGEMENT AND DISPOSAL**

- .1 Remove from Site and dispose of packaging Materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging Material for recycling in accordance with Waste Management Plan.
- .3 Divert unused gypsum from landfill to gypsum recycling facility for disposal approved by Contract Administrator.
- .4 Divert unused metal Materials from landfill to metal recycling facility approved by Contract Administrator.

- .5 Divert unused wood Materials from landfill to recycling, composting facility approved by Contract Administrator.
- .6 Divert unused paint and caulking Material from landfill to official hazardous Material collections Site approved by Contract Administrator.
- .7 Do not dispose of unused paint and caulking Materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Give preference to gypsum board manufacturers that manufacture in the Province of the Work or have recycled content.
- .2 Standard interior board: to ASTM C 36 regular, 5/8" Type X, 4'-0" wide x maximum practical length, square ends with edges bevelled.
- .3 Boarding at wet areas: to ASTM C630, use moisture resistant GWB at wet areas, typical.
- .4 Use abuse-resistant GWB at bottom 4'-0" of walls in public areas, typical.
- .5 Water resistant backer board for all washroom walls behind ceramic tile: to ASTM C630/C630M regular, 1/2" thick, in maximum practical width and length. Acceptable products: Durock Tile Backer Board (CGC), DensShield Tile Backer, or approved equal in accordance with B7 in accordance with B7; cover joints with tape type as per manufacturer's directions.
- .6 Exterior wall and soffit sheathing board: 5/8", Type X, DensGlass Gold by Georgia Pacific or approved equal in accordance with B7.
- .7 Exterior roof parapet sheathing board: Type X, DensDeck by Georgia Pacific or approved equal in accordance with B7. Thicknesses as noted on Drawings.
- .8 Gypsum liner panels: 1" thick Certainteed Sheetrock gypsum liner panels or approved equal in accordance with B7, to meet ULC design W452, system C.
- .9 Drywall furring channels: 1/64" core thickness galvanized steel channels for screw attachment of gypsum board.
- .10 Resilient channel: 1/64" base steel thickness galvanized steel for resilient attachment of gypsum board.
- .11 Steel drill screws: to ASTM C 1002 or latest.
- .12 Stud adhesive: to CAN/CGSB-71.25 or latest.
- .13 Laminating compound: as recommended by manufacturer, asbestos-free.
- .14 Sealants: in accordance with Section 07 92 00 – Joint Sealers.
- .15 Acoustic sealant: See Section 07 92 00 – Joint Sealers.
- .16 Polyethylene: to CAN/CGSB-51.34 or latest, Type 2.
- .17 Insulating strip: rubberized, moisture resistant, 1/8" thick closed cell neoprene strip, 1/2" wide, with self sticking permanent adhesive on one face, lengths as required.
- .18 Joint compound: to ASTM C 475 or latest, asbestos-free.

## **Part 3 Execution**

### **3.1 ERECTION**

- .1 Do application and finishing of gypsum board in accordance with ASTM C 840 or latest except where specified otherwise.

- .2 Do application of gypsum sheathing in accordance with ASTM C 1280 or latest.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C 840 or latest except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 6" of each corner and at maximum 2'-0" around perimeter of fixture.
- .5 Install Work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers and grilles.
- .7 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .8 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .9 Install wall furring for gypsum board wall finishes in accordance with ASTM C 840 or latest, except where specified otherwise.
- .10 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .11 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .12 Erect drywall resilient furring transversely across studs, spaced maximum 2'-0" o.c. and not more than 6" from ceiling/wall juncture. Secure to each support with 1 1/2" common nail or 1" drywall screw.
- .13 Install 6" continuous strip of 1/2" gypsum board along base of partitions where resilient furring installed.

### 3.2 APPLICATION

- .1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical Work are approved.
- .2 Apply single or double layer gypsum board to wood or metal furring or framing using screw fasteners for first layer, screw fasteners for second layer. Maximum spacing of screws 1'-0" o.c.
- .3 Apply single layer gypsum board to concrete or concrete block surfaces, where indicated, using laminating adhesive. Brace or fasten gypsum board until fastening adhesive has set. Gypsum board shall be mechanically fastened at top and bottom of each sheet.
- .4 Apply water-resistant gypsum board where wall tiles to be applied and adjacent to slop sinks and 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.
- .5 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, ducts, in partitions where perimeter sealed with acoustic sealant.
- .6 On ceilings: Apply base layer prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 1'-0". Apply base layers at right angles to supports unless otherwise indicated.

### 3.3 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 6".
- .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.
- .4 Feather coats onto adjoining surfaces so that difference is max 1/32".
- .5 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .6 Provide continuous polyethylene dust barrier behind and across control joints.
- .7 Locate control joints where indicated on Drawings and at a maximum 30'.
- .8 Install control joints straight and true.
- .9 Apply J-trim and Fast-Mask trim to all visible surfaces of dissimilar Materials: ie. To timber, PVC, metal, masonry, glass, etc.
- .10 Install access doors to electrical and mechanical fixtures specified in respective Sections.
  - .1 Rigidly secure frames to furring or framing systems.
- .11 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.
- .12 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.
- .13 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .14 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .15 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .16 Remove ridges by light sanding or wiping with damp cloth.
- .17 Install sound attenuation blankets where indicated.
- .18 Install ceiling boards in the direction that will minimize the number of end-but joints. Stagger end joints at least 1'-0".
- .19 Install gypsum board on wall vertically to avoid end-but 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.
- .20 Install gypsum board with face side out. Do not install damaged or damp boards.
- .21 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite side of wall.

3.4 SCHEDULES

- .1 Construct fire rated assemblies where indicated.
- .2 Use water resistant + abuse resistant drywall in all washrooms and where indicated.

**END OF SECTION**

**Part 1**

**General**

- 1.1 RELATED SECTIONS
  - .1 Section 01 33 00 – Submittal Procedures
  - .2 Section 01 78 00 – Closeout Submittals
  - .3 Section 07 92 00 – Joint Sealing
- 1.2 REFERENCES
  - .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)
    - .1 ANSI A108.1-99, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-13, A118.1-10, ANSI A136.1) or latest.
    - .2 CTI A118.3-92, Specification for Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1) or latest.
    - .3 CTI A118.4-92, Specification for Latex Portland Cement Mortar (included in ANSI A108.1) or latest.
    - .4 CTI A118.5-92, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1) or latest.
    - .5 CTI A118.6-92, Specification for Ceramic Tile Grouts (included in ANSI A108.1) or latest.
  - .2 American Society for Testing and Materials (ASTM International) International
    - .1 ASTM C144-99, Specification for Aggregate for Masonry Mortar or latest.
    - .2 ASTM C 207-91(1997), Specification for Hydrated Lime for Masonry Purposes or latest.
    - .3 ASTM C847-95(2000), Specification for Metal Lath or latest.
    - .4 ASTM C979-99, Specification for Pigments for Integrally Coloured Concrete or latest.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-51.34-M86 (R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction or latest.
    - .2 CGSB 71-GP-22M-78, Adhesive, Organic, for Installation of Ceramic Wall Tile or latest.
    - .3 CAN/CGSB-75.1-M88, Tile, Ceramic or latest.
    - .4 CAN/CGSB-25.20-95, Surface Sealer for Floors or latest.
  - .4 Canadian Standards Association (CSA International)
    - .1 CAN/CSA-A3000-98, Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98) or latest.
    - .2 CSA A123.3-98, Asphalt Saturated Organic Roofing Felt or latest.
  - .5 Terrazzo Tile and Marble Association of Canada (TTMAC)
    - .1 Tile Specification Guide 09300 2000, Tile Installation Manual.
    - .2 Tile Maintenance Guide 2000.
- 1.3 PRODUCT DATA
  - .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.
  - .2 Include manufacturer's information on:
    - .1 Each tile type, size, and shape required.

- .2 Chemical resistant mortar and grout (Epoxy and Furan).
- .3 Cementitious backer unit.
- .4 Dry-set Portland cement mortar and grout.
- .5 Divider strip.
- .6 Elastomeric membrane and bond coat.
- .7 Reinforcing tape.
- .8 Leveling compound.
- .9 Latex-Portland cement mortar and grout.
- .10 Commercial Portland cement grout.
- .11 Organic adhesive.
- .12 Slip resistant tile.
- .13 Waterproofing isolation membrane.
- .14 Fasteners.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit duplicate 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.
- .4 Adhere tile samples to 11 mm thick plywood and grout joints to represent project installation.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver Materials in containers with labels legible and intact and grade-seals unbroken.
- .2 Store Material so as to prevent damage or contamination.
- .3 Store Materials in a dry area, protected from freezing, staining and damage.
- .4 Store cementitious Materials on a dry surface.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from Site and dispose of all packaging Materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging Material [in appropriate on-site] for recycling in accordance with Waste Management Plan.
- .3 Unused adhesive, sealant and coating Materials must be disposed of at an official Hazardous Materials collections Site as approved by the Contract Administrator.
- .4 Unused adhesive, sealant and coating Materials must not be disposed of into the sewer system, into streams, lakes, onto the ground or in other location where it will pose a health or environmental hazard.
- .5 Broken ceramic Materials must be diverted from landfill to a local facility as approved by Contract Administrator.

1.7 ENVIRONMENTAL CONDITIONS

- .1 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 °C for 48 h before, during, and 48 h after, installation.
- .2 Do not install tiles at temperatures less than 12 °C or above 38 °C.
- .3 Do not apply epoxy mortar and grouts at temperatures below 15 °C or above 25 °C.



1.8 EXTRA MATERIAL

- .1 Provide maintenance Materials in accordance with Section 01 78 00 - Closeout Submittals, to a minimum 2% of the total area of each tile type and colour required for maintenance use to the City and store where directed.
- .2 Maintenance Material to be of same production run as installed Material.

**Part 2 Products**

2.1 FLOOR AND WALL TILES

- .1 Field and accent tile: to match existing size, colour, pattern and finish of adjacent tiles where selective demolition, and patch-and-make-good occurs. Contractor to submit Shop Drawings and samples for approval by Contract Administrator.
- .2 Acceptable manufacturers and suppliers: Dal-Tile, Olympia Tile, or approved equal in accordance with B7.
- .3 All tiling to include matching specialty tiles for external corner and angles, and coved bases.

2.2 MORTAR AND ADHESIVE MATERIALS

- .1 Portland 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 portland cement mortar and thin set bond coat.
- .5 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.

2.3 BOND COAT

- .1 Dry set Portland cement mortar: to ANSI A108.1.
- .2 Organic adhesive: to [CGSB 71-GP-22M, Type [1] [2]] [ANSI A136.1].
- .3 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<sup>2</sup>.
  - .2 Bond Strength: 53 kg/cm<sup>2</sup>.
  - .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.

2.4 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. (Site coloured grout is not acceptable).
  - .3 Use in Commercial Portland Cement Grout, Dry-Set Grout, and Latex-Portland Cement Grout.

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- .2 Commercial Portland Cement Grout: to CTI A118.6.
  - .3 Dry-Set Grout: to CTI A118.6.
  - .4 Latex-Portland Cement Grout: to ANSI A108.1, 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.
- 2.5 ACCESSORIES
- .1 Reinforcing mesh: 50 x 50 x 1.6 x 1.6 mm galvanized steel wire mesh, welded fabric design, in flat sheets, where required.
  - .2 Transition Strips: purpose made metal extrusion; anodized aluminum type.
  - .3 Reducer Strips: purpose made metal extrusion; anodized aluminum type; maximum slope of 1:2.
  - .4 Prefabricated Movement Joints: 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.
  - .5 Sealant: in accordance with Section 07 92 00 – Joint Sealers.
  - .6 Floor sealer and protective coating: to CAN/CGSB-25.20, Type 1 to tile and grout manufacturers recommendations with 0 or low VOC.
- 2.6 MIXES
- .1 Portland Cement:
    - .1 Scratch coat: 1 part portland cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand, 1 part water, [and latex additive where required]. Adjust water volume depending on water content of sand.
    - .2 Slurry bond coat: portland cement and water mixed to creamy paste. Latex additive may be included.
    - .3 Mortar bed for floors: 1 part portland cement, 4 parts sand, 1 part water. Adjust water volume depending on water content of sand. [Latex additive may be included].
    - .4 Mortar bed for walls and ceilings: 1 part portland cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand and 1 part water. Adjust water volume depending on water content of sand. [Latex additive may be included].
    - .5 Levelling coat: 1 part portland cement, 4 parts sand, minimum 1/10 part latex additive, 1 part water including latex additive.
    - .6 Bond or setting coat: 1 part portland cement, 1/3 part hydrated lime, 1 part water.
    - .7 Measure mortar ingredients by volume.
  - .2 Dry set mortar: mix to manufacturer's instructions.
  - .3 Organic adhesive: pre-mixed.
  - .4 Mix bond and levelling coats, and grout to manufacturer's instructions.
  - .5 Adjust water volumes to suit water content of sand.
- 2.7 PATCHING AND LEVELING COMPOUND
- .1 Portland 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 levelling compounds and elastomeric waterproofing membrane and coat. Materials containing acid or caustic Material are not acceptable.

**Part 3 Execution**

3.1 WORKMANSHIP

- .1 All tile Work shall be in accordance with TTMAC Tile Installation Manual 2000, "Ceramic Tile", unless specified otherwise, and appropriate to the location and to the substrate.
- .2 Apply tile or backing coats 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 a minimum of 1/2 size. Centre patterns as shown on Drawings.
- .7 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .8 Allow minimum 24 h after installation of tiles, before grouting.
- .9 Clean installed tile surfaces after installation and grouting cured.
- .10 Make control joints at 3m in each direction. Make joint width same as tile joints. Fill control joints with sealant in accordance with Section 07 92 00 – Joint Sealers. Keep building expansion joints free of mortar and grout.

3.2 FLOOR SEALER AND PROTECTIVE COATING

- .1 Apply in accordance with manufacturer's instructions.

**END OF SECTION**

- Part 1**            **General**
- 1.1                SUMMARY
- .1            Section Includes:
- .1        Materials and application of acoustical ceiling tile units for application and installation within a suspended ceiling.
- .2            Related Sections:
- .1        Section 01 33 00 – Submittal Procedures
- .2        Section 01 35 30 – Health and Safety Requirements
- .3        Section 01 45 00 – Quality Control
- .4        Section 01 78 00 – Closeout Submittals
- 1.2                REFERENCES
- .1            American Society for Testing and Materials International (ASTM)
- .1        ASTM C423-02a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method or latest
- .2        ASTM E1264-98, Standard Classification for Acoustical Ceiling Products or latest.
- .3        ASTM E1477-98a(2003), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers or latest.
- .2            Canadian General Standards Board (CGSB)
- .1        CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction and Amendment No. 1 1988 or latest.
- .2        CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units or latest.
- .3            Canadian Standards Association (CSA International)
- .1        CSA B111-1974(R2003), Wire Nails, Spikes and Staples or latest.
- .4            Department of Justice Canada (Jus)
- .1        Canadian Environmental Protection Act (CEPA), 1999, c. 33 or latest.
- .2        Transportation of Dangerous Goods Act (TDGA), 1992, c. 34 or latest.
- .5            Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1        Material Safety Data Sheets (MSDS).
- .6            Underwriter's Laboratories of Canada (ULC)
- .1        CAN/ULC-S102-2003, Surface Burning Characteristics of Building Materials and Assemblies or latest.
- 1.3                SUBMITTALS
- .1            Submit samples in accordance with Section 01 33 00 - Submittal Procedures
- .2            Submit duplicate samples of each type and colour of acoustical units.
- 1.4                QUALITY ASSURANCE
- .1            Regulatory Requirements:
- .1        Fire-resistance rated floor/ceiling and roof/ceiling assembly (where applicable): certified by Canadian Certification Organization accredited by Standards Council of Canada.

- .2 Health and Safety:
  - .1 Construction occupational health and safety shall be in accordance with Section 01 35 30 - Health and Safety Requirements.
- 1.5 DELIVERY, STORAGE AND HANDLING
  - .1 Protect on Site stored or installed absorptive Material from moisture damage.
  - .2 Waste Management and Disposal:
    - .1 Remove from Site and dispose of packaging Materials at appropriate recycling facilities.
    - .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 (WMP)].
    - .3 Separate for reuse and recycling and place in designated containers waste in accordance with Waste Management Plan.
    - .4 Place Materials defined as hazardous or toxic in designated areas.
    - .5 Handle and dispose of hazardous Materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.
    - .6 Ensure emptied containers are sealed and stored safely.
    - .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.
- 1.6 ENVIRONMENTAL REQUIREMENTS
  - .1 Permit wet Work to dry before beginning of installation.
  - .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20- 40% before and during installation.
  - .3 Store Materials in Work area 48 hours prior to installation.
- 1.7 EXTRA MATERIALS
  - .1 Provide extra acoustic ceiling tile units in accordance with Section 01 78 00 - Closeout Submittals, to an extra quantity of 2% of the gross ceiling area for each pattern, type, and colour selected for this project. Ensure extra Materials are from same production run as installed Materials.
  - .2 Clearly identify each type of acoustic unit, including colour and texture.
  - .3 Deliver to the City upon completion of the Work of this section and store as directed.
- Part 2** **Products**
- 2.1 MATERIALS – SUSPENSION SYSTEM
  - .1 Suspension system to meet load compliance to ASTM C635: commercial quality cold rolled steel with hot dipped galvanized coating and minimum recycled content of 25%.
  - .2 Hanger wire: galvanized soft annealed steel wire.
    - .1 5/32" mm diameter for accessible tile ceilings to ULC design requirements for fire rated assemblies.
    - .2 1/8" diameter for other ceilings.
  - .3 Hanger inserts: purpose made.
  - .4 Carrying channels: 1 1/2" x channel, of galvanized steel.

- .5 Accessories: splices, clips, wire ties, retainers and wall moulding to complement suspension system components, as recommended by system manufacturer.
- .6 Suspension system: non-fire rated unless otherwise noted. Two-directional exposed tee system with standard type wall moulding clip. Colour white. Acceptable Material: CertainTeed 15/16" Classic Hook System or approved equal in accordance with B7 Substitutions.

## 2.2 MATERIALS – ACOUSTICAL TILES

- .1 Acoustical Panels, (ACT-1):
  - .1 24" x 24" x 3/4". Fire Class A. Colour white. Minimum standards: NRC 0.75; LR 0.85; recycled content 75%. Trim edge, lay-in.
  - .2 Acceptable Products: CGC Mars ClimaPlus, Armstrong Health Zone OPTIMA, CertainTeed Symphony m, or Architect approved equal. Execution

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Install acoustical panels and tiles after ceiling space above has been inspected by the Contract Administrator.

### 3.2 INSTALLATION

- .1 Install acoustical tile units to fit snugly into ceiling suspension system, in accordance with manufacturer's printed instructions.
- .2 Install acoustical units generally parallel to building lines with border units not less than 50% of a typical unit width and to patterns as shown on the drawings.
- .3 Scribe acoustic units to fit adjacent Work. Butt joints tight and terminate edges with purpose made edging.

### 3.3 INTERFACE WITH OTHER WORK

- .1 Co-ordinate and cut ceiling units to accommodate components such as light fixtures, diffusers, speakers, sprinkler heads, and all other items that penetrate through.

**END OF SECTION**

- PART 1            General**
- 1.1            RELATED WORK
- .1            Section 03 35 00 – Concrete Finishing
- 1.2            SAMPLES
- .1            Submit sample 12" square pieces of all sheet Materials.
- 1.3            MAINTENANCE DATA/MATERIALS
- .1            Provide maintenance data for the City's use.
- .2            Provide Material equal to two percent (2%) of sheet flooring area (minimum 12ft x 12ft) for maintenance use.
- 1.4            ENVIRONMENTAL REQUIREMENTS
- .1            Air temperature and substrate temperature at flooring installation area must be above 20°C for 72 hours before, during, and 48 hours after installation.
- .2            Store Materials for three days prior to installation in area of installation to achieve temperature stability.
- 1.5            WARRANTY
- .1            The Flooring Subcontractor and the manufacturer are to jointly warrant this installation against defects in workmanship and Material for a period of two (2) years from date of Certificate of Substantial Performance.
- 1.6            WASTE MANAGEMENT AND DISPOSAL
- .1            Remove from Site and dispose of packaging Materials at appropriate recycling facilities.
- .2            Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging Materials for recycling in accordance with the Waste Management Plan.
- .3            Dispose of unused finish and adhesive Materials at official Hazardous Material collections Site approved by the Contract Administrator.
- .4            Do not dispose of unused finish and adhesive Materials into sewer system, into streams, lakes, onto the ground or in other locations where it will pose health or environmental hazard.
- PART 2            Products**
- 2.1            RESILIENT SHEET FLOORING (RSF)
- .1            Resilient sheet flooring, homogeneous vinyl, 2.0mm thick: Contract Administrator to choose from standard pattern and colour range (allow for 3 colours). Acceptable products:
- .1            iQ Granit by Johnsonite
- .2            Medintone/Medintech by Armstrong
- .3            Equal approved by Contract Administrator, in accordance with B7 Substitutes.
- 2.2            RESILIENT ATHLETIC TILE FLOORING (RAF)
- .1            Resilient Rubber Athletic Tile Flooring with the following physical characteristics:
- .1            Complies with requirements for ASTM F 1344 Standard Specification for Rubber Floor Tile Class 1-A and 1-B.
- .2            Tile manufactured of dual durometer layers composed of 100% synthetic and natural rubber.

- .3 Tile is two-ply vulcanized construction which incorporates a rubber wear layer and an elastic cushioned performance layer.
  - .4 Spike and Skate warrantied.
  - .5 Wear layer thickness: .090" (2.3 mm).
  - .6 Overall thickness: must be 3/8".
  - .7 Tile design, texture, and color:
    - .1 Supplier to allow for custom colour selections as noted below.
    - .2 Square Edge (glue down), 24" x 24", Hammered Texture:
      - .1 Solid Color – custom colour from Pantone colour swatch system.
      - .2 Speckled Color – selected from manufacturer's full available colour range.
      - .3 Marbleized Color – selected from manufacturer's full available colour range.
  - .8 ASTM D 2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring of 0.6 or greater.
  - .9 ASTM F 970, Standard Test Method for Static Load Limit – passes 250 PSI.
  - .10 ASTM D 3389 Standard Test Method for Coated Fabrics Abrasion Resistance: < 1.00 gram weight loss.
  - .11 ASTM E 648, Standard Test method for Critical Radiant Flux of 0.45 watts/cm<sup>2</sup> or greater, Class I.
  - .12 Resilient Rubber Athletic Flooring contains 7% rapidly renewable content
  - .13 100% Recyclable
  - .14 Phthalate, chlorine and halogen-free
  - .15 Rubber Athletic Tile Flooring contains 53% pre-consumer recycled content
  - .16 Manufacturing facilities must be ISO 9001 and ISO 14001 Certified
  - .17 No dye lot production
  - .18 Must contain no Red List Ingredients
  - .19 Must be C2C Bronze Certification
  - .20 No bricks or weights required for installation (for weighing down product for proper adhesion)
  - .21 Standard of Acceptance:
    - .1 Triumph Rubber Multi-functional and Sports Floor Tiles by Tarkett
    - .2 Sport Impact by Mondo
      - .1 Tiles – 36" x 36" (915mm x 915mm) – 3/8" (10mm) thick
    - .3 Sportfloor Reaction by Northwest Rubber
      - .1 Tiles – 39" x 39" (1m x 1m) – 3/8" (10mm) thick
    - .4 Equal approved by Contract Administrator, in accordance with B7 Substitutes.
- 2.3 RESILIENT STAIR/RAMP - DETECTABLE WARNING SURFACES (DWS)
- .1 Tactile Stair/Ramp Detectable Warning Surface: tile-type (to match flooring), non-slip with texture, pattern and colour in contrast to floor covering on landing, of size in accordance with Code requirements, and thickness/materials/durability to match adjacent flooring, including skate/spike warrantied flooring.
    - .1 Size: width to match clear width btw. handrails at top and bottom of ramp, depth to be min. 2'-0"



2.4 BASES

- .1 Resilient rubber base: top set coved, 1/8" thick, rubber, 4" high. Standard of acceptance: Roppe vinyl wall base. Colour: to be selected by Contract Administrator from standard range of colours.

2.5 MISC. MATERIALS

- .1 Reducer strips: 1" wide, thickness of tile, rubber, colour to be selected from full range of colours. Standard of acceptance: Johnsonite "Color Match" system. Roppe products are acceptable "as Equal".
- .2 Primers and adhesives: Two-part polyurethane adhesive suitable for moisture exposure (all areas) – specific adhesive to be as per manufacturer's warrantable installation for specific flooring product.
- .3 Sub-floor filler: polymer modified cementitious-based floor patch, with acrylic additive. Standard of acceptance: Mapei Plani-Patch, Roberts R-Krete.
- .4 Poly-sheet: to CAN/CGSB-51.33, "Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction", Type 2, 0.15mm (6 mil) thick.

**PART 3 Execution**

3.1 SITE AND SUBSTRATE

- .1 Building shall be dry and closed in, with minimum temperature of 18°C. All painting shall be completed.
- .2 Store Material in area of application 72 hours before application.
- .3 Accept or reject concrete substrate as to moisture content and level ( $\pm$  6mm/3000mm (1/4"/10ft) radius).
- .4 Ensure concrete floors exhibit negative alkalinity, carbonization, or dusting.
- .5 Ensure smooth, hard surface, without imperfections, which may 'telegraph' through the flooring.

3.2 MOISTURE TESTING

- .1 Ensure concrete floors are dry (maximum seven percent (7%) moisture content) by using test methods recommended by flooring manufacturer.

3.3 SUBSTRATE PREPERATION

- .1 Remove substrate ridges and bumps with power sander.
- .2 Fill minor low spots (up to 1/4"), cracks, joints, holes and other defects with sub- floor filler.
- .3 Clean substrate and apply filler, trowel and float to leave smooth, flat, hard surface. Prohibit traffic until filler cured.
- .4 Prime or seal substrate to resilient flooring manufacturer's recommendations.

3.4 INSTALLATION - SHEET FLOORING

- .1 Install in strict compliance with manufacturer's current installation Specifications, using skilled, trained installer technicians.
- .2 Unroll and layout strips full length, with seams parallel to building lines to produce a minimum number of seams. Cross-joints are not permitted. Border widths minimum 1/3 width of full Material.
- .3 Spread adhesive uniformly using recommended trowel and lay strips. Do not spread more adhesive than can be covered by flooring before initial set take place.

- .4 Double cut sheet joints and continuously seal. Heat weld sides and seams with manufacturer's matching vinyl thread with approved heat welding equipment.
  - .5 As installation progresses, and after installation, roll flooring with a 45 kg (100 lb) roller to ensure full adhesion.
  - .6 Cut flooring and fit neatly around fixed or excessively heavy objects.
  - .7 Install feature strips and floor markings where indicated. Fit joints tightly.
  - .8 Install flooring in pan type floor access covers. Maintain floor pattern.
  - .9 Continue flooring over areas, which will be under built-in furniture.
  - .10 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
  - .11 Terminate flooring at centerline of door in openings where adjacent floor finish thickness or colour is dissimilar. Note locations where Material thickness changes, flooring Material on door swing side shall continue to accommodate door drop sound seals.
  - .12 Install metal edge strips at unprotected or exposed edges where flooring terminates.
  - .13 Install reducer strips at edge of tile and resilient sheet Material, seamless Material and tile of different thickness.
  - .14 Seal with silicone sealant around perimeter at wall-floor joint before installing resilient base and at door frame-floor junction.
  - .15 Install cove filler strip and provide 4" high self-base with cap, mitre inside corners, and fill outside corners.
- 3.5 INSTALLATION – ATHLETIC TILE FLOORING
- .1 Install per manufacturer's instructions.
  - .2 Use 975 two part urethane adhesive, typical.
- 3.6 INSTALLATION - BASE
- .1 Fit joints tight and vertical. Maintain minimum measurements of 24" between joints.
  - .2 Miter internal corners. At vertical corners, "V" cut back of base strip to 2/3 of its thickness and fold.
  - .3 Install base on solid backing. Bond tight to wall and floor surface.
  - .4 Scribe and fit to door frames and other interruptions.
- 3.7 CLEANING
- .1 Section 01 74 00 – Cleaning. Clean Work.
  - .2 Remove access adhesive from floor, base and wall surface without damage.
  - .3 Clean, seal and wax floor and base surfaces in accordance with manufacturer's instructions.
- 3.8 PROTECTION OF FINISHED WORK
- .1 Prohibit traffic on floor finish for 48 hours after installation.
  - .2 Protect new floors with polyethylene cover until just before final cleaning or finish.

**END OF SECTION**

- PART 1            General**
- 1.1            SECTION INCLUDES
- .1            Two-component, solid colour, seamless, self-priming, epoxy resin flooring.
- 1.2            RELATED SECTIONS
- .1            Section 07 91 26 - Joint Fillers.
- .2            Section 09 29 00 - Gypsum Board.
- 1.3            REFERENCES
- .1            ASTM C 307: Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
- .2            ASTM C 501: Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
- .3            ASTM C 522: Standard Test Method for Airflow Resistance of Acoustical Materials.
- .4            ASTM C 531: Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- .5            ASTM C 884: Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay.
- .6            ASTM D 570: Standard Test Method for Water Absorption of Plastics.
- .7            ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- .8            ASTM D 2047: Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
- .9            ASTM D 2240: Standard Test Method for Rubber Property-Durometer Hardness.
- .10            ASTM D 5054: Gardner Impact Test.
- .11            ASTM F 1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- .12            ASTM F 2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- .13            MIL-D-3134F: Bond Strength.
- .14            MIL-F-52505: Fungus and Bacteria Growth.
- 1.4            SUBMITTALS
- .1            Submit under provisions of Section 01 30 00 – Submittal Procedures.
- .2            [ Product Data ]: Manufacturer's data sheets on each product to be used, including:
- .1            Submit descriptive data and specific recommendations for mixing, application, curing including any precautions of special handling instructions required to comply with the Occupational Safety and Health Act.
- .2            Prepare instructions and recommendations.
- .3            Submit storage and handling requirements and recommendations.
- .3            Shop Drawings: Shop Drawings shall be furnished showing installation and details at floor material transitions and flexible joints.

- .1 Locate and provide detailing for flexible joints if required in area of installation.
  - .4 Selection Samples: For each finish product specified, submit maximum of three samples, 6 inches by 6 inches for each color and type of coating available from manufacturer's full range.
  - .5 Maintenance Literature: Submit two copies of manufacturer's maintenance recommendations at project closeout.
- 1.5 QUALITY ASSURANCE
- .1 Manufacturer Qualifications: Materials used in the floor surfacing shall be the products of a single manufacturer.
  - .2 Installer Qualifications:
    - .1 Installation shall be performed by an applicator with minimum 3 years experience in work of similar nature and scope. Installer shall be approved by the manufacturer of the floor surfacing materials. The Contractor shall furnish a written statement from the manufacturer that the installer is acceptable.
    - .2 Contractor shall have proven experience with specified system.
  - .3 Certification:
    - .1 Manufacturer shall furnish certification attesting that materials meet specification requirements.
    - .2 Manufacturer shall furnish properly labeled material and Material Safety Data Sheets which comply to current state and federal requirements.
    - .3 Manufacturer shall submit certification that installer is an approved applicator of material selected.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- .1 All materials shall be delivered to project site in original manufacturer's sealed containers including type of material, batch numbers, date of manufacture, and pertinent labels intact and legible.
  - .2 Store materials in dry protected area at a temperature between 60 degree F (15 degrees C) and 80 degree F (27 degrees C).
  - .3 Follow all manufacturer's specific instructions and prudent safety practices for storage and handling.
  - .4 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- 1.7 PROJECT CONDITIONS
- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- 1.8 WARRANTY
- .1 Defective Material Warranty: One year from date of Substantial Performance.

**PART 2 Products**

2.1 FLUID-APPLIED FLOORING SYSTEM

- .1 Acceptable System: SikaFloor 261 CA
  - .1 Requests for substitutions will be considered in accordance with B7.
  - .2 Thickness: to manufacturers minimum requirements.
  - .3 Primer: Only as recommended by the manufacturer.
  - .4 Color: Selected by Contract Administrator from manufacturers full range.

**PART 3 Execution**

3.1 EXAMINATION

- .1 Examine areas to receive coatings for:
  - .1 Concrete surfaces shall be in sound condition and properly prepared prior to flooring system installation.
  - .2 Defects in existing work that affect proper execution of coating work.
  - .3 Deviations beyond allowable tolerances for the concrete slab work.
- .2 Do not begin installation until substrates have been properly prepared.
- .3 If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- .1 Prepare substrate to receive coating in accordance with manufacturer's recommendations.
- .2 Substrate shall be free of dirt, waxes, curing agents, and other foreign materials.
- .3 Objectionable substrate irregularities that will transmit through coating system shall be removed.
- .4 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- .5 Cast-in-Place Concrete:
  - .1 Shotblast or rough grind area to receive coating according to manufacturer's recommendations.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Locate all flexible joints required.
- .3 Provide accessories necessary for complete installation.

3.4 CLEANING

- .1 Wash all surfaces with a neutral cleaner.

3.5 PROTECTION

- .1 Upon completion, the work shall be ready for final review by the City and Contract Administrator.

3.6 PROTECTION

- .1 The Contractor shall protect the finished floor from the time that the coating installer completes the work.
- .2 Protect installed products until completion of project.
- .3 Touch-up, repair or replace damaged products before Substantial Performance.

END OF SECTION

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 This section includes labor, Materials and other services necessary to complete vinyl wall coverings.
- .2 Conform with requirements of all Sections of Division 1, General Requirements, as it applies to the Work of this Section.

**1.2 RELATED SECTIONS**

- .1 Section 06 10 00 - Rough Carpentry.
- .2 Division 7 - Thermal and Moisture Protection.
- .3 Section 09 29 00 – Gypsum Board.

**1.3 REFERENCES**

- .1 General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- .2 American Society for Testing & Materials (ASTM):
  - .1 AST ASTM E 84-05 Standard Test Method for Surface Burning Characteristics of Building Materials. CLASS A
  - .2 ASTM D5420 Gardner Impact Exceeds 160 inch pounds

**1.4 SYSTEM DESCRIPTION**

- .1 Performance Requirements: Provide hygienic Altro Whiterock wall covering which has been manufactured by Altro and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

**1.5 SUBMITTALS**

- .1 Product Data: Submit manufacturer's current printed Product literature, specifications, installation instructions, and field reports in accordance with Section 01330 - Submittal Procedures.
- .2 Shop Drawings: Submit shop drawings to indicate Materials, details, and accessories in accordance with Section 01 33 00 Submittal Procedures including but limited to the following:
- .3 Submit a layout diagram indicating the location of each panel and joining method.
- .4 Samples: Submit duplicate sample pieces of panel Material, as well as accessory pieces in accordance with Section 01 33 00 Submittal Procedures.
- .5 Quality Assurance Submittals: Submit the following:
  - .1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
  - .2 Manufacturer's Instructions: Current published manufacturer's installation and maintenance instructions.
  - .3 Manufacturer's Field Reports: Specified herein.

- .6 Closeout Submittals: Submit the following:
  - .1 Operation and Maintenance Data: Operation and maintenance data for installed Products in accordance with Section 01 78 00 Closeout Submittals (Maintenance Data and Operation Data). Include methods for maintaining installed Products and precautions against cleaning Materials and methods detrimental to finishes and performance.
  - .2 Warranty: Warranty documents specified herein.
- 1.6 QUALITY ASSURANCE
  - .1 Installer Qualifications: Installer experienced in performing Work of this section who has specialized in installation of Work similar to that required for this project.
    - .1 Training: Installer who has attended an Altro Whiterock installation training clinic.
  - .2 Mock-ups: Install at project Site a job mock-up using acceptable Products and manufacturer approved installation methods. Obtain the City's and Contract Administrator's acceptance of finish color, texture and pattern, and Workmanship standards.
    - .1 Mock-Up Size: two full size panels.
    - .2 Maintenance: Maintain mock-up during construction for Workmanship comparison; remove and legally dispose of mock-up when no longer required.
    - .3 Incorporation: Mock-up may be incorporated into final construction upon The City's approval.
  - .3 Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.
- 1.7 DELIVERY, STORAGE, AND HANDLING
  - .1 Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
  - .2 Deliver, store and handle Altro Whiterock wall panels in accordance with Section 01 60 00 Basic Product Requirements.
  - .3 Deliver Materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
  - .4 Store Materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
  - .5 Store panels in temperature controlled environments. Leave protective blue film on panel until ready to use.
- 1.8 WASTE MANAGEMENT AND DISPOSAL
  - .1 Deposit all packaging Materials in appropriate container on Site for recycling or reuse.
  - .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
  - .3 Keep all discarded packaging away from children.
- 1.9 PROJECT CONDITIONS
  - .1 Temperature Requirements: If storage temperature is below 65F (18C), the Altro Whiterock wall panel must be moved to a warmer place and allowed to reach this



temperature before installation. For further information, refer to current Installation Guide.

- .2 Maintain air temperature and structural base temperature at installation area between 65F (18C) and 80F (26C) for 48 hours before, during and 24 hours after installation.

#### 1.10 WARRANTY

- .1 Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- .2 Manufacturer's Warranty: Submit, for the City's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the City may have under Contract Documents.
- .3 Warranty Period for Altro Whiterock shall be 20 years commencing on Date of Substantial Performance.

#### 1.11 EXTRA MATERIALS

- .1 Provide extra Materials of Product and adhesives in accordance with Section 01 78 00 Closeout Submittals.
- .2 Provide two panels (minimum 1220mm x 2490mm each) for each colour, of extra Materials in one piece and from same Production run as installed Materials.
- .3 Clearly identify each wall panel and each container of adhesive.
- .4 Deliver to the City, upon completion of the Work of this Section and store where directed.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- .1 Manufacturer: Altro  
USA: 80 Industrial Way, Wilmington, MA 01887  
Toll-free: 800.377.5597 Fax: 978.694.0433  
E-mail: support@altrofloors.com Web Site: www.altrofloors.com.

#### 2.2 HYGIENIC WALL COVERINGS

- .1 100% pure vinyl, extruded, semi-rigid PVCu sheet. No plasticizers or fillers. Homogenous.
- .2 Acceptable Material: Altro Whiterock™ (measurements and Product weights given below are approximate) or approved equal in accordance with B7 Substitutions:
  - .1 Thickness: 2.5mm
  - .2 Panel size: 1220mm wide x 2490mm long
  - .3 Colour: Selected by Contract Administrator from manufacturer's full range. Allow for two colours.
  - .4 Standard White 3 / 4: Thickness: 0.10" (2.5 mm); Panel Width: 4' (1.22m) Panel Height: Either 8'2" or 9' 10.25" (2.5m or 3m); Weight 4'x8'2" Panel: 24 lbs (10.7 kg) Weight 4'x9' 10.25" Panel: 28 lbs (12.8 kg).

#### 2.3 ACCESSORIES

- .1 Vinyl welding rod: Acceptable Material:
  - .1 Altro weld rod – Colour to match panels.

- .2 Polyurethane Adhesive: The default adhesive for most installations, suitable for wet area, non-climate controlled areas, and non-absorbent surfaces, use AltroFix W39, a two-part resin-based polyurethane adhesive as recommended by manufacturer.
- .3 Caulking and Sanitary Sealant Sealant Compounds and Tools:
  - .1 Altro Sanitary Sealant Sealant – Colour to match panels.
- 2.4 SOURCE QUALITY
  - .1 Source Quality: Obtain wall Products from a single manufacturer.
- PART 3 EXECUTION**
- 3.1 MANUFACTURER'S INSTRUCTIONS
  - .1 Compliance: Comply with manufacturer's Product data, including Product technical bulletins, Product catalog, installation instructions and Product label instructions for installation.
- 3.2 EXAMINATION
  - .1 Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for Product installation in accordance with manufacturer's instructions.
- 3.3 SUBSTRATE PREPARATION
  - .1 Walls should be smooth and level. High points must be removed and low points filled with filler intended for the substrate and environmental conditions.
  - .2 Wall tiles must be fixed firmly to the wall. As long as the tile edges do not protrude you do not have to skim grout joints.
  - .3 Surfaces must be permanently dry and free from all substances that may contribute to adhesive bond failure.
  - .4 Remove loose paint and conduct an adhesive bond test with paint.
  - .5 Exterior walls must be adequately damp-proofed and insulated.
  - .6 Dry wall substrates should be paint ready.
- 3.4 PREPARATION
  - .1 All surfaces must be free from dust and cleaned prior to installation. The Working environment must also be dust free. Failure to comply with these conditions will reduce the bond strength between the adhesive and substrate, and may cause the panels to debond.
  - .2 Very absorbent / porous substrates (particularly plaster finishes and unprimed sheetrock) must have a proprietary sealer e.g. PVA primer or similar, applied to the surface a minimum of 12 hours prior to the installation.
  - .3 All electrical switches, power points etc., should be in a first fix / installation state. All electrical equipment should only be moved or altered by a qualified electrician.
  - .4 All plumbing should have pipe-Work removed to a first fix or installation state and "tails" left protruding from the substrate. Panels can then be drilled and slid over the pipe tails. All holes should be drilled 1/8" (3mm) oversize to allow for expansion, then sealed with Sanitary Sealant. Plumbing should always be done by a qualified plumber.

- .5 Hot pipes and steam pipes should be insulated and a 1/8" to 1/4" (3-6mm) expansion gap should be created when installing panels around these pipes, then sealed with Sanitary Sealant.
- .6 All pipes, fixing bolts, etc. extending through the panels should have a minimum 1/8" (3mm) expansion gap and be sealed using Sanitary Sealant.
- .7 If fitting to door frames, these must be in place prior to installation of panels.
- .8 Prior to installation, it is advisable to complete any painting which comes in contact with panels, as sealant used at junctions is non-paintable.
- .9 Panels should be stored flat and be pre-conditioned a minimum of 24 hours in ambient temperatures similar to the prevailing operational conditions.
- .10 The panels must be stored on a level flat surface off the ground (risk of condensation on the panels if stored on damp surfaces). Storage on uneven surfaces could cause the panels to distort prior to installation.
- .11 Check the room using a 6' (2 m) level to ensure all walls are flat, paying particular attention to the corners, window reveals, and door entrances. These need to be inspected to ensure they are free of any debris or irregularities, which could prevent the panels laying flat to the substrate after the adhesive has been applied and the panel installed.

### 3.5 INSTALLATION

- .1 Hygienic Wall Installation: Install panels in accordance with the current published Manufacturer's Installation Guide. All joints should be joined by approved methods as detailed in the installation guide.

### 3.6 CLEANING

- .1 Altro Whiterock can be cleaned with a diluted soap/detergent solution, such as Altro 44 Cleaner.
- .2 When cleaning the Altro Whiterock surface, we recommend the temperature of water does not exceed 140° F (60° C).
- .3 Pressure cleaning with hot water may be used with the pressure nozzle a minimum of 2 feet (600mm) away from the surface.
- .4 To reduce the buildup of static, cleaning the panels with an anti-static solution is recommended.
- .5 Stubborn stains use AltroClean 44 cleaner or equivalent alkaline cleaner.
- .6 Remove construction debris from project Site and legally dispose of debris.

### 3.7 PROTECTION

- .1 Do not install near open heat sources (ovens, etc). Stainless steel panels should be used in such areas.

**END OF SECTION**

**PART 1      General**

1.1            RELATED SECTIONS

- .1      Section 01 33 00 – Submittal Procedures
- .2      Section 01 45 00 – Quality Control
- .3      Section 01 60 00 – Basic Product Requirements
- .4      Section 01 77 00 – Closeout Procedures
- .5      Section 01 78 00 – Closeout Submittals
- .6      Section 03 35 00 – Concrete Finishing
- .7      Section 04 05 10 – Common Masonry
- .8      Division 05 – Metals
- .9      Division 06 – Wood, Plastics and Composites
- .10     Division 08 – Openings
- .11     Section 09 29 00 – Gypsum Board
- .12     Division 21 – Mechanical General Requirements
- .13     Division 26 – Electrical

1.2            REFERENCES

- .1      Master Painters Institute (MPI) Architectural Painting Specifications Manual, current edition.
- .2      Systems and Specifications Manual, SSPC Painting Manual, Volume Two, Society for Protective Coatings (SSPC).
- .3      Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings) of the Environmental Protection Agency (EPA).
- .4      National Fire Code of Canada.

1.3            QUALITY ASSURANCE

- .1      Contractor shall have a minimum of five (5) years proven satisfactory experience. When requested, provide a list of last three (3) comparable jobs including, job name and location, specifying authority, and project manager.
- .2      Qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting Work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.
- .3      Conform to latest MPI requirements for interior painting Work including preparation and priming.
- .4      Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with MPI Painting Specification Manual "Approved Product" listing and shall be from a single manufacturer for each system used.
- .5      Other paint Materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating Materials as required.
- .6      Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Contract Administrator.

- .7 Standard of Acceptance:
    - .1 Walls and Vertical Surfaces (i.e. columns): No defects visible from a distance of 1000 mm at 90 deg to surface.
    - .2 Ceilings: No defects visible from floor at 45 deg to surface when viewed using final lighting source.
  - .8 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
  - .9 All painting and decorating work shall be inspected a Paint Inspection Agency (inspector) selected by the Contract Administrator. The painting subcontractor shall notify the Paint Inspection Agency a minimum of one week prior to commencement of work.
  - .10 All surfaces requiring painting shall be inspected by the Paint Inspection Agency who shall notify the Contract Administrator and Contractor in writing of any defects or problems, prior to commencing painting work, or after the prime coat shows defects in the substrate.
  - .11 Where “special” painting, coating or decorating system applications (i.e. non-MPI listed products or systems) are to be used, the paint or coating manufacturer shall provide as part of this work, certification of all surfaces and conditions for specific paint or coating system application as well as on-site supervision, inspection and approval of their paint or coating system application as required at no additional cost to the City.
- 1.4 SCHEDULING OF WORK
- .1 Submit Work schedule for various stages of painting to Contract Administrator for approval. Submit schedule minimum of 48 hours in advance of proposed operations.
  - .2 Obtain written authorization from Contract Administrator for any changes in Work schedule.
  - .3 Schedule painting operations to prevent disruption of occupants in and about the building.
- 1.5 SUBMITTALS
- .1 Submit product data and manufacturer's installation/application instructions for each paint and coating product to be used in accordance with Section 01 33 00 - Submittal Procedures. List products according to the MPI system, substrate and location for review by the Contract Administrator and the Painting Inspection Agency.
  - .2 Upon completion, submit records of products used. List products in relation to finish system and include the following:
    - .3 Product name, type and use.
    - .4 Manufacturer's product number.
    - .5 Colour numbers.
- 1.6 SAMPLES
- .1 Upon request, submit 300 x 300 mm sample panels of each paint, stain and 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 3 mm plate steel for finishes over metal surfaces.
    - .3 13 mm birch plywood for finishes over wood surfaces.
    - .4 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
    - .5 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

When approved, sample panels shall become acceptable standard of quality for appropriate On-Site surface with one of each sample retained On-Site.

1.7 QUALITY CONTROL

- .1 When requested by Contract Administrator and/or Paint Inspection Agency, prepare and paint designated surface, area, room or item (in each colour scheme) to requirements specified herein, with specified paint or coating showing selected colours, gloss/sheen, textures and workmanship to MPI Painting Specification Manual standards for review and approval. When approved, surface, area, room and/or items shall become acceptable standard of finish quality and workmanship for similar On-Site Work.

1.8 EXTRA MATERIALS

- .1 Submit maintenance Materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit one - four litre can of each type and colour of stain and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.
- .3 Deliver to Site and store where directed by the City.

1.9 DELIVERY, HANDLING AND STORAGE

- .1 Deliver, store and handle Materials in accordance with Section 01 60 00 - Basic Product Requirements.
- .2 Labels shall clearly indicate:
- .3 Manufacturer's name and address.
- .4 Type of paint or coating.
- .5 Compliance with applicable standard.
- .6 Colour number in accordance with established colour schedule.
- .7 Remove damaged, opened and rejected Materials from Site.
- .8 Provide and maintain dry, temperature controlled, secure storage.
- .9 Observe manufacturer's recommendations for storage and handling.
- .10 Store Materials and supplies away from heat generating devices.
- .11 Store Materials and equipment in a well ventilated area with temperature range 7 °C to 30 °C.
- .12 Store temperature sensitive Products above minimum temperature as recommended by manufacturer.
- .13 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Contract Administrator. After completion of operations, return areas to clean condition to approval of Contract Administrator.
- .14 Remove paint Materials from storage only in quantities required for same day use.
- .15 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of Hazardous Materials.
- .16 Fire Safety Requirements:
- .17 Provide one 9 kg Type ABC fire extinguisher adjacent to storage area.
- .18 Store oily rags, waste products, empty containers and Materials subject to spontaneous combustion in ULC approved, sealed containers and remove from Site on a daily basis.

- .19 Handle, store, use and dispose of flammable and combustible Materials in accordance with the National Fire Code of Canada.

1.10 SITE REQUIREMENTS

- .1 Heating, Ventilation and Lighting:
  - .2 Ventilate enclosed spaces.
  - .3 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 deg C for 24 hours before, during and after paint application until paint has cured sufficiently.
  - .4 Where required, provide continuous ventilation for seven (7) days after completion of application of paint.
  - .5 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.
  - .6 Perform no painting Work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by Contractor.
  - .7 Temperature, Humidity and Substrate Moisture Content Levels:
    - .8 Unless specifically pre-approved by the specifying body and the applied product manufacturer, perform no painting Work when:
      - .1 Ambient air and substrate temperatures are below 10 °C.
      - .2 Substrate temperature is over 32 °C unless paint is specifically formulated for application at high temperatures.
      - .3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.
      - .4 The relative humidity is above 85% or when the dew point is less than 3 °C variance between the air/surface temperature.
      - .5 Perform no painting Work when the maximum moisture content of the substrate exceeds:
        - .6 12% for concrete and masonry (clay and concrete brick/block).
        - .7 15% for wood.
        - .8 12% for plaster and gypsum board.
        - .9 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
        - .10 Test concrete, masonry and plaster surfaces for alkalinity as required.
    - .9 Surface and Environmental Conditions:
      - .1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
      - .2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.
      - .3 Apply paint only when previous coat of paint is dry or adequately cured.
  - .10 Additional Interior Application Requirements:
    - .1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

1.11 WASTE MANAGEMENT AND DISPOSAL

- .1 Paint, stain and wood preservative finishes and related Materials (thinners, solvents, etc.,) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
- .2 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
- .3 Place Materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
- .4 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground the following procedures shall be strictly adhered to:
  - .1 Retain cleaning water for water-based Materials to allow sediments to be filtered out.
  - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
  - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
  - .4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
  - .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
- .5 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.
- .6 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

1.12 PROTECTION

- .1 Adequately protect other surfaces from paint and damages. Make good any damage as a result of inadequate or unsuitable protection.

**PART 2 Products**

2.1 MATERIALS

- .1 Acceptable general products/manufacturers are:
  - .1 ICI/Dulux
    - .1 Dulux Lifemaster
    - .2 Devflex/Devguard
    - .3 Glidden Pro
    - .4 Weatherguard
  - .2 Cloverdale Paint:
    - .1 Eco-Logic Series
    - .2 Multi-Master
  - .3 General Paint (GP)
    - .1 Enviroguard series.
    - .2 Z-Coat Enviro-Friendly
  - .4 Wooster Products Inc.
    - .1 Epoxy WP-70 Anti slip coating
      - .1 Allow for 2 colours: Black and Safety Yellow



NOTE: All other paint Materials shall be listed in the MPI Approved Products List (APL).

- .2 Only paint Materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .3 Paint Materials for paint systems shall be products of a single manufacturer.
- .4 Only qualified products with E2 "Environmentally Friendly" rating are acceptable for use on this project. Use E3 rated products where possible.
- .5 Paints, stains, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, shall:
  - .1 Be water-based unless otherwise specified.
  - .2 Be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
  - .3 Do not contain toxic metal pigments.
  - .4 Have a recycled content if cost neutral.
- .6 Water-borne surface coatings must be manufactured and transported in a manner that steps of process, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).
- .7 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .8 Water-borne surface coatings and recycled water-borne surface coatings must have a flash point of 61.0°C or greater.
- .9 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
  - .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
  - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
- .10 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.
- .11 Recycled water-borne surface coatings must not contain:
  - .1 Lead in excess of 600.0 ppm weight/weight total solids.
  - .2 Mercury in excess of 50.0 ppm weight/weight total product.
  - .3 Cadmium in excess of 1.0 ppm weight/weight total product.
  - .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
  - .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.
- .12 The following must be performed on each batch of consolidated post-consumer Material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.

- .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
- .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
- .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

## 2.2 COLOURS

- .1 Paint:
  - .1 Provide to the Contract Administrator colour fans (samples) of manufacturer.
  - .2 Colour selection will be based on two (2) base colours, and four (4) accent colours with a maximum of three (3) deep or bright colours. No more than six (6) colours will be selected for the entire project, and no more than three (3) colours will be selected in each area. Note that this does not include pre-finished items by others, e.g. flashings, windows, etc.
  - .3 Paint colours will be selected by the Contract Administrator. One (1) copy of the colour schedule will be provided to the Contractor prior to commencement of painting operations.
  - .4 Maintain one copy of the colour schedule on Site during painting.
- .2 Wood Clear Coat/Stain:
  - .1 Provide the Contract Administrator with clear coat/stain samples from manufacturer on each wood substrate in the project.
  - .2 Allow for three colours of stain, and one clear coat for wood Materials. Stain selection to be done by the Contract Administrator.

## 2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to Site. On-site tinting of painting Materials is allowed only with Contract Administrator's written permission.
- .2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.
- .3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Contract Administrator.
- .5 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.

## 2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level Category	Units @ 60 deg	Units @ 85 deg
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

- .2 Gloss level ratings of painted surfaces shall be as specified herein.

## 2.5 EXTERIOR PAINTING SYSTEMS

- .1 Galvanized steel: doors, frames, misc. steel, pipes, as indicated in Drawings to MPI EXT 5.3K
- .1 One (1) coat epoxy primer (MPI #101)
  - .2 Two coats water-borne light industrial coating to Gloss level G5 (MPI #163).
- .2 Primed Ferrous Metal: to MPI EXT 5.1D
- .1 One (1) coat alkyd metal primer (MPI #79)
  - .2 Two (2) coats alkyd enamel to Gloss level G6 (MPI #9)
- .3 Exterior Concrete / Concrete Masonry Units (CMU) – Elastomeric Coating: to MPI EXT 4.2D
- .1 Surface preparation:
  - .2 One (1) coat elastomeric coating (MPI #113)

## 2.6 INTERIOR PAINTING SYSTEMS - GENERAL

- .1 Concrete floors: all areas to MPI INT 3.2G, and to GPS level E3
- .1 One (1) coat waterborne clear acrylic sealer– first coat reduced as per manufacturer’s recommendations for more penetration into concrete (MPI #99)
  - .2 One (1) coat water borne clear acrylic sealer (MPI #99)
- .2 Concrete: exposed ceilings only, soffits, beams, columns, to be left natural to MPI INT 3.1A
- .1 One (1) coat latex sealer/primer (MPI #50)
  - .2 Two (2) finish coats of acrylic latex to Gloss level G4 (MPI #43).
- .3 Concrete / concrete masonry unit (CMU) walls: to MPI INT 4.2A
- .1 One (1) coat latex block filler/primer (MPI #4)
  - .2 Two (2) finish coats of acrylic latex to Gloss level G3.
- .4 Concrete / concrete masonry unit (CMU) walls (epoxy) at washrooms, kitchenette, and other wet areas: to MPI INT 4.2G
- .1 One (1) coat epoxy block filler (MPI #116)
  - .2 Two (2) coats epoxy coating to Gloss level G5 (MPI #115 x-green)

- .5 Structural steel and metal fabrications exposed (not galvanized): to MPI INT 5.1Q
  - .1 One (1) coat spot primer
  - .2 One (1) coat alkyd primer (MPI #76)
  - .3 Two (2) finish coats of acrylic latex to Gloss level G5 typical (except to Gloss level G1 at ceilings) (MPI #54)
- .6 Exposed Structural Steel & Metal Fabrications: Wet Areas – Pool Area, Pool Changerooms, Showers, Pool Storage, Lifeguard Area to MPI INT 5.1H – Polyurethane Pigmented
  - .1 Surface Preparation: SSPC-SP3 Power Tool Cleaning
  - .2 Inorganic zinc primer
  - .3 Highbuild epoxy, MP #108
  - .4 Polyurethane MPI #72, G5
- .7 Galvanized Metal: Wet Areas – Pool Area, Changerooms, Showers, Pool Storage, Lifeguard Area: doors, frames, railings, miscellaneous steel, pipes, overhead roof decking, ductwork, electrical conduit, etc.) to MPI INT 5.3D (Modified Paint System)
  - .1 Surface preparation (new): etching cleaner, MPI #25, refer to MPI Manual 5.3, Galvanized Metal.
  - .2 Surface preparation (existing): SSPC-SP3 Power Tool Cleaning
  - .3 Epoxy Primer, MPI #101
  - .4 High Build Epoxy, MP #108
  - .5 Polyurethane MPI #72, G5
- .8 Galvanized steel: doors, frames, railings, misc. steel, pipes: to MPI INT 5.3M
  - .1 One (1) coat waterborne galvanized primer (MPI #134)
  - .2 Two (2) two finish coats of high performance architectural latex to Gloss level G5 (MPI #141)
- .9 Galvanized metal roof deck: to MPI INT 5.3H
  - .1 Two (2) coats waterborne dry fall coating to Gloss level G1 (MPI #133)
- .10 Dressed Lumber: solid hardwood trim, wood ceilings to MPI INT 6.3Q
  - .1 One (1) coat sand-able sealer (MPI #128)
  - .2 Two (2) coats clear, waterborne acrylic to Gloss level G4 (MPI #128)
- .11 Gypsum Board: to MPI INT 9.2A
  - .1 One (1) coat latex sealer/primer (MPI #50)
  - .2 Two (2) finish coats of acrylic latex to Gloss level G3 (for walls) and G3 (ceilings & bulkheads). (MPI #52)
- .12 Gypsum Board (epoxy): to MPI INT 9.2F
  - .1 One (1) coat latex sealer/primer (MPI #50)
  - .2 Two (2) coats, two-component epoxy coating (MPI #115)

2.7 INTERIOR PAINTING SYSTEMS – ARENA RE-PAINTING

- .1 Galvanized metal roof deck (existing); galvanized metal wall panels (existing); exposed structural steel and metal fabrications (existing); galvanized ductwork, piping, conduit, etc. (new and existing):
  - .1 Surface preparation to MPI SSPC-SP2 Hand Tool Cleaning (in coordination with Division 02 specifications for lead paint abatement) and removal of dust by compressed air or other means prior to re-coating.
  - .2 One (1) coat High Performance Architectural Latex to Gloss Level G3. Acceptable product: Cloverdale MultiMaster #71453 (MPI #161), applied at the approved mil thickness as per the paint manufacturer. Proposed equivalent products will be considered provided they pass 3<sup>rd</sup> party inspection review of test patches conducted on each substrate type to be coated.
- .2 Concrete / Concrete Masonry Unit (CMU) (new & existing surfaces):
  - .1 Surface preparation to MPI SSPC-SP2 Hand Tool Cleaning (in coordination with Division 02 specifications for lead paint abatement) and removal of dust by compressed air or other means prior to re-coating.
  - .2 One (1) coat High Performance Architectural Latex to Gloss Level G3. Acceptable product: Cloverdale MultiMaster #71453 (MPI #161), applied at the approved mil thickness as per the paint manufacturer. Proposed equivalent products will be considered provided they pass 3<sup>rd</sup> party inspection review of test patches conducted on each substrate type to be coated.

**PART 3 Execution**

3.1 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Painting Specifications Manual except where specified otherwise.
- .2 Apply paint Materials in accordance with paint manufacturer's written application instructions.

3.2 EXISTING CONDITIONS

- .1 Prior to commencement of work of this Section, thoroughly examine (and test as required) all conditions, surfaces, and existing substrates for problems related to proper and complete preparation of surfaces to be painted, and conditions that will adversely affect the Work of this Section. Report to Contract Administrator any damages, defects, unsatisfactory or unfavourable conditions before proceeding with Work.
- .2 Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to Contract Administrator. Do not proceed with Work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Maximum moisture content as follows:
  - .1 Stucco, Plaster and Gypsum Board: 12%.
  - .2 Concrete: 12%.
  - .3 Clay and Concrete Block/Brick: 12%.
  - .4 Wood: 15%.

### 3.3 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 Contract Administrator.
- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.
- .4 Protect passing pedestrians and general public about the building.
- .5 Removal of electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings shall be done prior to undertaking any painting operations by Contractor. Items shall be securely stored and re-installed after painting is completed by Contractor.
- .6 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

### 3.4 CLEANING AND PREPARATION

- .1 Clean and prepare surfaces in accordance with MPI Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
  - .1 Remove dust, dirt, and other surface debris by vacuuming or wiping with dry, clean cloths.
  - .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 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
  - .6 Use trigger operated spray nozzles for water hoses.
  - .7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean up water-based paints.
- .2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .3 Where possible, prime surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
  - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
  - .2 Apply wood filler to nail holes and cracks.
  - .3 Tint filler to match stains for stained woodwork.
- .4 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

- .5 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by blowing with clean dry compressed air, or vacuum cleaning.
- .6 Touch up of shop primers with primer as specified in applicable section. Major touch-up including cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas, shall be by supplier of fabricated Material.
- .7 Substrate defects shall be made good and sanded by others ready for painting particularly after the first coat of paint. Start of finish painting of defective surfaces (e.g. gypsum board) shall indicate acceptance of substrate and any costs of making good defects shall be borne by the painting subcontractor including re-painting of the entire defective surface (no touch up painting).
- .8 Do not apply paint until prepared surfaces have been accepted by Contract Administrator.

### 3.5 APPLICATION

- .1 Apply paint and other finishes in accordance with MPI Painting Manual Premium Grade finish requirements.
- .2 Brush and Roller Application:
  - .1 Apply paint in a uniform layer using brush and/or roller of types 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 shall be free of roller tracking and heavy stipple unless approved by Contract Administrator.
  - .5 Remove runs, sags and brush marks from finished Work and repaint.
- .3 Apply paint in a workmanlike manner using skilled and trade qualified applicators.
- .4 Apply each coat at the proper consistency.
- .5 Each coat of paint is to be slightly darker than the preceding coat, unless otherwise approved by the Contract Administrator.
- .6 Unless otherwise approved, apply a minimum of four (4) coats of paint where deep or bright colours are used to achieve satisfactory results.
- .7 Sand and dust between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1000mm (39”).
- .8 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.
- .9 Paint finish shall continue through behind all wall-mounted items (re: white and tack boards).
- .10 Where clear finishes are required, ensure tint fillers match wood. Work fillers well into the grain before it has set. Wipe excess from the surface.

- .11 Back prime interior woodwork, which is to receive a paint or enamel finish, with enamel undercoat paint.
  - .12 Back prime interior woodwork, which is to receive stain and/or varnish finish, with a gloss varnish, reduced by twenty-five percent (25%) with mineral spirits.
  - .13 Apply enamel undercoat to all primed and galvanized/zinc coated doors, frames, etc.
  - .14 Prime top and bottom edges of metal doors with enamel undercoater when they are to be painted.
  - .15 Prime top and bottom edges of wood doors with gloss varnish when they are to receive a stain or clear finish.
  - .16 Paint tops of low partitions (partitions stopping below ceiling height).
  - .17 At locations where demolition has exposed previously unpainted surfaces, provide additional base coats so new finish will blend with adjacent painted surfaces.
- 3.6 MECHANICAL/ELECTRICAL EQUIPMENT
- .1 Unless otherwise specified, prime and paint finished area exposed insulated and bare pipes, conduits, piping, hangers, brackets, collars, and supports, except where items are plated or covered with a pre-finished cladding. Paint to colours of adjacent walls, ceiling etc. to Contract Administrator's direction.
  - .2 In service rooms, leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
  - .3 Colour coding of equipment, piping, conduit, and exposed ductwork: All colour banding and identification (flow arrows, naming, etc.) shall be coordinated with Mechanical and Electrical Subcontractors.
  - .4 For hot surfaces, such as hot water piping, use "Bonding Primer" and "Industrial Enamel" for heat-resistant primer and finish.
  - .5 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
  - .6 Do not paint over nameplates.
  - .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint, extending min. 450mm behind grille.
  - .8 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
  - .9 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
  - .10 All mechanical equipment including equipment on roof shall be cleaned and coated with semi-gloss latex.
  - .11 Do not paint interior transformers and substation equipment.
- 3.7 RESTORATION
- .1 Clean and re-install all hardware items removed before undertaking painting operations.
  - .2 Remove protective coverings and warning signs as soon as practical after operations cease.
  - .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.



- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Contract Administrator. Avoid scuffing newly applied paint.
  - .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Contract Administrator.
- 3.8 CLEANING
- .1 As the Work proceeds, and upon completion, promptly remove all paint where spilled, splashed, spattered, or sprayed, using means and Materials that are not detrimental to affected surfaces.
  - .2 During the progress of Work, keep premises free from any unnecessary accumulation of tools, equipment, surplus Materials and debris.
  - .3 Remove combustible rubbish Materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.
  - .4 Upon completion of Work, leave premises neat and clean, to the satisfaction of the Contract Administrator.
- 3.9 ACCENT & DEEP COLOURS
- .1 Contract Administrator to provide colour schedule and diagrams for locations of accent colour finishes, bands and wall areas, super-graphics, etc. Note that deep tone colours may be required as per the colour schedules.
  - .2 Use deep tone primers for deep tone colours.
- 3.10 PREFINISHED ITEMS
- .1 This trade should note that casework in Section 06 40 00 – Architectural Woodwork is all prefinished, where plastic laminates are used.
  - .2 This trade should note that doors in Section 08 14 00 – Wood Doors, are all factory finished.
- 3.11 SITE TOLERANCES
- .1 Painting surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:
    - .1 Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 39”.
    - .2 Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39”.
    - .3 Visible defects are evident on ceiling, soffit or other overhead surfaces when viewed at normal viewing angles.
    - .4 When final coat on any surface exhibits a lack of uniformity of colour, sheen, texture, and hiding across full surface area.

**END OF SECTION**

**Part 1 General**

1.1 RELATED WORK

- .1 Section 06 10 00 – Rough Carpentry. Blocking and backing for attachment of items specified in this Section.

1.2 REGULATORY REQUIREMENTS

- .1 All items supplied are to be CSA approved.

1.3 SUBMITTALS

- .1 Submit Shop Drawings and product data to requirements of Section 01 33 00 – Submittal Procedures.
- .2 Submit operation and maintenance data to requirements of Section 01 33 00 – Submittal Procedures.

**Part 2 Products**

The following is an itemized list of products followed by required Specifications for each of these products.

- 2.1 Washroom Accessories
- 2.2 Janitor Storage
- 2.3 Telescoping Shower Rod and Curtain
- 2.4 Signage
- 2.5 Fire Extinguishers
- 2.6 Vinyl Window Film
- 2.7 Frameless Glass Partitions and Doors
- 2.8 Handrails and Handrail Brackets
- 2.9 Pre-cast Concrete Splash Pads
- 2.10 Corner Guards

2.1 WASHROOM ACCESSORIES

Code	Description	Manufacturer's Products No.		
		Bobrick	Frost	Bradley
BCS	Baby Change Station, surface mounted			962-11
EHD	Electric Hand Dryer, white	B-7125	1196	
FSS	Folding Shower Seat. Refer to Drawings for left/right configuration.		975	
GB-1	Grab Bar – 24"	B-5806X24	1001-SP24"	

GB-2	Grab Bar – 36"	B-5806X36	1001-SP36"	
GB-3	Grab Bar – 30"	B-5806X30	1001-SP30"	
GB-4	Grab Bar – 24" x 36"		1016-SP 24x36	
GB-5	Grab Bar – Flip-up, with carrier		1055-S, 1055-500	
GB-6	Grab Bar – Flip-up, with carrier and toilet paper holder		1055-FTS, 1055-500	
GB-7	Grab Bar – 36" x 36"		1003-SP 36x36	
MIR	304 stainless steel sheet, #8 mirror finish, custom sizes, fasten to plywood and mount to wall. No visible fasteners. In BF applications over single wall mounted sinks, use BradleyCorp product.			748-2436
PTD	Paper Towel Dispenser – Kimberley Clark #09990 "Smoke"			
RH	Robe Hook, collapsible		1150	
RSD	Recessed Soap Dish		1132HD	
SH	Shelf, stainless steel	B-295		
SD	Soap Dispenser, surface mounted	B-4112	707	
SN	Sanitary Napkin Disposal, surface mounted	B-270		
TP	Toilet Paper Dispenser, surface mounted		165	
WR	Waste Receptacle, surface mounted	B-279		
Waste Chute	Waste Receptacle chute mounted in millwork with floor standing open top waste receptacle below	B-529 and B-2260		

2.2 JANITOR STORAGE

- .1 provide one adjacent to each floor sink.

Code	Description	Manufacturer's Products No.		
		Bobrick	Watrous	Bradley
JS	Mop Strip & utility Shelf (8" deep shelf)	B-239	W-1315A	9983

2.3 TELESCOPING SHOWER ROD AND CURTAIN

- .1 Opaque matte, white, vinyl curtain, with stainless steel hooks.
- .2 Standard of Acceptance: Winco model 3400-9.

2.4 SIGNAGE

- .1 Interior: Insign Architectural Signage – "Classic" Series, c/w pictograms and braille to meet City of Winnipeg Accessibility Guidelines.
- .2 Exterior: Polished, stainless steel laser cut letters, c/w pink mounting hardware to exterior wall surface. Allow for 20 letters, approx. 16" letter height.

2.5 FIRE EXTINGUISHERS

- .1 5lb. ABC 3A, 40BC, multipurpose by Flag or Williams
- .2 Wall-mounted in quantity to meet the requirement of the National Fire Code in utility and service areas.
- .3 Cabinet mounted in Public areas.

2.6 VINYL WINDOW FILM

- .1 Provide vinyl decals as required by the authority having jurisdiction at glazed partitions and doors, as outlined in the Manitoba Building Code and the City of Winnipeg Accessibility Design Guidelines.

2.7 FRAMELESS GLASS PARTITIONS AND DOORS

- .1 Glass screen partitions and doors as shown on Drawings.
  - .1 13mm thick tempered glass with stainless steel u-channel at floor and ceiling.
  - .2 Match height of u-channel to bottom rail of door.
  - .3 Allow for a continuous row of 2" diameter round, white, vinyl decals on all glass partitions, as required by local codes and authorities.
- .2 Glass Door Hardware – CRL Dry Glaze Door Rails
  - .1 End caps: Cap at each end of door and on exposed ends of adjacent glass wall.
    - .1 Cladding Cat. No. SP25RCBS
    - .2 End Cap Cat. No. SP25ECBS
    - .3 Rail Height: 1"
    - .4 Finish: Brushed Stainless
  - .2 Slender Profile Door Rails
    - .1 Cat. No. without lock: SP25BS12C
    - .2 Rail Height: 1"

- .3 Finish: Brushed Stainless
  - .4 Slender Profile Door Rail Pivot Inserts
  - .5 Bottom Pivot Insert: Cat. No.: 1NT801
  - .6 Top Pivot Insert: Cat. No.: 1NT803
  - .7 Coordinate hardware with Section 08 71 00 – Door Hardware
  - .8 Hardware provided by Glass Door and Partition Supplier:
    - i. Lockset: DL610 Office function hardware in brushed stainless finish.
    - ii. Brushed stainless door keeper.
    - iii. CRL overhead concealed closer.
    - iv. CRL concealed single door header.
    - v. Provide hardware concealed in header, compatible with card access equipment that allows access to room via card, and egress from this room without card or key, to suit program requirements, function of office lockset, and building codes.
- 2.8 HANDRAIL BRACKETS AND HANDRAIL
- .1 Handrail: 38mm outside diameter, brushed stainless steel. CR Laurence HRH15BS or approved equal.
  - .2 Handrail Brackets: brushed stainless steel. CR Laurance HR2FWBS.
- 2.9 PRE-CAST CONCRETE SPLASH PADS
- .1 Pre-cast concrete splashpads c/w integral steel reinforcing, as manufactured by Barkman Concrete Ltd., or equivalent. Sizes/details as per Drawings.
- 2.10 CORNER GUARDS
- .1 Corner Guard (CG) Type 430, 16 ga. Stainless steel, surface mount, cement on, corner guard with 38mm wrap. 1220mm length.
  - .2 181124C-430 by IPC Door and Wall Protection Systems, or approved equal in accordance with B7.
- 2.11 TOILET PARTITIONS
- .1 Designer series, gapless, ceiling and floor mounted, full height partitions.
  - .2 Model 2086G.67P by Bobrick, or approved equal in accordance with B7.
  - .3 Colour selected by Contract Administrator from manufacturer's standard range.
  - .4 Hardware:
    - .1 Four stainless steel barrel hinges per door.
    - .2 Occupancy indicator latch (#1002612) with emergency access.
    - .3 Stainless steel brackets and shoes.
    - .4 Stainless steel latch and keeper.
    - .5 Collapsible robe hook.

### Part 3 Execution

- 3.1 INSPECTION
- .1 Verify that surfaces and internal wall blocking are ready to receive Work and opening dimensions are as instructed by the manufacturer.
  - .2 Beginning of installation means acceptance of substrate conditions.

- .3 Install specialties square, plumb, straight, and true, at proper elevations and alignment with other Work, accurately fitted and adjusted by experienced workmen, in accordance with the manufacturer's instructions.
- .4 Provide suitable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .5 Supply items to be built-in by others, to appropriate trades in adequate time for incorporation into the Work.
- .6 Touch up fastenings scratched or otherwise damaged surfaces after completion of installation, to match finish.

### 3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.

**END OF SECTION**

- Part 1            General**
- 1.1            RELATED WORK
- .1          Temporary power supply.
- .2          Division 26 Electrical
- 1.2            REFERENCES & QUALITY ASSURANCE
- .1          Manufacture material lifts to ASME A17.1/CSA-B44, CSA/C22.1, CSA W47.1 and W59, local codes and regulations except where specified otherwise.
- .2          Welding to conform to CSA W47.1 and W59 welding codes.
- 1.3            SHOP DRAWINGS
- .1          Submit complete Shop Drawings for all equipment, hoistway, and pit construction.
- .2          Location and size of the required fused disconnect.
- 1.4            MAINTENANCE DATA
- .1          Provide maintenance manuals c/w separate breakdown of the hydraulic cylinder, hydraulic power pack, hydraulic and electrical schematics.
- 1.5            WARRANTY
- .1          Provide two year written parts and labour guarantee.
- Part 2            Products**
- 2.1            MATERIAL LIFT – Standard of Acceptance
- .1          Provide Type "B" (w/ rider) Hydraulic Material Lifts, Model SFPL, Loading Class "C3" by Atlantic Lifts Ltd. (Contact: 905-666-2002 – Alex Smith.), or equal, approved in accordance with B7 Substitutions.
- .2          Rated Load/Capacity: 2,700 lbs uniformly distributed on car.
- .3          Platform Size: 60" clear width x 96" clear length x 84" clear height
- .4          Hoistway Size: T.B.D. (74" x 102")
- .5          Lift Speed: 30 FPM up and down
- .6          Travel Distance: ±11'-6"
- .7          Overhead Clearance: ±9'-10"
- .8          Number of Landings: 2
- .9          Number of Entrances: 2 inline
- .10         Machine Space: 6'-6" width x 9'-9" length
- .11         Hoistway: combination of Site built concrete masonry unit walls (new and exist), and steel stud/GWB partition walls
- 2.2            CYLINDER AND PLUNGER
- .1          Construct plunger of select chromed shafting, machined true to surface finish of 0.0008 mm roughness rating or better.
- .2          At top of cylinder provide stuffing box and seal.
- .3          Provide safety bulkhead on cylinder to ASME A17.1/CSA-B44.
- .4          Install cylinder and plunger plumb. Operate with minimum friction.
- 2.3            ELECTRO-HYDRAULIC SYSTEM
- .1          Provide hydraulic system consisting essentially of hydraulic pump, holeless side mounted synchronized hydraulic cylinder(s), and piston, pressure relief valve, reservoir, valves, and connections.

- .2 Operate pump continuously in "up" direction, "down" travel shall be by gravity.
- .3 Include:
  - .1 Internal Stop Ring to prevent piston from leaving cylinder in case of limit switch failure.
  - .2 Oil seals, wipers, guide bearings, gaskets, oil connections, and air elimination means.
  - .3 Pump suction-line strainer.
  - .4 Fluid-level gauge with minimum fluid level clearly indicated.
  - .5 Reservoir with filling opening filter and cover, also with reservoir vent that will not allow entrance of dust.
  - .6 Safety orifice at cylinder(s) to control oil flow in case of pipe breakage.
- 2.4 CONTROL SYSTEM
  - .1 Control Material lift by heavy duty, constant pressure push-button stations. (CPPB)
  - .2 Push-buttons to be clearly and permanently identified "UP", "DOWN" and "STOP".
  - .3 Provide accurately controlled stopping in both up and directions and maintain car in any position at which it is stopped until direction button is pressed.
  - .4 Provide approved limit switch to limit up travel of car.
- 2.5 MATERIAL LIFT CAR
  - .1 Construct car of 1/4" Steel Checker Plate.
  - .2 Provide 12GA steel panel sides (to match door height.)
- 2.6 HOISTWAY
  - .1 As per building code requirements – 1 hr. fire-separation all around, incl. doors.
- 2.7 FINISH
  - .1 Ferrous metal:
    - .1 Clean metal surfaces, treat with phosphate.
    - .2 Apply one coat of primer in accordance with CGSB 1-GP-40M.
    - .3 Apply one coat of alkyd type machine enamel in colour to be selected by Contract Administrator from standard offering of colours.
  - .2 Fasteners:
    - .1 Zinc or cadmium finish.
- 2.8 DOORS AND FRAME
  - .1 Double swing clear opening: 72" wide x 84" clear opening height.
  - .2 Hollow-metal, as per building code.
- 2.9 POWER SUPPLY Co-ordinate with Electrical
  - .1 Power supply 600/3/60 Volts, Fused disconnect in machine space.
  - .2 Separate Lighting supply 120/1/60. GFCI receptacle for machine space.
  - .3 Separate Lighting supply 120/1/60. GFCI receptacle for Pit area.
- Part 3 Execution**
- 3.1 WELDING
  - .1 To conform to the CSAW47.1 and W59 welding code.
- 3.2 SHOP DRAWINGS
  - .1 Submit complete Shop Drawings For all equipment, hoistway and pit construction where required.



- .2 Location and size of the required fused disconnect.
- 3.3 MAINTENANCE DATA
  - .1 Provide maintenance manuals c/w separate breakdown of the hydraulic cylinder, hydraulic power pack, hydraulic and electrical schematics.
- 3.4 WARRANTY
  - .1 Provide two year written parts and labour guarantee.
- 3.5 FIELD QUALITY CONTROL
  - .1 Perform and meet tests required by authorities having jurisdiction.
  - .2 Supply instruments and carry out additional specified to approval of Engineer.
  - .3 Submit to Engineer test and approval certificates issued by jurisdictional authorities.
  - .4 Test stop ring and hydraulic system by operating car with rated load in up direction against stop ring at rated speed.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1 Documents and certain applicable terminology.
- .2 Associated requirements.
- .3 Work expectations.
- .4 Work by other parties.
- .5 Words and terms.
- .6 Examination
- .7 Closeout submittals
- .8 Operation and maintenance manual format.
- .9 Contents each volume.
- .10 Recording actual site conditions.
- .11 Record documents.
- .12 Warranties and bonds.
- .13 Quality Assurance.
- .14 Demonstration and Training
- .15 Conditions for Demonstrations
- .16 Shop drawings and product data.
- .17 Samples.
- .18 Certificates and transcripts.
- .19 Product quality, availability, storage, handling, protection, and transportation.
- .20 Product changes and substitutions.
- .21 Manufacturer's instructions.
- .22 Quality of Work, coordination and fastenings.
- .23 Accessibility of Equipment
- .24 Coordination, work for other trades, electrical requirements, temporary use of equipment.
- .25 Existing facilities.

**1.2                RELATED SECTIONS**

- .1 Applicable sections in Division 01, including:
  - .1 Allowances
  - .2 Construction Progress Documentation.
  - .3 Submittal Procedures.
  - .4 Product Exchange Procedures.
  - .5 Substitutions
  - .6 Closeout Submittals.

- .2 This section describes common work applicable to all Sections within project Divisions 21, 22, 23 and 25.

### **1.3 COMPLEMENTARY DOCUMENTS**

- .1 Drawings, specifications, and schedules are complementary to each other and what is called for by one will be binding as if called for by all.
- .2 Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of the plans, and specifications, the Contractor shall obtain a ruling in writing from the Contract Administrator in writing before submitting the bid. If this is not done it will be assumed that the most expensive alternative has been included in the bid price.
- .3 The drawings for mechanical work are performance drawings. They are generally diagrammatic and are not to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions showing every offset, fitting, valve or every difficulty encountered during execution of work and will not be used as an excuse for deficiencies or omissions. Where required installations are not shown on plans or are only shown diagrammatically, install in such a way as to conserve headroom and interfere as little as possible with free use or space through which they pass, while adequate space is allowed for service, maintenance, repair, or replacement for all equipment.
- .4 Drawings indicate general location and route of new and existing mechanical systems. The review of exact location and routing of systems prior to bidding is the responsibility of the Contractor. Install piping and duct systems not exactly shown in plan or indicated by note, by graphic, or diagrammatically in schematic or riser diagrams to provide an operational assembly or system.
- .5 Install components to physically conserve headroom, to minimize furring spaces, to accommodate installed Work, or other obstructions.
- .6 Install ceiling mounted or exposed mechanical components such as diffusers, sprinkler heads and grilles in accordance with reflected ceiling drawings or floor plans.
- .7 Locate devices with primary regard for convenience of operation and usage.
- .8 Examine all discipline drawings, specifications, and schedules and related Work to ensure that Work can be satisfactorily executed. Conflicts or additional Work beyond Work described, to be brought to the attention of the Contract Administrator.
- .9 All specification sections of the Project Manual and Drawings are affected by requirements of Division 01 sections.

### **1.4 DESCRIPTION OF THE WORK**

- .1 Division of the Work among other contractors, subcontractors, suppliers or vendors is solely the Contractor's responsibility. Neither The City nor Contract Administrator assumes any responsibility to act as an arbiter to establish subcontract terms or disagreements between sectors or disciplines of the Work.

### **1.5 CONTRACT METHOD**

- .1 Construct Work under the contract requirements in the applicable Division 00 sections.
- .2 Refer to Section 01 21 00 for cash allowances.
- .3 Contract Documents were prepared by the Contract Administrator for The City. Any use which a third party makes of the Contract Documents, or any reliance on or decisions to be made based on them, are the responsibility of such third parties. The Contract

Administrator accepts no responsibility for any damages suffered by any third party as a result of decisions made or actions based on the Contract Documents.

## 1.6 PERMITS, INSPECTION AND TESTING

- .1 File all necessary notices and approved layouts, obtain and pay for all Local Authority and Fire Underwriters Inspections, approvals and permits applicable to each Mechanical Section. Make changes required to secure Local Authorities approval, without extra cost. Where conflicting requirements occur, comply with most stringent regulation. Note that requirements shown or specified may exceed minimum standards set by Local Authorities.
- .2 The Regulations of the A.S.M.E. Code and the Provincial Labour Department shall cover the design, manufacture, installation, welding and tests of piping and other equipment as specified hereafter.
- .3 Obtain Registration Certificates for all pressure vessels, with suitable metal-framed glass covers installed where directed. Furnish all certificates required by Local Authorities before acceptance of building by The City.
- .4 The City may request the Mechanical Section to operate device or material installed for such time as Contract Administrator may require, as a thorough test, before final acceptance. Such tests shall not be construed as evidence of acceptance, and no claim for cost of such operation for test, or damage due to inadequacy or defect will be recognized.
- .5 Note that site reviews by the Contract Administrator are for the purpose of determining in general if the work is proceeding in accordance with the Contract Documents, and to endeavour to guard The City against defects and deficiencies and not to superintend the execution of the work, which is the Mechanical Subcontractor's and their Subcontractors' responsibility.

## 1.7 WORDS AND TERMS

- .1 Conform to definitions and their defined meanings as in Section 01 19 00.
- .2 Refer to Section 01 19 00 for Specification Grammar.
- .3 Conform to the following definitions and their defined meanings in addition to those referenced in Section 01 19 00:
  - .1 **Install:** To remove from site storage, move or transport to intended location, install in position, connect to utilities, repair site caused damage, and make ready for use.
  - .2 **Supply:** To acquire or purchase, ship or transport to the site, unload, remove packaging to permit inspection for damage, re-package, replace damaged items, and safely store on-site.
  - .3 **Provide:** Wherever the term "provide" is used in relationship to equipment, piping and other materials specified for the work, it means "supply, install and connect". Wherever the terms "provide" is used in connection with services such as testing, balancing, start-up, preparation of drawings for any part of the work, it means procure, prepare, supervise, take responsibility for, and pay for these services.
  - .4 **Typical:** A representative characteristic that is standard for all installations whether individually noted or not throughout the documents. "Typical" applies to each individual or combined installation except where specifically noted or otherwise indicated that the application is non-typical.

- .5 **Exposed:** Any work not concealed in wall, shaft, or ceiling cavities or spaces. Work behind doors, in closets or cupboards or under counters is considered exposed.
- .6 **New:** Produced from new materials.
- .7 **Renewed:** Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.
- .8 **Defective:** A condition determined exclusively by the Contract Administrator.

## 1.8 EXAMINATION

- .1 Inspect existing conditions, including elements or adjacent Work subject to irregularities, damage, movement, including Work during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of the Work.
- .3 Examine all contract documents to ensure work can be performed without changes to the Work as shown on plans. No allowance will be made later for necessary changes, unless notification of interferences have been brought to Contract Administrator's attention in writing, prior to bid closing.
- .4 Verify that materials and equipment can be delivered to the place of the work and that sufficient space and access is available to permit installation as shown on the drawings.
- .5 Verify the locations and inverts of service lines leaving and entering building to ensure their proper function prior to commencing work.

## 1.9 CLOSEOUT SUBMITTALS

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Four (4) weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, three (3) final copies of operating and maintenance manuals in Canadian English.
- .3 Copy will be returned with Contract Administrator's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Two (2) weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, three (3) final copies of operating and maintenance manuals, revised as per Contract Administrator's comments.
- .6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7 Summary audit documents associated with requirements for LEED classification documentation.
- .8 If requested, furnish evidence as to type, source and quality of products provided.
- .9 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .10 Pay costs of transportation.

## 1.10 OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Refer also to Section 01 78 10 for formats for manuals. Where there is a discrepancy with this section, follow the requirements of 01 78 10.
- .2 Organize data in the form of an instructional manual.

- .3 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 8.5 x 11 inch (219 x 279 mm) with spine and face pockets.
- .4 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .5 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .6 Arrange content by systems under Section numbers and sequence of Table of Contents.
- .7 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .8 Text: Manufacturer's printed data, or typewritten data.
- .9 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

#### **1.11 CONTENTS - EACH VOLUME**

- .1 Refer also to Section 01 78 10 for formats for contents. Where there is a discrepancy with this section, follow the requirements of 01 78 10.
- .2 Table of Contents: Provide:
  - .1 Title of project.
  - .2 Date of submission.
  - .3 Names, addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties.
  - .4 Schedule of products and systems, indexed to content of volume.
- .3 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .4 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.
- .5 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .6 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including code compliance certificate, life safety systems performance certificate, pressure vessel acceptance.
- .7 Training: Refer to Demonstration and Training in this Section.

#### **1.12 RECORDING ACTUAL SITE CONDITIONS**

- .1 Record information on a full-sized set of drawings, and within the Project Manual.
- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.
- .4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
  - .1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

- .2 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
- .3 Field changes of dimension and detail.
- .4 Changes made by change orders.
- .5 Details not on original Contract Drawings.
- .6 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .6 Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records required by individual specifications sections.

### **1.13 RECORD DOCUMENTS**

- .1 Prior to Substantial Performance of the Work, electronically transfer the marked-up information from the as-built documents, as follows:
  - .1 Drawings: Scan the full-sized field-verified as-built drawing set and save to PDF format. Scans shall be in colour and with good resolution to ensure drawings and markups are legible.
  - .2 Specifications: Adobe Acrobat (PDF).
- .2 Mark revised documents as "RECORD DOCUMENTS". Include all revisions.
- .3 Submit completed record documents to Contract Administrator on a CD, DVD, or by electronic transfer.

### **1.14 WARRANTIES AND BONDS**

- .1 Refer also to Section 01 78 10 for Warranties and Bonds.
- .2 Provide written guarantee that complete installation including materials, work and operation of all equipment provide under Mechanical Sections are first class in every respect, subject only to improper usage by The City, and make good forthwith when reported all defects which develop within one year from date of acceptance of building by The City at no additional cost to The City.
- .3 In addition, guarantee heating and cooling systems through one complete heating or cooling season, as applicable.
- .4 Deliver to The City all equipment manufacturer's guarantees specified in excess of one year.

### **1.15 FABRICATION AND WORKMANSHIP**

- .1 Employ skilled mechanics in their respective trades, under competent supervision, and where required by Provincial or Local regulations holder of acceptable qualification certificates.

### **1.16 QUALITY ASSURANCE**

- .1 Provide testing organization services as specified in subsequent Sections.
- .2 Testing organization: Current member in good standing of their respective professional or industry organization and certified to perform specified services.
- .3 Comply with applicable procedures and standards of the certification sponsoring association.

- .4 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.
- .5 Qualifications:
  - .1 Provide adequate workforce training through meetings and demonstrations.
  - .2 Provide a designated experienced person on site with de-construction experience throughout the project for consultation and supervision purposes.

#### 1.17 DEMONSTRATION AND TRAINING

- .1 Refer also to Section 01 79 00 for Demonstration and Training. Where there is a discrepancy with this section, follow the requirements of 01 79 00.
- .2 Instruct The City's designated employees in proper care, operation, use and maintenance of all systems and equipment, and provide general explanatory literature required and start up supervision and instructions.
- .3 Provide two (2) weeks prior notice to The City to schedule the training.
- .4 The City will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.
- .5 Upon completion of instructions, forward to Contract Administrator with a copy to The City a letter indicating person instructed and dates that the instruction took place. If in Contract Administrator's opinion, this is not done satisfactorily, Contract Administrator may direct such instruction, and charge all costs involved to relevant section.

#### 1.18 CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation in accordance with related sections.
- .2 Testing, adjusting, and balancing have been performed and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

#### 1.19 SHOP DRAWINGS - ADMINISTRATIVE REQUIREMENTS

- .1 **Shop drawings shall be submitted electronically in PDF format documents to [shopdrawings@eppsiepmann.com](mailto:shopdrawings@eppsiepmann.com).**
- .2 Shop drawing documents **shall be grouped by specification section**. Clearly list the specification section on the front page or cover sheet of the submittal. Shop drawings related to **multiple sections may not be grouped together** into a single document. Documents that are groups incorrectly will be returned without being examined and shall be considered rejected.
- .3 Each drawing shall include the name of project as found on the drawings or specifications, the equipment supplier and the specification section that the equipment is specified under.
- .4 Submit to Contract Administrator submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 Work affected by submittal shall not proceed until review is complete.
- .6 Present Shop Drawings, product data, samples and mock-ups in SI Metric and/or Imperial inch-pound units, to match the units used in the schedules.



- .7 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.
- .8 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.
- .9 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .10 Verify field measurements and affected adjacent Work are coordinated.
- .11 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- .12 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.
- .13 Keep one (1) reviewed copy of each submission on site.

**1.20 SHOP DRAWINGS AND PRODUCT DATA**

- .1 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications. Indicate layouts, quantity, details of equipment, control wiring diagrams, sizes, capacities and roughing in and exact requirements for concrete pits, bases and other supporting members.
- .3 Each shop drawing must be certified by manufacturer and as such shall indicate that all product engineering has been performed to ensure the product will meet the requirements of the intended installation.
- .4 Shop drawings for grilles, registers and diffusers shall be accompanied by an itemized list indicating the unit locations by room number and the unit size.
- .5 Allow ten (10) days for Contract Administrator's review of each submission.
- .6 Adjustments made on Shop Drawings by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
- .7 Make changes in Shop Drawings as Contract Administrator may require, consistent with Contract Documents. When resubmitting, notify Contract Administrator in writing of any revisions other than those requested.
- .8 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .9 Submissions shall include:

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- .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to other parts of the Work.
  - .10 After Contract Administrator's review, distribute copies.
  - .11 Submit one (1) copy of Shop Drawings as a pdf document by email attachment for each requirement requested in specification Sections and as Contract Administrator may reasonably request. Any electronic copy of shop drawings shall bear all the required marks of certification and approval by the manufacturer and contractor(s) as indicated above. The Contract Administrator will review and mark up one copy of the shop drawing, and return to the contractor by email attachment. The contractor shall then make copies as required for ordering and documentation purposes. Multiple copies of shop drawings will not be returned.
  - .12 Submit one electronic copy of product data sheets or brochures for requirements requested in specification sections and as requested by Contract Administrator where Shop Drawings will not be prepared due to standardized manufacture of product. Submittals shall be submitted as a pdf document by email attachment, or delivered as a hard copy. Any electronic copy of shop drawings shall bear all the required marks of certification and approval by the manufacturer and contractor(s) as indicated above.
  - .13 Delete information not applicable to project.
  - .14 Supplement standard information to provide details applicable to project.
  - .15 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, one electronic copy will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed. The contractor shall then make copies as required for ordering and documentation purposes. Multiple copies of shop drawings will not be returned.
  - .16 Checking of shop drawings by the Contract Administrator does not constitute acceptance of responsibility. Such checking constitutes assistance only to the Mechanical Division in the proper execution of their work.

**1.21 SAMPLES**

- .1 Submit for review samples in duplicate or triplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Contract Administrator's business address unless otherwise instructed.
- .3 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
- .6 Make changes in samples which Contract Administrator may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

**1.22 MOCK-UP**

- .1 Erect mock-ups to the requirements of Division 01.

**1.23 PRODUCT QUALITY**

- .1 Products, materials, equipment, parts or assemblies (referred to as Products) incorporated in Work: New, not damaged or defective, of best quality (compatible with specification requirements) for purpose intended. If requested, provide evidence as to type, source and quality of Products provided.
- .2 Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Contract Administrator.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

**1.24 AVAILABILITY**

- .1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items.
- .2 If delays in supply of Products are foreseeable, notify Contract Administrator of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .3 In event of failure to notify Contract Administrator at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Contract Administrator reserves right to substitute more readily available Products of similar character, at no increase in Contract Price or Contract Time.

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**1.25 STORAGE AND PROTECTION**

- .1 Store and protect Products in accordance with manufacturers' written instructions.
- .2 Store with seals and labels intact and legible.
- .3 Store sensitive Products in weather tight, climate controlled, enclosures in an environment favourable to Product.
- .4 For exterior storage of fabricated Products, place on sloped supports above ground.
- .5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.
- .6 Cover open ends of pipes, fixtures, ductwork, etc. to prevent entry of building rubbish.
- .7 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- .8 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- .9 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

**1.26 TRANSPORTATION AND HANDLING**

- .1 Transport and handle Products in accordance with manufacturer's written instructions.
- .2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- .3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.
- .4 Protect all finished and unfinished work from soiling or damage, cover floors with tarpaulins or plywood as necessary, and repair any damage resulting from work of Mechanical Section.
- .5 Protect finished surfaces to remain exposed, by paper, polyethylene or other satisfactory removable protective covering using paste acceptable to fixture manufacturer to prevent possible damage to finishes, until all reason for construction damage has passed and until acceptance by The City, and make good any such damage.

**1.27 SPECIAL CLEANING**

- .1 Maintain tidiness within work of Mechanical Sections and at completion remove protective paper, labels, etc. and tools and waste materials. Leave clean and in perfect operating condition.
- .2 Remove dirt, rubbish, grease, and dust for which this section is responsible from all exposed surfaces and fixtures.
- .3 Operate, drain and flush out bearings and refill with new charge of lubricant, before final acceptance.
- .4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances within the scope of work area. Disconnect, clean and reconnect whenever necessary for purpose of locating and removing obstructions. Repair work damaged in course of removing obstructions. Refer to 23 31 00 for any additional duct cleaning requirements.
- .5 Clean exposed surfaces of mechanical equipment, ductwork, piping, etc., and polish plated work.

- .6 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install extended nipples to outside of bearing enclosures for lubrication purposes.
- .7 Remove tools, surplus, and waste material from the building site upon completion of work. Clean grease, dirt, and excess material from walls, floors, ceilings, surfaces, and fixtures for which this Contractor was responsible, and leave the premises suitable for immediate use.
- .8 At the end of construction all systems shall be left ready for operation.
- .9 This Section shall be responsible for repair work as may be necessary to remove dents and touch-up of factory finishes.

#### **1.28 PRODUCT CHANGES & SUBSTITUTIONS**

- .1 Change in Product/Products: Submit request for substitution or alternative in accordance with this Section, the Instructions to Bidders, and Division 01 Product Exchange Procedures Division 01 Substitutions Sections. In case of a discrepancy between this section and Division 00 and Divisions 01, the more stringent requirements shall apply.
- .2 The Instructions to Bidders specify time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section.
- .3 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- .4 Any substituted item submitted for consideration must not exceed the available space and weight limitations, and all additional costs for mechanical, electrical, structural and architectural revisions required to incorporate the substituted material shall be the responsibility of the Mechanical Division. Review maximum dimensions and weights when provided in the specification and schedules, and where not specified review the drawings for space limitations.
- .5 A request constitutes a representation that the Bidder:
  - .1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
  - .2 Will provide the same warranty for the Substitution as for the specified Product.
  - .3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to The City.
  - .4 Waives claims for additional costs or time extension which may subsequently become apparent.
  - .5 Will reimburse The City and Contract Administrator for review or redesign services associated with re-approval by authorities.
- .6 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

#### **1.29 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to the Work, building occupants, or pedestrian or vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**1.30 MANUFACTURER'S WRITTEN INSTRUCTIONS**

- .1 Unless otherwise indicated in the specifications, install or erect Products to manufacturer's written instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .2 Notify Contract Administrator in writing, of conflicts between specifications and manufacturer's instructions, so that Contract Administrator may establish course of action.
- .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and re-installation at no increase in Contract Price or Contract Time.

**1.31 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Contract Administrator if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Contract Administrator reserves right to require dismissal from site any workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Contract Administrator, whose decision is final.
- .4 Assume full responsibility for layout of own work and for any damage caused to property of others through improper location or poor workmanship.

**1.32 ACCESSIBILITY OF EQUIPMENT**

- .1 The City places a high priority on being able to safely and efficiently gain access to systems and equipment for replacement and repair. All equipment must be accessible, as defined as follows:
  - .1 Ceiling mounted equipment shall only be considered accessible if a tradesman can place both hands on the equipment components which requires services (ie: fan motor, belt, pulley, bearing, fire damper linkages, valve/control valve, strainer or any other equipment component which requires periodic maintenance). The component must be in clear view, and access must be gained from an 8 or 10 foot step ladder. Access panels provided in drywall shall be sized and placed in such a manner that trades personnel can place two hands on the equipment components as stated above. Equipment located above acoustic tile ceiling shall be positioned in such a manner that equipment and its components can be accessed through a full tile which does not contain any devices such as light fixtures, speakers, smoke detectors or sprinkler heads. If this is not possible, it should be reviewed by the Contract Administrator/The City before deemed acceptable.
  - .2 Conduit, pipe, ducting and support racking or any other obstruction to accessibility shall be relocated at the contractor's expense by the contractor's forces.

**1.33 COORDINATION**

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

- .3 Check levels shown before commencement to ensure adequate falls for sewers and pipes and report discrepancies immediately. Failure to so check and report does not relieve this section from responsibility for consequent extra expenditures.
- .4 Where space is indicated as reserve for future equipment, leave clear and install piping and other work so that connections can be made to future equipment.
- .5 Secure approval where necessary to cut holes in either finished or unfinished work, employ section whose work is involved, cut openings no larger than necessary and without damage to adjoining work and carefully repair all damage to match adjacent work. Note the Mechanical Division is responsible for all required cutting and patching relating to this Contract, except as specifically noted otherwise.
- .6 Provide and set bolts, templates, sleeves and fixing materials for fixing work under this section securely to work provided under other sections, in advance of other work, where required.
- .7 Locate all openings in walls, partitions, beams, etc. required for installation of ducts, pipes and equipment, etc. specified in this section of the specifications and frame all openings as required.
- .8 Installation of all equipment shall allow sufficient space to facilitate ease of maintenance. Clearance space shall allow for the removal of all components of equipment without hindrance. Where clearance requirements are not shown on the mechanical plans, manufacturer clearances must be maintained at a minimum.

**1.34 WORK FOR OTHER TRADES**

- .1 The Mechanical Subcontractor shall install rough-ins and/or connections for all equipment requiring mechanical services, as shown on drawings or mentioned elsewhere in the specifications.
- .2 Supply other trades with all necessary details, rough-in drawings, wiring diagrams, etc. as required.

**1.35 ELECTRICAL REQUIREMENTS**

- .1 Motors and electrical equipment supplied under Mechanical Division shall comply with Electrical Section and electrical characteristics scheduled or shown.
- .2 See "Installation and Wiring Controls" in Electrical Section for equipment supplied under Electrical Section.
- .3 The Electrical section shall provide starters for all motors and wire from starters to motors, unless otherwise indicated.
- .4 The Electrical section shall wire between starters and switching components such as relays, float switches, and pressure switches.
- .5 Supply to Electrical Section within four (4) weeks after contract award, fully detailed diagrams of power and control wiring required for equipment supplied by Sections 21 – 25.
- .6 Motors shall be squirrel cage induction type 1800 RPM unless otherwise noted. Where dampness occurs, all motors and electrical apparatus such as float switches, etc. supplied integrally with any piece of apparatus, shall be totally enclosed.
- .7 All motors 1 hp and larger shall be high efficiency as defined in CSA C390.

**1.36 CONCEALMENT**

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

- .2 Before installation, inform Contract Administrator if there is interference. Install as directed by Contract Administrator.

**1.37 ACCESS PANELS**

- .1 Provide in ample time for installation under relevant sections all necessary access panels in walls and ceilings to allow access to dampers, valves, etc., size 300 mm x 300 mm (12" x 12") min. or as required for proper maintenance with steel panel and frame, similar to Acudor, type to suit application. Instruct relevant section for proper location of access panels. Final locations subject to Contract Administrator's approval. ULC approved access panels must be provided where access is through or into a fire partition or assembly. If access doors have been specified by architectural sections the architectural specification shall supersede this section.

**1.38 REMEDIAL WORK**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

**1.39 ALTERATION WORK**

- .1 Where work is to be done in existing buildings, accurately survey, provide for avoidance of damage and interference to existing work and rectify any such damage due to work under Mechanical Sections. Accept existing work as it exists at time of Bid Submission.
- .2 Carefully dismantle existing mechanical equipment to be removed or relocated. Temporarily disconnect, remove, and reinstall existing equipment, piping, ductwork, conduit, light fixtures, and similar items, which interfere with the new installation after completion of new work or of existing installations to be demolished. Store equipment and materials on the premises as directed by The City.
- .3 All usable salvaged equipment and materials shall remain the property of The City unless specifically noted otherwise. Such material shall be removed from the building and be safely and neatly stored on the site for removal by The City. The Contractor shall remove all rejected salvage from the site and legally dispose of it off site.
- .4 Reuse existing equipment in new work after first repairing and reconditioning any defective items where noted. Safely cap and seal disconnected mechanical services within finished surfaces.
- .5 The abandonment of existing equipment and material in place is not acceptable. All redundant services are to be removed back to active mains, which shall then be capped at existing point of connection.
- .6 All mechanical equipment conflicting with new equipment being installed shall be moved or disconnected, without damage, by Contractor and shall remain property of The City. Remove ducts and piping not required in revised systems and interfering with new installation. This material shall become property of Contractor.
- .7 Disconnect existing equipment indicated, intended to be reused, rough-in in new position, and after replacement connect fully, ready for use.
- .8 Removal and relocation of mechanical equipment by relevant Mechanical Sections.

**1.40 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.



- .2 Inform Contract Administrator of conflicting installation. Install as directed.

**1.41 FASTENINGS**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

**1.42 FASTENINGS - EQUIPMENT**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 304 or 316 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**1.43 TEMPORARY USE OF EQUIPMENT**

- .1 No portion of any mechanical system or equipment provided under Mechanical Sections may be used for temporary heating without Consultant's written permission and observance of the following procedure:
  - .1 Oil and grease motor, fan and pump bearings, etc. check on a regular basis and maintain as recommended by manufacturer.
  - .2 Maintain and clean when necessary cleanable type filters and clean and oil just prior to take-over of building by The City. Replace throwaway type filters.
  - .3 Ensure that mechanical air handling equipment is not operated during painting.
  - .4 Employ equipment manufacturers and subtrades to ensure and certify that all systems and equipment are in proper condition, and guarantee all work used prior to take-over as for new work, from date of acceptance of building by The City.
  - .5 If permission for temporary use of mechanical equipment is granted, use Canadian Plumbing and Mechanical Contractors Association standard form of agreement as basis of responsibilities. Guarantee on complete installation shall not start until acceptance of building by The City.
- .2 All return air grilles/openings shall be equipped with MERV 8 filters to keep return air system clean of dust and dirt if air handling equipment is being used before turnover to The City.

**1.44 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of any part of the Project.

- .2 Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Consultant.

**1.45 EQUIPMENT START UP, AND VERIFICATION REPORTS**

- .1 The contractor shall supply the equipment start-up reports for the mechanical equipment being installed.
  - .1 Forms shall be filled out in full, with all required and suggested fields.
  - .2 Forms shall include tester's signature and the signature by the project manager for the Mechanical Subcontractor.
- .2 The controls contractor shall supply a completed sequence verification checklist confirming all points of the system are functioning, reporting, and properly executing the sequence operation.
  - .1 Forms shall be developed and filled out by the contractor
  - .2 Forms shall include tester's signature and the signature by the project manager for the Mechanical Subcontractor.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1     Pipe, fittings, valves, and connections for sprinkler, standpipe and fire hose, combination sprinkler and standpipe systems.
- .2     Back flow prevention

**1.2                RELATED SECTIONS**

- .1     Submittal Procedures.
- .2     Product Requirements.
- .3     Closeout Submittals.
- .4     Painting: Preparation and painting of fire protection piping systems.
- .5     Section 21 13 00 - Sprinklers.
- .6     Section 23 05 53 - Mechanical Identification.
- .7     Section 23 05 29 - Supports and Anchors.

**1.3                REFERENCES**

- .1     ASME Boiler and Pressure Vessel Code Section IX - Welding and Brazing Qualifications.
- .2     ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- .3     ASME B16.3 - Malleable Iron Threaded Fittings.
- .4     ASME B16.4 - Cast Iron Threaded Fittings.
- .5     ASME B16.5 - Pipe Flanges and Flanged Fittings.
- .6     ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings.
- .7     ASME B16.11 - Forged Fittings Socket Welding and Threaded.
- .8     ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .9     ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .10    ASME B16.25 - Buttwelding Ends.
- .11    ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
- .12    ASTM A135 - Electric-Resistance-Welded Steel Pipe.
- .13    ASTM A47/A47M - Ferritic Malleable Iron Castings.
- .14    ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
- .15    ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

- .16 ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- .17 ASTM B32 - Solder Metal.
- .18 ASTM B75/B75M - Seamless Copper Tube.
- .19 ASTM B88 - Seamless Copper Water Tube.
- .20 ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- .21 AWS A5.8 - Filler Metal for Brazing and Braze Welding.
- .22 AWS D10.10 - Recommended Practices for Local Heating of Welds in Piping and Tubing.
- .23 AWWA C110 - Ductile-Iron and Gray-Iron Fittings 76 mm through 1219 mm (3 Inch through 48 inch) for Welder.
- .24 AWWA C151 - Ductile Iron Pipe, Centrifugally Cast, for Water.
- .25 NFPA 13 - Installation of Sprinkler Systems.
- .26 UL - Fire Resistance Directory.
- .27 UL 262 - Gate Valves for Fire-Protection Service.
- .28 UL 312 - Check Valves for Fire-Protection Service.
- .29 UL 405 - Fire Department Connections.
- .30 Underwriters Laboratories of Canada (ULC)
- .31 NSF/ANSI 61 – Drinking Water System Components – Health Effects
- .32 AWWA C220 – Stainless Steel Pipe 1/2In. (13 mm) and Larger.
- .33 ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- .34 ASTM A779 – Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products

#### **1.4 SUBMITTALS FOR REVIEW**

- .1 Section: Procedures for submittals.
- .2 Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- .3 Shop Drawings:
  - .1 Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
  - .2 Indicate hazard levels, and NFPA codes that are applicable to the system.
- .4

#### **1.5 SUBMITTALS AT PROJECT CLOSEOUT**

- .1 Section: Procedures for submittals.

- .2 Project Record Documents: Record actual locations of components and tag numbering.
- .3 Operation and Maintenance Data: Include installation instructions and spare parts lists.

## **1.6 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Carbon steel pipe and fittings manufactured in China or India will not be permitted.
- .3 All carbon steel pipe and fittings shall be manufactured in Canada or the United States of America. This does not include stainless steel.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience, licensed in the Province of Manitoba, member in good standing with the Canadian Automatic Sprinkler Association, and approved by manufacturer.

## **1.7 REGULATORY REQUIREMENTS**

- .1 Conform to cUL., UL., FM.
- .2 Sprinkler Systems: Conform to NFPA 13.
- .3 Welding Materials and Procedures: Conform to Manitoba Department of Labour and ASME Code requirements.
- .4 Valves: Bear UL/cUL label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- .5 Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

## **1.8 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section: Transport, handle, store, and protect products.
- .2 Deliver and store valves in shipping containers, with labelling in place.
- .3 Provide temporary protective coating on cast iron and steel valves.
- .4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

## **1.9 EXTRA MATERIALS**

- .1 Section: Operation and Maintenance Data.
- .2 Provide two of valve stem packings for each size and type of valve installed.

## **1.10 DESIGN CALCULATIONS**

- .1 The contractor shall carry out all necessary calculations and shall submit all calculations, data, and drawings in conformance with the requirements of NFPA 13 and the local authority having jurisdiction for Contract Administrator's review prior to proceeding with work. All design calculations are to be sealed by a Professional Engineer and shall be stamped reviewed by the authority having jurisdiction. Calculations shall be completed based on direction and restrictions given on drawings.
- .2 The design shall be based on hazard occupancy as scheduled in Section 211300.

- .3 The contractor shall be responsible to obtain water supply flow and pressure from the local municipal authority. If this information is not available, the contractor shall include all costs necessary for the testing.

### **1.11 INSPECTION AND TESTS**

- .1 All inspections and tests required by the above-mentioned authorities and agencies shall be arranged for and performed by this contractor.
- .2 Carry out any necessary flow tests without extra compensation.
- .3 All piping and fittings in the standpipe and sprinkler systems shall be hydrostatically tested at a pressure of 1380 kPa (200psi) for 2 hours without evidence of loss or leakage or as per NFPA 13 and/or 14.

## **Part 2 Products**

### **2.1 ABOVE GROUND PIPING AND FITTINGS**

- .1 Steel Pipe: ASTM A53; ASTM A135; ASTM A135 UL listed, threadable, light wall; ASTM A795; or ASME B36.10; Schedule 10 black; or ASME B36.10; Schedule 40 black; or ASME B36.10; Schedule 10 galvanized; or ASME B36.10; Schedule 40 galvanized as scheduled below.
  - .1 Steel Fittings: ASME B16.9, wrought steel, buttwelded; ASME B16.25, buttweld ends; ASTM A234, wrought carbon steel and alloy steel; ASME B16.5, steel flanges and fittings; ASME B16.11, forged steel socket welded and threaded.
  - .2 Cast Iron Fittings: ASME B16.1, flanges and flanged fittings; ASME B16.4, threaded fittings.
  - .3 Malleable Iron Fittings: ASME B16.3, threaded fittings ASTM A47.
  - .4 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
  - .5 Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
- .2 Stainless Steel pipe over 50mm (2"): Schedule 10, type 304/304L or 316/316L. Pipe to meet ASTM 312 or ASTM 778.
  - .1 Fittings:
    - .1 Welded fittings to ASTM A312 or A778 or,
    - .2 Grooved fittings to ANSI/NSF 61 & ANSI/NSF 372 for potable water service.

### **2.2 FLEXIBLE SPRINKLER HOSE**

- .1 Stainless steel braided flexible sprinkler hose
  - .1 Construction: 300 series stainless steel, EPDM gasket seal, nylon isolation ring, zinc plated carbon steel nuts and nipples.

- .2 Inlet connectons:
  - .1 Grooved
  - .2 NPT threaded to NFPA standards
- .3 Reducers provided by flexible hose manufacturer.
- .2 cUL listed or FM approval
- .3 Working conditions
  - .1 Maximum temperature: 107°C (225°F)
  - .2 Maximum Working Pressure: 1206 kPa (175 psi) cUL listed [1375 kPa/200 psi (FM Approval) ]
  - .3 Minimum bend radius: 51 mm (2 inch) cULus Listed [178 mm (7 inch) FM approval]
- .4 Bracket assemblies by hose manufacturer approved for hose application.

### **2.3 BACKFLOW PREVENTERS**

- .1 Listed Double Check Valve Assemblies:
  - .1 Manufacturers:
    - .1 Beeco.
    - .2 Zurn.
    - .3 Watts.
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 ANSI/ASSE 1024 / CSA B64.4

### **2.4 GATE VALVES**

- .1 Up to and including 50 mm (2 Inches):
  - .1 Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
- .2 Over 50 mm (2 Inches):
  - .1 Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged grooved ends.
- .3 Over 100 mm (4 Inches):
  - .1 Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

### **2.5 GLOBE OR ANGLE VALVES**

- .1 Up to and including 50 mm (2 Inches):
  - .1 Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.
- .2 Over 50 mm (2 Inches):
  - .1 Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

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## 2.6 BALL VALVES

- .1 Up to and including 50 mm (2 Inches):
  - .1 Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.
- .2 Up to and including 50 mm (2 Inches):
  - .1 Stainless steel two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.
- .3 Over 50 mm (2 Inches):
  - .1 Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 250 mm (10 inches) and over, flanged.

## 2.7 BUTTERFLY VALVES

- .1 Bronze Body:
  - .1 Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch.
- .2 Cast or Ductile Iron Body
  - .1 Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and tamper switch rated 10 amp at 115 volt AC.

## 2.8 CHECK VALVES

- .1 Up to and including 50 mm (2 Inches):
  - .1 Bronze body and swing disc, rubber seat, threaded ends.
- .2 Over 50 mm (2 Inches):
  - .1 Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
- .3 100 mm (4 Inches) and Over:
  - .1 Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

## 2.9 DRAIN VALVES

- .1 Compression Stop:
  - .1 Bronze with hose thread nipple and cap.
- .2 Ball Valve:
  - .1 Brass with cap and chain, 20 mm (3/4 inch) hose thread unless otherwise noted.



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**2.10 FLOOR PLATES**

- .1 In new construction, where pipes pass through concrete or masonry walls provide steel pipe sleeves full thickness of wall.
- .2 In new construction, risers shall have watertight floor sleeves as recommended in NFPA 13. In renovation or existing construction, cored openings are acceptable provided the penetration is sealed and watertight, and meets all requirements of NFPA 13.
- .3 Provide split or solid round floor plates on all exposed pipes passing through walls, floors, or ceilings.

**2.11 SPECIALITES**

- .1 Sight glass shall be a combination moisture and liquid indicator with protection cap. Sight glass shall be Alco, Mueller, Sporlan or Henry. Size shall be full line size.
- .2 Pressure gauges shall comply with NFPA 13. Port connection shall not be smaller than 6.4mm. The pressure limit must not be less than twice the working pressure of the sprinkler/standpipe system.
- .3 Signs
  - .1 Signs indicating valves shall be secured with metal wire or chains.
  - .2 Shall identify the portion of building served.
  - .3 Sign shall be made out of metal or rigid plastic
  - .4 As per NFPA 13

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- .2 Remove scale and foreign material, from inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

**3.2 INSTALLATION**

- .1 Use grooved mechanical couplings and fasteners only in accessible locations.
- .2 Install piping to NFPA 13 for sprinkler systems
- .3 Pipe 38mm (1-1/2") and smaller shall be joined by threaded connections.
- .4 Pipe 50mm (2") and larger may be joined by roll groove mechanical joints.
- .5 Flexible sprinkler hoses acceptable where site conditions permit usage.
- .6 Provide galvanized pipe and fittings for dry sprinkler systems.
- .7 All pipe installed so as to be inaccessible shall be joined by welded fittings. Piping in bulkheads or behind drywall shall be considered accessible. Piping in shaft walls or behind fire-rated drywall shall be considered inaccessible.
- .8 Welded pipe sections shall be shop fabricated as far as possible to minimize field welding required.

- .9 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by the same manufacturer.
- .10 Side outlet mechanical tees that are comprised of gasketed cast iron housings that fully encircle the pipe and are secured with through-bolts are acceptable. Mechanical tees that use U-bolts or wire to secure the tee to the pipe will not be accepted.
- .11 Route piping in orderly manner, plumb and parallel to building structure and as instructed on drawings. Maintain gradient.
- .12 Install piping to conserve building space, to not interfere with use of space and other work.
- .13 Group piping whenever practical at common elevations.
- .14 In new construction, sleeve pipes passing through concrete or masonry partitions, walls, and floors.
- .15 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .16 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- .17 Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- .18 Do not penetrate building structural members unless indicated.
- .19 In new construction, provide sleeves when penetrating footings floors and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required. Sleeve locations shall be noted on shop drawings.
- .20 When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- .21 Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- .22 Provide gate, ball or butterfly valves for shut-off or isolating service.
- .23 Provide drain valves at main shut-off valves, low points of piping and apparatus. Obtain written approval from Contract Administrator for final locations of all drain valves not shown on drawings.
- .24 All drains shall be routed to sanitary drainage points. Draining to the storm sewer system or sump pits is not allowed.
- .25 Division 26 to wire monitoring alarm switches for each supervised valve. Alarms shall be connected to the annunciator panel. Coordinate wiring requirements with electrical trade.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Wet-pipe sprinkler assembly.
- .2 Dry-pipe sprinkler assembly.
- .3 System design, installation, and certification.
- .4 Fire department connections.

**1.2 RELATED SECTIONS**

- .1 Section - Mechanical Identification.
- .2 Section - Vibration Isolation.
- .3 Section - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3 REFERENCES**

- .1 NFPA 13 - Installation of Sprinkler Systems.
- .2 FM - Factory Mutual Approval Guide.
- .3 NFPA 70 - National Electrical Code.
- .4 UL - Fire Resistance Directory.
- .5 UL 199 - Automatic Sprinklers for Fire-Protection Service.
- .6 Underwriters Laboratories of Canada (ULC)

**1.4 SYSTEM DESCRIPTION**

- .1 System to provide coverage for entire building.
- .2 Provide system to NFPA 13 requirements.
- .3 Determine volume and pressure of incoming water supply from water flow test data.
- .4 Interface system with building fire and smoke alarm system if applicable.
- .5 Provide fire department connections where indicated.

**1.5 SUBMITTALS FOR REVIEW**

- .1 Section: Procedures for submittals.
- .2 Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalogue information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- .3 Shop drawings:
  - .1 Submit working plans for sprinkler systems in accordance with requirements of NFPA 13, this specification, and the Contract drawings. Plans shall include sprinkler locations coordinated with the architectural reflected ceiling plan and with the mechanical drawing set. All plans shall be sealed by a professional engineer prior to submission to the Contract Administrator for review, regardless of the size of the project.
  - .2 The Contract drawings and specifications include project-specific requirements that may exceed the minimum requirements of the NFPA codes. These items

shall be included in the fire protection Subcontractor's work and shown on the working plans.

- .3 Submit calculations in accordance with NFPA 13 requirements. Hydraulic calculations are required for all projects, subject to the following exception:
  - .1 Subject to the approval of the fire protection Subcontractor's engineer of record, hydraulic calculations may be waived for renovation projects that affect 12 sprinkler or less, or with total renovated areas of 140 m<sup>2</sup> (1500ft<sup>2</sup>) or less, that are limited to relocation and/or conversion of sprinkler heads from upright to pendant (or vice versa), in which hazard classification(s) has not changed.
  - .2 Should the fire protection Subcontractor's engineer of record be satisfied that design conditions have not changed enough to warrant updated hydraulic calculations, submit a letter under seal stating as such along with the rationale for the assessment. Alternatively, include a note on the sealed working drawings indicating same as above.
- .4 Submit to authority having jurisdiction for review and approval prior to submission to Contract Administrator. Submit proof of approval to Contract Administrator.

#### **1.6 SUBMITTALS AT PROJECT CLOSEOUT**

- .1 Section: Procedures for submittals.
- .2 Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- .3 Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- .4 Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- .5 Warranty: Submit manufacturer warranty and ensure forms have been completed in The City's name and registered with manufacturer.

#### **1.7 QUALITY ASSURANCE**

- .1 Perform Work to NFPA 13.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- .4 Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed at the place where the Project is located.

#### **1.8 REGULATORY REQUIREMENTS**

- .1 Conform to ULC and FM.
- .2 Perform Work to NFPA 13.
- .3 Equipment and Components: Bear ULC, UL, FM label or marking.
- .4 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.9 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section: Transport, handle, store, and protect products.
- .2 Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

**1.10 EXTRA MATERIALS**

- .1 Section: Operation and maintenance data.
- .2 Provide extra sprinklers to NFPA 13
- .3 Provide suitable wrenches for each sprinkler type.
- .4 Provide metal storage cabinet located adjacent to alarm valve.

**Part 2 Products**

**2.1 SPRINKLERS**

- .1 Suspended Ceiling:
  - .1 Type: Standard [Semi-recessed] pendant type with matching push on escutcheon plate.
  - .2 Finish: Chrome plated. [Brass.] [Enamel, colour [\_\_\_\_\_] [as selected].]
  - .3 Escutcheon Plate Finish: To match sprinkler body.
  - .4 Fusible Link: Glass bulb type temperature rated for specific area hazard unless otherwise noted.
  - .5 Provide concealed sprinkler complete with white [colour] cover in locations noted on drawings.
- .2 Exposed Area Type:
  - .1 Type: Standard upright type.
  - .2 Finish: Brass. [Enamel, colour [\_\_\_\_\_] [as selected].]
  - .3 Fusible Link: Glass bulb type temperature rated for specific area hazard unless otherwise noted.
- .3 Sidewall Type:
  - .1 Type: Standard [Semi-recessed] [Recessed] horizontal sidewall type with matching push on escutcheon plate.
  - .2 Finish: Chrome plated. [Brass.] [Enamel, colour [\_\_\_\_\_] [as selected].]
  - .3 Escutcheon Plate Finish: To match sprinkler body.
  - .4 Fusible Link: Glass bulb type temperature rated for specific area hazard unless otherwise noted.
- .4 Dry Sprinklers:
  - .1 Type: Standard [Recessed] [Exposed] pendant type with matching push on escutcheon plate.
  - .2 Finish: Chrome plated. [Brass.] [Enamel, colour [\_\_\_\_\_] [as selected].]
  - .3 Escutcheon Plate Finish: To match sprinkler body.
  - .4 Fusible Link: Glass bulb type temperature rated for specific area hazard unless otherwise noted.
- .5 Guards: Finish to match sprinkler finish.

- .6 Provide protective guards for all sprinkler heads installed in confined but accessible spaces.
- .7 All sprinkler shall be permanently marked so as to identify each sprinkler based on type, orifice size, shape, deflector characteristic, pressure rating and thermal sensitivity.

## 2.2 PIPING SPECIALTIES

- .1 Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim ; with test and drain valve.
- .2 Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with accelerator ; with test and drain valve.
- .3 Pressure Gauge: Provide ULC FM approved listed for fire protection, having aluminum cases, bronze geared movements, bronze bourdon type, friction glass cover and precision type pointer. Accuracy to be 1% of full span. Gauges shall be 100mm diam. throughout. Pressure range shall be selected so that needle is approximately vertical at normal system pressure. Gauges shall have dual scale (psi/kPa) with psi more prominent.
- .4 Pressure Reducing Valves: Provide, where required, ULC and FM labelled pressure reducing valves (PRV) with adjustable spring range, sized to suit required flow and pressure differential, capable of maintaining differential pressure at 138 kPa (20 psi) during both flow and static conditions. Provide all necessary trim: Downstream and upstream pressure gauges, isolation valves, by-pass valves, pressure relief valve on low pressure side to compensate for leakage across the PRV.
- .5 Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- .6 Fire Department Connections:
  - .1 Flush Mount Type: Brass [chrome plated] finish.
  - .2 Free Standing Type: Ductile iron pedestal brass finish. [chrome plated] [red enamel]
  - .3 Outlets: Single 100mm (4") Angled Stortz type with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
  - .4 Drain: 19 mm (3/4 inch) automatic drip, [outside] [connected to drain].
  - .5 Label: "Sprinkler - Fire Department Connection". Subcontractor shall submit wording to local fire department for approval.
- .7 Supervisory Switches: As manufactured by [\_\_\_\_\_] Model [\_\_\_\_\_].
- .8 Water Level Supervisory Switches: As manufactured by [\_\_\_\_\_] Model [\_\_\_\_\_].
- .9 Tank Temperature Supervisory Switches: As manufactured by [\_\_\_\_\_] Model [\_\_\_\_\_].
- .10 Room Temperature Supervisory Switches: As manufactured by [\_\_\_\_\_] Model [\_\_\_\_\_].

## 2.3 SPLASH PAD

- .1 Provide a splash pad at the point of discharge for the drains outside of the building, if the ground will be disturbed by the flow of water.

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**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install to NFPA 13.
- .2        Install equipment to manufacturers written instructions.
- .3        Install buried shut-off valves in valve box. Provide post indicator.
- .4        Provide approved double backflow preventer assembly at sprinkler system water source connection as required by authority having jurisdiction.
- .5        Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent fire department connectors to allow full swing of fire department wrench handle.
- .6        Coordinate location of outside alarm gong on building wall with fire alarm subcontractor.
- .7        Place pipe runs to minimize obstruction to other work.
- .8        Place piping in concealed spaces above finished ceilings.
- .9        Centre sprinklers in one direction only in ceiling tile with location in other direction at  $\frac{1}{4}$ ,  $\frac{1}{2}$ , or  $\frac{3}{4}$  of the ceiling tile length, dependent upon spacing and coordination with ceiling elements. Layout instructions provided on the architectural and mechanical drawings override spacing instruction given above.
- .10       Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. The subcontractor shall bear all responsibility to clean sprinklers of paint or if necessary to replace with new.
- .11       Install and connect to fire pump system to Section 21 11 00, NFPA 13.
- .12       Install air compressor on vibration isolators. Refer to Section 23 05 48.
- .13       Flush entire piping system of foreign matter.
- .14       Install guards on sprinklers where indicated and as per NFPA 13.
- .15       Hydrostatically test entire system. Test shall be witnessed by authority having jurisdiction.
- .16       System drains and test connections: run to the nearest open drain in the building or to outdoors through wall away from paved areas. Seal and caulk around piping through wall and provide escutcheon and prime paint all metal surfaces exposed to outdoors.
- .17       Before commencement of any work, examine work of other trades and make immediate report to Contract Administrator of any defect or interference affecting work or guarantee of this work.
- .18       If drilling of structural beams or other load bearing members is required by design or by site conditions for passage of piping, obtain Contract Administrator's approval for location and proposed drilling procedure before drilling. Drill only in locations previously approved by Contract Administrator. Where drilling is required by design or existing site conditions, be responsible for carrying out same to approved procedure.
- .19       Allow for expansion and contraction when installing pipe hangers.
- .20       Install horizontal valves with stems upright where space allows.
- .21       Carefully coordinate work with other trades so that unnecessary offsets and revisions to the approved drawings are avoided. Failure to coordinate does not relieve Subcontractor from meeting performance standards.
- .22       The Project Coordinator shall approve any shutdowns of existing water distribution systems, fire sprinkler systems, domestic water systems or fire alarm systems. Provide

advance written notice at least 14 days prior to the shutdown to the Construction Coordinator.

- .23 Application specific sprinklers such as window sprinklers shall be installed in accordance with the listing requirements.

### **3.2 INTERFACE WITH OTHER PRODUCTS**

- .1 Ensure required devices are installed and connected as required to fire alarm system.

### **3.3 SCHEDULES**

- .1 Refer to the drawings for sprinkler schedules.

**END OF SECTION**



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- Part 1            General**
- 1.1            SECTION INCLUDES**
- .1            Fire Extinguishers
- 1.2            RELATED SECTIONS**
- .1            Section 21 05 00 – Submittal Procedures.  
.2            Section 21 05 00 - Product Requirements.  
.3            Section 21 05 00 – Closeout Submittals.  
.4            Section 10 44 13 - Fire Extinguisher Cabinets.  
.5            Section 21 11 00 - Fire Protection Piping.  
.6            Section 21 13 00 - Sprinklers.  
.7            Section 23 05 53 - Mechanical Identification.  
.8            Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.
- 1.3            REFERENCES**
- .1            FM - Factory Mutual Approval Guide.  
.2            NFPA 10 - Portable Fire Extinguishers.  
.3            NFPA 13 – Installation of Sprinkler Systems  
.4            UL - Fire Protection Equipment Directory.  
.5            ITS (Intertek Testing Services) - Certification Listings.
- 1.4            SUBMITTALS FOR REVIEW**
- .1            Section 21 05 00: Procedures for submittals.  
.2            Product Data: Provide manufacturer's catalogue sheet for equipment indicating rough-in size, finish, and accessories.  
.3            Shop Drawings: Indicate supports, components, accessories, and sizes.
- 1.5            SUBMITTALS AT PROJECT CLOSEOUT**
- .1            Section 21 05 00: Procedures for submittals.  
.2            Project Record Documents: Record actual locations of components.  
.3            Operation Data: Include manufacturer's data.  
.4            Maintenance Data: Include servicing requirements and test schedule.  
.5            Certificates: Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.
- 1.6            QUALITY ASSURANCE**
- .1            Perform Work to NFPA 10.  
.2            Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience.

**1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Deliver and store products in shipping packaging until installation.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- .2 Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
  - .1 Sheet: ASTM B 209M (ASTM B 209).
  - .2 Extruded Shapes: ASTM B 221M (ASTM B 221).
- .3 Stainless-Steel Sheet: ASTM A 666, Type 304.
- .4 Copper-Alloy Brass Sheet: ASTM B 36/B 36M, alloy UNS No. C26000 (cartridge brass, 70 percent copper).
- .5 Copper-Alloy Bronze Sheet: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).
- .6 Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, [3] [6] mm thick.
- .7 Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, [Class 1 (clear)] [Class 2 (tinted, heat absorbing, and light reducing), bronze tint].
- .8 Wire Glass: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
- .9 Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), [1.5] [3] [6] mm thick, with [Finish 1 (smooth or polished)] [Finish 2 (patterned, textured)].

**2.2 FIRE EXTINGUISHERS**

- .1 Pump Tank: [Copper] [Galvanized steel] [Red plastic] container with positive displacement pump and discharge hose.
  - .1 11 Litres (2-1/2 gallon) capacity with 2A rating.
  - .2 22 Litres (5 gallon) capacity with 4A rating.
- .2 Carbon Dioxide: Insulated handle, hose and horn discharge assembly, self-closing lever or squeeze grip operated, insulated handle.
  - .1 2.2 kg (5 pound) capacity with 5BC rating.
  - .2 4.5 kg (10 pound) capacity with 10BC rating.
  - .3 6.8 kg (15 pound) capacity with 10BC rating.
  - .4 9.0 kg (20 pound) capacity with 10BC rating.
- .3 Multi-Purpose Dry Chemical: Cartridge operated with hose and shut-off nozzle or integral shut-off nozzle.
  - .1 1.1 kg (2-1/2 pound) capacity with 1A:10BC rating.
  - .2 2.2 kg (5 pound) capacity with 2A:10BC rating.
  - .3 2.7 kg (6 pound) capacity with 3A:40BC rating.
  - .4 4.5 kg (10 pound) capacity with 4A:60BC rating.
  - .5 9.0 kg (20 pound) capacity with 20A:120BC rating.

## 2.3 FIRE EXTINGUISHERS CABINETS

- .1 Cabinet Type: Suitable for fire [extinguisher] [extinguisher and hose valve] [hose valve].
- .2 Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
  - .1 Fire End & Croker Corporation; <Insert product name or designation>.
  - .2 J. L. Industries, Inc., a division of Activar Construction Products Group; <Insert product name or designation>.
  - .3 Kidde Residential and Commercial Division, Subsidiary of Kidde plc; <Insert product name or designation>.
  - .4 Larsen's Manufacturing Company; <Insert product name or designation>.
  - .5 Modern Metal Products, Division of Technico Inc.; <Insert product name or designation>.
  - .6 Moon-American; <Insert product name or designation>.
  - .7 Potter Roemer LLC; <Insert product name or designation>.
  - .8 Watrous Division, American Specialties, Inc.; <Insert product name or designation>.
- .3 Cabinet Construction: [Nonrated] [1-hour fire rated] [2-hour fire rated].
  - .1 Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 1.1 mm- (0.0428-inch-) thick, cold-rolled steel sheet lined with minimum 16 mm- (5/8-inch-) thick, fire-barrier material. Provide factory-drilled mounting holes.
- .4 Cabinet Material: [Steel] [Aluminum] [Stainless-steel] sheet.
  - .1 Shelf: Same metal and finish as cabinet.
- .5 Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
  - .1 Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as [plaster stop] [drywall bead].
  - .2 Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
  - .3 Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- .6 Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
  - .1 Square-Edge Trim: 32- to 38-mm (1-1/4- to 1-1/2-inch) backbend depth.
  - .2 Rolled-Edge Trim: [64-mm (2-1/2-inch)] [102-mm (4-inch)] [114-mm (4-1/2-inch)] <Insert dimension> backbend depth.
- .7 Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semirecessed cabinet installation.

- .8 Cabinet Trim Material: [Steel sheet] [Aluminum sheet] [Extruded-aluminum shapes] [Stainless-steel sheet] [Copper-alloy brass sheet] [Copper-alloy bronze sheet] [Same material and finish as door].
- .9 Door Material: [Steel sheet] [Aluminum sheet] [Extruded-aluminum shapes] [Stainless-steel sheet] [Copper-alloy brass sheet] [Copper-alloy bronze sheet].
- .10 Door Style: [Fully glazed, frameless, backless, acrylic panel] [Fully glazed panel with frame] [Full bubble, frameless] [Full bubble with frame] [Full bubble with frameless, rotating turntable] [Horizontal duo panel with frame] [Vertical duo panel with frame] [Center glass panel with frame] [Solid opaque panel with frame] [Flush opaque panel, frameless, with no exposed hinges].
- .11 Door Glazing: [Clear float glass] [Tempered float glass (clear)] [Tempered float glass (bronze tint)] [Wire glass] [Acrylic sheet].
  - .1 Acrylic Sheet Color: [Clear] [Bronze] transparent acrylic sheet.
  - .2 Acrylic Sheet Color: Clear transparent acrylic sheet painted [white] [red] [black] on unexposed side.
- .12 Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - .1 Provide [projecting lever handle with cam-action latch] [projecting door pull and friction latch] [recessed door pull and friction latch] [manufacturer's standard].
  - .2 Provide [continuous hinge, of same material and finish as trim,] [concealed hinge] [pivot hinge] [manufacturer's standard hinge] permitting door to open 180 degrees.
- .13 Accessories:
  - .1 Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  - .2 Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
  - .3 Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate [as indicated] [as directed by Contracting Officer] <Insert location>.
    - .1 Identify fire extinguisher in fire protection cabinet with the words "[FIRE EXTINGUISHER] <Insert identification>."
      - .1 Location: Applied to [cabinet door] [cabinet glazing] [location indicated on Drawings].
      - .2 Application Process: [Silk-screened] [Engraved] [Etched] [Decals] [Pressure-sensitive vinyl letters].
      - .3 Lettering Color: [Red] [Black] [White].
      - .4 Orientation: [Vertical] [Horizontal] [As indicated on Drawings].
- .14 Finishes:
  - .1 Manufacturer's standard baked-enamel paint for the following:
    - .1 Exterior of cabinet [door] [trim] [, door, and trim] except for those surfaces indicated to receive another finish.
    - .2 Interior of cabinet[ and door].
  - .2 Aluminum: [Clear anodic] [Color anodic] [Baked enamel or powder coat].
  - .3 Steel: [Factory primed for field painting] [Baked enamel or powder coat].
  - .4 Stainless Steel: [No. 2B] [No. 4] [No. 6] [No. 7] [No. 8].

- .5 Copper Alloy, Brass: [Buffed] [Hand rubbed] [Hand rubbed, lacquered] [Medium satin] [Fine matte] [Statuary conversion] [Patina conversion].
- .6 Copper Alloy, Bronze: [Buffed] [Hand rubbed] [Hand rubbed, lacquered] [Medium satin] [Fine matte] [Statuary conversion] [Patina conversion].

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install to NFPA 10.
- .3 Locate and secure cabinets plumb and level. Establish top of cabinet (inside horizontal surface) 1675 mm (66 inches) above finished floor.

**3.2 FIELD QUALITY CONTROL**

- .1 Test entire system to NFPA 10.
- .2 Test shall be witnessed by authority having jurisdiction.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1     Pipe, pipe fittings, valves, and connections for piping systems.
  - .1        Sanitary sewer.
  - .2        Domestic water.
  - .3        Storm water.
  - .4        Natural gas.
  - .5        Propane gas
  - .6        Reverse Osmosis & Distilled Water

**1.2                RELATED SECTIONS**

- .1     Section 08 31 13 - Access Doors and Frames.
- .2     Section 09 91 10 - Painting.
- .3     Section 23 05 48 - Vibration Isolation.
- .4     Section 23 05 53 - Mechanical Identification.
- .5     Section 23 07 19 - Piping Insulation.
- .6     Section 23 05 16 – Piping Expansion Compensation.
- .7     Section 23 05 29 – Supports and Anchors.
- .8     Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.
- .9     Section 31 23 16 - Excavating.
- .10    Section 31 23 18 - Trenching.
- .11    Section 31 23 23 - Backfilling.

**1.3                REFERENCES**

- .1     ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
- .2     UL 1479 - Fire Tests of Through-Penetration Firestops.
- .3     CAN/ULC-S102.2 - Standard method of test for surface burning characteristics of flooring, floor covering and miscellaneous materials and assemblies
- .4     CAN/CSA-B1800 - Thermoplastic non-pressure piping
- .5     NSF/ANSI 14 - Plastics Piping System Components and Related Materials
- .6     NSF/ANSI 61 – Drinking Water System Components – Health Effects
- .7     ANSI/NSF 372 - Drinking Water System Components - Lead Content
- .8     ASME B31.9 - Building Services Piping.
- .9     ASME SEC IV - Construction of Heating Boilers.
- .10    ASME SEC IX - Welding and Brazing Qualifications.
- .11    ASME B16.3 - Malleable Iron Threaded Fittings.
- .12    MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

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- .13 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
  - .14 MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
  - .15 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
  - .16 MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
  - .17 NCPWB - Procedure Specifications for Pipe Welding.
  - .18 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
  - .19 ASME B16.4 - Grey Iron Threaded Fittings.
  - .20 ANSI/AWWA C651 - Disinfecting Water Mains.
  - .1 AWS A5.8 - Filler Metals for Brazing and Braze Welding.
  - .2 ASME B16.22-2001 (R2005) - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .3 ASME B16.26 - Copper Alloy Bronze Fittings for Flared Copper Tubes.
  - .4 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
  - .5 ASTM B42 - Seamless Copper Pipe, Standard Sizes.
  - .6 ASTM B43 - Seamless Red Brass Pipe, Standard Sizes.
  - .7 ASTM B68 - Seamless Copper Tube, Bright Annealed.
  - .8 ASTM B75 - Seamless Copper Tube.
  - .9 ASTM B22.18-03 - Seamless Copper Water Tube.
  - .10 ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
  - .11 ASTM B302 - Threadless Copper Pipe, Standard Sizes.
  - .12 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
  - .13 ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
  - .14 ASME B16.32 - Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems.
  - .15 ASTM A74 - Cast Iron Soil Pipe and Fittings.
  - .16 ASTM B306 - Copper Drainage Tube (DWV).
  - .17 ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
  - .18 ASTM B32-04 - Solder Metal.
  - .19 CISPI 301 - Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
  - .20 CISPI 310 - Joints with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
  - .21 MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends.
  - .22 MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .23 MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
  - .24 MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.

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- .25 ASTM D2665 - Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
  - .26 ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
  - .27 ASTM D2855-96 (2002) - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
  - .28 ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - .29 ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
  - .30 ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - .31 ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  - .32 AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 inch - 48 inch (350 mm - 1200mm).
  - .33 ASTM C1053 - Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
  - .1 CAN/CSA-B1800 - Thermoplastic non-pressure piping
  - .2 NSF/ANSI 14 - Plastics Piping System Components and Related Materials
  - .3 ASTM D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
  - .4 ASTM F1412. - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems
  - .5 ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  - .6 ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - .7 AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe (and Fabricated Fittings), 4 inch - 12 inch (100 mm - 300 mm), for Water Distribution.
  - .8 CSA B137.2 - Polyvinylchloride (PVC) injection-moulded gasketed fittings for pressure applications
  - .9 CSA B137.3 - Rigid polyvinylchloride (PVC) pipe and fittings for pressure applications
  - .10 CSA B137.3.1 - Molecularly oriented polyvinylchloride (PVCO) pipe for pressure applications
  - .11 ASTM D2239 - Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
  - .12 AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 inch - 3 inch (13 mm - 76 mm) for Water Service.
  - .13 ASTM D2447 - Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
  - .14 ASTM D2609 - Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
  - .15 CAN/CSA B137.9-17 - Polyethylene/aluminum/polyethylene (PE- AL-PE) composite pressure-pipe systems
  - .16 ASTM F1281 - Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe.
  - .17 CAN/CSA B137.5 - Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications



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- .18 CAN/CSA B137.10 - Crosslinked polyethylene/aluminum/crosslinked polyethylene (PEX-AL-PEX) composite pressure-pipe systems
  - .19 ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.
  - .20 ASTM F437 - Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
  - .21 ASTM F438 - Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
  - .22 ASTM F439 - Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
  - .23 ASTM F441 - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
  - .24 ASTM F442 - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe k(SDR-PR).
  - .25 ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
  - .26 ASTM F679 - Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
  - .27 CAN/CSA B137.6 - Chlorinated Polyvinylchloride (CPVC) Pipe, Tubing, and Fittings for Hot-and Cold-Water Distribution Systems
  - .28 CAN/CSA-B1800-15 - Thermoplastic non-pressure piping.
  - .29 ASME B31.1 - Power Piping.
  - .30 CSA 6.10/ANSI Z21.24 - Connectors for gas appliances
  - .31 CSA 6.16/ANSI Z21.69 - Connectors for moveable gas appliances
  - .32 CSA 6.26-18/ANSI LC 1 - Fuel gas piping systems using corrugated stainless steel tubing (CSST)
  - .33 CSA 6.27/ANSI Z21.75 - Connectors for outdoor gas appliances and manufactured homes
  - .34 CAN/CSA B137.4-17 - Polyethylene (PE) piping systems for gas services
  - .35 CAN/CSA B137.4.1-17 - Electrofusion-type polyethylene (PE) fittings for gas services
  - .36 CAN/CSA B149.1 – Natural Gas and Propane Installation Code.
  - .37 CAN/CSA B149.2 – Propane storage & handling code
  - .38 AGA Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
  - .39 ASME B31.2 - Fuel Gas Piping.
  - .40 NFPA 54 - National Fuel Gas Code.
  - .41 NFPA 58 - Liquefied Petroleum Gas Code.
  - .42 ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
  - .43 ASTM A47/A47M - Ferritic Malleable Iron Castings.
  - .44 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - .45 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

- .46 AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping Systems.
- .47 AWWA C220 – Stainless Steel Pipe 1/2In. (13 mm) and Larger.
- .48 ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- .49 ASTM A779 – Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
- .50 ISO/TS 11731 - Water quality -- Enumeration of Legionella

#### **1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Submission procedures.
- .2 Product Data: Provide data on all valves larger than 50mm (2”), and all backflow prevention devices and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Section 21 05 00: Submission procedures.
- .2 Record Documentation: Record actual locations of valves on record drawings.

#### **1.6 QUALITY ASSURANCE**

- .1 Perform Work to the standards of the Province and Municipality of Jurisdiction.
- .2 Valves: Manufacturer's name and pressure rating marked on valve body.
- .3 Welding Materials and Procedures: Conform to ASME SEC IX and applicable Provincial labour regulations.
- .4 Welder's Certification: To Manitoba Department of Labour standards.
- .5 Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.
- .6 Carbon steel pipe and fittings manufactured in China or India will not be permitted.
- .7 All carbon steel pipe and fittings shall be manufactured in Canada or the United States of America. This does not include stainless steel.

#### **1.7 REGULATORY REQUIREMENTS**

- .1 Perform Work to the latest version of the Manitoba Plumbing Code and local Municipal requirements
- .2 Perform natural gas and propane work to the latest version of the CSA B149.1 gas code, Manitoba Gas Notices and local Municipal requirements.
- .3 Conform to applicable code for installation of backflow prevention devices.
- .4 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

#### **1.8 DELIVERY, STORAGE, AND PROTECTION**

- .1 Refer to specification section Product Requirements: Transport, handle, store, and protect products.
- .2 Accept valves on site in shipping containers with labelling in place. Inspect for damage.
- .3 Provide temporary protective coating on cast iron and steel valves.

- .4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### **1.9 ENVIRONMENTAL REQUIREMENTS**

- .1 Refer to specification section Environmental Protection: Environmental conditions affecting products on site.
- .2 Do not install underground piping when bedding is wet or frozen.

## **Part 2 Products**

### **2.1 SANITARY SEWER PIPING, BURIED BEYOND 1500 MM (5 FEET) OF BUILDING**

- .1 PVC Pipe: SDR 35; CAN/CSA B1800.
  - .1 Fittings: PVC.
  - .2 Joints: ASTM F477, elastomeric gaskets.

### **2.2 SANITARY SEWER PIPING, BURIED WITHIN 1500 MM (5 FEET) OF BUILDING**

- .1 Cast-iron mechanical joint or pipe and fittings to CSA B70, Class 4000
  - .1 Fittings: Cast iron.
  - .2 Joints: ASTM C564 and CISPI Standard 310, neoprene gasket system and stainless steel clamp-and-shield assemblies.
- .2 PVC Pipe: CAN/CSA B1800
  - .1 Fittings: PVC.
  - .2 Joints: ASTM D2855, solvent weld to ASTM D2564.

### **2.3 SANITARY SEWER PIPING, ABOVE GRADE**

- .1 75mm (3") and over - Cast Iron Pipe: CISPI 301, hubless, service weight. Class 4000
  - .1 Fittings: Cast iron.
  - .2 Joints: ASTM C564 and CISPI Standard 310, neoprene gasket system and stainless steel clamp-and-shield assemblies.
- .2 Copper Tube: ASTM B306, DWV.
  - .1 Fittings: ASTM B306 with lead-free soldered cast brass drainage fittings to CSA B158.1 or wrought copper fittings to ANSI B16-29
  - .2 Joints: ASTM B32, lead-free solder, Grade 50B.
- .3 Urinal drains: On all cast-iron / copper DWV systems, the drains serving urinals from the fixture outlet to the branch main and the vents from fixture outlet to branch vent shall be PVC DWV pipe. Pipe and fittings with solvent cement socket fittings.
- .4 PVC Pipe with FSR25: CAN/CSA B1800
  - .1 Fittings: PVC.
  - .2 Joints: ASTM D2855, solvent weld to ASTM D2564.
- .5 PVC Pipe with FSR25/SDC50: CAN/CSA B1800

- .1 Piping shall be tested and listed in accordance with CAN/ULC-S102.2 and clearly marked with the certification logo indicating a flame spread rating (FSR) not exceeding 25 and a smoke developed classification (SDC) not exceeding 50.
- .2 Fittings: PVC.
- .3 Joints: ASTM D2855, solvent weld to ASTM D2564.
- .4 Manufacturer: IPEX System XFR or equal.

**2.4 SEWAGE AND SUMP PUMP DISCHARGE PIPING, ABOVE GRADE**

- .1 Copper Tubing: ASTM B88, Type L hard drawn.
  - .1 Fittings: 50-50 solder

**2.5 SEWAGE AND SUMP PUMP DISCHARGE PIPING, BELOW GRADE**

- .1 PVC Pipe: CAN/CSA B1800
  - .1 Fittings: PVC.
  - .2 Joints: ASTM D2855, solvent weld to ASTM D2564.

**2.6 WATER PIPING, BURIED BEYOND 1500 MM (5 FEET) OF BUILDING**

- .1 PVC Pipe: AWWA C900.
  - .1 Joints: CSA B137.3 ring gasket joints class 150
- .2 Up to 50mm (2"): Soft temper copper, Type K: ASTM B88
  - .1 Fittings: ANSI B22.18 or ANSI B16.18 soldered pressure fittings.
  - .2 Joints: ASTM B32, lead-free solder, Grade 50B.

**2.7 WATER PIPING, BURIED WITHIN 1500 MM (5 FEET) OF BUILDING**

- .1 Up to 50mm (2"): Soft temper copper, Type K: ASTM B88
  - .1 Fittings: ANSI B22.18 or ANSI B16.18 soldered pressure fittings.
  - .2 Joints: ASTM B32, lead-free solder, Grade 50B.

**2.8 WATER PIPING, ABOVE GRADE**

- .1 Copper Tubing 50mm (2") and under: ASTM B88, Type L hard drawn.
  - .1 Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - .2 Joints ASTM B32, solder, Grade 95TA.
- .2 Copper Tubing over 50mm (2"): ASTM B88, Type L hard drawn.
  - .1 Fittings: Silver brazed fittings.
- .3 Stainless Steel pipe over 50mm (2"): Schedule 10, type 304/304L or 316/316L. Pipe to meet ASTM 312 or ASTM 778.
  - .1 Fittings:
    - .1 Welded fittings to ASTM A312 or A778 or,
    - .2 Grooved fittings to ANSI/NSF 61 & ANSI/NSF 372 for potable water service.

**2.9 STORM WATER PIPING, BURIED BEYOND 1500 MM (5 FEET) OF BUILDING**

- .1 Cast-iron mechanical joint or pipe and fittings to CSA B70. Class 4000

- .1 Fittings: Cast iron.
- .2 Joints: Neoprene gasket and stainless steel clamp and shield assemblies.
- .2 PVC Pipe: SDR 35; CAN/CSA B1800.
  - .1 Fittings: PVC.
  - .2 Joints: ASTM F477, elastomeric gaskets.

**2.10 STORM WATER PIPING, BURIED WITHIN 1500 MM (5 FEET) OF BUILDING**

- .1 Cast-iron mechanical joint or pipe and fittings to CSA B70. Class 4000
  - .1 Fittings: Cast iron.
  - .2 Joints: Neoprene gasket and stainless steel clamp and shield assemblies.
- .2 PVC Pipe: SDR 35; CAN/CSA B1800.
  - .1 Fittings: PVC.
  - .2 Joints: ASTM F477, elastomeric gaskets.

**2.11 STORM WATER PIPING, ABOVE GRADE**

- .1 Cast Iron Pipe: ASTM A74 extra heavy weight. Class 4000
  - .1 Fittings: Cast iron.
  - .2 Joints: ASTM C564, neoprene gasket system or lead and oakum.
- .2 Cast Iron Pipe: CISPI 301, hubless, service weight. Class 4000
  - .1 Fittings: Cast iron.
  - .2 Joints: ASTM C564 and CISPI Standard 310, neoprene gasket system and stainless steel clamp-and-shield assemblies.
- .3 PVC Pipe: CAN/CSA B1800
  - .1 Fittings: PVC.
  - .2 Joints: ASTM D2855, solvent weld to ASTM D2564.
- .4 Non-combustible PVC Pipe: piping shall be tested and listed in accordance with CAN/ULC-S102.2 and clearly marked with the certification logo indicating a flame spread rating of 25 and a smoke developed classification not exceeding 50.
  - .1 Fittings: PVC.
  - .2 Joints: ASTM D2855, solvent weld to ASTM D2564.
  - .3 Manufacturer: IPEX System XFR or equal

**2.12 NATURAL GAS PIPING, BURIED BEYOND 1500 MM (5 FEET) OF BUILDING**

- .1 Steel Pipe: ASTM A53 Schedule 40 black.
  - .1 Fittings: ASTM A234/A234M, forged steel welding type, with AWWA C105 polyethylene jacket or double layer, half-lapped 0.25 mm (10 mil) polyethylene tape.
  - .2 Joints: ANSI B31.9], welded.

**2.13 NATURAL GAS PIPING, BURIED WITHIN 1500 MM (5 FEET) OF BUILDING**

- .1 Steel Pipe: ASTM A53 Schedule 40 black.
  - .1 Fittings: ASTM A234/A234M, forged steel welding type.
  - .2 Joints: ASME B31.9, welded.

- .3 Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 0.25 mm (10 mil) polyethylene tape.

## **2.14 NATURAL GAS PIPING, ABOVE GRADE**

- .1 Steel Pipe: ASTM A53 Schedule 40 Black.
  - .1 Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, forged steel welding type.
  - .2 Joints: NFPA 54, threaded or welded to ANSI B31.9.

## **2.15 FLANGES, UNIONS, AND COUPLINGS**

- .1 Pipe Size 80 mm (3 inches) and under:
  - .1 Ferrous pipe: Class 150 malleable iron threaded unions.
  - .2 Copper tube and pipe: Class 150 bronze unions with soldered joints.
- .2 Pipe Size Over 25 mm (1 inch):
  - .1 Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
  - .2 Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- .3 Grooved and Shouldered Pipe End Couplings:
  - .1 Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
  - .2 Sealing gasket: "C" shape composition sealing gasket.
- .4 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## **2.16 GLOBE VALVES**

- .1 Construction Up To and Including 80 mm (3 inches), bronze disc:
  - .1 Manufacturers:
    - .1 Red-White/Toyo
    - .2 Kitz
    - .3 Crane
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 MSS SP-80, Class 150, bronze body, bronze trim, handwheel, bronze, solder ends.
- .2 Construction Up To and Including 80 mm (3 inches), teflon disc:
  - .1 Manufacturers:
    - .1 Kitz
    - .2 Crane
    - .3 Substitutions: Refer to Section 21 05 00.
  - .2 MSS SP-80, Class 150, bronze body, bronze trim, handwheel, teflon disc, solder ends.
- .3 Construction: 50 mm (2 inches) and Larger:
  - .1 Manufacturers:

- .1 Red-White/Toyo
  - .2 Kitz
  - .3 Crane
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 MSS SP-85, Class 150, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends.

## 2.17 BALL VALVES

- .1 Manufacturers:
- .1 MAS
  - .2 Kitz
  - .3 Crane.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Construction 63 mm (2.5 inches) and smaller:
- .1 MSS SP-110, Class 150, 2760 kPa (400 psi) brass,
  - .2 Two piece body,
  - .3 316 stainless ball and trim, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder ends.
- .3 Construction 75mm (3 inches) and larger:
- .1 Ball valves shall be of the floating-ball design capable of providing bi-directional, tight shutoff in accordance with MSS SP-72.
  - .2 The valves shall be rated at 150# WSP/300# WOG.
  - .3 Bodies shall be ductile iron per ASTM A536, With ANSI Class 150 raised-face flanges.
  - .4 The interior and exterior of the body shall be epoxy-coated.
  - .5 The ball shall be PFA infused stainless steel, with a stainless steel blowout-proof stem.
  - .6 The seats and body seals shall be PTFE.
  - .7 The stem seal shall be PTFE, externally adjustable chevron type.
  - .8 Valves shall be equipped with locking handles as standard. If service conditions require, valves may be equipped with 2" square operating nuts, manual gear operators, or pneumatic, electric, or hydraulic actuators.

## 2.18 PLUG VALVES

- .1 Manufacturers:
- .1 Nordstrom Valves, Inc. MSS SP-78, Type II.
  - .2 Substitutions: Refer to Section 21 05 00.
- .2 Construction 50 mm (2 inches) and smaller: Figure 114, MSS SP-78, 2700 kPa (400 psi), cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged or threaded ends. Provide lever operator with set screw.
- .3 Construction 65 mm (2-1/2 inches) and larger: MSS SP-78, 1200 kPa (175 psi), cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged ends. Provide lever operator with set screw.

## 2.19 FLOW CONTROLS

- .1 Manufacturers:

- .1 Watts.
  - .2 Conbraco.
  - .3 Substitutions: Refer to Section 21 05 00.
- .2 Construction: Class 150, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- .3 Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum pressure 24 kPa (3.5 psi).

## **2.20 SWING CHECK VALVES**

- .1 Construction: Up to and including 80 mm (3 inches):
- .1 Manufacturers:
    - .1 Kitz.
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 MSS SP-80, Class 150, bronze body and cap, bronze swing disc with rubber seat, solder ends.
- .2 Construction: 50 mm (2 inches) and Larger:
- .1 Manufacturers:
    - .1 American Valve, Inc.
    - .2 Kitz Corporation.
    - .3 Watts Regulator ;
    - .4 Zy-Tech Global Industries, Inc.
    - .5 Substitutions: Refer to Section 21 05 00.
  - .2 MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged ends.

## **2.21 SPRING LOADED CHECK VALVES**

- .1 Manufacturers:
- .1 Class 150: Mueller 72-IHB-3-H (Ductile Iron Body) Moygro &-I515WM5B (SS Disc, Viton Seat)
  - .2 Substitutions: Refer to Section 21 05 00.
- .2 Class 150, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

## **2.22 WATER PRESSURE REDUCING VALVES**

- .1 Construction: Up to 50 mm (2 inches):
- .1 Manufacturers:
    - .1 Ames ACV
    - .2 Honeywell International Inc.
    - .3 Watts Regulator
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded and double union ends.
- .2 Construction over 50 mm (2 inches):
- .1 Manufacturers:



- .1 Ames ACV
- .2 Honeywell International Inc.
- .3 Watts Regulator
- .4 Substitutions: Refer to Section 21 05 00.
- .2 MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

## 2.23 RELIEF VALVES

- .1 Pressure Relief:
  - .1 Manufacturers:
    - .1 Watts
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- .2 Temperature and Pressure Relief:
  - .1 Manufacturers:
    - .1 Watts
    - .2 Conbraco
    - .3 Substitutions: Refer to Section 21 05 00
  - .2 AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 98.9 degrees C (210 degrees F), capacity ASME SEC IV certified and labelled.

## 2.24 STRAINERS

- .1 Construction: Size 50 mm (2 inch) and under:
  - .1 Manufacturers:
    - .1 Spirax-Sarco
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Threaded bronze body Y pattern 2070 kPa (300 psi) CWP, Y pattern with 0.8 mm 1/32 inch stainless steel perforated screen.
- .2 Construction: Size 40 mm (1-1/2 inch) to 100 mm (4 inch):
  - .1 Manufacturers:
    - .1 Spirax-Sarco
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Class 125, bronze body, Y pattern, flanged ends, with 1.6 mm (1/16 inch) stainless steel perforated screen.

## 2.25 FIRE STOP SYSTEMS

- .1 General Purpose Fire Stopping Sealant:
  - .1 Manufacturers:
    - .1 Dow Corning Silicone Elastomer Fire Stop Penetration Seal and/or Dow-Corning liquid silicone elastomer Fire Stop Foam of density, width and depth to maintain assembly fire resistive rating.
    - .2 Hilti.
    - .3 Substitutions: Refer to Section 21 05 00.

- .2 Water based, non-slumping, premixed sealant with intumescent properties, rated for 3 hours per ASTM E814 and UL 1479.
- .2 DWV Plastic Pipe Systems Fire Stopping Sealant:
  - .1 Manufacturers:
    - .1 Hilti FS-ONE Intumescent Firestop Sealant
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Silicone based, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours per ASTM E814 and UL 1479 with metal collars.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Section 21 05 00: Verify existing conditions before starting work.
- .2 Verify that excavations are to required grade, dry, and not over-excavated.

#### **3.2 PREPARATION**

- .1 Ream pipe and tube ends. Remove burrs.
- .2 Remove scale and dirt, on inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

#### **3.3 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- .3 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- .4 Install piping to maintain headroom, conserve space, and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
- .7 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
- .8 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
- .9 Establish elevations of buried piping outside the building to ensure not less than 2.4 m (8 ft) of cover.
- .10 Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- .11 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- .12 Provide support for utility meters to requirements of utility companies.
- .13 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 91 10.

- .14 Support for buried pipe under concrete structural slabs shall be hung from the slab using epoxy coated or stainless steel hangers, hardware and hanger rod secured to the rebar.
- .15 Excavate to Sections 31 23 18 and 31 23 23 for work of this Section.
- .16 Backfill to Sections 31 23 16 and 31 23 23 for work of this Section.

**OR**

- .17 Excavation and burial
  - .1 Where pipe is buried, excavate ground to buried pipe depth plus 75 mm.
  - .2 Where ground is excavated for buried pipe placement, add new crawlspace vapour barrier (polyurethane sheet, 10 mil) against the soil surface. Extend vapour barrier 600 mm past edge of excavation.
  - .3 Provide sand bed to 75mm above excavated level over vapour barrier.
  - .4 Seal vapour barrier at every penetration.
- .18 Install bell and spigot pipe with bell end upstream.
- .19 Install valves with stems upright or horizontal, not inverted.
- .20 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather-proof hood.
- .21 Install water piping to ASME B31.9.
- .22 Install fuel oil piping to ASME B31.9 and CSA B139.
- .23 Sleeve pipes passing through partitions, walls and floors. Set sleeves in concrete forms for all pipes passing through concrete walls, beams and slabs.
- .24 Install 100 mm (4 inch) concrete curbs around all pipe penetrations in mechanical rooms.
- .25 Pipe sleeves to extend above floor line as follows:
  - .1 Unfinished areas – 25 mm (1 inches).
  - .2 Finished areas (copper sleeves) – 7 mm (1/4 inches).
  - .3 Mechanical rooms, kitchens and washrooms – 100 mm (4 inches).
- .26 Caulk sleeves to provide watertight installation.
- .27 Where pipes pass through floors and walls in finished areas and where exposed to view, provide Crane #10 B.C. chrome-plated, pressed steel floor plates.
- .28 Install galvanized, oversize pipe sleeves on passing through walls or partitions, for building into wall construction, by other trades.
- .29 Sleeves and holes for piping on cold water systems shall be large enough to accommodate pipe insulation. Insulation on piping for hot water systems may stop at walls or floors.
- .30 Prior to installing sleeves in concrete beams, receive final jobsite approval by Structural Contract Administrator.
- .31 Storm water piping: Install clamps across all no-hub MJ couplings on piping 125 mm (5") and larger for all horizontal piping, including elbows at the base of vertical pipes. Refer to 23 05 29 for supports and anchors on storm water piping.

**3.4 PIPE PRESSURE TESTING**

- .1 Do not insulate pipe prior to pressure testing. Pressure test in sections if necessary before concealing or insulating pipe.

- .2 Do not introduce water for testing where freezing conditions exist or where piping systems being tested are located above sensitive areas or equipment that may be damaged or contaminated by water leakage.
- .3 Hydraulically test all pipe. Pneumatic testing not permitted without prior approval from the Contract Administrator and the Authority Having Jurisdiction.
- .4 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment. Pipe dope, caulking, tape, lead wool, dresser couplings, etc. shall not be used to correct deficiencies. The Contractor shall be responsible for all cleanup related to leakage during flushing, testing, and chemical treatment of piping, including original building piping if included in the testing.
- .5 Subject piping to a hydrostatic pressure of at least that 1-½ times the operating pressure of the system for a period of at least 12 hours. If leaks are detected, such leaks shall be repaired and the test started over. Record results and submit witnessed (by Contract Administrator or The City’s representative) reports to the Contract Administrator.
- .6 Cast iron piping systems: water-test each portion of the system for 15 minutes at a head pressure of 10’ of water. Test procedure shall be in accordance with CISPI and the manufacturer’s recommendations. Compressed air shall not be used for testing.
- .7 Register pressures at the highest system point.
- .8 Provide at least 48 hours (during working days) notice to Contract Administrator or The City’s Representative prior to testing to allow the tests to be witnessed.

**3.5 APPLICATION**

- .1 Use grooved mechanical couplings and fasteners only in accessible locations.
- .2 Install unions downstream of valves and at equipment or apparatus connections.
- .3 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- .4 Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- .5 Install globe or ball valves for throttling, bypass, or manual flow control services.
- .6 Provide spring loaded check valves on discharge of water pumps.
- .7 Provide plug valves in natural and propane gas systems for shut-off service.
- .8 Provide flow controls in water recirculating systems where indicated.
- .9 PVC DWV piping installed in non-combustible buildings shall comply with the restrictions in the following table.

<b>COMBUSTIBLE PIPE APPLICATIONS SUITABILITY FOR USE</b>					
Product	NON-COMBUSTIBLE BUILDING				
	General Usage	Air Plenum <sup>1</sup>	Vertical Services Spaces <sup>2</sup>	High-Rise Building	Underground
Combustible Pipe FSR25: (eg. IPEX System 15)	P	N <sup>3</sup>	N	N	P

Combustible Pipe FSR25/SDC50: (eg. IPEX XFR, CPVC)	P	P	N	P	P
MJ Grey Coupling	P	P	N	P	N
1. Restrictions for air plenums also apply to combustible buildings as well. 2. Certified firestopping devices are required whenever the system penetrates a vertical or horizontal separation, and shall be certified to CAN4-S115 and tested with a pressure differential of 50 Pa. 3. Sizes 20" and 24" are N					

**3.6 ERECTION TOLERANCES**

- .1 Section 01 73 00: Tolerances.
- .2 Establish invert elevations, slopes for drainage to one percent (1/8 inch per foot) minimum, except pipe sized 75 mm (3 inches) or less shall have a slope no less than two percent (1/4 inch per foot). Maintain gradients.
- .3 Slope water piping minimum 0.25 percent and arrange to drain at low points.

**3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- .1 Prior to starting work, verify system is complete, flushed and clean.
- .2 Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- .3 Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- .4 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- .5 Maintain disinfectant in system for 24 hours.
- .6 If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- .7 Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- .8 Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze to ANSI/AWWA C651.

**3.8 SERVICE CONNECTIONS**

- .1 Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- .2 Provide new water service complete with approved reduced pressure double check backflow preventer and water meter with by-pass valves and pressure reducing valve. Meter and valve arrangement to confirm to the requirements of the Authority Having Jurisdiction.
  - .1 Provide 1.20 mm (18 gauge) galvanized sheet metal sleeve around service main to 150 mm (6 inch) above floor and 1800 mm (6 feet) minimum below grade. Size for minimum of 50 mm (2 inches) of loose batt insulation stuffing.

**END OF SECTION**

**Part 1**

**General**

**1.1**

**SECTION INCLUDES**

- .1 Flexible Pipe Connections
- .2 Roof drains.
- .3 Downspouts nozzles
- .4 Vent Stack Jack
- .5 Floor Drains
- .6 Trap seal primers.
- .7 Cleanouts.
- .8 Backwater valves
- .9 Backflow preventers.
- .10 Water hammer arrestors.
- .11 Potable Water Automatic Balancing Valves
- .12 Thermostatic mixing valves.
- .13 Pressure Balanced Mixing Valves
- .14 Domestic Water Manifolds
- .15 Fiberglass Sump Pit
- .16 Polyethylene Sump Pit

**1.2**

**RELATED SECTIONS**

- .1 Roofing Section.
- .2 Section 22 10 00 - Plumbing Piping.
- .3 Section 22 42 02 - Plumbing Fixtures.
- .4 Section 22 47 00 - Plumbing Equipment.
- .5 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3**

**REFERENCES**

- .1 ASME - SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.
- .2 ASME A112.6.3 - Floor and Trench Drains
- .3 ASME A112.26.1 - Water Hammer Arrestors.
- .4 ASSE 1011 - Hose Connection Vacuum Breakers.
- .5 ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
- .6 ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- .7 ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.
- .8 ASTM C478 - Precast Reinforced Concrete Manhole Sections.

- .9 ASTM D2855 - Standard Practice for the Two-Step Method of Joining PVC or CPVC Pipe and Piping Components with Tapered Sockets
- .10 AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
- .11 CSA B70 – Cast Iron Soil Pipe, Fittings, and Means of Joining
- .12 CAN/CSA-B181.1 - Acrylonitrile-Butadiene-Styrene(ABS) Drain, Waste, and Vent Pipe and Pipe Fittings
- .13 CAN/CSA-B181.2 - Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Drain, Waste, and Vent Pipe and Pipe Fittings
- .14 CAN/CSA-B182.1 – Plastic Drain and Sewer Pipe and Pipe Fittings
- .15 CSA B79 - Commercial and Residential Drains and Cleanouts.
- .16 CAN/CSA B356 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .17 NSF/ANSI 61 – Drinking Water System Components – Health Effects
- .18 PDI WH-201 - Water Hammer Arrestors.
- .19 CSA-B64-2011 Series - Backflow Preventers and Vacuum Breakers.
  - .1 CSA B64.1.1/ANSI/ASSE 1001– Performance requirements for Atmospheric Type Vacuum Breakers (AVB)
  - .2 CSA B64.4 - Reduced pressure principle (RP) backflow preventers
  - .3 CSA B64.10 - Selection and installation of backflow preventers/Maintenance and field testing of backflow preventers
- .20 CSA B125.3 – Plumbing Fittings
- .21 ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
- .22 ASSE 1069 - Performance Requirements for Automatic Temperature Control Mixing Valves
- .23 ASSE 1070/ASME A112.1070/CSA B125.70 - Performance Requirements for Water Temperature Limiting Devices

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Submission procedures.
- .2 Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- .3 Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Section 21 05 00: Submission procedures.
- .2 Operation Data: Indicate frequency of treatment required for interceptors.
- .3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- .4 Record Documentation: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, trap seal primers.



**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Section 01 78 40: Maintenance and extra material requirements.
- .2 Extra Stock Materials: Supply two (2) loose keys for outside hose bibs.

**1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

**1.8 REGULATORY REQUIREMENTS**

- .1 Perform Work to the latest version of the Manitoba Plumbing Code and local Municipal requirements.
- .2 All components installed in domestic water system to be lead free.

**1.9 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Accept specialties on site in original factory packaging. Inspect for damage.

**Part 2 Products**

**2.1 FLEXIBLE PIPE CONNECTORS**

- .1 Manufacturers:
  - .1 Flextrol
  - .2 Flex Tech Industries
  - .3 Hydro-flex
  - .4 Substitutions: Refer to Section 21 05 00
- .2 Supply and install where shown on the drawings as in details, flexible pipe connectors as manufactured by Flex Tech Industries, selected to meet operating and test pressures of systems served.
- .3 Minimum 450 mm (18") in length unless otherwise noted.
- .4 Domestic Water Services
  - .1 Braided stainless steel outer sheathing with nylon reinforced vinyl tubing, threaded fixture connections, 125 psi pressure rating, 180°F temperature rating, NSF 61 and UPC certified

**2.2 ROOF DRAINS**

- .1 Manufacturers:
  - .1 Mifab
  - .2 Zurn
  - .3 Watts.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Standard Roof Drain (RD-1):
  - .1 Assembly: AMSE A112.6.4.
  - .2 Body: Lacquered cast iron with sump.
  - .3 Strainer: Removable cast metal dome with vandal proof screws.

- .4 Accessories: Coordinate with roofing type, refer to Roofing Section:
  - .1 Membrane flange and membrane clamp with integral gravel stop.
  - .2 Adjustable under deck clamp.
  - .3 Roof sump receiver.
  - .4 Waterproofing flange.
  - .5 Parabolic controlled flow weir.
  - .6 Levelling frame.
  - .7 Adjustable extension sleeve for roof insulation.
  - .8 Strainer free area of 43 square inches.

.3

### 2.3 VENT STACK JACKS

- .1 Manufacturer
  - .1 Thaler
  - .2 Substitutions: Refer to Section 21 05 00.
- .2 Flat Roof, no cap, insulated vent stack;
  - .1 13" (330 mm) high [7" (178mm) high] [19" (483 mm) high] 0.064" (1.6 mm) mill finish 1100-0T alloy aluminum, [.032" (0.831mm) 24 oz copper] [.031" (0.79 mm) 22 ga. Type 304 stainless steel] to CSA B272-93 complete with pre-moulded urethane insulation liner
  - .2 Size to be 2" (51 mm), 3" (76 mm), 4" (102 mm), 5" (127mm), or 6" (152 mm) diameter
  - .3 EPDM Triple Pressure Grommet Seal and EPDM Base Seal, [PVC coated deck flange] [bituminous painted deck flange]

### 2.4 FLOOR DRAINS

- .1 Manufacturers:
  - .1 Mifab
  - .2 Zurn.
  - .3 Watts.
  - .4 Jay R. Smith
  - .5 Substitutions: Refer to Section 21 05 00.
- .2 Floor Drain
  - .1 ASME A112.6.3,
  - .2 Epoxy coated cast iron two piece body with double drainage flange,
  - .3 Weep holes,
  - .4 ½" trap primer connection port,
  - .5 Refer to floor drain schedule below,
  - .6 Funnels shall be supplied in lieu of strainer as noted in schedule below,
  - .7 Floor without Surface Membrane
    - .1 Reversible clamping collar,
    - .2 Primary and secondary weep holes,
    - .3 Adjustable 5" (127mm) [6" (152mm)] [8" (203mm)] [square...] strainer less membrane clamp, refer to schedule for type.

- .8 Floor with Surface Membrane
  - .1 Reversible clamping collar,
  - .2 Primary and secondary weep holes,
  - .3 Adjustable 5" (127mm) 7" (178mm) [9" (228mm)] strainer with surface membrane clamp, refer to schedule for type.
- .9 Floor without Surface Membrane
  - .1 Adjustable 5" (127mm) [6" (152mm)] [8" (203mm)] [square...] strainer less membrane clamp, refer to schedule for type.
- .10 Non-membrane Floor with Surface Membrane Floors
  - .1 Adjustable 7" (178mm) [9" (228mm)] strainer with surface membrane clamp, refer to schedule for type.
- .11 Wood Floors with Surface Membrane
  - .1 Designed for wood deck installation,
  - .2 countersunk steel mounting flange,
  - .3 Adjustable 5" (127mm) heel proof strainer with surface membrane clamp, refer to schedule for type.
- .12 Wood Floors with tile finish
  - .1 Designed for wood deck installation,
  - .2 countersunk steel mounting flange,
  - .3 Adjustable 5" (127mm) heel proof strainer.

**Floor Drain Schedule**

Tag	Body Material	Inlet Strainer	Vandal Proof	Sediment Bucket	Trap Seal Primer
FD-1	Epoxy coated Cast Iron	Heavy Duty, Nickel Bronze	No	No	Yes
FD-2	Epoxy coated Cast Iron	Nickel Bronze, 4"x9" Funnel	No	No	Yes
FD-3	Epoxy coated Cast Iron	Nickel Bronze, 5" Hub inlet, 4" Outlet	No	No	Yes

Contractor shall provide the floor drain suitable for the finished floor unless otherwise noted on the drawing. Refer to architectural details and plans for membrane requirements. Floors with sheet membranes (vinyl floor, etc) shall have surface membrane clamp.

**2.5**

**TRAP SEAL PRIMER**

- .1 Manufacturers:
  - .1 Mifab
  - .2 Zurn.
  - .3 Watts.
  - .4 Precision Plumbing Products.
  - .5 Substitutions: Refer to Section 21 05 00.
- .2 Pressure drop activated brass trap seal primer
  - .1 Inlet opening of 1/2" (13mm) male N.P.T. and outlet opening of female 1/2" (13mm) N.P.T.

- .2 Complete with four view holes and removable filter screen.
- .3 Requires no site adjustments and no air pre-charge.
- .4 Each trap seal primer shall be installed with brass trap seal primer air gap fitting,
- .5 Where multiple floor drains are being served install a trap seal primer distribution unit.
- .6 Primers shall be installed with union directly upstream, and shut off valve.
- .7 Supply line to primer shall have a reverse bend in it to reduce the change of sediment collecting in primer, refer to manufacturer's installation instructions.
- .3 Electronic trap priming assembly
  - .1 Inlet Connection:
    - .1 3/4" inch NPT female. ANSI/ASME BI.20.1.
  - .2 Outlet Connection:
    - .1 5/8" or 1/2" inch compression fitting. SAEJ512.
    - .2 Quantity of outlets to match number of floor drains in the area.
  - .3 Manifold:
    - .1 3/4" Type "L" copper tubing. ASTM B88.
  - .4 Soldered joints:
    - .1 95-5 lead free containing lead not in excess of 0.2%.
  - .5 Electrical components:
    - .1 Circuit Breaker, Switch, Timer, Solenoid Valve marked as UL listed.
  - .6 Backflow Prevention:
    - .1 Anti-Siphon atmospheric vacuum breaker meets Los Angeles code, IAPMO, New York Board of Standards, ASSE 1001 and CSA.
    - .2 Provide air Gap connection where hazard level is considered severe as per CSA B64.
  - .7 Metal cabinet:
    - .1 Recessed
      - .1 16 gauge steel, galvanized. 3-3/8 (85mm) depth
      - .2 Fire Rated Depth 6" (150mm)
      - .3 Access Door:
        - .1 Prime Coat (Finish as per architectural)
        - .2 Stainless Steel (in mechanical rooms or locations of high humidity)
        - .3 Fire Rated.
    - .2 Surface mount
      - .1 4" (100mm) Depth
      - .2 NEMA 1 Cover
  - .8 Electrical:
    - .1 120v/220v Solenoid Valve
    - .2 120v/220v 3/Wire Connection

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**2.6 CLEANOUT COVERS**

- .1 Exterior Surfaced Areas:
  - .1 Manufacturers:
    - .1 Mifab
    - .2 Zurn.
    - .3 Watts.
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 Round cast nickel bronze access frame and non-skid cover.
- .2 Exterior Unsurfaced Areas:
  - .1 Line type with lacquered cast iron body and round epoxy coated gasketed cover.
- .3 Interior Finished Floor Areas:
  - .1 Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- .4 Interior Finished Wall Areas:
  - .1 Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- .5 Interior Unfinished Accessible Areas:
  - .1 Caulked or threaded type.
  - .2 Bolted stack cleanouts on vertical rainwater leaders.

**2.7 BACKFLOW PREVENTERS**

- .1 Reduced Pressure Backflow Preventers:
  - .1 Manufacturers:
    - .1 Beeco.
    - .2 Zurn.
    - .3 Watts.
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 ANSI/ASSE 1013 / CSA B64.4,
  - .3 Bronze body with bronze internal parts and stainless steel springs,
  - .4 Two independently operating, spring loaded check valves,
  - .5 Diaphragm type differential pressure relief valve located between check valves,
  - .6 Third check valve that opens under back pressure in case of diaphragm failure,
  - .7 Non-threaded vent outlet,
  - .8 Assembled with two gate valves, strainer, and four test cocks.\
- .2 Double Check Valve Assemblies:
  - .1 Manufacturers:
    - .1 Beeco.
    - .2 Zurn.
    - .3 Watts.
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 ANSI/ASSE 1024 / CSA B64.4
  - .3 Bronze body with corrosion resistant internal parts and stainless steel springs,

- .4 Two independently operating check valves with intermediate atmospheric vent.
- .3 Atmospheric Vacuum Breaker
  - .1 Manufacturers:
    - .1 Beeco.
    - .2 Zurn.
    - .3 Watts.
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 ANSI/ASSE 1001 / CSA B64.1.1
  - .3 Bronze/brass body with heat and water hammer resistant tight sealing disc float.
  - .4 Lead free for all potable water applications.

## 2.8 WATER HAMMER ARRESTORS

- .1 Manufacturers:
  - .1 Mifab
  - .2 Zurn.
  - .3 Watts.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 ASME A112.26.1,
  - .1 Stainless steel construction,
  - .2 Bellows type sized to PDI WH-201,
  - .3 Pre-charged suitable for operation in temperature range -73 to 149 degrees C (-100 to 300 degrees F) and maximum 1700 kPa (250 psi) working pressure.

## 2.9 POTABLE WATER AUTOMATIC BALANCING VALVES

- .1 Manufacturers:
  - .1 Victaulic/IMI TA (Tour & Andersson) Series 76X
  - .2 Substitutions: Refer to Section 21 05 00.
- .2 Construction up to and including 50mm (3/4" inch):
  - .1 Lead-free construction, Certified in accordance with NSF/ANSI 61 for commercial cold and hot water service, rated to 83°C (180°F), and NSF/ANSI 372
  - .2 Series 300 stainless steel body, nickel plated brass union nut.
  - .3 One-piece body to include a handle ball valve, a flow control cartridge assembly.
  - .4 Dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes combined with a manual air vent, and a union end.
  - .5 Valve shall be suitable for a flow range of 0.33 GPM/1.50 LPM to 12 GPM/45.4 LPM and flow rate pre-set accuracy variation of +/-5% over 95% of the control range
  - .6 Valves shall be offered with two pressure differential control ranges of 13-220 kPa (2-3 psi) or 35-414 kPa (5-60 psi) differential
- .3 Valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.
- .4 Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.
- .5 Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance.

- .6 All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale

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### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to manufacturer instructions.
- .2 Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- .3 Install wall cleanouts serving urinals above the flood plane of the fixture but below the top of the fixture it serves not including the flush valve.
- .4 Encase exterior cleanouts in concrete flush with grade.
- .5 Install floor cleanouts at elevation to accommodate finished floor.
- .6 Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- .7 All water cross connection and backflow prevention shall comply with the Authority Having Jurisdiction, City of Winnipeg By-Law 107 and CSA B64.10. Note that where severe hazards exist, an approved control device must be installed both on service pipe as well as on pipe at source of potential contamination.
- .8 Expenses for material, installation, testing and approval of cross connection and backflow prevention shall be paid by Section 22 40 10.
- .9 Provide minimum 1-1/4" (32mm) clearance between backflow preventer body and adjacent structure (wall, ceiling, etc.) and equipment. Clearance space shall be sufficient to facilitate easy removal for servicing. The BFP shall be located no higher on wall than 48" (1200mm) above the finished floor.
- .10 Backflow preventers shall be sized for the maximum rated flow of the equipment it is serving.
- .11 All testable backflow prevention devices shall be installed in accessible locations as defined by CSA-B64.10. If this cannot be accomplished, provide access platforms, etc. at no extra cost to The City.
- .12 Install testable backflow preventers on outlets to washing machines and dishwashing equipment.
- .13 Pipe relief from backflow preventer to nearest drain.
- .14 Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets, banks of flush valve fixtures (eg. Water closets, urinals).
- .15 Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 20 mm (3/4 inch) minimum, and minimum 450 mm (18 inches) long.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Water closets.
- .2 Lavatories.
- .3 Sinks.
- .4 Electric water coolers.
- .5 Drinking fountains.

**1.2 RELATED SECTIONS**

- .1 Section 21 05 00 – Submittal Procedures.
- .2 Section 01 43 00 - Quality Assurance.
- .3 Section 21 05 00 - Product Requirements.
- .4 Section 21 05 00 - Closeout Submittals.
- .5 Section 06 41 11 - Architectural Cabinetwork:
  - .1 Preparation of counters for sinks,
  - .2 Lavatory tops.
- .6 Section 07 92 00 - Joint Sealants: Seal fixtures to walls and floors.
- .7 Section 23 05 29 - Supports And Anchors.
- .8 Section 22 10 00 - Plumbing Piping.
- .9 Section 22 42 01 - Plumbing Specialties.
- .10 Section 22 47 00 - Plumbing Equipment.
- .11 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3 REFERENCES**

- .1 CSA B125.1 / ASME A112.18.1 - Plumbing Supply Fittings
- .2 CAN/CSA B125.3 - Plumbing Fittings
- .3 CSA B651 – Barrier-free Design.
- .4 ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
- .5 ASSE 1069 - Performance Requirements for Automatic Temperature Control Mixing Valves
- .6 ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices
- .7 ARI 1010 - Self-Contained Mechanically Refrigerated Drinking Water Coolers.
- .8 ASME A112.6.1 - (Floor Affixed) Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- .9 ASME A112.19.1 / CSA B45.2 - Enamelled Cast Iron Plumbing Fixtures.
- .10 ASME A112.19.2 / CSA B45.1 - Vitreous China Plumbing Fixtures.



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- .11 ASME A112.19.4 - Porcelain Enamelled Formed Steel Plumbing Fixtures.
  - .12 ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
  - .13 NFPA 70 - National Electrical Code.
  - .14 NBCC 2010 - National Building Code of Canada
  - .15 NPCC 2010 – National Plumbing Code of Canada
  - .16 NFCC 2010 – National Fire Code of Canada
- 1.4 SUBMITTALS FOR REVIEW**
- .1 Section 21 05 00: Submission procedures.
  - .2 Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- 1.5 CLOSEOUT SUBMITTALS**
- .1 Section 21 05 00: Submission procedures.
  - .2 Maintenance Data: Include fixture trim exploded view and replacement parts lists.
  - .3 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in The City's name and registered with manufacturer.
- 1.6 QUALITY ASSURANCE**
- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- 1.7 REGULATORY REQUIREMENTS**
- .1 Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.
- 1.8 DELIVERY, STORAGE, AND PROTECTION**
- .1 Section 21 05 00: Transport, handle, store, and protect products.
  - .2 Accept fixtures on site in factory packaging. Inspect for damage.
  - .3 Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
- Part 2 Products**
- 2.1 FLUSH VALVE WATER CLOSETS – FLOOR-MOUNTED**
- .1 WC-1:
    - .1 Manufacturer: TOTO CT705ULN(G).
    - .2 Other acceptable manufacturers offering equivalent products.
      - .1 American Standard.
      - .2 Contrac
      - .3 Kohler
      - .4 Substitutions: Refer to Section 21 05 00.
    - .3 ASME A112.19.2 / CSA B45.1:
      - .1 Floor mounted, vitreous china closet bowl, with elongated rim,

- .2 (1-1/2 inch) 38 mm top spud,
- .3 China bolt caps.
- .1 Exposed Sensor Operated Flush Valve (Hard Wired):
- .2 Delta Model 81T201BTA cut sheet
  - .1 Manufacturer: Delta Model 81T201HW.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 ASME A112.19.2 / CSA B45.1:
    - .1 Exposed chrome plated,
    - .2 Electronic hard wired operated diaphragm flush valve with infrared sensor,
    - .3 Integral screwdriver stop and vacuum breaker,
    - .4 Metal "non hold down" ADA compliant over-ride button,
    - .5 Pressure loss check angle stop with cap,
    - .6 Valve outlet tube 292 mm (11-1/2 inches) height
    - .7 Factory-set to 4.8L (1.28 gal) flush volume.
    - .8 Complete with junction box and stainless steel cover plate.
    - .9 120V to 24V transformer required.
  - .3 Transformer Schedule:
    - .1 For up to 10 Electronic Valves Provide:
      - .1 110 to 24VAC Class II 20VA ( )
      - .2 Manufacturer: Delta Model 060704A
    - .2 For up to 20 Electronic Valves Provide:
      - .1 110 to 24VAC Class II 40VA
      - .2 Manufacturer: Delta Model 060771A
    - .3 For up to 50 Electronic Valves Provide:
      - .1 110 to 24VAC Class II 100VA
      - .2 Manufacturer: Delta Model 060772A
- .3 Seat:
  - .1 Manufacturer: TOTO SC534.
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Bemis 1955SSC.
    - .2 Substitutions: Refer to Section 21 05 00.
  - .3 Solid white plastic, open front less cover, extended back,
  - .4 Sized for elongated bowl.
- .1 WC-2: Barrier Free Water Closet:
  - .1 Manufacturer: TOTO Model CT705ULN(G).
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 American Standard.
    - .2 Contrac.
    - .3 Substitutions: Refer to Section 21 05 00.
  - .3 ASME A112.19.2 / CSA B45.1:
    - .1 Floor mounted, vitreous china closet bowl, with elongated rim,

- .2 (1-1/2 inch) 38 mm top spud,
- .3 China bolt caps.
- .4 ADA / CSA B651:
  - .1 422mm (16-5/8 inch) high bowl.
- .2 Exposed Sensor Operated Flush Valve (Hard Wired) – Barrier Free:
  - .1 Manufacturer: Delta Model 81T201HW.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 ASME A112.19.2 / CSA B45.1:
    - .1 Exposed chrome plated,
    - .2 Electronic hard wired operated diaphragm flush valve with infrared sensor,
    - .3 Integral screwdriver stop and vacuum breaker,
    - .4 Metal “non hold down” ADA compliant over-ride button,
    - .5 Pressure loss check angle stop with cap,
    - .6 Valve outlet tube 292 mm (11-1/2 inches)
    - .7 Factory-set to 4.8L (1.28 gal) flush volume.
    - .8 Complete with junction box and stainless steel cover plate.
    - .9 120V to 24V transformer required.
  - .3 Transformer Schedule:
    - .1 For up to 10 Electronic Valves Provide:
      - .1 110 to 24VAC Class II 20VA ( )
      - .2 Manufacturer: Delta Model 060704A
    - .2 For up to 20 Electronic Valves Provide:
      - .1 110 to 24VAC Class II 40VA
      - .2 Manufacturer: Delta Model 060771A
    - .3 For up to 50 Electronic Valves Provide:
      - .1 110 to 24VAC Class II 100VA
      - .2 Manufacturer: Delta Model 060772A
- .3 Seat:
  - .1 Manufacturer: TOTO SC534.
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Bemis 1950SS.
    - .2 Substitutions: Refer to Section 21 05 00.
  - .3 Solid white plastic, open front with cover, extended back,
  - .4 Sized for elongated bowl.
- .4 Back Rest:
  - .1 Manufacturer: Franke CM-16104.
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .3 Stainless steel bar uses #4 gloss with flanges and covers.
  - .4 Antique white solid core plastic laminate 10”x4” panel back.
  - .5 Concealed snap flanges and mounting hardware included.

- .6 Provide adequate backing in wall for support and comply to local codes for barrier free requirements.

## 2.2 LAVATORIES

- .1 LAV-1 – Integral Deck
  - .1 Manufacturer: Bradley Omnideck – 3010 Series.
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Corian.
    - .2 Substitutions: Refer to Section 21 05 00.
  - .3 ASME A112.19.2 / CSA B45.1:
    - .1 Wall to wall installation. Refer to architectural drawings for dimensions,
    - .2 Barrier Free installation
    - .3 Three integral rectangular basins, (SL-TR1) complete with overflow
    - .4 Solid surface material, Terreon or equivalent. Minimum 1 mm thick
    - .5 TerreonRE colour to be provided, coordinate colour with architectural.
    - .6 Seamless backsplash.
    - .7 Decorative trap covers.
    - .8 Round over edge.
    - .9 Drilled to suit faucet.
    - .10 Front Apron,
    - .11 Stainless steel Brackets,
  - .4 ADA / CSA B651:
    - .1 Barrier free compliant.
  - .5 Lavatory - Single hole mount, electronic faucet:
    - .1 Manufacturer: Delta Model 591TP1250
    - .2 Other acceptable manufacturers offering equivalent products.
      - .1 Substitutions: Refer to Section 21 05 00.
    - .3 ASME A112.18.1:
      - .1 Hands free (touchless) on/off faucet,
      - .2 H2Optics™ technology, no external adjustments required,
      - .3 all metal faucet construction,
      - .4 4" long rigid spout, no lift rod hole,
      - .5 vandal resistant 0.5 gpm (1.9 L/min) spray outlet,
      - .6 Hard Wire (24VAC) infrared electronic handwash (Product supplied with a Converter to convert 24VAC to 6 VDC), single hole installation,
      - .7 supplied with open grid strainer, chrome finish
      - .8 Solenoid and Controller in Plastic Surface Mount Housing-
    - .4 Thermostatic Mixing Valve Delta Commercial Model R2570-MIXLF
      - .1 Brass body
      - .2 Thermostatic element senses the outlet water temperature and reacts to maintain a constant delivery temperature even under changing flows or variations in supply temperatures or pressures
      - .3 Regulating piston made from Engineered polymer

- .4 Outlet flow reduced to a trickle in the event of a cold water supply failure
- .5 Snap-on cover over a spindle mechanism that requires a special tool to adjust temperature. The special tool is provided with each valve.
- .6 Supplied with integral poppet style check valves on both inlets to prevent crossflow
- .7 Inlets/outlets: 1/2" copper sweat
- .8 Outlet temperature range: 95 - 120°F (35 - 49°C)
- .9 Hot temperature supply range: 120 - 180°F (49 - 82°C)
- .10 Minimum acceptable temperature differential of hot water inlet to tempered water outlet is 5°F (3°C)
- .11 Working pressure: 145 psi (1,000 kPa) max.
- .12 Pressure difference between hot and cold supply should not exceed  $\pm 20\%$
- .13 Maximum flow rate @ 45 psi pressure loss – 11.0 gpm (42 L/min)
- .14 Minimum flow rate – 0.34 gpm (1.36 L/min)
- .15 Provide external check valves on hot and cold supplies
- .6 Pipe Insulation:
  - .1 Manufacturer: TrueBro Lav Guard 2 E-Z
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .3 Material:
    - .1 Molded vinyl Nominal Wall 1/8" constant
    - .2 UV Protection
    - .3 Trimming (E-Z Series) "Internal, E-Z Tear-To-Fit trim feature"
    - .4 Fasteners (E-Z Series) Internal E-Z Grip fasteners (reusable)
    - .5 Color - China white, Paintable
    - .6 Burning Characteristics ASTM D-635
- .2 LAV-2 – Vitreous China Wall Hung Basin:
  - .1 Manufacturer: TOTO Model LT307(A).
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 American Standard.
    - .2 Contrac.
    - .3 Substitutions: Refer to Section 21 05 00.
  - .3 ASME A112.19.2 / CSA B45.1:
    - .1 Vitreous china wall hung lavatory,
    - .2 Ledge back,
    - .3 Single hole mounting
    - .4 Rectangular basin and splash lip,
    - .5 Integral rear overflow.
    - .6 Angle valve screwdriver stop,
    - .7 Chrome-plated copper supplies.
  - .4 ADA / CSA B651:

- .1 Barrier-free compliant.
- .5 Lavatory - Single hole mount, electronic faucet:
  - .1 Manufacturer: Delta Model 591TP1250
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .3 ASME A112.18.1:
    - .1 Hands free (touchless) on/off faucet,
    - .2 H2Optics™ technology, no external adjustments required,
    - .3 all metal faucet construction,
    - .4 4" long rigid spout, no lift rod hole,
    - .5 vandal resistant 0.5 gpm (1.9 L/min) spray outlet,
    - .6 Hard Wire (24VAC) infrared electronic handwash (Product supplied with a Converter to convert 24VAC to 6 VDC), single hole installation,
    - .7 supplied with open grid strainer, chrome finish
    - .8 Solenoid and Controller in Plastic Surface Mount Housing
  - .4 Thermostatic Mixing Valve Delta Commercial Model R2570-MIXLF
    - .1 Brass body
    - .2 Thermostatic element senses the outlet water temperature and reacts to maintain a constant delivery temperature even under changing flows or variations in supply temperatures or pressures
    - .3 Regulating piston made from Engineered polymer
    - .4 Outlet flow reduced to a trickle in the event of a cold water supply failure
    - .5 Snap-on cover over a spindle mechanism that requires a special tool to adjust temperature. The special tool is provided with each valve.
    - .6 Supplied with integral poppet style check valves on both inlets to prevent crossflow
    - .7 Inlets/outlets: 1/2" copper sweat
    - .8 Outlet temperature range: 95 - 120°F (35 - 49°C)
    - .9 Hot temperature supply range: 120 - 180°F (49 - 82°C)
    - .10 Minimum acceptable temperature differential of hot water inlet to tempered water outlet is 5°F (3°C)
    - .11 Working pressure: 145 psi (1,000 kPa) max.
    - .12 Pressure difference between hot and cold supply should not exceed ± 20%
    - .13 Maximum flow rate @ 45 psi pressure loss – 11.0 gpm (42 L/min)
    - .14 Minimum flow rate – 0.34 gpm (1.36 L/min)
    - .15 Provide external check valves on hot and cold supplies
- .6 Wall Mounted Carrier:
  - .1 Manufacturer: Mifab Model MC-41
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Watts
    - .2 Zurn.
    - .3 Substitutions: Refer to Section 21 05 00.

- .3 ASME A112.6.1:
  - .1 Cast iron and steel frame with two structural steel legs,
  - .2 Lugs for floor and wall attachment,
  - .3 Concealed arm supports,
  - .4 Bearing plate and studs.
- .7 Lavatory Pipe Insulation:
  - .1 Manufacturer: TrueBro Lav Guard 2 E-Z
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .3 Material:
    - .1 Molded vinyl Nominal Wall 1/8" constant
    - .2 UV Protection
    - .3 Trimming (E-Z Series) "Internal, E-Z Tear-To-Fit trim feature"
    - .4 Fasteners (E-Z Series) Internal E-Z Grip fasteners (reusable)
    - .5 Color - China white, Paintable
    - .6 Burning Characteristics ASTM D-635
- .3 LAV-3 – Vitreous China Count Mount Basin:
  - .1 Manufacturer: TOTO Model LT501.
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 American Standard.
    - .2 Contrac.
    - .3 Kohler.
    - .4 Substitutions: Refer to Section 21 05 00.
  - .3 ASME A112.19.2 / CSA B45.1:
    - .1 Vitreous china self-rimming counter top lavatory,
    - .2 Single hole mounting
    - .3 Front overflow,
    - .4 Seal of putty, caulking, or concealed vinyl gasket.
  - .4 ADA / CSA B651:
    - .1 Barrier-free compliant when installed in a 533mm (21 inch) minimum depth countertop
  - .5 Lavatory - Single hole mount, electronic faucet:
    - .1 Manufacturer: Delta Model 591TP1250
    - .2 Other acceptable manufacturers offering equivalent products.
      - .1 Substitutions: Refer to Section 21 05 00.
    - .3 ASME A112.18.1:
      - .1 Hands free (touchless) on/off faucet,
      - .2 H2Optics™ technology, no external adjustments required,
      - .3 all metal faucet construction,
      - .4 4" long rigid spout, no lift rod hole,
      - .5 vandal resistant 0.5 gpm (1.9 L/min) spray outlet,
      - .6 Hard Wire (24VAC) infrared electronic handwash (Product supplied with a Converter to convert 24VAC to 6 VDC), single hole installation,

- .7 supplied with open grid strainer, chrome finish
- .8 Solenoid and Controller in Plastic Surface Mount Housing
- .4 Thermostatic Mixing Valve Delta Commercial Model R2570-MIXLF
  - .1 Brass body
  - .2 Thermostatic element senses the outlet water temperature and reacts to maintain a constant delivery temperature even under changing flows or variations in supply temperatures or pressures
  - .3 Regulating piston made from Engineered polymer
  - .4 Outlet flow reduced to a trickle in the event of a cold water supply failure
  - .5 Snap-on cover over a spindle mechanism that requires a special tool to adjust temperature. The special tool is provided with each valve.
  - .6 Supplied with integral poppet style check valves on both inlets to prevent crossflow
  - .7 Inlets/outlets: 1/2" copper sweat
  - .8 Outlet temperature range: 95 - 120°F (35 - 49°C)
  - .9 Hot temperature supply range: 120 - 180°F (49 - 82°C)
  - .10 Minimum acceptable temperature differential of hot water inlet to tempered water outlet is 5°F (3°C)
  - .11 Working pressure: 145 psi (1,000 kPa) max.
  - .12 Pressure difference between hot and cold supply should not exceed  $\pm 20\%$
  - .13 Maximum flow rate @ 45 psi pressure loss – 11.0 gpm (42 L/min)
  - .14 Minimum flow rate – 0.34 gpm (1.36 L/min)
  - .15 Provide external check valves on hot and cold supplies
- .4 Accessories:
  - .1 Chrome plated 1.3 mm (17 gauge) brass P-trap with clean-out plug and arm with escutcheon.
  - .2 Offset waste with perforated open strainer.
  - .3 Angle valve screwdriver stop,
  - .4 Chrome-plated copper supplies.
- .5 Lavatory Pipe Insulation:
  - .1 Manufacturer: TrueBro Lav Guard 2 E-Z
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .3 Material:
    - .1 Molded vinyl Nominal Wall 1/8" constant
    - .2 UV Protection
    - .3 Trimming (E-Z Series) "Internal, E-Z Tear-To-Fit trim feature"
    - .4 Fasteners (E-Z Series) Internal E-Z Grip fasteners (reusable)
    - .5 Color - China white, Paintable
    - .6 Burning Characteristics ASTM D-635



## 2.3 SHOWER ENCLOSURES

- .1 Barrier-Free Shower Cabinet:
  - .1 Manufacturer: Hytec H6296.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 CSA B45.5/IAPMO Z124:
    - .1 Unit size 1019mm x 1594 mm x 1991 mm (40.25 inch x 62.75 inch x 78.38 inch).
    - .2 Designed to comply with CSA B651-12 Barrier Free requirements for a Roll-in Shower and City of Winnipeg Bylaw requirements.
    - .3 Units must be set in a mortar base leveled and any clearances between the pit opening and the unit be filled with mortar. Shimming is necessary.
    - .4 Stainless steel grab bars.
    - .5 Fold-up seat installed.
    - .6 Stainless steel shower rod installed.
    - .7 Reinforcements for hand showers, nurse call stations, seats, etc.
  - .3 Shower Drain:
    - .1 Manufacturer: Mifab Model SD7102.
    - .2 Other acceptable manufacturers offering equivalent products.
      - .1 Zurn.
      - .2 Watts.
    - .3 50mm (2") with lacquered cast iron body, membrane clamp, adjustable strainer with stainless steel grate.
- .2 Shower Trim – Barrier-Free with Hand-Held Shower:
  - .1 Manufacturer: Delta Model 13220.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 ASME A112.18.1 / CSA-B125.1 / ASSE 1016
    - .1 Pressure-balanced shower valve,
    - .2 Pressure Balancing Cartridge with integral spool and sleeve assembly;
    - .3 Adjustable hot water limit stop.
    - .4 Cartridge shall contain all the movable parts and shall be accessible from the front of the unit.
    - .5 The escutcheon will have a hot and cold coded index.
    - .6 The valve shall have a lever handle.
  - .3 Handshower Package
    - .1 Manufacturer: Delta Model RPW324HDF-1.5.
      - .1 Substitutions: Refer to Section 21 05 00.
    - .2 ASME A112.18.1 / CSA-B125.1; ASSE A112.18.3
      - .1 Handshower with Shut-off Button and Integral Backflow Protection,
      - .2 1.5 U.S.Gpm (5.7 L/min.) Flow Control
      - .3 1753 mm (69") Long Double Spiral Metal Hose
      - .4 610mm (24") SS Finish Sliding Handshower Bar w/Vertical Mounting Pin and Screws
      - .5 CP Brass Swivel Handshower Elbow for Vertical Mounting Pin
      - .6 Integral ASSE Approved Vacuum Breakers

- .3 ADA / CSA B651:
  - .1 Barrier-free compliant when installed in conjunction with other requirements.

## 2.4 ELECTRIC WATER COOLERS

- .1 DF-1 – Combination Drinking Fountain & Bottle Filler:
  - .1 Manufacturer: Elkay Model LZS8WSLP.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 Filtered Cooler with Bottle Filling Station
  - .3 Unit shall provide 8.0 gph of 50°F water at 90°F ambient and 80°F inlet water.
  - .4 Bottle filling unit shall include an electronic sensor for no-touch activation with an automatic 30-second shut-off timer.
  - .5 Shall provide 1.1-1.5 gpm flow rate with laminar flow to minimize splashing.
  - .6 Shall include antimicrobial protected plastic components to prevent mold and mildew.
  - .7 Cooler unit shall have pushbar activation and water-efficient Stream-Saver™ bubbler.
  - .8 Shall include the WaterSentry® Plus filter, certified to NSF/ANSI 42 and 53 for lead reduction, with visual monitor to indicate when replacement is necessary.
  - .9 Bottle Filling unit shall meet ADA guidelines for parallel approach.
  - .10 Cooler shall meet ADA guidelines for frontal or parallel approach.
  - .11 Complete with 3 pack replacement filter, and vandal resistant streamSaver bubbler.
  - .12 1-1/4" P-trap, SS braided supply with stops.
  - .13 Electrical: Hermetically sealed, reciprocating type 115V, 60Hz single phase compressor.
  - .14 2 m (6 foot) cord and plug for connection to electric wiring system including grounding connector.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- .3 Verify that electric power is available and of the correct characteristics.
- .4 Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

### 3.2 PREPARATION

- .1 Rough-in fixture piping connections to minimum sizes indicated in fixture rough-in schedule for particular fixtures.

### 3.3 INSTALLATION

- .1 Install to manufacturer's instructions.

- .2 Install each fixture with trap, easily removable for servicing and cleaning.
- .3 Provide chrome plated rigid supplies to fixtures with screwdriver stops, reducers, and escutcheons. Install all exposed piping and valves neatly and close to the wall. Supplies should be run as plumb as possible.
- .4 Install components level and plumb.
- .5 All mixing valves serving multiple fixtures shall be installed in recessed cabinets.
- .6 *Tempered domestic water pipe shall run fully concealed within plumbing chase and only penetrate wall directly inline with each faucet. There shall be one penetration per faucet. Domestic water pipe penetration shall be 200mm below counter height. Isolate each fixture with chrome plated stops. Exposed pipe shall be chrome plated copper.*
- .7 *Sanitary pipe serving lavatories shall run fully concealed within plumbing chase and only penetrate wall directly inline with each basin. No lateral offset will be permitted. There shall be one penetration per basin. All exposed sanitary pipe shall be chrome plated complete with echeloned plates at wall. Echeloned plate shall be secured to wall with silicone.*
- .8 Install lavatory mixing valves neatly and out of site under millwork unless specified as installed in recessed cabinet. Secure with proper fasteners – galvanized strapping is not acceptable. Where provided on the drawings, refer to mixing valve installation details.
- .9 The temperature of water discharging into a bathtub or shower shall be set and tested by the Contractor to not exceed 120°F (49°C).
- .10 Install and secure fixtures in place with wall supports or wall carriers (as specified in Part 2 Products) and bolt, washer, nut fasteners.
- .11 Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 92 00, colour to match fixture.
- .12 Seal sinks and lavatories to the millwork. Install gasket where supplied or recommended by sink or lavatory manufacturer.
- .13 Solidly attach water closets to floor with lag screws.
- .14 Emergency shower / eye-wash stations should be installed so that shower head is at least 82" above floor and 32" from wall or nearest obstruction.
- .15 Thermally insulate and jacket all exposed drain pipe extensions, traps, and trap arms below barrier-free wall-hung lavatories.
- .16 Transformers serving electronic plumbing fixtures shall be supplied by this section. Coordinate installation with electrical trades. Low voltage wiring by this section. Contractor is responsible for coordinating quantity of transformers required. Transformers shall be installed in nearest fully accessible ceiling space unless noted otherwise on drawings. Coordinate exact location with The City.

### **3.4 INTERFACE WITH OTHER PRODUCTS**

- .1 Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

### **3.5 ADJUSTING**

- .1 Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- .2 Adjust stops or valves to comply with specified flow rates.
- .3 Adjust sensor ranges to allow consistent operation of fixtures.

**3.6 CLEANING**

- .1 Section 01 74 00: Cleaning installed work.
- .2 Clean plumbing fixtures and equipment.

**3.7 PROTECTION OF FINISHED WORK**

- .1 Section 01 78 40: Protecting installed work.
- .2 Do not permit use of fixtures.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1 Domestic Water Heat Exchangers.
- .2 Potable Water Expansion Tank
- .3 Pumps.
  - .1 Circulators.
  - .2 Sump Pumps.

**1.2            RELATED SECTIONS**

- .1 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3            REFERENCES**

- .1 ASHRAE 90A - Energy Conservation in New Building Design.
- .2 ASME Section 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.
- .3 CSA B51-03 - Boiler, Pressure Vessel, and Pressure Piping Code.
- .4 NFPA 30 - Flammable and Combustible Liquids Code, 2008 Edition.
- .5 NFPA 54 - National Fuel Gas Code, 2006 Edition.
- .6 CSA B64 Definitions, General Requirements, and Test Methods for Vacuum Breakers and Backflow Preventers

**1.4            SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Submission procedures.
- .2 Product Data:
  - .1 Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
  - .2 Indicate pump type, capacity, power requirements.
  - .3 Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
  - .4 Provide electrical characteristics and connection requirements.
- .3 Shop Drawings:
  - .1 Indicate heat exchanger dimensions, size of tappings, and performance data.
  - .2 Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

**1.5            CLOSEOUT SUBMITTALS**

- .1 Section 21 05 00: Submission procedures.
- .2 Record Documentation: Record actual locations of components and electrical power supply.

- .3 Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- .4 Test Results: Provide water hardness results for pre- and post-softened water.
- .5 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in The City's name and registered with manufacturer.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Section 01 78 40: Maintenance and extra material requirements.

## **1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.
- .2 Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- .3 Ensure products and installation of specified products are to recommendations and requirements of the following organizations:
  - .1 American Gas Association (AGA).
  - .2 National Sanitation Foundation (NSF).
  - .3 American Society of Mechanical Engineers (ASME).
  - .4 National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
  - .5 National Electrical Manufacturers' Association (NEMA).
  - .6 Underwriters Laboratories (UL).
- .4 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

## **1.8 REGULATORY REQUIREMENTS**

- .1 Conform to CGA / AGS requirements for water heaters.
- .2 Conform to ASME Section 8D for manufacture of pressure vessels for heat exchangers.
- .3 Conform to ASME Section 8D for tanks.
- .4 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## **1.9 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Provide temporary inlet and outlet caps. Maintain caps in place until installation.

## **1.10 WARRANTY**

- .1 Section 21 05 00: Warranties.
- .2 Provide a five (5) year warranty to include coverage for failure to meet specified requirements, for domestic water heaters, water storage tanks, and packaged water heating systems.

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**Part 2            Products**

**2.1                DOMESTIC WATER HEAT EXCHANGERS**

- .1 Manufacturers:
  - .1 ITT/B & G.
  - .2 Taco.
  - .3 Armstrong.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Tubes: U-tube type with 19 mm (3/4 inch) diameter seamless copper tubes suitable for 860 kPa (125 psi) working pressure.
- .3 Heads: [steel,] [Brass,] with [steel] [brass] tube sheets, threaded or flanged for piping connections.
- .4 Water Chamber and Tube Bundle: Removable for inspection and cleaning.
- .5 Coating: Prime coat exterior.
- .6 Code: ASME Code for pressure vessels for service pressures, ASME "U" symbol stamped on heat exchanger.
- .7 Shell and Tube Type:
  - .1 Steel shell with threaded or flanged piping connections and necessary tapings,
  - .2 Steel saddle and attaching U-bolts,
  - .3 Designed for heating fluid in shell and heated fluid in tubes.
- .8 Accessories:
  - .1 Wells for temperature regulator sensor and high limit sensor at water outlet.
  - .2 ASME rated pressure and temperature relief valve on water outlet.
  - .3 ASME rated pressure relief valves from tapping on heated water side, set at 820 kPa (120 psig).
  - .4 ASME rated pressure relief valve on steam inlet on downstream side of control valve.
  - .5 Thermometers and pressure gauge tapings in water inlet and outlet.
  - .6 Vacuum breaker and pressure gauge tapping with pigtail siphon in shell.
- .9 Accessories:
  - .1 Wells for temperature regulator sensor at heated water outlet.
  - .2 ASME rated pressure and temperature relief valve on heated water discharge.
  - .3 ASME rated pressure relief valves from tapping on heated water side, set at 820 kPa (120 psig).
  - .4 ASME rated pressure relief valve on water inlet on downstream side of control valve.
  - .5 Thermometers and pressure gauge tapings on water inlets and outlets.

**2.2                IN-LINE CIRCULATOR PUMPS**

- .1 Manufacturers:
  - .1 ITT / B & G.
  - .2 Taco.
  - .3 Armstrong.

- .4 Substitutions: Refer to Section 21 05 00.
- .2 Casing: Bronze, rated for 860 kPa (125 psig) working pressure, with stainless steel rotor assembly.
- .3 Impeller: PPE Resin
- .4 Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings or Ceramic.
- .5 Seal: Carbon rotating against a stationary ceramic seat.
- .6 Drive: Flexible coupling.
- .7 Accessories:
  - .1 Automatic Timer Kit
    - .1 Modes: On/off/Intervals.
  - .2 Check Valve
  - .3 Three Speed
- .8 Performance:
  - .1 Refer to schedule.

### 2.3 SUBMERSIBLE SUMP PUMPS

- .1 Manufacturers:
  - .1 Little Giant ESP33 Series.
  - .2 Liberty
  - .3 ITT / Goulds.
  - .4 Barnes.
  - .5 Substitutions: Refer to Section 21 05 00.
- .2 Type: Completely submersible, vertical, centrifugal.
- .3 Motor: thermal overload protected, stainless-steel heat-treated shaft, continuous duty oil-free motor, permanently lubricated lip seal.
- .4 Casing: Cast iron pump body.
- .5 Impeller: Glass-reinforced thermoplastic, stainless-steel heat-treated shaft.
- .6 Solids handling capability: 1/2".
- .7 Bearings: Ball bearings.
- .8 Sump: Fibreglass basin with steel cover plate; [\_\_\_\_] mm([\_\_\_\_] inches) diameter, [\_\_\_\_] mm([\_\_\_\_] inches) deep.
- .9 Accessories: Oil resistant 3 m (10 foot) cord and plug with three-prong connector for connection to electric wiring system.
- .10 Controls: Automatic, mercury-free mechanical float switch with separate liquid level control high level alarm.

**[OR]**
- .11 Controls:
  - .1 Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button,



- .2 Circuit breaker,
- .3 Control transformer,
- .4 Electro mechanical alternator,
- .5 Hand-off-automatic selector switches,
- .6 Pilot lights, high water alarm pilot light,
- .7 Reset button and alarm horn,
- .8 Mercury switch liquid level controls,
- .9 Steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm.

**[OR]**

.12 Controls:

- .1 Duplex Alarm System & Pump Control – ( Little Giant)
- .2 Controls the pump and warns of high liquid levels
- .3 NEMA 4X ultraviolet stabilized thermoplastic enclosure
- .4 HOA switch allows for “Hand” (manual) “Off” or “Automatic” operation
- .5 Control/Alarm ON/OFF switch controls power to the control float and circuitry; this and the pump HOA switch provide an additional safety feature when servicing
- .6 Entire unit UL listed and tested by UL to CSA standards
- .7 Two sensor floats and an alarm float included
- .8 Designed to operate with or without optional fourth
- .9 83-85db audible alarm buzzer

.13 Performance:

- .1 Refer to schedules.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Coordinate with plumbing piping and related fuel piping, gas venting, and electrical work to achieve operating system.
- .2 Domestic Water Heat Exchangers:
  - .1 Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
  - .2 Support unit on steel frame, painted.
  - .3 Pipe relief valves and drains to nearest floor drain.
  - .4 Connect steam branch line from top of main.
  - .5 Pipe in flexible manner, pitched with steam flow, with pipe union connections.
  - .6 Provide steam pressure gauge at exchanger inlet.
  - .7 Provide steam traps and valves as indicated.
  - .8 Pitch shell for condensate drain to traps.
- .3 Pumps:
  - .1 Ensure shaft length allows sump pumps to be located minimum 600 mm (24 inches) below lowest invert into sump pit and minimum (150 mm 6 inches) clearance from bottom of sump pit.

- .2 Provide air cock and drain connection on horizontal pump casings.
- .3 Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
- .4 Decrease from line size with long radius reducing elbows or reducers.
- .5 Support piping adjacent to pump such that no weight is carried on pump casings.
- .6 Provide supports under elbows on pump suction and discharge line sizes 100 mm (4 inches) and over.
- .7 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- .8 Align and verify alignment of base mounted pumps prior to start-up.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Single phase electric motors.
- .2      Three phase electric motors.

**1.2                RELATED SECTIONS**

- .1      Section 21 05 00 – Submittal Procedures.
- .2      Section 21 05 00 - Product Requirements.
- .3      Section 21 05 00 - Closeout Submittals.
- .4      Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3                REFERENCES**

- .1      AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- .2      AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- .3      IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
- .4      NEMA MG 1 - Motors and Generators.

**1.4                SUBMITTALS**

- .1      Section 21 05 00: Procedures for submittals.
- .2      Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- .3      Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 15 Kw (20 horsepower).
- .4      Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

**1.5                OPERATION AND MAINTENANCE DATA**

- .1      Section 21 05 00: Submittals for project closeout.
- .2      Operation Data: Include instructions for safe operating procedures.
- .3      Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

**1.6                QUALIFICATIONS**

- .1      Manufacturer: Company specializing in manufacture of electric motors and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

**1.7                REGULATORY REQUIREMENTS**

- .1      Conform to applicable electrical code.
- .2      Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

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**1.8 DELIVERY, STORAGE, AND HANDLING**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

**1.9 WARRANTY**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide five year warranty.
- .3 Warranty: Include coverage for motors larger than 20 horsepower.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Baldor.
- .2 Toshiba.
- .3 WEG
- .4 Substitutions: Refer to Section 21 05 00.

**2.2 GENERAL CONSTRUCTION AND REQUIREMENTS**

- .1 Motors less than 250 Watts, for intermittent service: Equipment manufacturer's standard and need not conform to these specifications.
- .2 Electrical Service:
  - .1 The following are required electrical characteristics unless otherwise indicated in the drawings and schedules.
  - .2 Motors 0.5 kW (3/4 hp) and smaller: 115 volts, single phase, 60 Hz.
  - .3 Motors Larger than 0.5 kW (3/4 hp): 575 volts, three phase, 60 Hz.
  - .4 Motors Larger than 0.5 kW (3/4 hp): 208 volts, three phase, 60 Hz.
  - .5 Motors Larger than 0.5 kW (3/4 hp): 208 volts, single phase, 60 Hz.
- .3 Type:
  - .1 Open drip-proof except where specifically noted otherwise.
  - .2 Motors: Design for continuous operation in 40 degrees C environment.
  - .3 Design for temperature rise to NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  - .4 Motors with frame sizes 254T and larger: Energy Efficient Type.
- .4 Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- .5 Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- .6 Wiring Terminations:
  - .1 Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code, threaded for conduit.

- .2 For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

**2.3 SINGLE PHASE POWER - SPLIT PHASE MOTORS**

- .1 Starting Torque: Less than 150 percent of full load torque.
- .2 Starting Current: Up to seven times full load current.
- .3 Breakdown Torque: Approximately 200 percent of full load torque.
- .4 Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- .5 Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

**2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

- .1 Starting Torque: Exceeding one fourth of full load torque.
- .2 Starting Current: Up to six times full load current.
- .3 Multiple Speed: Through tapped windings.
- .4 Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

**2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS**

- .1 Starting Torque: Three times full load torque.
- .2 Starting Current: Less than five times full load current.
- .3 Pull-up Torque: Up to 350 percent of full load torque.
- .4 Breakdown Torque: Approximately 250 percent of full load torque.
- .5 Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- .6 Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.
- .7 Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

**2.6 SINGLE PHASE POWER – ELECTRONIC COMMUTATED MOTORS (ECM)**

- .1 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications.
- .2 Permanently lubricated with ball bearings.
- .3 Motor shall be a minimum of 85% efficient.
- .4 Internal motor circuitry shall convert AC power supplied to the fan to DC power.
- .5 Motor shall be speed controllable down to 20% of full speed.
- .6 Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.

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**2.7 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

- .1 Starting Torque: Between 1 and 1-1/2 times full load torque.
- .2 Starting Current: Six times full load current.
- .3 Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- .4 Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- .5 Insulation System: NEMA Class B or better.
- .6 Testing Procedure: To IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- .7 Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- .8 Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 23 - Variable Frequency Controllers.
- .9 Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- .10 Sound Power Levels: To NEMA MG 1.
- .11 Part Winding Start where indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- .12 Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- .13 Nominal Efficiency: As scheduled at full load and rated voltage when tested to IEEE 112.
- .14 Nominal Power Factor: As scheduled at full load and rated voltage when tested to IEEE 112.

**2.8 MOTORS CONTROLLED BY VARIABLE FREQUENCY DRIVES**

- .1 Motors controlled by variable frequency drives (VFDs) shall comply with requirements of CSA Specification C22.2 No. 100-95, Clause 12.4 and shall be permanently marked with the following in addition to the normal marking requirements:
  - .1 Machine Application (Inverter Duty);
  - .2 Speed range over which the machine is designed to operate;
  - .3 Type of torque application for which the machine is designed (eg. VT (variable torque), CT (constant torque), Chp (constant horsepower) or equivalent;
  - .4 Type(s) of inverter(s) with which the machine is intended to be used (eg.: VSI or VVI (6-step voltage source), CSI (6-step current source), VPWM (voltage-source pulse width modulated), LCI (load commutated), cyclonverter, or equivalent).

**Part 3 Execution**

**3.1 APPLICATION**

- .1 Single phase motors for shaft mounted fans, oil burners, centrifugal pumps: Split phase type.
- .2 Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- .3 Single phase motors for [fans], [pumps] [blowers] [air compressors]: Capacitor start type.
- .4 Single phase motors for [fans] [blowers] [pumps]: Capacitor start, capacitor run type.
- .5 Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, dust collection systems, [\_\_\_\_\_]: Totally enclosed type.
- .6 Motors located in outdoors, wet air streams downstream of sprayed coil dehumidifiers, draw thru cooling towers, humidifiers, [\_\_\_\_\_]: Totally enclosed weatherproof epoxy-treated type.
- .7 Motors located in outdoors, draw thru cooling towers, [\_\_\_\_\_]: Totally enclosed weatherproof epoxy-sealed type.

**3.2 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- .3 Check line voltage and phase and ensure agreement with nameplate.

**3.3 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE**

	<b>kW (HP)</b>	<b>3600 RPM</b>	<b>1800 RPM</b>	<b>1200RPM</b>	<b>900RPM</b>
	0.12-0.25(1/6-1/3)	1.35	1.35	1.35	1.35
	0.38(1/2)	1.25	1.25	1.25	1.15
	0.5(3/4)	1.25	1.25	1.15	1.15
	0.75(1)	1.25	1.15	1.15	1.15
	1.1-1.11(1.5-150)	1.15	1.15	1.15	1.15

**3.4 PERFORMANCE SCHEDULE: THREE PHASE - ENERGY EFFICIENT, OPEN DRIP-PROOF**

	<b>kW (HP)</b>	<b>RPM (Syn)</b>	<b>NEMA Frame</b>	<b>Minimum Percent Efficiency</b>	<b>Minimum Percent Power Factor</b>
	0.75(1)	1800	143T	82	84
	1.1(1-1/2)	1800	145T	84	85
	1.5(2)	1800	145T	84	85
	2.25(3)	1800	182T	86	86
	3.7(5)	1800	184T	87	87
	5.6(7-1/2)	1800	213T	88	86
	7.5(10)	1800	215T	89	85
	11(15)	1800	256T	91	85
	15(20)	1800	256T	91	86

	<b>kW (HP)</b>	<b>RPM (Syn)</b>	<b>NEMA Frame</b>	<b>Minimum Percent Efficiency</b>	<b>Minimum Percent Power Factor</b>
	1.1(1-1/2)	3600	143T	82	85
	1.5(2)	3600	145T	82	87
	2.25(3)	3600	145T	84	85
	3.7(5)	3600	182T	85	86
	5.6(7-1/2)	3600	184T	86	88
	7.5(10)	3600	213T	87	86
	11(15)	3600	215T	89	
	15(20)	3600	254T	90	89
	18(25)	3600	256T	90	92

**3.5 PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED**

	<b>kW(HP)</b>	<b>RPM(Syn)</b>	<b>NEMA Frame</b>	<b>Minimum Percent Efficiency</b>	<b>Minimum Percent Power Factor</b>
	0.75(1)	1800	143T	82	84
	1.1(1-1/2)	1800	145T	84	85
	1.5(2)	1800	145T	84	85
	2.25(3)	1800	182T	87	83
	3.7(5)	1800	184T	88	83
	5.6(7-1/2)	1800	213T	89	85
	7.5(10)	1800	215T	90	84
	11(15)	1800	254T	91	86
	15(20)	1800	256T	91	85
	1.1(1-1/2)	3600	143T	82	85
	1.5(2)	3600	145T	82	87
	2.25(3)	3600	182T	82	87
	3.7(5)	3600	184T	85	88
	5.6(7-1/2)	3600	213T	86	86
	7.5(10)	3600	215T	86	86
	11(15)	3600	254T	88	91
	15(20)	3600	256T	89	89
	18(25)	3600	284T	90	92

**END OF SECTION**



**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Flexible pipe connectors.
- .2      Expansion joints and compensators.
- .3      Pipe loops, offsets, and swing joints.

**1.2                RELATED SECTIONS**

- .1      Section 21 11 00 - Fire Protection Piping.
- .2      Section 22 10 00 - Plumbing Piping.
- .3      Section 23 21 00 - Hydronic Piping.
- .4      Section 23 22 00 - Steam And Steam Condensate Piping.
- .5      Section 23 23 00 - Refrigerant Piping And Specialties.

**1.3                REFERENCES**

- .1      MIL-E-17814E - Expansion Joints, Pipe, Slip-Type, Packed.

**1.4                PERFORMANCE REQUIREMENTS**

- .1      Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.
- .2      Expansion Calculations:
  - .1          Installation Temperature (hot water heating, domestic hot water): 10 degrees C (50 degrees F).
  - .2          Hot Water Heating: 99 degrees C (210 degrees F).
  - .3          Domestic Hot Water: 60 degrees C (140 degrees F).
  - .4          Installation Temperature (chilled water): 27 degrees C (80 degrees F).
  - .5          Chilled Water: 7 degrees C (45 degrees F).
  - .6          Safety Factor: 30 percent.

**1.5                SUBMITTALS**

- .1      Section 21 05 00: Procedures for submittals.
- .2      Product Data:
  - .1          Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per metre(foot) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  - .2          Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- .3      Design Data:
  - .1          Indicate selection calculations.

- .2 Provide steam piping layout from connection to central plant supply to building entry with measurements including location and size of expansion loops and anchors based on site conditions.
- .3 Provide piping layout with measurements including location and size of expansion loops and anchors based on site conditions.
- .4 Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

## **1.6 PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

## **1.7 OPERATION AND MAINTENANCE DATA**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Maintenance Data: Include adjustment instructions.

## **1.8 QUALIFICATIONS**

- .1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- .3 Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

## **1.10 WARRANTY**

- .1 Warranty: Include coverage for leak free performance of packed expansion joints.

## **1.11 EXTRA MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide two 340 gm (12 ounce) containers of packing lubricant and cartridge style grease gun.

## **Part 2 Products**

### **2.1 FLEXIBLE PIPE CONNECTORS**

- .1 Steel Piping:
  - .1 Manufacturers:
    - .1 HYSPAN.
    - .2 Substitutions: Refer to Section 21 05 00
  - .2 Inner Hose: Stainless Steel.

- .3 Exterior Sleeve: Double braided stainless steel.
- .4 Pressure Rating: [ 862 kPa (125 psig) WSP and 204 degrees C (400 degrees F)]  
[ 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F)].
- .5 Joint: As specified for pipe joints.
- .6 Size: Use pipe sized units.
- .7 Maximum offset: 20 mm (3/4 inch) on each side of installed centre line.
- .2 Copper Piping – domestic water services up to and including 50 mm (2”):
  - .1 Manufacturers:
    - .1 Hydro Flex Inc.
    - .2 HYPAN.
    - .3 Substitutions: Refer to Section 21 05 00.
  - .2 Inner Hose: Bronze
  - .3 Exterior Sleeve: Single braided bronze.
  - .4 Pressure Rating: [ 862 kPa (125 psig) WSP and 204 degrees C (400 degrees F)]  
[ 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F)].
  - .5 Joint: As specified for pipe joints.
  - .6 Size: Use pipe sized units
  - .7 Maximum offset: 20 mm (3/4 inch) on each side of installed centre line.
- .3 Copper Piping – domestic water services up over 50 mm (2”):
  - .1 Manufacturers:
    - .1 Hydro Flex Inc.
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Inner Hose: Bronze
  - .3 Exterior Sleeve: Single braided stainless steel with Van Stone floating flanges  
and stainless steel sleeve at all wetted areas.
  - .4 Pressure Rating: [ 862 kPa (125 psig) WSP and 204 degrees C (400 degrees F)]  
[ 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F)].
  - .5 Joint: flanged.
  - .6 Size: Use pipe sized units
  - .7 Maximum offset: 20 mm (3/4 inch) on each side of installed centre line.
- .4 Copper Piping – heating water, chilled water, and condenser water up to and including 50 mm (2”):
  - .1 Manufacturers:
    - .1 Hydro Flex.
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Inner Hose: 300 series stainless steel.
  - .3 Exterior Sleeve: Braided stainless steel.
  - .4 Pressure Rating: [ 862 kPa (125 psig) WSP and 204 degrees C (400 degrees F)]  
[ 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F)].
  - .5 Joint: threaded male ends.
  - .6 Size: Use pipe sized units
  - .7 Maximum offset: 20 mm (3/4 inch) on each side of installed centre line.
- .5 Copper Piping – heating water, chilled water, and condenser water up to over 50 mm (2”):
  - .1 Manufacturers:

- .1 Model G-FLEX.
- .2 Substitutions: Refer to Section 21 05 00.
- .1 neoprene and nylon body, cadmium steel flanges, spring wire beading. Where excess vibration and noise is encountered use Model GD-FLEX double sphere.
- .2 Pressure Rating: [ 862 kPa (125 psig) WSP and 204 degrees C (400 degrees F)] [ 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F)].
- .3 Joint: As specified for pipe joints.
- .4 Size: Use pipe sized units
- .5 Maximum offset: 20 mm (3/4 inch) on each side of installed centre line.

## 2.2 EXPANSION JOINTS

- .1 Stainless Steel Bellows Type:
  - .1 Manufacturers:
    - .1 HYSPAN Model 8503
    - .2 Flextronics.
    - .3 Substitutions: Refer to Section 21 05 00.
  - .2 Pressure Rating: [ 862 kPa (125 psig) WSP and 204 degrees C (400 degrees F)] [ 1380 kPa (200 psig) WOG and 121 degrees C (250 degrees F)].
  - .3 Maximum Compression: 45 mm (1-3/4 inch).
  - .4 Maximum Extension: 6 mm (1/4 inch).
  - .5 Joint: As specified for pipe joints.
  - .6 Size: Use pipe sized units.
  - .7 Application: Steel piping 75 mm (3 inch) and under.
- .2 External Ring Controlled Stainless Steel Bellows Type:
  - .1 Manufacturers:
    - .1 HYSPAN Model 3500 series.
    - .2 Flextronics.
    - .3 Substitutions: Refer to Section 21 05 00.
  - .2 Pressure Rating: [ 862 kPa (125 psig) WSP and 204 degrees C (400 degrees F)] [ 1380 kPa (200 psig) WOG and 121 degrees C (250 degrees F)] [ 1550 kPa (225 psig) and 21 degrees C (70 degrees F)].
  - .3 Maximum Compression: 24 mm (15/16 inch) [ 32 mm(1-1/4 inch)].
  - .4 Maximum Extension: 8 mm (5/16 inch) [ 10 mm(3/8 inch)].
  - .5 Maximum Offset: 3 mm (1/8 inch) [8 mm(5/16 inch)] [ [ ] mm([ ] inch)].
  - .6 Joint: Flanged.
  - .7 Size: Use pipe sized units.
  - .8 Accessories: Internal flow liner. Externally guided.
  - .9 Application: Steel piping over 75 mm (3 inch).
- .3 Low Pressure Compensator for Wall Fin Elements and Baseboard:
  - .1 Manufacturers:
    - .1 HYSPAN Model 8501.
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Working Pressure: 550 kPa (80 psig).
  - .3 Maximum Temperatures: 121 degrees C (250 degrees F).
  - .4 Maximum Compression: 12.7 mm (1/2 inch).

- .5 Maximum Extension: 4.0 mm (5/32 inch).
- .6 Joint: Soldered
- .7 Size: Use pipe sized units
- .8 Application: Copper or steel piping 50 mm (2 inch) and under.

### 2.3 ACCESSORIES

- .1 Pipe Alignment Guides:
  - .1 Manufacturers:
    - .1 Anvil.
    - .2 HYSPAN.
    - .3 Substitutions: Refer to Section 21 05 00.
  - .2 Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 25 mm (1 inch) thick insulation, minimum 75 mm (3 inch) travel.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required and where indicated on the drawings.
- .2 If not otherwise indicated on the drawings 1200 mm x 1200 mm (4' x 4') expansion loops shall be installed on all copper hot water heating piping having a straight run in excess of 12 m (40'). The expansion loop shall be centred in the straight run, with alignment guides on each side of the loop and anchors at the extreme ends of the pipe run. Similar loops shall be installed on straight runs of steel steam, condensate and hot water piping which exceeds 18 m (60') in length.
- .3 Follow Manufacturer's written instructions in regard to proper length, anchoring and guiding, pre-compression, removal of spacers, and testing.
- .4 When expansion joints are installed at ambient temperatures higher than minimum system operating temperature, they shall be precompressed prior to installation, to allow for eventual contraction of piping.
- .5 Construct spool pieces to exact size of flexible connection for future insertion.
- .6 Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
- .7 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- .8 Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- .9 Provide victaulic piping with minimum one joint per 25 mm (1 inch) pipe diameter instead of flexible connector supported by vibration isolation. Victaulic piping need not be anchored.

### 3.2 MANUFACTURER'S FIELD SERVICES

- .1 Prepare and start systems to Section 01 43 00.

- .2 Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is to manufacturer's recommendations and connectors are performing satisfactorily.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Positive displacement meters.
- .2 Flow meters.
- .3 Pressure gauges and pressure gauge taps.
- .4 Thermometers and thermometer wells.
- .5 Static pressure gauges.
- .6 Filter gauges.

**1.2 RELATED SECTIONS**

- .1 Section 25 50 02 - Digital Control Equipment.
- .2 Section 25 90 00 - Sequence Of Operation.
- .3 Section 23 21 00 - Hydronic Piping: Installation of thermometer wells and pressure gauge tapings.

**1.3 REFERENCES**

- .1 ASME B40.100 - Pressure Gauges and Gauge Attachments.
- .2 ASTM E1 - Specification for ASTM Thermometers.
- .3 ASTM E77 - Inspection and Verification of Thermometers.
- .4 AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
- .5 UL 393 - Indicating Pressure Gauges for Fire-Protection Services.
- .6 UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide list which indicates use, operating range, total range and location for manufactured components.

**1.5 SUBMITTALS AT PROJECT CLOSEOUT**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Project Record Documents: Record actual locations of components and instrumentation.

**1.6 ENVIRONMENTAL REQUIREMENTS**

- .1 Section 21 05 00: Environmental conditions affecting products on site.
- .2 Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

**1.7 EXTRA MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide two bottles of red gauge oil for static pressure gauges.

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**Part 2            Products**

**2.1            PRESSURE GAUGES**

- .1    Manufacturers:
  - .1      Winters.
  - .2      Trerice.
  - .3      Ashcroft.
  - .4      Substitutions: Refer to Section 21 05 00.
- .2    Gauge: ASME B40.1, stainless steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
  - .1      Case: Steel with bronze or brass bourdon tube.
  - .2      Gauges shall be dry – no glycerine or silicone fill.
  - .3      Size: 102 mm (4 inch) diameter dial - gauges located up to 3000 mm (10'-0") above finished floor.
  - .4      Size: 152 mm (6 inch ) diameter dial - gauges located above 3000 mm (10'-0") above finished floor.
  - .5      Range: gauges shall be selected based on the application to show twice the normal operating pressure with indicating needle at 12 o'clock position for normal operating pressure.
  - .6      Mid-Scale Accuracy: One percent (1%) of full span.
  - .7      Scale: Both psi and kPa with psi prominent figure.

**2.2            PRESSURE GAUGE TAPPINGS**

- .1    Gauge Cock: Tee or lever handle, brass for maximum 1034 kPa (150 psig).
- .2    Needle Valve: Brass 6 mm (1/4 inch) NPT for minimum 1034 kPa (150 psig).
- .3    Pulsation Damper: Pressure snubber, brass with 6 mm (1/4 inch) connections.
- .4    Syphon for gauges on steam systems: Stainless-steel shut-off ball valve complete with ¼" NPT stainless-steel coil siphon rated minimum 1723 kPa (250 psig) working pressure.

**2.3            STEM TYPE THERMOMETERS**

- .1    Manufacturers:
  - .1      Winters.
  - .2      Trerice.
  - .3      Ashcroft.
  - .4      Substitutions: Refer to Section 21 05 00.
- .2    Thermometer: ASTM E1, adjustable angle, blue organic fluid, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
- .3    Choice of stem types shall not be made until piping and equipment, etc., has been erected. Stem type must be approved by Contract Administrator.
  - .1      Size: 225 mm (9 inch) scale.
  - .2      Window: Clear heavy-duty strength glass or acrylic.
  - .3      Stem: Minimum length 152 mm (6 inch).
  - .4      Accuracy: ASTM E77 2 percent. Calibration: Both degrees F and degrees C.



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## 2.4 DIAL THERMOMETERS

- .1 Manufacturers:
  - .1 Winters.
  - .2 Trerice.
  - .3 Ashcroft.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
- .3 Choice of stem types shall not be made until piping and equipment, etc., has been erected. Stem type must be approved by Contract Administrator.
  - .1 Size: 75 mm (3 inch) diameter dial - thermometers located up to 1500 mm (5'-0") above finished floor.
  - .2 Size: 125 mm (5 inch ) diameter dial - thermometers located above 1500 mm (5'-0") above finished floor.
  - .3 Lens: Clear heavy-duty strength glass.
  - .4 Accuracy: 1 percent.
  - .5 Calibration: Both degrees F and degrees C.

## 2.5 THERMOMETER SUPPORTS

- .1 Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- .2 Flange: 75 mm (3 inch) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

## 2.6 TEST PLUGS

- .1 Test Plug: 6 mm (1/4 inch) or 13 mm (1/2 inch) brass or stainless steel (depending on system) fitting and cap for receiving 3 mm (1/8 inch) outside diameter pressure or temperature probe with neoprene core for temperatures up to 93 degrees C (200 degrees F), Nordel core for temperatures up to 176 degrees C (350 degrees F), Viton core for temperatures up to 204 degrees C (400 degrees F).
- .2 Test Kit: Carrying case, internally padded and fitted containing two 60 mm (2-1/2 inch) diameter pressure gauges, two gauge adapters with 3 mm (1/8 inch) probes, two 38 mm (1-1/2 inch) dial thermometers.

## 2.7 STATIC PRESSURE GAUGES

- .1 90 mm (3-1/2 inch) diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- .2 Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- .3 Accessories: Static pressure tips with compression fittings for bulkhead mounting, 6 mm (1/4 inch) diameter tubing.

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**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install positive displacement meters with isolating valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.
- .3 Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- .4 Install pressure gauges with pulsation dampers. Provide needle valve to isolate each gauge. Provide syphon on gauges in steam systems. Extend nipples and syphons to allow clearance from insulation.
- .5 Gauges subject to vibration shall have copper tube extension and shall be located away from source of vibration; preferably on an adjacent wall or other stable mounting surface.
- .6 Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 60 mm (2-1/2 inch) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- .7 Install thermometers with back or bottom inlet stems, depending on which is better for ease of reading.
- .8 Brass separable wells to have insulation extensions, where mounted on insulated piping or equipment, to ensure dials are clear. Stems and wells to be immersed in liquid flow, minimum length of stems to be 152mm.
- .9 Where a separable well is mounted in pipe 38mm diam. or less, enlarge pipe to 50mm diam. for well length plus 76mm.
- .10 Install thermometers in air duct systems on flanges.
- .11 Dial thermometers to be installed on air handling units on outside-air ducts, mixed air ducts, and supply-air ducts.
- .12 Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 25 50 01 and/or 25 50 02.
- .13 Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.
- .14 Install static pressure gauges at all built-up filter banks, unitary filter sections, and supply fan discharge.
- .15 Coil and conceal excess capillary on remote element instruments.
- .16 Provide instruments with scale ranges selected according to service with largest appropriate scale.
- .17 Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- .18 Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- .19 Locate test plugs adjacent to control device sockets.
- .20 Install thermometers on supply and return fluid lines serving air handling unit coils.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Flexible Pipe Connectors
- .2 Expansion tanks.
- .3 Air vents.
- .4 Air-sediment separators.
- .5 Hydraulic Separator
- .6 Strainers.
- .7 Pump suction diffusers.
- .8 Combination fittings.
- .9 Manual Flow Controls
- .10 Automatic Flow Controls
- .11 Potable Water Automatic Balancing Valves
- .12 Pressure Independent Balancing & Control Valve
- .13 Radiator valves.
- .14 Relief valves.
- .15 Glycol specialties.
- .16 Condensate pumps

**1.2 RELATED SECTIONS**

- .1 Section 22 42 01 - Plumbing Specialties: Backflow Preventers.
- .2 Section 23 05 29 – Support and Anchors.
- .3 Section 23 07 19 – Piping Insulation.
- .4 Section 23 21 00 - Hydronic Piping.
- .5 Section 23 21 23 – HVAC Pumps.
- .6 Section 23 25 00 - Chemical Treatment For Piping: Pipe Cleaning.

**1.3 REFERENCES**

- .1 ASME - SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.
- .2 ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- .3 NBCC 2010 - National Building Code of Canada
- .4 NPCC 2010 – National Plumbing Code of Canada
- .5 NFCC 2010 – National Fire Code of Canada

**1.4 SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.

- .2 Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.
- .3 Submit inspection certificates for pressure vessels from authority having jurisdiction.
- .4 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

## **1.5 PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittal Procedures.
- .2 Record actual locations of hydronic specialties.

## **1.6 OPERATION AND MAINTENANCE DATA**

- .1 Section 21 05 00: Submittal Procedures.
- .2 Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

## **1.7 QUALITY ASSURANCE**

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- .3 Provide temporary protective coating on cast iron and steel valves.
- .4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## **1.9 MAINTENANCE SERVICE**

- .1 Provide service and maintenance of glycol system for one (1) year from date of substantial completion.
- .2 Provide a monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

## **Part 2 Products**

### **2.1 FLEXIBLE PIPE CONNECTORS**

- .1 Manufacturers:
  - .1 Flextrol
  - .2 Flex Tech Industries
  - .3 Hydro-flex
  - .4 Substitutions: Refer to Section 21 05 00

- .2 Supply and install where shown on the drawings as in details, flexible pipe connectors as manufactured by Flex Tech Industries, selected to meet operating and test pressures of systems served.
- .3 Minimum 450 mm (18") in length unless otherwise noted.
- .4 Heating Water Services, Condenser and Chilled Water Systems
  - .1 Up to 50 mm (2") - Stainless steel connectors constructed of 304 series stainless corrugated hose and braid with steel ends to match equipment.
  - .2 Over 50 mm (2") - flexible rubber joint with neoprene and nylon body, cadmium steel flanges, spring wire beading.

## 2.2 REPLACEABLE BLADDER TYPE EXPANSION TANKS

- .1 Manufacturers:
  - .1 Bell and Gossett
  - .2 Taco
  - .3 Armstrong
  - .4 Armtrol
  - .5 Calefactio
  - .6 Substitutions: Refer to Section 21 05 00
- .2 Provide pre-charged, replaceable bladder expansion tanks meeting current ASME and CSA code requirements designed for a minimum working pressure of 860 kPa (125 psi).
- .3 Tanks to be constructed of mild steel with finish painted surface and complete with all necessary tappings in combination with fill valve and automatic vent, angle cocks and guards.
- .4 Air charging valve connection to be .302"-32 (standard tire valve).
- .5 Bladders to be Butyl or EPDM.
- .6 Sizes to be as shown on the drawings and as specified.
- .7 Expansion tanks shall be finish painted
- .8 Hot Water Heating and Chilled Water Systems:
  - .1 Select expansion tank pressure relief valve as noted in schedule.
  - .2 Set pressure reducing valve as noted in schedule.

## 2.3 DIAPHRAGM-TYPE EXPANSION TANKS

- .1 Manufacturers:
  - .1 Bell and Gossett
  - .2 Taco
  - .3 Armstrong
  - .4 Armtrol
  - .5 Calefactio
  - .6 Substitutions: Refer to Section 21 05 00
- .1 Provide pre-charged, diaphragm expansion tanks meeting current ASME and CSA code requirements designed for a minimum working pressure of 860 kPa (125 psi).

- .2 Tanks to be constructed of mild steel with finish painted surface and complete with all necessary tappings in combination with fill valve and automatic vent, angle cocks and guards.
- .3 Air charging valve connection to be standard Schrader tire valve.
- .4 Diaphragm to be Heavy Duty Butyl Rubber.
- .5 Sizes to be as shown on the drawings and as specified.
- .6 Expansion tanks shall be finish painted
- .7 Hot Water Heating and Chilled Water Systems:
  - .1 Select expansion tank pressure relief valve as noted in schedule.
  - .2 Set pressure reducing valve as noted in schedule.

## 2.4 AIR VENTS

- .1 Manual Type:
  - .1 Manufacturers:
    - .1 Dole
    - .2 Bell and Gossett
    - .3 Taco
    - .4 Maid O'Mist
    - .5 Watts
    - .6 Substitutions: Refer to Section 21 05 00
  - .2 Short vertical sections of 50 mm (2 inch) diameter pipe to form air chamber, with 3 mm (1/8 inch) brass needle valve at top of chamber.
  - .3 On aqueous glycol systems, provide with threaded or sweat connection for drainage connection.
- .2 Float Type:
  - .1 Manufacturers:
    - .1 Maid O'Mist
    - .2 Watts
    - .3 Bell and Gossett
    - .4 Taco
    - .5 Armstrong
    - .6 Armtrol
    - .7 Substitutions: Refer to Section 21 05 00
  - .2 Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

## 2.5 AIR AND AIR-SEDIMENT SEPARATORS

- .1 Small In-line Air Separators on services less than 50mm (2 inches):
  - .1 Manufacturers:
    - .1 Bell and Gossett
    - .2 Taco
    - .3 Armstrong
    - .4 Substitutions: Refer to Section 21 05 00

- 
- .2 In-line integral weir style separator; heavy duty cast iron construction; tested for 1207 kPa (175 psig) operating pressure and maximum working pressure of 150 degrees C (300 degrees F)
  - .2 Coalescing In-line Air Separators on services less than 50mm (2 inches):
    - .1 Manufacturers:
      - .1 Spyrotherm
      - .2 Bell and Gossett
      - .3 Taco
      - .4 Substitutions: Refer to Section 21 05 00
    - .2 Coalescing style in-line separator; steel body; tested and stamped to ASME SEC 8-D; for 1035 kPa (150 psig) operating pressure.
    - .3 Copper tube core with continuous wound copper wire medium.
    - .4 Unit to be complete with separate venting chamber and shall have top mounted full port float and brass venting mechanism. Venting mechanism shall be threaded to allow for the piping of overflow.
    - .5 Elimination efficiency:
      - .1 Free air – 100%
      - .2 Entrained air – 100%
      - .3 Dissolved air – 99.6%
  - .3 Tangential/vortex style In-line Air Separators:
    - .1 Manufacturers:
      - .1 Bell and Gossett
      - .2 Taco
      - .3 Armstrong
      - .4 Substitutions: Refer to Section 21 05 00
    - .2 Tangential/vortex style in-line separator; steel body; tested and stamped to ASME SEC 8-D; for 862 kPa (125 psig) operating pressure.
    - .3 Unit to be complete with internal 304 stainless steel strainer.
    - .4 Unit shall be complete with threaded air vent connection and threaded blowdown connection.
  - .4 Combination Air & Air-Sediment Separators:
    - .1 Manufacturers:
      - .1 Spyrotherm
      - .2 Bell and Gossett
      - .3 Taco
      - .4 Armstrong
      - .5 Substitutions: Refer to Section 21 05 00
    - .2 Coalescing style in-line dirt and air separator; steel body; tested and stamped to ASME SEC 8-D; for 862 kPa (125 psig) operating pressure.
    - .3 Removable Coalescing medium to be stainless steel.
    - .4 Unit to be complete with separate venting chamber and shall have top mounted full port float and brass venting mechanism. Venting mechanism shall be threaded to allow for the piping of overflow.
    - .5 Unit complete with removable end cover for access to coalescing medium.

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## 2.6 HYDRAULIC SEPARATOR

- .1 Manufacturers:
  - .1 Bell and Gossett
  - .2 Taco
  - .3 Armstrong
  - .4 Substitutions: Refer to Section 21 05 00
- .2 Operating Data
  - .1 With Insulation
    - .1 Working Pressure: 150 psi
    - .2 Operating Temperature – Threaded: 32°-210°F
    - .3 Operating Temperature – Flanged: 32°-220°F
  - .2 Without Insulation
    - .1 Working Pressure: 150 psi
    - .2 Operating Temperature – Threaded and Flanged: 32°-230°F
- .3 Threaded Connections: 1", 1-1/4", 1-1/2" FNPT with Unions
- .4 Flanged Connections: 2", 2-1/2", 3" & 4" ANSI 150 CLASS
- .5 Materials:
  - .1 Body: Steel
  - .2 Air Vent: Brass
  - .3 Drain Valve: Brass
  - .4 Insulation – Threaded: PEX
  - .5 Insulation – Flanged: Polyurethane Foam
- .6 Medium: water, glycol solution non-hazardous
  - .1 Percentage of Glycol Maximum: 30% Threaded & 50% Flanged
- .7 Included Accessories
  - .1 Air-vent and check valve assembly
  - .2 Drain valve
  - .3 Insulation

## 2.7 STRAINERS

- .1 Manufacturers:
  - .1 Spirax-Sarco
  - .2 Watts
  - .3 Crane
  - .4 Mueller
  - .5 Substitutions: Refer to Section 21 05 00.
- .2 On Liquid heat transfer services,
  - .1 50 mm (2 inch) and under:
    - .1 Screwed brass or iron body for 1200 kPa (175 psig) working pressure, Y pattern with stainless steel or Monel perforated screen.
    - .2 Mesh:



- .1 0.8 mm (1/32 inch) serving all temperature control valves, automatic flow control devices,
- .2 1.6 mm (1/16 inch) serving pumps on systems with dirt-air separators,
- .2 Size 63 mm (2-1/2 inch) and larger:
  - .1 Flanged iron body for 1200 kPa (175 psig) working pressure, Y pattern with stainless steel or Monel perforated screen.
  - .2 Mesh:
    - .1 0.8 mm (1/32 inch) serving all temperature control valves, automatic flow control devices,
    - .2 3.2 mm (1/8 inch) serving pumps on systems with dirt air separators,

## 2.8 PUMP SUCTION DIFFUSERS

- .1 Manufacturers: Suction diffuser shall match supplied pump manufacturer.
  - .1 Bell and Gossett
  - .2 Taco
  - .3 Armstrong
  - .4 Substitutions: Refer to Section 21 05 00
- .2 Fitting: Angle pattern, cast-iron body, threaded for 50 mm (2 inch) and smaller, flanged for 65 mm (2-1/2 inch) and larger, rated for 1200 kPa (175 psig) working pressure.
- .3 Suction diffuser to be complete with inlet vanes, cylinder strainer with 5 mm (3/16 inch) diameter openings, disposable fine mesh strainer to fit over cylinder strainer.
- .4 Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

## 2.9 COMBINATION PUMP DISCHARGE (TRIPLE-DUTY) VALVES

- .1 Manufacturers:
  - .1 Bell and Gossett
  - .2 Taco
  - .3 Armstrong
  - .4 Substitutions: Refer to Section 21 05 00
- .2 Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 1200 kPa (175 psig) operating pressure.
- .3 Valve to be complete with :
  - .1 non-slam check valve with spring-loaded bronze disc and seat,
  - .2 stainless steel stem,
  - .3 calibrated adjustment permitting flow regulation, brass readout,
- .4 Packing to be Teflon-Graphite. NO ASBESTOS PERMITTED.

## 2.10 MANUAL FLOW CONTROLS

- .1 Manufacturers:
  - .1 Griswold Controls
  - .2 Bell and Gossett
  - .3 Watts.
  - .4 Victaulic/IMI TA (Tour & Andersson)

- .5 Substitutions: Refer to Section 21 05 00.
- .2 Up to and including 50mm (2 inch):
  - .1 Brass or bronze body, rated for 2070 kPa (300 psi) at 120 degrees C (250 degrees F),
  - .2 sweat or NPT end connections,
  - .3 full port nickel-plated brass ball valve with Teflon seats,
  - .4 temperature and pressure test valves and air vent,
  - .5 handle complete with memory stop and graduated markings.
- .3 50mm to 300mm (2 inch to 12 inch):
  - .1 Carbon steel body, rated for 1200 kPa (175 psi) at 120 degrees C (250 degrees F),
  - .2 flanged end connections,
  - .3 carbon steel low-loss venturi with Piezon-Ring,
  - .4 bronze disc butterfly valve,
  - .5 temperature and pressure test valves and air vent,
- .4 Calibration: Control flow within 3 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.

## 2.11 AUTOMATIC FLOW CONTROLS

- .1 Manufacturers:
  - .1 Griswold Controls
  - .2 Nexus
  - .3 Hays.
  - .4 Victaulic/IMI TA (Tour & Andersson)
  - .5 Substitutions: Refer to Section 21 05 00.
- .2 Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.
- .3 Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance.
- .4 All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.
- .5 Up to and including 50mm (2 inch):
  - .1 Cast brass body, rated at no less than 1900 kPa (275 psi) at 120 degrees C (250 degrees F),
  - .2 shall be constructed in a one-piece body to include a handle ball valve, a flow control cartridge assembly, dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes combined with a manual air vent, and a union end which will accept various end pieces,
  - .3 shall include a removable 20 mesh stainless steel strainer,
  - .4 available flow rates shall be from 0.25 GPM to 160.0 GPM,
  - .5 the body design shall allow inspection or removal of cartridge or strainer without disturbing piping connections.
  - .6 the body design shall allow inspection or repair of handle operated stem without disturbing piping connections. The repairable stem shall include

- two Teflon seals and one EPDM O-ring for protection against chemicals and modulating temperature,
- .7 the valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.
- .6 50mm to 500mm (2 inch to 20 inch):
  - .1 Class 150 Flange End Valves:
    - .1 Shall consist of steel pipe with flange ends, and stainless steel flow control cartridge assembly;
    - .2 rated assembly at 1585 kPa (230 psi) at 150 degrees C (300 degrees F);
    - .3 shall be supplied with dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes;
    - .4 shall have flange ends compatible with ANSI B 16.5-1968 150 lb. Steel flanges;
    - .5 shall be permanently marked to show direction of flow, shall have body tag to indicate model number and flow rate;
    - .6 shall be available in 50mm through 500mm (2 inch through 20 inch) sizes with flow rates from 0.8 L/s to 430 L/s (14.0 GPM to 6,800.0 GPM).
  - .7 Automatic flow control valve cartridges shall automatically control flow rates with 5 percent accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 20 kPa (3 PSID) to actuate the mechanism.

## 2.12 PRESSURE INDEPENDENT BALANCING & CONTROL VALVE

- .1 Manufacturers:
  - .1 Victaulic/IMI TA (Tour & Andersson) Series 7MP
  - .2 Griswold
  - .3 Hays
  - .4 Siemens
  - .5 Substitutions: Refer to Section 21 05 00.
- .2 Construction Up to and including 50mm (3" inch):
  - .1 Forged brass, rated to 1600 kPa (230 psi), EPDM o-ring seat and spindle seal, stainless steel return spring, stainless steel ball
  - .2 NPT threaded or sweat ends,
  - .3 Valve shall stabilize differential pressure to a maximum of 400 kPa (58psi)
  - .4 The valve shall be designed for modulating of terminal units in glycol, hot water, and cooling systems, suitable for control, pre-setting (of flow), differential pressure control, measuring and shut-off.
  - .5 The valve shall be a control valve with adjustable Cv, i.e a stepless, pre-settable balancing and a built-in dp-controller. It shall be supplied and installed as shown on the drawings to ensure proper balancing and performs the control function for water flows in the hydronic heating and cooling system.. The valve shall retain EQM characteristic for all recommended pre-settings

- .6 The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.
- .3 Construction 63mm (2.5") to 250mm (10"):
  - .1 Cast iron body to ASTM A395, rated to 4000 kPa (580 psi), EPDM and Nitrile o-rings, 316 stainless steel return spring, Rubber diaphragm
  - .2 Flange ends ANSI Class 150,
  - .3 Valve shall stabilize differential pressure to a maximum of 600 kPa (87psi)
  - .4 The valve shall be designed for modulating of terminal units in glycol, hot water, and cooling systems, suitable for control, pre-setting (of flow), differential pressure control, measuring and shut-off.
  - .5 The valve shall be a control valve with adjustable Cv, i.e a stepless, pre-settable balancing and a built-in dp-controller. It shall be supplied and installed as shown on the drawings to ensure proper balancing and performs the control function for water flows in the hydronic heating and cooling system.. The valve shall retain EQM characteristic for all recommended pre-settings
  - .6 The valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.
- .4 Designed for simple and accurate measurements for balancing, differential pressure control, trouble shooting and power measurement in heating and cooling systems. True flow measurement verification must be possible with a balancing instrument.
- .5 Flow deviation max  $\pm 10\%$  at fully open. Valve shall allow for adjustable flow settings, with valve and actuators supplied together ensuring optimum control performance.
- .6 Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance.
- .7 All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale.

## 2.13 RELIEF VALVES

- .1 Manufacturers:
  - .1 Kunkle
  - .2 Spiraz-Sarco
  - .3 Watts
  - .4 Bell and Gossett
  - .5 Substitutions: Refer to Section 21 05 00.
- .2 AMSE Section VIII rated valve:
  - .1 Carbon steel body, resilient EPDM or EPR soft seat, stainless steel stem and springs, packed lever with gag. All wetted parts on lever and gag screw to be stainless steel.
  - .2 Must be rated and stamped for ASME Section VIII.
  - .3 On 63mm (2 ½ inch) and larger connections, provide 150# flanges.
- .3 Non-ASME rated valve:
  - .1 Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated.

- .2 Designed for liquid service.

## **2.14 GLYCOL FEED SYSTEM**

- .1 Manufacturers:
  - .1 Axiom.
  - .2 Calefactio
  - .3 Substitutions: Refer to Section 21 05 00.
- .2 Glycol systems shall be equipped with a mix-and-fill tank with manual fill capabilities, hose bib from domestic water for tank filling, and tank level alarm. Direct-connect city makeup lines to glycol systems are NOT permitted.
- .3 The entire system to be factory pre-piped and pre-wired with numbered terminal strip for wiring of remote items such as the pressure switch and the contact head meter.
- .4 Unit to be complete with low-level pump cutout float switch, which plugs directly into standard duplex outlet and stops the pump if glycol level is too low.
- .5 The piping system shall be provided with a low-pressure sensor, which shall alarm on the DDC system. On alarm generation, feed system will be manually started after checking for system leaks. This manual operation will avoid feed system from automatically filling and compensating for a system leak. Fully automatic operation can be selected by HOA switch if suitable for system.
- .6 Unit to be complete with low-level remote monitoring panel complete with dry contacts and be connected to DDC system alarm.

### **MEDIUM SYSTEM**

- .7 Provide packaged glycol feed system consisting of:
  - .1 208 litre (55 US gal.) polyethylene tank with cover;
  - .2 Pump suction hose with inlet strainer;
  - .3 Pressure pump with thermal cut-out;
  - .4 Integral pressure switch;
  - .5 Integral check valve;
  - .6 Cord and plug;
  - .7 Pre-charged accumulator tank with EPDM diaphragm;
  - .8 Manual diverter valve for purging air and agitating contents of storage tank;
  - .9 Adjustable 35-380 kPa (5-55 psi) pressure regulating valve with pressure gauge;
  - .10 Integral replaceable strainer;
  - .11 Built-in check valve;
  - .12 Union connection; 12 mm (1/2") x 900 mm (36") long flexible connection hose with check valve.
- .8 System shall be compatible with glycol solutions.
- .9 Pump shall be capable of running dry without damage.
- .10 Power supply: 3-prong plug and cord, 115v/60/1, 0.7 amps.
- .11 Unit shall be completely assembled and certified to CSA standard C22.2 No 68.

## **2.15 GLYCOL SOLUTION**

- .1 Glycol Solution:

- .1 Manufacturers:
  - .1 Dow Model Dowfrost
  - .2 Brenntag Model Stanfrost
  - .3 Substitutions: Refer to Section 21 05 00.
- .2 Provide aqueous solution by using propylene glycol and distilled or de-ionized water and shall contain red dye for easy leak detection.
- .3 Following systems to be filled with 50% aqueous glycol solution. Solution shall be blended up 50% glycol and 50% distilled or de-ionized water concentration, with a freezing point of  $-37.8$  degrees C ( $-36$  degrees F).
  - .1 Glycol heating systems
- .4 Glycol solution supplier shall provide The City and Contract Administrator with written analysis results of tested product after installation, and also provide free analysis on an annual basis.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install specialties to manufacturer's written instructions.
- .2 Adjust expansion tank pressure to suit design criteria and as directed by the Contract Administrator.
- .3 Install pressure gauge at inlet to tank.
- .4 Provide valved drain connection on tank side of expansion tank isolation valve.
- .5 Provide union connection and isolation valve at each tank to allow removal of tank without disrupting service.
- .6 Where large air quantities can accumulate, provide enlarged air collection standpipes.
- .7 Provide manual air vents at system high points and as indicated.
- .8 For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- .9 On aqueous glycol systems, automatic air vents are not permitted.
- .10 Pipe all air vents on aqueous glycol systems back to glycol fill tank. Piping to be a minimum of 12mm (1/2 inches)
- .11 Provide air separator on suction side of system circulation pump and connect to expansion tank.
- .12 Provide valved drain and hose connection on strainer blow down connection.
- .13 Supply and install strainers ahead of all temperature control valves, pressure reducing valves, pump suctions and where indicated on the drawings.
- .14 Provide pump suction fitting on suction side of base mounted centrifugal pumps [where indicated]. Remove temporary strainers after cleaning systems.
- .15 Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps [where indicated].
- .16 Support pump fittings with floor mounted pipe and flange supports.
- .17 Manual balancing valves shall be sized to flow and selected for 5.98 kPa (2 feet) pressure drop across the valve in the fully open position in accordance with manufactures

- 
- recommendation. Mechanical Subcontractor shall consult with balancing valve manufacturer to ensure correct valve selection.
- .18 For pressure independent control valves, the controls subcontractor shall select modulating control valves to have a design authority of at least 0.5 and a minimum authority of 0.25 in worst conditions.
  - .19 Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.
  - .20 Provide radiator balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.
  - .21 Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
  - .22 Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
  - .23 Pipe relief valve outlet to nearest floor drain.
  - .24 Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
  - .25 Clean and flush glycol system before adding glycol solution. Refer to Section 23 25 00.
  - .26 Feed glycol solution to system through make-up line with pressure regulator, venting system high points.
  - .27 Perform tests determining strength of glycol and water solution and submit written test results.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Pipe and equipment hangers and supports.
- .2 Equipment bases and supports.
- .3 Sleeves and seals.
- .4 Flashing and sealing equipment and pipe stacks.

**1.2 RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-place Concrete: Equipment bases.
- .2 Section 07 84 00 - Firestopping: Joint seals for piping and duct penetration of fire rated assemblies.
- .3 Section 09 91 10 - Painting.
- .4 Section 21 11 00 - Fire Protection Piping.
- .5 Section 23 07 19 - Piping Insulation.
- .6 Section 23 07 16 - Equipment Insulation.
- .7 Section 22 10 00 - Plumbing Piping.
- .8 Section 23 21 00 - Hydronic Piping.

**1.3 REFERENCES**

- .1 ASME B31.1 - Power Piping.
- .2 ASME B31.2 - Fuel Gas Piping.
- .3 ASME B31.9 - Building Services Piping.
- .4 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .5 CSA 149.1 - Natural gas and propane installation code
- .6 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- .7 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .8 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- .9 NFPA 13 - Installation of Sprinkler Systems.
- .10 UL 203 - Pipe Hanger Equipment for Fire protection Service.

**1.4 SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- .3 Product Data: Provide manufacturers catalogue data including load capacity.
- .4 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- .5 Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.



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**1.5 REGULATORY REQUIREMENTS**

- .1 Conform to applicable code for support of plumbing, hydronic, steam and steam condensate piping.
- .2 Supports for Sprinkler Piping: To NFPA 13.
- .3 Supports for Standpipes: To NFPA 14.

**Part 2 Products**

**2.1 PIPE HANGERS AND SUPPORTS**

- .1 Manufacturers:
  - .1 Anvil.
  - .2 Grinnel.
  - .3 Substitutions: Refer to Section 21 05 00.
- .2 Fire Protection Piping:
  - .1 Conform to NFPA 13.
  - .2 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.
  - .3 Hangers for Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.
  - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - .5 Wall Support for Pipe Sizes to 75 mm (3 inches): Cast iron hook.
  - .6 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.
  - .7 Vertical Support: Steel riser clamp.
  - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .3 Plumbing Piping - DWV:
  - .1 Conform to ASME B31.9.
  - .2 Cast Iron DWV Piping:
    - .1 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.
    - .2 Hangers for Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.
    - .3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
    - .4 Wall Support for Pipe Sizes to 75 mm (3 inches): Cast iron hook.
    - .5 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.
    - .6 Vertical Support: Steel riser clamp.
    - .7 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
    - .8 Clamping for MJ couplings: Socket-pipe clamps with washers, threaded rod, and nuts (Anvil Fig. 594 & 595 or equal).

- .3 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .4 PVC DWV Pipe Support: to manufacturer's requirements.
- .4 Plumbing Piping - Water:
  - .1 Conform to ASME B31.9.
  - .2 Perforated strap or wire hangers are not permitted.
  - .3 Hangers to be adjustable after pipe is in place.
  - .4 Clevis hangers shall be oversized to suit the outside diameter of insulation and jacket to maintain the integrity of insulation and vapour barrier.
    - .1 Protection Saddles
      - .1 On piping 2" and smaller, carry insulation over pipe hangers. On all domestic cold water piping over 1-1/4", use oversized clevis hangers and GSS insulation protection shield to maintain integrity of vapour barrier.
      - .2 On copper piping over 2", use at each hanger or support Grinnell Fig. 167 protection shield or equal. Shields shall have a minimum length of 12" (305mm) to spread weight. Rectangular solid wood blocks, cut to suit the insulation thickness, shall be installed at hanger locations. Wedges are not permitted.
  - .5 Hangers for Pipe Sizes 15 to 40 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.
  - .6 Hangers for Cold Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.
  - .7 Hangers for Hot Pipe Sizes 50 to 100 mm (2 to 4 inches): Carbon steel, adjustable, clevis.
  - .8 Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable steel yoke, cast iron pipe roll, double hanger.
  - .9 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
  - .10 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
  - .11 Wall Support for Pipe Sizes to 80 mm (3 inches): Cast iron hook.
  - .12 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.
  - .13 Wall Support for Hot Pipe Sizes 150 mm (6 inches) and over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
  - .14 Vertical Support: Steel riser clamp.
  - .15 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .16 Floor Support for Hot Pipe Sizes to 100 mm (4 inches): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
  - .17 Floor Support for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
  - .18 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  - .19 Isolation: Copper piping shall be isolated from steel supports by appropriate use of copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators.
- .5 Hydronic Piping:

- .1 Conform to ASME B31.9.
- .2 Perforated strap or wire hangers are not permitted.
- .3 Hangers to be adjustable after pipe is in place.
- .4 Clevis hangers shall be oversized to suit the outside diameter of insulation and jacket to maintain the integrity of insulation and vapour barrier.
  - .1 Protection Saddles
    - .1 On piping 2" and smaller, carry insulation over pipe hangers. On all chilled water piping, and domestic cold water piping over 1-1/4", use oversized clevis hangers and GSS insulation protection shield to maintain integrity of vapour barrier.
    - .2 On insulated steel pipe over 2" use at each hanger or support, Grinnell Fig. 160, 161 or 162 to suit pipe size and insulation thickness. Pack space between saddle and pipe with insulation.
    - .3 On copper piping over 2", use at each hanger or support Grinnell Fig. 167 protection shield or equal. Shields shall have a minimum length of 12" (305mm) to spread weight. Rectangular solid wood blocks, cut to suit the insulation thickness, shall be installed at hanger locations. Wedges are not permitted.
- .5 Where pipe expansion in excess of 12mm (1/2") axially occurs or where indicated to be installed on the drawings, provide Grinnell Fig. 171 Adjustable Pipe Roll or Grinnell Fig. 271 Pipe Roll Stand.
- .6 Hangers for Pipe Sizes 13 to 38 mm ( 1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.
- .7 Hangers for Cold Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.
- .8 Hangers for Hot Pipe Sizes 50 to 100 mm (2 to 4 inches): Carbon steel, adjustable, clevis.
- .9 Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable steel yoke, cast iron roll, double hanger.
- .10 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- .11 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Steel channels with welded spacers and hanger rods, cast iron roll.
- .12 Wall Support for Pipe Sizes to 76 mm (3 inches): Cast iron hook.
- .13 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.
- .14 Wall Support for Hot Pipe Sizes 150 mm (6 inches) and over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- .15 Vertical Support: Steel riser clamp.
- .16 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .17 Floor Support for Hot Pipe Sizes to 100 mm (4 inches): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .18 Floor Support for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- .19 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .20 Isolation: Copper piping shall be isolated from steel supports by appropriate use of copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators.

- .21 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- .22 Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- .6 For outdoor mounted piping, provide supports equivalent to:
  - .1 Guided or Hung pipe supports
    - .1 PHP Systems portable pipe hanger model PP 10 roof supported strut style with pipe roller guides, channel or hanger.
    - .2 PHP Systems portable pipe hanger Model PSE-2-2 with clevis style hangers or supports with roof mount base for multiple pipes.
    - .3 Supports to be galvanized steel [aluminium] [stainless steel] with stainless steel clamps and cast iron [stainless steel] rollers. Membrane pads to be closed-cell extruded polystyrene insulation equal to Dow Chemical Roofmate. Pipe shall be a minimum of 8" above finished roof level.
  - .2 MIFAB C-Port Series. Minimum 6 1/2" in height, supports to be constructed of recycled rubber, UV resistant and designed to support rooftop equipment. Supports to be selected, sized, and configured to match equipment installation requirements and roof construction, with galvanized steel channel. All metal work including strut or pipe clamps to be stainless steel.

## 2.2 ACCESSORIES

- .1 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

## 2.3 INSERTS

- .1 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.4 FLASHING

- .1 Metal Flashing: 0.5 mm thick (26 gauge) galvanized steel.
- .2 Metal Counterflashing: 0.8 mm thick (22gauge) galvanized steel.
- .3 Lead Flashing:
  - .1 Waterproofing: 24.5 kg/sq m (5 lb/sq ft) sheet lead
  - .2 Soundproofing: 5 kg/sq m (1 lb/sq ft) sheet lead.
- .4 Flexible Flashing: 1.2mm (47 mil) thick sheet butyl; compatible with roofing.
- .5 Caps: Steel, 0.8 mm (22 gauge) minimum; 1.5 mm (16 gauge) at fire resistant elements.

## 2.5 SLEEVES

- .1 Sleeves for Pipes Through Non-fire Rated Floors: 1.2 mm thick (18 gauge) galvanized steel.
- .2 Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 1.2mm thick (18 gauge) galvanized steel.

- .3 Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed refer to Section 07 84 00.
- .4 Where pipes pass through floors, walls or ceilings, in finished areas and where exposed to view, supply and install chrome-plated pressed steel floor plates.
- .5 Sleeves for Round Ductwork: Galvanized steel.
- .6 Sleeves for Rectangular Ductwork: Galvanized steel or wood.
- .7 Firestopping Insulation: Glass fibre type, non-combustible; refer to Section 07 84 00.
- .8 Sealant: Acrylic; refer to Section 07 92 00.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.

#### **3.2 INSERTS**

- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm (4 inches).
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.
- .6 All sleeves are to be large enough to accommodate pipe insulation as specified.
- .7 The Mechanical Division shall include in Bid price all cost of drilling for sleeves up to 175 mm (7") in precast sections relative to work under Mechanical Division. Prior to drilling all openings/locations must be checked by the Contract Administrator. Drilling shall be done using diamond core drilling machinery.
- .8 All sleeves in mechanical rooms, janitors closets and washrooms shall extend 100 mm (4") above the finished floor level to prevent water seeping down.
- .9 Caulk the space between pipes and floor sleeves or openings, to prevent water seeping down, with an approved caulking compound. The caulking compound and method of application shall be to the Contract Administrator's approval.
- .10 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

#### **3.3 PIPE HANGERS AND SUPPORTS**

- .1 Install to manufacturer's written instructions.
- .2 Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9.
- .3 Perforated strap or wire hangers will not be permitted.
- .4 Support horizontal piping as scheduled.

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- .5 Support for buried pipe under a new slabs or existing shall be hung from the slab using epoxy coated or stainless steel hangers, hardware and hanger rod secured to the rebar.
  - .6 Hangers in new concrete structural floor systems shall be supported by inserts placed prior to pouring of concrete. Inserts shall be Grinnell cast iron or wrought steel adjustable type.
  - .7 Where hangers must be installed in existing concrete slabs, approved expansion type inserts shall be used, or if heavy weights must be supported, a hole shall be drilled through the slab and a 50 mm x 50 mm (2" x 2") washer and nut installed above rough slab before the floor finish is poured.
  - .8 Where the structural system is open web steel joists, piping shall be supported by means of angles spanning the top chords of adjacent joists. The number of joists to be spanned in this way shall be determined by the incident load of piping.
  - .9 In no case shall the hanging of piping directly from roof or ceiling decking be allowed, unless special permission is obtained from the Contract Administrator.
  - .10 Copper hot water piping in long runs, where expansion may be significant and where hanger rods are less than 600 mm (2") in length may require roller hangers. Any such cases which cannot be avoided shall be referred to the Contract Administrator for a decision. If necessary, roller hangers shall be installed as directed with protection saddles as specified. Expansion and contractions of domestic H.W. piping should not be a problem, as wide fluctuations in temperature are not normal. Piping shall be hung from slabs, rather than from the bottom of beams, in order to keep hanger rods sufficiently long to take up any movement.
  - .11 Install hangers to provide minimum 13 mm (1/2 inch) space between finished covering and adjacent work.
  - .12 Place hangers within 300 mm (12 inches) of each horizontal elbow.
  - .13 Use hangers with 38 mm (1-1/2 inch) minimum vertical adjustment.
  - .14 Support horizontal cast iron pipe adjacent to each hub, with 1.5 m (5 feet) maximum spacing between hangers.
  - .15 Support all pipe with MJ couplings on both sides of the joint. At multiple fittings or short lengths, support every 300 mm (12").
  - .16 Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub or with pipe clamps on hubless pipe.
  - .17 Storm water piping:
    - .1 All pipe supports, anchors, clamping, and thrust supports shall support the weight of the pipe and its contents.
    - .2 Provide all necessary support to restrain thrust forces resulting from internal pipe pressures. Refer to CISPI 301 & 310.
    - .3 MJ couplings are not permitted on PVC storm water piping. All joints to be solvent-welded.
    - .4 For cast-iron systems, install restraint clamps across all no-hub MJ couplings on piping 125 mm (5") and larger for all horizontal piping, including elbows at the base of a vertical pipe. Clamps shall be socket clamps on either side of the coupling connected with suitably sized threaded rod.
    - .5 Restrain all joints on piping 125 mm (5") and larger to prevent horizontal movement. Use sway bracing as needed to restrain sideways movement of the system. Install blocks, rods, bracing or other suitable methods at each branch opening or change in direction.

- .6 Storm water piping below grade including in the crawlspace shall be adequately supported with thrust blocks or suitable anchors to restrain all sideways movement and thrust forces.
- .18 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .19 Support riser piping independently of connected horizontal piping.
- .20 Provide copper plated hangers and supports for copper piping.
- .21 Design hangers for pipe movement without disengagement of supported pipe.
- .22 All hanger rods shall have sufficient threaded length to allow for vertical adjustment of hangers after pipe is in place. Use 2 nuts on each rod, one above the clevis or angle iron and one below.
- .23 Where pipes or equipment are supported from floors or walls, structural steel supports shall be fabricated, using welded joints except where provision is made for adjustment. Where details of construction are not indicated, drawings shall be submitted to Contract Administrator for approval before fabrication.
- .24 Clamps should be located immediately below a coupling if possible. Risers up to 50 mm (2") size shall be braced at intervals not over 2100 mm (7').
- .25 Vertical piping other than risers through floors shall be provided with suitable supports, sway braces, etc.
- .26 Vertical piping shall be supported at the base in an approved manner.
- .27 On insulated piping supported by roller supports or trapeze supports (angle iron) provide at each hanger or support a protection saddle of 16 ga. galvanized sheet steel, rolled to match the outside diameter of the insulation. The saddle shall cover approximately the bottom one third of the circumference of the insulation. The length shall be at least as long as that recommended by the insulation manufacturer as published in their data.
- .28 On insulated pipe up to and including 50 mm (2") pipe, clevis hangers shall be sized to suit the O.D. of the pipe. On insulated pipe of 63 mm (2½") and above, the hangers shall be sized to suit the O.D. of the insulation and protection saddles, as described above shall be installed.
- .29 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

### **3.4 EQUIPMENT BASES AND SUPPORTS**

- .1 Provide housekeeping pads of concrete, minimum 100 mm (4 inches) thick and extending 150 mm (6 inches) beyond supported equipment. Refer to Section 03 30 00.
- .2 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- .3 Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- .4 Provide rigid anchors for pipes after vibration isolation components are installed.

### **3.5 FLASHING**

- .1 Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- .2 Provide copper flashing for sleeves passing through exterior surfaces or waterproof assemblies.

- .3 Flash floor drains in floors with topping over finished areas with lead, 250 mm (10 inches) clear on sides with minimum 910 x 910 mm (36 x 36 inch) sheet size. Fasten flashing to drain clamp device.
- .4 Seal floor, shower, & mop sink drains watertight to adjacent materials.
- .5 Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed to manufacturer's written instructions for sound control.
- .6 Provide curbs for mechanical roof installations 350 mm (14 inches) minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- .7 Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.6 SLEEVES

- .1 Set sleeves in position in formwork. Provide reinforcing around sleeves.
- .2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- .3 Extend sleeves through floors 25mm (1 inch) above finished floor level. Caulk sleeves.
- .4 All sleeves in mechanical rooms, janitors closets and washrooms shall extend 100 mm (4") above the finished floor level to prevent water seeping down.
- .5 Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.
- .6 All sleeves are to be large enough to accommodate pipe insulation as specified.
- .7 The Mechanical Division shall include in Bid price all cost of drilling for sleeves up to 175 mm (7") in precast sections relative to work under Mechanical Division. Prior to drilling all openings/locations must be checked by the Contract Administrator. Drilling shall be done using diamond core drilling machinery.
- .8 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with insulation and caulk, air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- .9 Install stainless steel escutcheons at finished surfaces.

### 3.7 SCHEDULES

- .1 Maximum spacing between pipe supports:
  - .1 Hangers shall be installed not more than 12" (300mm) from each change in direction of pipes.
  - .2 Where there are concentrations of valves and fittings, closer spacing will be necessary.
  - .3 Steel Pipe:

.1	Up to 50mm (2")	2.4m (8 ft.)
.2	65mm (2½") to 150mm (6")	3.6m (12 ft.)
.3	200mm (8") to 300mm (12")	5.4m (18 ft.)
.4	350mm (14") to 450mm (18")	7.2m (24 ft.)
.5	500mm (20") to 600mm (24")	9.0m (30 ft.)
  - .4 Copper Tubing (Hard):

.1	Up to 25mm (1")	1.8m (6 ft.)
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.2	32mm (1½") to 50mm (2")	2.4m (8 ft.)
.3	63mm (2 ½") to 75mm (3")	3.0m (10 ft.)
.4	100mm (4") to 150mm (6")	3.6m (12 ft.)
.5	200mm (8") to 300mm (12")	4.8m (16 ft.)
.5	Cast Iron Pipe	
.1	Maximum spacing – maximum 5 ft. (1.5m)	
.2	Support M.J. pipe on both sides of joint. Provide with sway braces and anchors to Contract Administrator's approval. At multiple fittings, or short lengths, support every 300mm (12").	
.6	Plastic (PVC, CPVC, PEX)	
.1	As recommended by manufacturer for corresponding sizes and materials.	
.2	All sizes – do not exceed	1.2m (4 ft.)

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1            Vibration isolation.

**1.2            RELATED SECTIONS**

- .1            Section 03 30 00 - Cast-in-place Concrete.
  - .1            Placement of isolators in floating floor slabs.
  - .2            Supply of concrete for placement by this section.
- .2            Section 23 05 16 - Piping Expansion Compensation.
- .3            Section 23 05 29 - Supports And Anchors.
- .4            Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3            PERFORMANCE REQUIREMENTS**

- .1            Provide vibration isolation on motor driven equipment over 0.35 kW (0.5 hp), plus connected piping and ductwork.
- .2            All outdoor mounted equipment shall be restrained for the highest wind speed as specified by the project's structural engineer, the governing building code(s) or the authority having jurisdiction.
- .3            Provide minimum static deflection of isolators for equipment as indicated.
  - .1            Upper Floors, Normal
    - .1            Under 400 rpm: 90 mm (3.5 inch)
    - .2            400 - 600 rpm: 90 mm (3.5 inch)
    - .3            600 - 800 rpm: 50 mm (2 inch)
    - .4            800 - 900 rpm: 25 mm (1 inch)
    - .5            1100 - 1500 rpm: 12 mm (0.5 inch)
    - .6            Over 1500 rpm: 5 mm (0.2 inch)
  - .2            Upper Floors, Critical
    - .1            400 - 600 rpm: 90 mm (3.5 inch)
    - .2            600 - 800 rpm: 90 mm (3.5 inch)
    - .3            800 - 900 rpm: 50 mm (2 inch)
    - .4            1100 - 1500 rpm: 25 mm (1 inch)
    - .5            Over 1500 rpm: 12 mm (0.5 inch)
- .4            Consider upper floor locations critical unless otherwise indicated.
- .5            Use concrete inertia bases for fans having static pressure in excess of 0.85 kPa (3.5 inch wc) or motors in excess of 30 kW (40 hp), and on base mounted pumps over 7.5 kW (10 hp).

**1.4            SUBMITTALS**

- .1            Section 21 05 00: Procedures for submittals.
- .2            Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.
- .3            Product Data: Provide schedule of vibration isolator type with location and load on each.

- .4 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
- .5 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

## **1.5 PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Record actual locations of hangers including attachment points.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Vibro-Acoustics.
- .2 Amber/Booth.
- .3 California Dynamics
- .4 Substitutions: Refer to Section 21 05 00.

### **2.2 VIBRATION ISOLATORS**

- .1 Open Spring Isolators:
  - .1 Spring Isolators:
    - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
    - .2 Code: Colour code springs for load carrying capacity.
  - .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
  - .3 Spring Mounts: Provide with levelling devices, minimum 6 mm (0.25 inch) thick neoprene sound pads, and zinc chromate plated hardware.
  - .4 Sound Pads: Size for minimum deflection of 1.2 mm (0.05 inch); meet requirements for neoprene pad isolators.
- .2 Restrained Spring Isolators:
  - .1 Spring Isolators:
    - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
    - .2 Code: Colour code springs for load carrying capacity.
  - .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
  - .3 Spring Mounts: Provide with levelling devices, minimum 6 mm (0.25 inch) thick neoprene sound pads, and zinc chromate plated hardware.
  - .4 Sound Pads: Size for minimum deflection of 1.2 mm (0.05 inch); meet requirements for neoprene pad isolators.
  - .5 Restraint: Provide heavy mounting frame and limit stops.
- .3 Closed Spring Isolators:
  - .1 Spring Isolators:
    - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

- .2 Code: Colour code springs for load carrying capacity.
- .2 Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
- .3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- .4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm (0.25 inch) clearance.
- .4 Restrained Closed Spring Isolators:
  - .1 Spring Isolators:
    - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
    - .2 Code: Colour code springs for load carrying capacity.
    - .2 Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
    - .3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
    - .4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm (0.25 inch) clearance and limit stops.
  - .5 Spring Hanger:
    - .1 Spring Isolators:
      - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
      - .2 Code: Colour code springs for load carrying capacity.
    - .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
    - .3 Housings: Incorporate [neoprene isolation pad meeting requirements for neoprene pad isolators] [rubber hanger with threaded insert].
    - .4 Misalignment: Capable of 20 degree hanger rod misalignment.
  - .6 Neoprene Pad Isolators:
    - .1 Rubber or neoprene waffle pads.
      - .1 30 durometer.
      - .2 Minimum 13 mm (1/2 inch) thick.
      - .3 Maximum loading 275 kPa (40 psi).
      - .4 Height of ribs: maximum 0.7 times width.
    - .2 Configuration: 13 mm (1/2 inch) thick waffle pads bonded each side of 6 mm (1/4 inch) thick galvanized steel plate.
  - .7 Rubber Mount or Hanger: Moulded rubber designed for 13 mm (0.5 inches) deflection with threaded insert.
  - .8 Glass Fibre Pads: Neoprene jacketed pre-compressed moulded glass fibre.

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**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install isolation for motor driven equipment.
- .3 Where recommended by the manufacturer, isolator base plates shall be bolted to the structure or foundation. Bolting shall incorporate neoprene bushings and washers.
- .4 Isolator hangers shall be installed with the housing a minimum of 1/4" (6 mm) below but as close to the structure as possible. Where isolator hangers would be concealed by non-accessible acoustical sub ceiling, install the hangers immediately below the sub ceiling for access.
- .5 Install spring hangers without binding.
- .6 On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- .7 Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- .8 Provide pairs of horizontal limit springs on fans with more than 1.5 kPa (6.0 inch) static pressure, and on hanger supported, horizontally mounted axial fans.
- .9 Support piping connections to isolated equipment resiliently as follows or according to the schedule.
  - .1 Up to 100 mm (4 inch) Diameter: First three points of support.
  - .2 125 to 200 mm (5 to 8 inch) Diameter: First four points of support.
  - .3 250 mm (10 inch) Diameter and Over: First six points of support.
  - .4 Select three hangers closest to vibration source for minimum 25 mm (1.0 inch) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 25 mm (1.0 inch) static deflection or 1/2 static deflection of isolated equipment.
- .10 Connect wiring to isolated equipment with flexible hanging loop.
- .11 All piping and ductwork shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork, and maintain a minimum of 3/4" and maximum of 1 1/4" clearance around the outside surfaces. This clearance space shall be tightly packed with 1.58 P.C.F. glass fiber and shall be caulked airtight after installation of the piping or ductwork. Penetrations through fire rated walls and floors shall be sealed to maintain the rating.
- .12 All outdoor equipment, piping and ductwork shall be restrained to resist wind forces per the applicable building code(s) as a minimum. Restraint attachments shall be made by bolts, welds or a positive fastening method. Friction shall not be considered. All attachments shall be proven capable of accepting the required wind load by calculations.
- .13 Install wind restraint devices per the restraint manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.

**3.2 MANUFACTURER'S FIELD SERVICES**

- .1 Examine systems to Section 01 43 00.
- .2 Inspect isolated equipment after installation and submit report. Include static deflections.

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**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Nameplates.
- .2    Tags.
- .3    Stencils.
- .4    Pipe Markers.

**1.2                RELATED SECTIONS**

- .1    Section 09 91 10 - Painting: Identification painting.
- .2    Section 22 60 00 - Medical Gas Systems: Supply of pipe labels for placement by this section.

**1.3                REFERENCES**

- .1    ASME A13.1 - Scheme for the Identification of Piping Systems.
- .2    CAN/CGSB 24.3 – Identification of Piping Systems
- .3    CSA/CGA B149.1, Natural Gas and Propane Installation Code.
- .4    NFPA 13, Standard for the Installation of Sprinkler Systems.

**1.4                SUBMITTALS**

- .1    Section 21 05 00: Procedures for submittals.
- .2    Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
- .3    Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- .4    Product Data: Provide manufacturers catalogue literature for each product required.
- .5    Manufacturer's Installation Instructions: Indicate special procedures, and installation.

**1.5                PROJECT RECORD DOCUMENTS**

- .1    Section 21 05 00: Submittals for project closeout.
- .2    Record actual locations of tagged valves.

**Part 2            Products**

**2.1                NAMEPLATES**

- .1    Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour.

**2.2                TAGS**

- .1    Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 40 mm (1-1/2 inch) diameter.
- .2    Chart: Typewritten letter size list in anodized aluminum frame.

## 2.3 STENCILS

- .1 Stencils: With clean cut symbols and letters of following size:
  - .1 20-30 mm (3/4 to 1-1/4 inch) Outside Diameter of Insulation or Pipe: 200 mm (8 inch) long colour field, 15 mm (1/2 inch) high letters.
  - .2 40-50 mm (1-1/2 to 2 inch) Outside Diameter of Insulation or Pipe: 200 mm (8 inch) long colour field, 20 mm (3/4 inch) high letters.
  - .3 65-150 mm (2-1/2 to 6 inch) Outside Diameter of Insulation or Pipe: 300 mm (12 inch) long colour field, 30 mm (1-1/4 inch) high letters.
  - .4 200-250 mm (8 to 10 inch) Outside Diameter of Insulation or Pipe: 600 mm (24 inch) long colour field, 65 mm (2-1/2 inch) high letters.
  - .5 Over 250 mm (10 inch) Outside Diameter of Insulation or Pipe: 800 mm (32 inch) long colour field, 90 mm (3-1/2 inch) high letters.
  - .6 Ductwork and Equipment: 65 mm (2-1/2 inch) high letters.
- .2 Stencil Paint: As specified in Section 09 91 10, semi - Painting.1.

## 2.4 PIPE MARKERS

- .1 Colour: Conform to ASME A13.1.
- .2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- .3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- .4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 150 mm (6 inches) wide by 0.10 mm (4 mil) thick, manufactured for direct burial service.

## 2.5 ADHESIVE MARKINGS

- .1 Colour: Conform to ASME A13.1.

Material	Colour Scheme
Hazardous	Black Text on Yellow Background
Inherently Low Hazard	White text on Green Background
Fire Protection	White Text on Red Background

- .2 Plastic Tape Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

## 2.6 CEILING TACKS

- .1 Description: Steel with 20 mm (3/4 inch) diameter colour coded head.
- .2 Colour code:
  - .1 Yellow - HVAC equipment
  - .2 Red - Fire dampers/smoke dampers
  - .3 Green - Plumbing valves
  - .4 Blue - Heating/cooling valves



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**2.7 T-BAR LABELS**

- .1 Description: Labels indicating equipment and maintainable elements behind concealed ceiling elements..
- .2 White label with black lettering

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Degrease and clean surfaces to receive adhesive for identification materials.
- .2 Prepare surfaces to Section 09 91 10 for stencil painting.

**3.2 INSTALLATION**

- .1 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- .2 Install tags with corrosion resistant chain.
- .3 Apply stencil painting to Section 09 91 10.
- .4 Install plastic pipe markers to manufacturer's written instructions.
- .5 Install plastic tape pipe markers complete around pipe to manufacturer's written instructions.
- .6 Install underground plastic pipe markers 150 to 200 mm (6 to 8 inches) below finished grade, directly above buried pipe.
- .7 Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- .8 Controls:
  - .1 Identify control panels and major control components outside panels with plastic nameplates.
  - .2 Identify thermostats relating to terminal boxes or valves with nameplates or adhesive labels.
  - .3 Provide identification on all conduits and junction box covers indicating associated system, panel and circuit numbering using tags or labels.
  - .4 Provide identification on all control points indicating point name, panel #/address and part number using tags or labels.
- .9 Identify valves in main and branch piping with tags.
- .10 Identify air terminal units and radiator valves with numbered tags.
- .11 Identify external heat tracing on insulated piping.
- .12 Tag automatic controls, instruments, and relays. Key to control schematic.
- .13 Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 20 mm (3/4 inch) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6 m (20 feet) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

- .14 Identify ductwork with stencilled painting adhesive labels. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- .15 Provide ceiling tacks T-Bar labels to locate equipment, valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Testing, adjustment, and balancing of air systems.
- .2 Fire and smoke damper testing & verification.
- .3 Testing, adjustment, and balancing of hydronic systems.
- .4 Measurement of final operating condition of HVAC systems.

**1.2 RELATED SECTIONS**

- .1 Section 01 10 00 – Summary of Work
- .2 Section 01 45 00 - Quality Assurance:
  - .1 Testing laboratory services.
  - .2 Employment of testing agency and payment for services.
  - .3 Inspection and testing allowances.
- .3 Section 21 05 00 - Closeout Submittals:
  - .1 Starting of Systems.
  - .2 Testing, Adjusting, and Balancing of Systems.
- .4 Section 23 31 00 - Duct Work
- .5 Section 23 33 00 - Duct Work Accessories

**1.3 ALLOWANCES**

- .1 Section 01 21 00: Cash Allowance Sum applicable to this section.
- .2 Allowance includes testing, adjusting, and balancing of mechanical systems.
- .3 Work is included in this section and is part of the Contract Sum/Price.

**1.4 REFERENCES**

- .1 AABC - National Standards for Total System Balance.
- .2 CAABC – Canadian Associated Air Balance Council
- .3 ADC - Test Code for Grilles, Registers, and Diffusers.
- .4 ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- .5 CSA B149.1 - Natural gas and propane installation code
- .6 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- .7 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

**1.5 SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

- .3 Submit draft copies of report for review prior to final acceptance of Project. Draft copies shall be submitted in electronic format (Adobe Acrobat PDF file). Provide final copies for Contract Administrator and for inclusion in operating and maintenance manuals.
- .4 Provide final reports in letter size, soft cover or 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Also submit an electronic copy (PDF file) of the same. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- .5 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in either S.I. Metric or IP units to match the primary units used on the drawings and schedules.

#### **1.6 PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Record actual locations of flow measuring stations, balancing valves, balancing dampers, and fire dampers.

#### **1.7 QUALITY ASSURANCE**

- .1 Perform total system balance to AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

#### **1.8 QUALIFICATIONS**

- .1 Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience[, and certified by CAABC or NEBB.]
- .2 Perform Work under supervision of CAABC or NEBB Certified Test and Balance Supervisor.

#### **1.9 PRE-BALANCING CONFERENCE**

- .1 Convene one week prior to commencing work of this section, to Section 21 05 00.

#### **1.10 SEQUENCING**

- .1 Sequence work to Section 01 10 00.
- .2 Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

#### **1.11 SCHEDULING**

- .1 Schedule work to Section 21 05 00.
- .2 Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation, and/or smoke control system with Fire Authority.

#### **1.12 PROJECT CLOSE-OUT**

- .1 The Testing, Adjusting and Balancing agency as part of its Contract shall act as authorized inspection agency, responsible to list all items that are installed incorrectly, require correction or have not been installed in accordance with Contract drawings and/or specifications, pertaining to the air distribution, cooling and heating systems. The Mechanical Subcontractor shall make good these items.

- .2 Final payment on the building will not be issued until the final air balance report has been submitted to the Contract Administrator and has been approved by the Contract Administrator.

**Part 2 Products**

- .1 Not used

**Part 3 Execution**

**3.1 AGENCIES**

- .1 Air Movement Services Ltd.
- .2 Airdronics Inc.
- .3 D.F.C. Mechanical Testing & Balancing Ltd.
- .4 AHS Testing & Balancing.

**3.2 EXAMINATION**

- .1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  - .1 Systems are started and operating in a safe and normal condition.
  - .2 Temperature control systems are installed complete and operable.
  - .3 Proper thermal overload protection is in place for electrical equipment.
  - .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - .5 Duct systems are clean of debris.
  - .6 Fans are rotating correctly.
  - .7 Fire and volume dampers are in place and open.
  - .8 Air coil fins are cleaned and combed.
  - .9 Access doors are closed and duct end caps are in place.
  - .10 Air outlets are installed and connected.
  - .11 Duct system leakage is minimized.
  - .12 Hydronic systems are flushed, filled, and vented.
  - .13 Pumps are rotating correctly.
  - .14 Proper strainer baskets are clean and in place.
  - .15 Service and balance valves are open.
- .2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- .3 Beginning of work means acceptance of existing conditions.

**3.3 PREPARATION**

- .1 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Contract Administrator to facilitate spot checks during testing.
- .2 Provide additional balancing devices as required.

### **3.4 INSTALLATION TOLERANCES**

- .1 Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- .2 Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- .3 Active Beams: Adjust beam plenum pressure to within plus 10 percent and minus 5 percent of manufacturer's requirement for operation based on shop drawings.
- .4 Hydronic Systems: Adjust to within plus or minus 10 percent of design.
- .5 Direct Fired Makeup Air Systems:
  - .1 Adjust exhaust air within 0 to plus 5 percent of design. Adjust supply air within plus or minus 5 percent of design but not exceed 10 percent of final exhaust air flow rate.
  - .2 For paint spray booths installations: adjust exhaust air within 0 to plus 5 percent of design. Adjust total supply air within plus or minus 5 percent of design but not greater than the final total exhaust air of the spray booth flow rate.
  - .3 For kitchen installations:
    - .1 Where the food preparation area and the public area is connected with a normally closed door or openings are lower than 1.5 square meters (16 square feet), adjust supply air within plus or minus 5 percent of design. Adjust total interlocked exhaust air within plus or minus 10 percent of design but not less than 90% of the final total supply air flow rate.
    - .2 Other than installations indicated in note .1, adjust supply air within plus or minus 5 percent of design. Adjust total interlocked exhaust air within 100 percent to 105 percent of final kitchen air supply flow rate.

### **3.5 ADJUSTING**

- .1 Ensure recorded data represents actual measured or observed conditions.
- .2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- .3 Make any changes in pulleys and belts, and add any manual dampers as required for correct balance, at no additional cost to The City.
- .4 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

### **3.6 AIR SYSTEM PROCEDURE**

- .1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- .2 Test and record motor full load amperes.
- .3 Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- .4 Measure air quantities at air inlets and outlets.
- .5 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- .6 Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

- .7 All outlets shall be adjusted to provide proper throw and directional distribution in accordance with the requirements on the drawings and/or schedules.
- .8 Vary total system air quantities by adjustment of fan speeds.
  - .1 Provide drive changes required to set airflows on belt driven units.
  - .2 Adjust fan motor speed using speed control, on electronic commutated (EC) motors and variable speed drives (VSD) serving AC motors. Indicate speed voltage (0-10 DC ) on EC motors and hertz (Hz) on VSD
  - .3 Vary branch air quantities by damper regulation.
- .9 Provide system schematic with required and actual air quantities recorded at each outlet or inlet. Each grille, diffuser and register shall be identified as to location and area. Include locations of pitot tube traverse locations, fire damper locations and tags, and balance damper locations.
- .10 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- .11 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Any re-adjustments of controls as deemed necessary, shall be made in co-operation with the Control Subcontractor.
- .12 Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
  - .1 Test and record entering air temperatures (D.B. heating and cooling).
  - .2 Test and record entering air temperatures (W.B. cooling).
  - .3 Test and record leaving air temperatures (D.B. heating and cooling).
  - .4 Test and record leaving air temperatures (W.B. cooling).
- .13 Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating. Refer to the maximum and minimum rates on the drawings and schedules.
- .14 Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 12.5 Pa (0.05 inches) positive static pressure near the building entries.
- .15 Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- .16 For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- .17 On fan powered VAV boxes, adjust air flow switches for proper operation.
- .18 All pitot-tube openings shall have plastic plugs of proper size in uninsulated or internally insulated ductwork. Insulated ductwork shall be provided with rubber plugs that extend to the face of the insulation. Cover the plugs on insulated ductwork with strip of grey tape.
- .19 After completion of final balance, the Balance Subcontractor shall permanently fix the damper operator with a strip of contact tape and spray the quadrant with bright paint to permanently mark its balanced position.

### **3.7 FIRE & SMOKE DAMPER TESTING & VERIFICATION**

- .1 Testing of Fire Dampers, Ceiling Fire Stops and/or Fire/Smoke Dampers

- .1 General
  - .1 The Testing, Adjusting and Balancing agency shall test this equipment after installation.
  - .2 Test and verify operation of all fire dampers and ceiling fire stops in this project.
  - .3 Test shall include manually releasing fusible link; allowing damper to close to ensure that it has tight-fit closing operation without binding; opening fire damper and/or closing ceiling fire stop and resetting fusible link connection.
  - .4 Instruct Sections 23 31 00 and 23 33 00 to repair all fire dampers and/or ceiling fire stops that have been identified as being faulty.
- .2 Identification of Fire Dampers and Ceiling Fire Stops
  - .1 At all fire dampers and ceiling fire stops, supply and install tags as approved by the Contract Administrator.
  - .2 Tags shall be mechanically fastened to duct fire damper access door, or onto or on structure near fire dampers or ceiling fire stops which have no connecting ductwork.
  - .3 After each fire damper has been tested and has been proven to operate satisfactorily as noted in previous clause, a representative of the Testing, Adjusting and Balancing agency shall label unit number and mark date and signature on tag. Tags shall have space for minimum size further dates and signatures for future checking of damper operation by The City's staff.
- .3 Test Report for Fire Dampers and Ceiling Fire Stops
  - .1 The Testing, Adjusting and Balancing agency shall provide a Test Report.
  - .2 The report shall include following for each fire damper:
    - .1 Verification that the unit is fully accessible.
    - .2 Verification that the unit has been successfully tested.
    - .3 Verification that the unit has been reset.
    - .4 Name of tester.
    - .5 Date that the unit tested successfully.
    - .6 Location schedule of all dampers i.e. each damper must be labelled.
  - .3 Provide one copy of completed report to Contract Administrator. After the Contract Administrator has reviewed report, provide to the Mechanical Subtrade sufficient copies of report to insert one in each Maintenance/Operating Manual.
- .4 Testing of Fire/Smoke Dampers
  - .1 Provide all testing, tagging, and Test Report for all Fire/Smoke Dampers.
  - .2 Follow instruction noted in previous clause as noted for Fire Dampers and Ceiling fire stops.

### **3.8 LEAK TESTING OF AIR DUCTS**

- .1 Leak test all ductwork.
- .2 Co-ordinate with Section 23 31 00. Section 23 31 00 shall repair all leaks found in ductwork before and after testing of systems.
- .3 Witness above final leak tests and issue report to Contract Administrator.



- .4 Test shall be performed by this Section.
- .5 Section 23 31 00 shall provide all necessary temporary connections, blank-offs and tees required for testing. This Section shall provide all test fans, equipment and labour required for testing.  
Section 23 31 00 shall clean all ducts before testing.
- .6 During installation of ductwork include separate leakage air tests of each complete air riser; each completed horizontal distribution system, and after ductwork is installed and central station apparatus is erected, leakage testing of pressure side of whole system. Include testing of flexible run-outs (where applicable).
- .7 Perform preliminary tests and repair all leaks before notifying Contract Administrator of final tests.
- .8 Maintain log lock of all tests showing dates, personnel observers' initials.
- .9 Be responsible for any damage resulting from failure of items under test.
- .10 Section 23 31 00 shall repair all leaks in duct systems.
- .11 Retest ductwork after leaks have been repaired.
- .12 Coordinate with Section 23 31 00 to ensure that all ductwork is tested:
  - .1 before ducts are insulated.
  - .2 before ducts are concealed.

### **3.9 WATER SYSTEM PROCEDURE**

- .1 Adjust water systems to provide required or design quantities.
- .2 Use calibrated fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- .3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- .4 Effect system balance with automatic control valves fully open to heat transfer elements.
- .5 Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- .6 Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

### **3.10 SCHEDULES**

- .1 Equipment requiring testing, adjusting and balancing:
  - .1 Sprinkler Air Compressor
  - .2 Electric Water Coolers
  - .3 Plumbing Pumps
  - .4 Boiler Feedwater Pumps
  - .5 HVAC Pumps
  - .6 Packaged Steel Fire Tube Boilers
  - .7 Air Cooled Water Chillers
  - .8 Air Cooled Refrigerant Condensers

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- .9 Computer Room Air Conditioning Units
  - .10 Air Coils
  - .11 Terminal Heat Transfer Units
  - .12 Air Handling Units
  - .13 Fans
  - .14 Air Filters
  - .15 Air Terminal Units
  - .16 Air Inlets and Outlets
  - .2 Report Forms
    - .1 Title Page:
      - .1 Name of Testing, Adjusting, and Balancing Agency
      - .2 Address of Testing, Adjusting, and Balancing Agency
      - .3 Telephone number of Testing, Adjusting, and Balancing Agency
      - .4 Project name
      - .5 Project location
      - .6 Project Architect
      - .7 Project Engineer
      - .8 Project Contractor
      - .9 Project altitude
      - .10 Report date
    - .2 Summary Comments:
      - .1 Design versus final performance
      - .2 Notable characteristics of system
      - .3 Description of systems operation sequence
      - .4 Summary of outdoor and exhaust flows to indicate amount of building pressurization
      - .5 Nomenclature used throughout report
      - .6 Test conditions
    - .3 Instrument List:
      - .1 Instrument
      - .2 Manufacturer
      - .3 Model number
      - .4 Serial number
      - .5 Range
      - .6 Calibration date
    - .4 Electric Motors:
      - .1 Manufacturer
      - .2 Model/Frame
      - .3 HP/BHP
      - .4 Phase, voltage, amperage; nameplate, actual, no load
      - .5 RPM
      - .6 Service factor
      - .7 Starter size, rating, heater elements
      - .8 Sheave Make/Size/Bore

- 
- .5 V-Belt Drive:
    - .1 Identification/location
    - .2 Required driven RPM
    - .3 Driven sheave, diameter and RPM
    - .4 Belt, size and quantity
    - .5 Motor sheave diameter and RPM
    - .6 Centre to centre distance, maximum, minimum, and actual
  - .6 Pump Data:
    - .1 Identification/number
    - .2 Manufacturer
    - .3 Size/model
    - .4 Impeller
    - .5 Service
    - .6 Design flow rate, pressure drop, BHP
    - .7 Actual flow rate, pressure drop, BHP
    - .8 Discharge pressure
    - .9 Suction pressure
    - .10 Total operating head pressure
    - .11 Shut off, discharge and suction pressures
    - .12 Shut off, total head pressure
  - .7 Combustion Test:
    - .1 Boiler manufacturer
    - .2 Model number
    - .3 Serial number
    - .4 Firing rate
    - .5 Overfire draft
    - .6 Gas meter timing dial size
    - .7 Gas meter time per revolution
    - .8 Gas pressure at meter outlet
    - .9 Gas flow rate
    - .10 Heat input
    - .11 Burner manifold gas pressure
    - .12 Percent carbon monoxide (CO)
    - .13 Percent carbon dioxide (CO<sub>2</sub>)
    - .14 Percent oxygen (O<sub>2</sub>)
    - .15 Percent excess air
    - .16 Flue gas temperature at outlet
    - .17 Ambient temperature
    - .18 Net stack temperature
    - .19 Percent stack loss
    - .20 Percent combustion efficiency
    - .21 Heat output
  - .8 Air Cooled Condenser:
    - .1 Identification/number
    - .2 Location

- 
- .3 Manufacturer
  - .4 Model number
  - .5 Serial number
  - .6 Entering DB air temperature, design and actual
  - .7 Leaving DB air temperature, design and actual
  - .8 Number of compressors
  - .9 Chillers:
    - .1 Identification/number
    - .2 Manufacturer
    - .3 Capacity
    - .4 Model number
    - .5 Serial number
    - .6 Evaporator entering water temperature, design and actual
    - .7 Evaporator leaving water temperature, design and actual
    - .8 Evaporator pressure drop, design and actual
    - .9 Evaporator water flow rate, design and actual
    - .10 Condenser entering water temperature, design and actual
    - .11 Condenser pressure drop, design and actual
    - .12 Condenser water flow rate, design and actual
  - .10 Heat Exchanger:
    - .1 Identification/number
    - .2 Location
    - .3 Service
    - .4 Manufacturer
    - .5 Model number
    - .6 Serial number
    - .7 Steam pressure, design and actual
    - .8 Primary water entering temperature, design and actual
    - .9 Primary water leaving temperature, design and actual
    - .10 Primary water flow, design and actual
    - .11 Primary water pressure drop, design and actual
    - .12 Secondary water leaving temperature, design and actual
    - .13 Secondary water leaving temperature, design and actual
    - .14 Secondary water flow, design and actual
    - .15 Secondary water pressure drop, design and actual
  - .11 Cooling Coil Data:
    - .1 Identification/number
    - .2 Location
    - .3 Service
    - .4 Manufacturer
    - .5 Air flow, design and actual
    - .6 Entering air DB temperature, design and actual
    - .7 Entering air WB temperature, design and actual
    - .8 Leaving air DB temperature, design and actual
    - .9 Leaving air WB temperature, design and actual

- .10 Water flow, design and actual
- .11 Water pressure drop, design and actual
- .12 Entering water temperature, design and actual
- .13 Leaving water temperature, design and actual
- .14 Saturated suction temperature, design and actual
- .15 Air pressure drop, design and actual
- .12 Heating Coil Data:
  - .1 Identification/number
  - .2 Location
  - .3 Service
  - .4 Manufacturer
  - .5 Air flow, design and actual
  - .6 Water flow, design and actual
  - .7 Water pressure drop, design and actual
  - .8 Entering water temperature, design and actual
  - .9 Leaving water temperature, design and actual
  - .10 Entering air temperature, design and actual
  - .11 Leaving air temperature, design and actual
  - .12 Air pressure drop, design and actual
- .13 Air Moving Equipment
  - .1 Location
  - .2 Manufacturer
  - .3 Model number
  - .4 Serial number
  - .5 Arrangement/Class/Discharge
  - .6 Air flow, specified and actual
  - .7 Return air flow, specified and actual
  - .8 Outside air flow, specified and actual
  - .9 Total static pressure (total external), specified and actual
  - .10 Inlet pressure
  - .11 Discharge pressure
  - .12 Sheave Make/Size/Bore
  - .13 Number of Belts/Make/Size
  - .14 Fan RPM
- .14 Return Air/Outside Air Data:
  - .1 Identification/location
  - .2 Design air flow
  - .3 Actual air flow
  - .4 Design return air flow
  - .5 Actual return air flow
  - .6 Design outside air flow
  - .7 Actual outside air flow
  - .8 Return air temperature
  - .9 Outside air temperature
  - .10 Required mixed air temperature

- 
- .11 Actual mixed air temperature
  - .12 Design outside/return air ratio
  - .13 Actual outside/return air ratio
  - .15 Exhaust Fan Data:
    - .1 Location
    - .2 Manufacturer
    - .3 Model number
    - .4 Serial number
    - .5 Air flow, specified and actual
    - .6 Total static pressure (total external), specified and actual
    - .7 Inlet pressure
    - .8 Discharge pressure
    - .9 Sheave Make/Size/Bore
    - .10 Number of Belts/Make/Size
    - .11 Fan RPM
  - .16 Duct Traverse:
    - .1 System zone/branch
    - .2 Duct size
    - .3 Area
    - .4 Design velocity
    - .5 Design air flow
    - .6 Test velocity
    - .7 Test air flow
    - .8 Duct static pressure
    - .9 Air temperature
    - .10 Air correction factor
  - .17 Duct Leak Test:
    - .1 Description of ductwork under test
    - .2 Duct design operating pressure
    - .3 Duct design test static pressure
    - .4 Duct capacity, air flow
    - .5 Maximum allowable leakage duct capacity times leak factor
    - .6 Test apparatus
      - .1 Blower
      - .2 Orifice, tube size
      - .3 Orifice size
      - .4 Calibrated
    - .7 Test static pressure
    - .8 Test orifice differential pressure
    - .9 Leakage
  - .18 Terminal Unit Data:
    - .1 Manufacturer
    - .2 Type, constant, variable, single, dual duct
    - .3 Identification/number
    - .4 Location

- .5 Model number
- .6 Size
- .7 Minimum static pressure
- .8 Minimum design air flow
- .9 Maximum design air flow
- .10 Maximum actual air flow
- .11 Inlet static pressure
- .19 Air Distribution Test Sheet:
  - .1 Air terminal number
  - .2 Room number/location
  - .3 Terminal type
  - .4 Terminal size
  - .5 Area factor
  - .6 Design velocity
  - .7 Design air flow
  - .8 Test (final) velocity
  - .9 Test (final) air flow
  - .10 Percent of design air flow

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Duct work insulation.
- .2 Duct Liner.
- .3 Insulation jackets.

**1.2 RELATED SECTIONS**

- .1 Section - Roofing: Finishing outdoor insulation jacket.
- .2 Section 09 91 10 - Painting: Painting insulation jackets.
- .3 Section 23 05 53 - Mechanical Identification.
- .4 Section 23 31 00 - Duct Work: Glass fibre duct work.
- .5 Section 23 31 00 - Duct Work: Duct liner.
- .6 Section - Roofing: Installation and finishing of outdoor insulation jacket under roofing.

**1.3 REFERENCES**

- .1 Section 01 43 00: Requirements for references and standards.
- .2 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .4 ASTM C553 - Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .5 ASTM C612 - Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
- .6 ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation
- .7 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .8 ASTM C1071 - Fibrous Glass Duct Lining Insulation(Thermal Sound Absorbing Material).
- .9 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .10 ASTM E96 - Water Vapour Transmission of Materials.
- .11 ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- .12 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .13 NAIMA National Insulation Standards.
- .14 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- .15 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .16 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.



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**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

**1.5 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Applicator Qualifications: Company specializing in performing the work of this section minimum three years documented experience.

**1.6 REGULATORY REQUIREMENTS**

- .1 Materials: Flame spread/smoke developed rating of 25/50 to NFPA 255 / UL 723.

**1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

**1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Section 21 05 00: Environmental conditions affecting products on site.
- .2 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .3 Maintain temperature during and after installation for minimum period of 24 hours.

**Part 2 Products**

**2.1 VAPOUR BARRIER EXTERNAL DUCT WRAP, GLASS FIBRE, FLEXIBLE**

- .1 Manufacturers:
  - .1 Johns Manville Microlite XG
  - .2 Owens Corning SoftR Duct Wrap.
  - .3 Other acceptable manufacturers offering equivalent products.
    - .1 Knauf.
- .2 Insulation: ASTM C553; flexible, noncombustible blanket.
  - .1 'ksi' ('K') value: ASTM C518, 0.045 W/m-K at 24 degrees C (0.31 Btu-in/(hr ft<sup>2</sup>-°F) at 75 degrees F).
  - .2 Maximum service temperature: 121 degrees C (250 degrees F).
  - .3 Maximum moisture absorption: 0.20 percent by volume.
  - .4 Density 12 kg/cu. meter (0.75 lb/cu. Foot).
- .3 Vapour Barrier Jacket:

- .1 Kraft paper with glass fibre yarn and bonded to aluminized film (FRK).
- .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
- .3 Secure with pressure sensitive tape.
- .4 Vapour Barrier Tape:
  - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- .5 Outdoor Vapour Barrier Mastic:
  - .1 Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.
- .6 Tie Wire: Annealed steel, 1.5 mm (16 gauge).

## **2.2 VAPOUR BARRIER EXTERNAL GLASS FIBRE RIGID INSULATION BOARD**

- .1 Manufacturers:
  - .1 Johns Manville 800 Series
  - .2 Owens Corning Series 700
  - .3 Other acceptable manufacturers offering equivalent products.
    - .1 Knauf.
- .2 Insulation: ASTM C612; rigid, noncombustible blanket.
  - .1 'ksi' ('K') value : ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).
  - .2 Maximum service temperature: 121 degrees C (250 degrees F).
  - .3 Maximum moisture absorption: 0.20 percent by volume.
  - .4 Density: 48 kg/cu m (3.0 lb/cu ft).
- .3 Vapour Barrier Jacket:
  - .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
  - .2 Moisture vapour transmission: ASTM E96; 0.04 perm.
  - .3 Secure with pressure sensitive tape.
- .4 Vapour Barrier Tape:
  - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- .5 Indoor Vapour Barrier Finish:
  - .1 Cloth: Untreated; 305 g/sq m (9 oz/sq yd) weight, glass fabric.
  - .2 Vinyl emulsion type acrylic, compatible with insulation, black colour.

## **2.3 JACKETS**

- .1 Canvas Jacket: UL listed.
  - .1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.
  - .2 Lagging Adhesive:
    - .1 Compatible with insulation.
- .2 Aluminum Flexible Self Adhesive Insulation Jacket: UL listed
  - .1 Manufacturers:
    - .1 VentureClad 1577CW
    - .2 Bakor Foilskin

- .3 Polyguard Alumaguard
  - .2 Tensile Strength: 316.5 N/25 mm (70 lb/in)
  - .3 Puncture: 111 N (25 lbs)
  - .4 Service Temperature: -50 to 70°C (-58°C to 160°F)
  - .5 Finish: Embossed [Flat/Smooth]
  - .6 Aluminum foil exterior surface over multilayer laminate, vapour barriered jacket with pressure sensitive adhesive integral to jacket application surface with peel off release liner.
  - .7 Permeation (ASTM E96): 0.05 perm (maximum)
  - .8 UV resistant.
  - .9 Flame based application not acceptable.
- .3 Sheet Aluminum Jacket: ASTM B209M.
  - .1 Thickness: 0.40 mm (0.016 inch) sheet.
  - .2 Finish: Smooth.
  - .3 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.
  - .4 Fittings: 0.4mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.
  - .5 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.015 mm thick aluminum.

## 2.4 GLASS FIBRE DUCT LINER, FLEXIBLE

- .1 Manufacturers:
  - .1 Johns Manville LinaTex
  - .2 Owens Corning QuietR Textile Duct Liner.
  - .3 Other acceptable manufacturers offering equivalent products.
    - .1 Knauf.
- .2 Insulation: ASTM C1071; flexible, noncombustible blanket with poly vinyl acetate polymer impregnated surface and edge coat, [with 28 Gauge Galvanized Steel Perforated Internal Cover.]
  - .1 'ksi' ('K') Value: ASTM C518, maximum 0.045 at 24 degrees C (0.31 at 75 degrees F).
  - .2 Maximum Service Temperature: 121 degrees C (250 degrees F).
  - .3 Maximum Velocity on Coated Air Side: 30.5 m/s (6,000 fpm).
  - .4 Minimum Noise Reduction Criteria: ASTM C1071 0.30 for 13 mm (1/2 inch) thickness; 0.45 for 25 mm (1 inch) thickness; 0.60 for 40 mm (1-1/2 inches) thickness; 0.70 for 50 mm (2 inch) thickness.
  - .5 Minimum 55% Certified Recycled Content.
- .3 Adhesive:
  - .1 Waterproof, ASTM E162 fire-retardant type.
- .4 Liner Fasteners: Galvanized steel, with press-on head.

## 2.5 GLASS FIBRE DUCT LINER, RIGID

- .1 Manufacturers:
  - .1 Johns Manville Linacoustic R-300
  - .2 Owens Corning QuietR Duct Liner Board
  - .3 Other acceptable manufacturers offering equivalent products.

- .1 Knauf.
- .2 Insulation: ASTM C612; rigid, noncombustible board with acrylic polymer meeting ASTM G21 impregnated surface and edge coat. [with 28 Gauge Galvanized Steel Perforated Internal Cover.]
  - .1 'ksi' ('K') value : ASTM C518, maximum 0.27 at at 24 degrees C (75 degrees F).
  - .2 Maximum service temperature: 121 degrees C (250 degrees F).
  - .3 Maximum Velocity on Coated Air Side: 24.5 m/s (5,000 fpm).
  - .4 Minimum Noise Reduction Criteria: ASTM C1071 0.55 for 25 mm (1 inch) thickness; 0.75 for 40 mm (1-1/2 inches) thickness; 0.90 for 50 mm (2 inch) thickness.
  - .5 Minimum 20% Certified Recycled Content.
- .3 Adhesive:
  - .1 Waterproof , ASTM E162 fire-retardant type.
- .4 Liner Fasteners: Galvanized steel, with press-on head.

## 2.6 GLASS FIBRE ROUND DUCT LINER

- .1 Manufacturers:
  - .1 Johns Manville Spiracoustic Plus
  - .2 Owens Corning QuietZone Spiral Duct Liner.
  - .3 Other acceptable manufacturers offering equivalent products.
    - .1 Knauf.
- .2 Insulation: Round, preformed in cylindrical sections with acrylic polymer meeting ASTM G21 impregnated surface coat. [with 28 Gauge Galvanized Steel Perforated Internal Cover.]
  - .1 'ksi' ('K') value : ASTM C1071, 0.033 at 24 degrees C (0.23 at 75 degrees F).
  - .2 Maximum service temperature: 121 degrees C (250 degrees F).
  - .3 Maximum Velocity on Coated Air Side: 30.5 m/s (6,000 fpm).

## 2.7 FIRE WRAP EXTERNAL DUCT FLEXIBLE

- .1 Manufacturers:
  - .1 3M Canada
  - .2 Other acceptable manufacturers offering equivalent products.
- .2 Listing
  - .1 Underwriters' Laboratories of Canada (ULC)
    - .1 Grease Duct Enclosures – Fire Resistant Ducts Guide No. (40 U21) Design No. FRD 4
    - .2 Ventilation / Pressurization Duct Enclosures – ISO 6944 Fire Resistant Ducts Guide No. (40 U21) Design No. FRD 3 and FRD 5
- .3 Insulation:
  - .1 'ksi' ('K') value: ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).
  - .2 Density 96 kg/cu. meter (6 lb/cu. Foot).
- .4 Flammability (ASTM E 84/UL 723)
  - .1 Foil:

- .1 Flame spread 5 & Smoke developed 5
- .2 Blanket:
  - .1 Flame spread & 0 Smoke Developed 0

.5 Application chart

Application	Fire Resistive Rating	Enclosure System	Through-Penetration System
Air Ventilation Duct Systems	1 hour	1 layer - 3" (7,6 cm) perimeter and longitudinal overlap or optional butt joint plus collar wrap method	ULC-FRD-3
Air Ventilation Duct Systems (2 or 3 Sides)	1 hour	1 layer - 3" (7,6 cm) perimeter and longitudinal overlap	ULC-FRD-5
Air Ventilation Duct Systems	2 hours	2 layers - 3" (7,6 cm) perimeter and longitudinal overlap or first layer butt joint with second layer overlap method	ULC-FRD-3
Air Ventilation Duct Systems (2 or 3 Sides)	2 hour	2 layers - 3" (7,6 cm) perimeter and longitudinal overlap OR first layer butt joint with second layer overlap 3" (7,6 cm)	ULC-FRD-5

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Section 01 70 00 - Examination and Preparation: Verification of existing conditions before starting work.
- .2 Verify that duct work has been tested before applying insulation materials.
- .3 Verify that surfaces are clean, foreign material removed, and dry.

**3.2 INSTALLATION**

- .1 Section 01 43 00 - Quality Assurance: Manufacturer's written instructions.
- .2 Install to NAIMA National Insulation Standards.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 All duct sizes on the drawings refer to inside duct dimensions. On all acoustically lined ductwork, the external duct dimensions shall be increased by the thickness of the lining.
- .5 Insulated duct work conveying air below ambient temperature:
  - .1 Provide insulation with vapour barrier jackets.
  - .2 Finish with tape and vapour barrier jacket.
  - .3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - .4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- .6 Insulated duct work conveying air above ambient temperature:
  - .1 Provide with or without standard vapour barrier jacket.
  - .2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

- .7 External insulation on duct work exposed in Mechanical Equipment Rooms or Finished Spaces below 3 metres (10 feet) above finished floor: Provide canvas jacket ready for finish painting.
- .8 Exterior Applications: Provide insulation with vapour barrier jacket. Cover the insulation with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- .9 Where ducts are acoustically lined to the equivalent R-value, no exterior duct insulation is required, except where exposed to outside temperature and weather.
- .10 External Duct Insulation Application:
  - .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
  - .2 Secure insulation without vapour barrier with staples, tape, or wires.
  - .3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.
  - .4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.
  - .5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- .11 Duct and Plenum Liner Application:
  - .1 Adhere insulation with adhesive for 90 percent coverage with adhesive complying with ASTM C916.
  - .2 Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
  - .3 Seal and smooth joints. Seal and coat transverse joints.
  - .4 Seal liner surface penetrations with adhesive.
  - .5 Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
- .12 Install Elastomeric Cellular Thermal Duct Liner as per manufacturer's recommendations.
- .13 External Fire Wrap Duct Insulation Application:
  - .1 Install in accordance to manufactures published installation manual.

**3.3 SCHEDULES**

- .1 Duct insulation shall follow the Schedules below as a minimum requirement. These requirements shall apply regardless of whether or not duct insulation is shown on the drawings.
- .2 Where duct insulation is shown on the drawings (either with the hatching convention or by means of a key note) and exceeds the requirements of the schedules below, the additional insulation requirements shall be met.

**3.4 EXTERNAL DUCT WRAP, GLASS FIBRE, FLEXIBLE**

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
All conditioned air supply ductwork in return plenums or un-conditioned	=< 400 mm (16") per side, or round duct	29mm (1 1/8") Installed 38mm (1 1/2") Nominal

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
interior space or mechanical rooms or electrical rooms		
Combustion Air ductwork	all	38mm (1 1/2") Installed 50mm (2") Nominal
Round exhaust ducts, relief ducts from external wall or roof back for length of 3000mm (10 feet) or to insulated damper, whichever is greater	All	57mm (2 1/4") Installed 75mm (3") Nominal
Round duct from insulated damper for length of up the 3000mm (10 feet)	All	38mm (1 1/2") Installed 50mm (2") Nominal
Round outdoor air ducts located in conditioned space to the air handler or mixed air plenum.	All	95mm (3 3/4") Installed 125mm (5") Nominal
Round ducts located outdoors or where exposed to outdoor temperatures (eg. Attics).	Not Permitted	Not Permitted
Round ducting to centrifugal exhaust fans on roofs.	All	38mm (1 1/2") Installed 50mm (2") Nominal

### 3.5 EXTERNAL GLASS FIBRE RIGID INSULATION BOARD

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
Air conditioning supply plenums, before, including, and after cooling coils	all	50mm (2")
All conditioned air supply ductwork in return plenums or un-conditioned interior space or mechanical rooms or electrical rooms	> 400 mm (16") per side	25mm (1")
Combustion Air ductwork	all	50mm (2")
Rectangular exhaust ducts, relief ducts from external wall or roof back for length of 3000mm (10 feet) or to insulated damper, whichever is greater	All	75mm (3")
Rectangular duct from insulated damper for length of up the 3000mm (10 feet)	All	50mm (2")
Outdoor air ducts located in conditioned space from the intake louver at outside wall or roof to the air handler or mixed air plenum	All	75mm (3")
Rectangular conditioned air ducts located outdoors or where exposed to outdoor temperatures (eg. Attics, roofs).	All	125mm (5")
Rectangular ducting to centrifugal exhaust fans on roofs.	All	50mm (2")

**3.6 GLASS FIBRE DUCT LINER, RIGID**

<b>DUCT SERVICE</b>	<b>DUCT SIZE &lt;Inch&gt;&lt;mm&gt;</b>	<b>THICKNESS &lt;mm&gt;&lt;Inch&gt;</b>
Rectangular air supply and return air ductwork where indicated on drawings by acoustic hatching symbol.	All	25mm (1")

**3.7 GLASS FIBRE DUCT LINER, FLEXIBLE**

<b>DUCT SERVICE</b>	<b>DUCT SIZE &lt;Inch&gt;&lt;mm&gt;</b>	<b>THICKNESS &lt;mm&gt;&lt;Inch&gt;</b>
Rectangular air supply and return air ductwork where indicated on drawings by acoustic hatching symbol.	All	25mm (1")

**END OF SECTION**



**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Equipment insulation.
- .2 Covering.
- .3 Breeching insulation.

**1.2 RELATED SECTIONS**

- .1 Section 09 91 10 - Painting: Painting insulation covering.
- .2 Section 23 05 53 - Mechanical Identification.
- .3 Section 22 10 00 - Plumbing Piping: Placement of hangers and hanger inserts.
- .4 Section 23 21 00 - Hydronic Piping: Placement of hangers and hanger inserts.

**1.3 REFERENCES**

- .1 Section 01 42 00: Requirements for references and standards.
- .2 ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .3 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .5 ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .6 ASTM C240 - Testing Cellular Glass Insulation Block.
- .7 ASTM C449/C449M - Mineral Fibre Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .8 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .9 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .10 ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .11 ASTM C552 - Cellular Glass Thermal Insulation.
- .12 ASTM C553 - Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .13 ASTM C592 - Mineral Fibre Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- .14 ASTM C612 - Mineral Fibre Block and Board Thermal Insulation.
- .15 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .16 ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- .17 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .18 ASTM E96 - Water Vapour Transmission of Materials.

- .19 NAIMA National Insulation Standards.
- .20 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- .21 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### **1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

#### **1.5 SUBMITTALS FOR INFORMATION**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

#### **1.6 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

#### **1.7 REGULATORY REQUIREMENTS**

- .1 Materials: Flame spread/smoke developed rating of 25/50 to NFPA 255 //UL 723.

#### **1.8 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### **1.9 ENVIRONMENTAL REQUIREMENTS**

- .1 Section 21 05 00: Environmental conditions affecting products on site.
- .2 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .3 Maintain temperature during and after installation for minimum period of 24 hours.

### **Part 2 Products**

#### **2.1 GLASS FIBRE, FLEXIBLE**

- .1 Manufacturers:
  - .1 Johns Manville Microlite XG
  - .2 Owens Corning SoftR Duct Wrap.
  - .3 Other acceptable manufacturers offering equivalent products.
    - .1 Knauf.

- .2 Insulation: ASTM C553; flexible, noncombustible blanket.
  - .1 'ksi' ('K') value: ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).
  - .2 Maximum service temperature: 121 degrees C (250 degrees F).
  - .3 Maximum moisture absorption: 0.20 percent by volume.
  - .4 Density 72 kg/cu. meter (4.5 lb/cu. Foot).
- .3 Vapour Barrier Jacket:
  - .1 ASTM C921, Kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
  - .2 Moisture vapour transmission: ASTM E96; 0.02 perm.
  - .3 Secure with self-sealing longitudinal laps and butt strips.
  - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Tie Wire: 1.22 mm (0.048 inch) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.

## 2.2 GLASS FIBRE, RIGID

- .1 Manufacturers:
  - .1 Johns Manville 800 Series
  - .2 Owens Corning Series 700
  - .3 Other acceptable manufacturers offering equivalent products.
    - .1 Knauf.
- .2 Insulation: ASTM C612; rigid, noncombustible blanket.
  - .1 'ksi' ('K') value : ASTM C518, 0.045 at 24 degrees C (0.31 at 75 degrees F).
  - .2 Maximum service temperature: 121 degrees C (250 degrees F).
  - .3 Maximum moisture absorption: 0.20 percent by volume.
  - .4 Density: 72 kg/cu m (4.5 lb/cu ft).
- .3 Vapour Barrier Jacket:
  - .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
  - .2 Moisture vapour transmission: ASTM E96; 0.04 perm.
  - .3 Secure with self-sealing longitudinal laps and butt strips.
  - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Facing: 25 mm (1 inch) galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .5 Vapour Barrier Lap Adhesive:
  - .1 Compatible with insulation.
- .6 Insulating Cement/Mastic:
  - .1 ASTM C195; hydraulic setting on mineral wool.

## 2.3 CELLULAR GLASS

- .1 Insulation: ASTM C552.
  - .1 'ksi' ('K') Value: 0.039 at 24 degrees C (0.35 at 75 degrees F).
  - .2 Maximum Service Temperature: 482 degrees C (900 degrees F).
  - .3 Maximum Water Vapour Transmission: 0.1 perm.

- .4 Maximum Moisture Absorption: ASTM C240, 0.2 percent by volume.
- .5 Density: 128 kg/cu m (8.0 lb/cu ft).

## **2.4 HYDROUS CALCIUM SILICATE**

- .1 Manufacturers:
  - .1 Industrial Insulation Group
  - .2 Johns Mansville Thermo-12 Gold.
  - .3 Substitutions: Refer to Section 21 05 00.
- .2 Insulation: ASTM C533; rigid moulded, asbestos free, gold colour.
  - .1 'ksi' ('K') Value: ASTM C177 and C518; 0.065 at 148 degrees C (0.5 0 at 300 degrees F).
  - .2 Maximum Service Temperature: 649 degrees C (1200 degrees F).
  - .3 Density: 232 kg/cu m (14.5 lb/cu ft).
- .3 Tie Wire: 1.22 mm (0.048 inches) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.
- .4 Insulating Cement
  - .1 ASTM C449.

## **2.5 CELLULAR FOAM**

- .1 Insulation: ASTM C534; flexible, cellular elastomeric, moulded or sheet.
  - .1 'ksi' ('K') Value: ASTM C177; 0.032 at 24 degrees C (0.25 at 75 degrees F).
  - .2 Minimum Service Temperature: -40 degrees C (-40 degrees F).
  - .3 Maximum Service Temperature: 104 degrees C (220 degrees F).
  - .4 Maximum Moisture Absorption: ASTM D1056; 1.0 percent by volume.
  - .5 Moisture Vapour Transmission: ASTM E96; 0.05 perm-inches.
  - .6 Connection: Waterproof vapour barrier adhesive.
- .2 Elastomeric Foam Adhesive:
  - .1 Air dried, contact adhesive, compatible with insulation.

## **2.6 JACKETS**

- .1 PVC Plastic:
  - .1 Jacket: ASTM C921, Sheet material, off-white colour.
    - .1 Minimum Service Temperature: -40 degrees C (-40 degrees F).
    - .2 Maximum Service Temperature: 66 degrees C (150 degrees F).
    - .3 Moisture Vapour Transmission: ASTM E96; 0.002 perm-inches.
    - .4 Thickness: 0.25 mm (10 mil).
    - .5 Connections: Brush on welding adhesive.
  - .2 Covering Adhesive Mastic:
    - .1 Compatible with insulation.
- .2 Canvas Jacket: UL listed.
  - .1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.
  - .2 Lagging Adhesive:

- .1 Compatible with insulation.
- .3 Aluminum Jacket: ASTM B209.
  - .1 Thickness: 0.40 mm (0.016 inch) sheet.
  - .2 Finish: Smooth.
  - .3 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.
  - .4 Fittings: 0.4mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.
  - .5 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.015 mm thick aluminum.
- .4 Stainless Steel Jacket: ASTM A167 Type 304 stainless steel.
  - .1 Thickness: 0.25 mm (0.010inch).
  - .2 Finish: Smooth.
  - .3 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.015 mm thick stainless steel.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Section 01 70 00 - Examination and Preparation: Verification of existing conditions before starting work.
- .2 Verify that equipment has been tested before applying insulation materials.
- .3 Verify that surfaces are clean and dry, with foreign material removed.

#### **3.2 INSTALLATION**

- .1 Section 01 43 00: Manufacturer's written instructions.
- .2 Factory Insulated Equipment: Do not insulate.
- .3 Exposed Equipment: Locate insulation and cover seams in least visible locations.
- .4 Apply insulation close to equipment by grooving, scoring, and bevelling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- .5 Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapour barrier cement.
- .6 Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- .7 Apply insulation to pump casings to match form of pump.
- .8 Fibre glass insulated equipment containing fluids below ambient temperature: Provide vapour barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapour barrier adhesive.
- .9 For hot equipment containing fluids 60 degrees C (140 degrees F) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- .10 For hot equipment containing fluids over 60 degrees C (140 degrees F), insulate flanges and unions with removable sections and jackets. Jackets to be suitable for the service temperature.
- .11 Fibre glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapour barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

- .12 Inserts and Shields:
  - .1 Application: Equipment 50 mm (2 inches) diameter or larger.
  - .2 Shields: Galvanized steel between hangers and inserts.
  - .3 Insert location: Between support shield and equipment and under the finish jacket.
  - .4 Insert configuration: Minimum 150 mm (6 inches) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - .5 Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- .13 Finish insulation at supports, protrusions, and interruptions.
- .14 Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish unless otherwise indicated.
- .15 For exterior piping applications, provide vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- .16 Insulation on all diesel exhaust piping, silencers and breeching shall be covered with aluminum jacket. All adhesives shall be suitable for the service temperatures. Installation of the insulation and jacket shall allow for thermal expansion. Fittings shall be insulated with mitred sections of the same insulation.
- .17 Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- .18 Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

### 3.3 SCHEDULES

- .1 Plumbing Systems:
  - .1 Domestic Hot Water Storage Tanks: Glass Fibre, Flexible Insulation: 50 mm (2 inches) thick.
- .2 Heating Systems:
  - .1 Shell & Tube Heat Exchangers/Converters: Calcium Silicate Insulation: 50 mm (2 inches) thick.
  - .2 Plate-type heat exchanger: not required.
  - .3 Air Separators: Glass Fibre, Flexible Insulation: 25 mm (1 inches) thick.
  - .4 Hot Thermal Storage Tanks: Glass Fibre, Flexible Insulation: 50 mm (2 inches) thick.
  - .5 Boiler Feed Water Storage Tanks: Glass Fibre, Flexible Insulation: 50 mm (2 inches) thick.
  - .6 Radiant Panels: See section 23 82 00 Terminal Heat Transfer Units for requirements.
- .3 Cooling Systems:
  - .1 Pump Bodies: Cellular Foam Insulation: 12 mm (1/2 inch) thick.
  - .2 Air Separators: Cellular Foam Insulation: 12 mm (1/2 inch) thick.
  - .3 Chiller Cold Surfaces (Not Factory Insulated): Cellular Foam Insulation: Minimum 19 mm (3/4 inch) thick, or match chiller supplier's specific requirements if more stringent.
  - .4 Cold Thermal Storage Tanks: Cellular Foam Insulation: 19 mm (3/4 inch) thick.

- .5 Plate and Frame Heat exchangers: See section 23 57 00 Heat Exchangers for insulation requirements.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Piping insulation.
- .2 Jackets and accessories.

**1.2 RELATED SECTIONS**

- .1 Section 09 91 10 - Painting: Painting insulation jacket.
- .2 Section 22 10 00 - Plumbing Piping: Placement of hangers and hanger inserts.
- .3 Section 23 05 53 - Mechanical Identification. Section 23 21 00 - Hydronic Piping: Placement of hangers and hanger inserts.
- .5 Section 23 22 00 - Steam And Steam Condensate Piping: Placement of hangers and hanger inserts.
- .6 Section 23 23 00 - Refrigerant Piping And Specialties: Placement of inserts.

**1.3 REFERENCES**

- .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .3 ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .4 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- .5 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.
- .6 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .7 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .8 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .9 ASTM C547 - Mineral Fibre Pipe Insulation.
- .10 ASTM C552 - Cellular Glass Thermal Insulation.
- .11 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .12 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- .13 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.
- .14 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.
- .15 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .16 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- .17 ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
- .18 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.



- .19 ASTM E84 - Surface Burning Characteristics of Building Materials.
- .20 ASTM E96 - Water Vapour Transmission of Materials.
- .21 CAN/ULC-S102-M88 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .22 NFPA 255 - Surface Burning Characteristics of Building Materials.
- .23 UL 723 - Surface Burning Characteristics of Building Materials.

#### **1.4 QUALITY ASSURANCE**

- .1 Materials: Flame spread/smoke developed rating of 25/50 or less to ASTM E84: NFPA 255; UL 723.

#### **1.5 QUALIFICATIONS**

- .1 Applicator: Company specializing in performing the work of this section with minimum three years documented experience.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Store insulation in original wrapping and protect from weather and construction traffic.
- .4 Protect insulation against dirt, water, chemical, and mechanical damage.

#### **1.7 ENVIRONMENTAL REQUIREMENTS**

- .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .2 Maintain temperature during and after installation for minimum period of 24 hours.

### **Part 2 Products**

#### **2.1 GLASS FIBRE PRE-FORMED PIPE INSULATION WITH ALL-SERVICE JACKET**

- .1 Manufacturers:
  - .1 Johns Manville Micro-Lok.
  - .2 Knauf Earthwool 1000.
  - .3 Owens Corning FIBREGLAS.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Insulation: ASTM C547; rigid moulded, non-combustible.
  - .1 'ksi' ('K') value : ASTM C335, 0.035 at 24 degrees C (0.24 at 75 degrees F).
  - .2 Minimum Service Temperature: -28.9 degrees C (-20 degrees F).
  - .3 Maximum Service Temperature: 454 degrees C (850 degrees F).
  - .4 Maximum Moisture Absorption: 0.2 percent by volume.
- .3 Vapour Barrier Jacket
  - .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.

- .2 Moisture Vapour Transmission: ASTM E96; 0.03 ng/(Pa s sq m) (0.02 perm inches).
- .3 Secure with self sealing longitudinal laps and butt strips.
- .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Tie Wire: 1.3 mm (18 gauge) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.
- .5 Vapour Barrier Lap Adhesive
  - .1 Compatible with insulation.

**2.2 PRE-FORMED, CFC and HCFC FREE PHENOLIC PIPE INSULATION SUPPORT WITH ALL-SERVICE JACKET**

- .1 Manufacturers:
  - .1 Belform, K-Block
  - .2 Resolco, Insul-phen
  - .3 Substitutions: Refer to Section 21 05 00.
- .2 Insulation: ASTM C547; rigid moulded, non-combustible, CFC and HCFC phenolic insulation.
  - .1 'ksi' ('K') value : ASTM C518-10, 0.035 at 24 degrees C (0.24 at 75 degrees F).
  - .2 Minimum Service Temperature: -28.9 degrees C (-20 degrees F).
  - .3 Maximum Service Temperature: 121 degrees C (250 degrees F).
  - .4 Maximum Moisture Absorption: 0.61 percent by volume.
- .3 Vapour Barrier Jacket
  - .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
  - .2 Moisture Vapour Transmission: ASTM E96; 0.03 ng/(Pa s sq m) (0.02 perm inches).
  - .3 Secure with self sealing longitudinal laps and butt strips.
  - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Vapour Barrier Lap Adhesive
  - .1 Compatible with insulation.

**2.3 HYDROUS CALCIUM SILICATE**

- .1 Manufacturers:
  - .1 Industrial Insulation Group
  - .2 Johns Mansville Thermo-12 Gold.
  - .3 Substitutions: Refer to Section 21 05 00.
- .2 Insulation: ASTM C533; rigid moulded; asbestos free.
  - .1 'ksi' ('K') value: ASTM C177 and C518; 0.065 at 147 degrees C (0.45 at 300 degrees F).
  - .2 Maximum Service Temperature: 649 degrees C (1200 degrees F).
  - .3 Density: 232 kg/cu m (14.5 lb/cu ft).
- .3 Tie Wire: 1.3 mm (18 gauge) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.

- .4 Insulating Cement
  - .1 ASTM C449.

## 2.4 CELLULAR FOAM

- .1 Manufacturers:
  - .1 Armacell AP Armaflex.
  - .2 Substitutions: Refer to Section 21 05 00.
- .2 Insulation: ASTM C534; flexible, cellular elastomeric, moulded or sheet.
  - .1 'ksi' ('K') Value: ASTM C177 or C518; 0.04 at 24 degrees C (0.27 at 75 degrees F).
  - .2 Minimum Service Temperature: -40 degrees C (-40 degrees F).
  - .3 Maximum Service Temperature: 104 degrees C (220 degrees F).
  - .4 Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
  - .5 Moisture Vapour Transmission: ASTM E96; 0.20 perm inches.
  - .6 Maximum Flame Spread: ASTM E84; 25.
  - .7 Maximum Smoke Developed: ASTM E84; 50.
  - .8 Connection: Waterproof vapour barrier adhesive.
- .3 Elastomeric Foam Adhesive
  - .1 Manufacturers:
    - .1 Armstrong 520 adhesive.
  - .2 Air dried, contact adhesive, compatible with insulation.
  - .3 Outdoor insulation shall be covered with Armstrong Armaflex finish.

## 2.5 JACKETS

- .1 PVC Plastic
  - .1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material, off white colour.
    - .1 Minimum Service Temperature: -40 degrees C (-40 degrees F).
    - .2 Maximum Service Temperature: 66 degrees C (150 degrees F).
    - .3 Moisture Vapour Transmission: ASTM E96; 0.002 perm inches.
    - .4 Maximum Flame Spread: ASTM E84; 25.
    - .5 Maximum Smoke Developed: ASTM E84; 50.
    - .6 Connections: installed in accordance with manufacturer's recommendations using PVC adhesive to seal joints, and tape or butt strips where joined to adjacent pipe covering. Use staples and insulation coating as specified at circumferential joints.
  - .2 Covering Adhesive Mastic
    - .1 Compatible with insulation.
- .2 Canvas Jacket: UL listed
  - .1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.
  - .2 Lagging Adhesive
    - .1 Bakelite 120-18 white fire retardant lagging adhesive.

- .3 Coating
  - .1 Finish with two full brush coats of Bakelite 120-09 white fire retardant paint.
- .3 Aluminum Jacket: ASTM B209.
  - .1 Thickness: 0.40 mm (0.016 inch) sheet.
  - .2 Finish: Embossed.
  - .3 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.
  - .4 Fittings: 0.4 mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.
  - .5 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.38 mm (0.015 inch) thick aluminum.
- .4 Stainless Steel Jacket: Type 304 stainless steel.
  - .1 Thickness: 0.25 mm (0.010 inch).
  - .2 Finish: Smooth.
  - .3 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.25 mm (0.010 inch) thick stainless steel.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verify that piping has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

#### **3.2 INSTALLATION**

- .1 Install materials to manufacturer's written instructions.
- .2 On exposed piping, locate insulation and cover seams in least visible locations.
- .3 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
  - .1 Provide vapour barrier jackets, factory applied or field applied.
  - .2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.
  - .3 Finish with glass cloth and vapour barrier adhesive.
  - .4 PVC fitting covers may be used.
  - .5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  - .6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- .4 For insulated pipes conveying fluids above ambient temperature:
  - .1 Provide standard jackets, with or without vapour barrier, factory applied or field applied.
  - .2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
  - .3 Finish with glass cloth and adhesive.
  - .4 PVC fitting covers may be used, except on steam and condensate piping systems.

- .5 For hot piping conveying fluids 60 degrees C (140 degrees F) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- .6 For hot piping conveying fluids over 60 degrees C (140 degrees F), insulate flanges and unions at equipment.
- .5 Inserts and Shields:
  - .1 Application: Piping 40 mm (1-1/2 inches) diameter or larger.
  - .2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - .3 Insert Location: Between support shield and piping and under the finish jacket.
  - .4 Insert Configuration: Minimum 150 mm (6 inches) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - .5 Insert Material: hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- .6 Finish insulation at supports, protrusions, and interruptions.
- .7 At penetrations through fire rated walls, provide firestopping at walls and run insulation to firestopping. Seal insulation ends. Where voids exist between fire stop seals within the cavity, fill void with mineral wool or alternative non-combustible insulation.
- .8 Pipe supports:
  - .1 All piping shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier shall be continuous, including material covered by the hanger saddle.
  - .2 Piping systems 3" (75 mm) in diameter or less may be supported by placing saddles of the proper length and spacing under the insulation as designated by the insulation manufacturer.
  - .3 For hot piping systems larger than 3" (75 mm) in diameter, operating at temperatures less than +200F (93C) and insulated with fiber glass, high density inserts such as fiberglass or foam with sufficient compressive strength shall be used to support the weight of the piping system. At temperatures exceeding +200F (93C), high temperature pipe insulation shall be used for high density inserts.
  - .4 For piping conveying fluids below ambient temperature and larger than 3" (75 mm) in diameter provide CFC and HFCF free phenolic insulation supports with sufficient compressive strength shall be used to support the weight of the piping system and with appropriate thickness for the required insulation values.
  - .5 Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.
  - .6 On vertical runs, insulation support rings shall be used as required.
- .9 For pipe exposed in mechanical equipment rooms or in finished spaces below 3 metres (10 feet) above finished floor, finish with canvas jacket sized for finish painting.
- .10 For all pipe in exposed in occupied areas, finish with PVC jacket.
- .11 For exterior piping applications, provide vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- .12 Insulation on all diesel exhaust piping, silencers and breeching shall be covered with aluminum jacket. All adhesives shall be suitable for the service temperatures. Installation

- of the insulation and jacket shall allow for thermal expansion. Fittings shall be insulated with mitred sections of the same insulation.
- .13 On outdoor chilled water and refrigerant lines, the insulation system shall be completely vapor sealed before the weather-resistant jacket is applied. The outer jacket shall not compromise the vapor barrier by penetration of fasteners, etc. Vapor stops at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion. Piping 38mm (1-1/2 inches) and less shall have UV resistant PVC jacket. Pipes larger than 38mm (1-1/2 inches) shall have aluminium jacket.
- .14 For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- .15 For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- .16 Insulate all roof hoppers and storm drain pipe in ceiling spaces or walls of finished areas, and all vent piping and exposed horizontal and vertical storm drain pipe within 3000 mm (10'-0") developed length from roof opening or located in vented attics and soffits.
- .17 Where internal roof drains discharge to grade, insulate all piping within 3000 mm (10'-0") developed length from the exterior wall termination. If the pipe is exposed within the building, continue insulation for all exposed lengths of pipe.
- .18 Fittings and Valves
- .1 Shall be insulated with pre-formed fiberglass fittings, fabricated sections of fiberglass pipe insulation. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on Contract drawings.
- .2 Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with suitable weather or vapor resistant mastic as dictated by the system location and service. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.
- .3 On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems shall be sealed with caulking to allow free movement of the stem but provide a seal against moisture incursion. Valve handle extensions are recommended.
- .19 ACCESSORY MATERIALS
- .1 All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

### 3.3 TOLERANCE

- .1 Substituted insulation materials: Thermal resistance within 10 percent at normal conditions, as materials indicated.

**3.4 FIBROUS GLASS INSULATION SCHEDULE**

	<b>PIPING SYSTEMS</b>	<b>PIPE SIZE &lt;Inch&gt;&lt;mm&gt;</b>	<b>THICKNESS &lt;Inch&gt;&lt;mm&gt;</b>
<b>Plumbing Systems</b>			
	Domestic Hot Water Supply & Domestic Hot Water Recirc	=< 2" (50mm)	1" (25mm)
	Domestic Hot Water Supply & Domestic Hot Water Recirc	> 2" (50mm)	1 ½" (38mm)
	Tempered Domestic Water Supply	=< 2" (50mm)	1" (25mm)
	Tempered Domestic Water Supply	> 2" (50mm)	1 ½" (38mm)
	Domestic Cold Water, medical gas piping	=< 2" (50mm)	1" (25mm)
	Domestic Cold Water, medical gas piping	> 2" (50mm)	1 ½" (38mm)
	Roof Drain Bodies	all	2" (50mm)
	Roof Drain piping above floor within 10 Feet (3 Metres) of the Exterior. Entire length of pipe where not trapped.	all	2" (50mm)
	Plumbing Vents Within 10 Feet (3 Metres) of the Exterior	all	2" (50mm)
<b>Heating Systems</b>			
	Heating water & glycol supply and return	=< 2" (50mm)	1" (25mm)
	Heating water & glycol supply and return	> 2" (50mm)	1-1/2" (38mm)
	Boiler Feed Water	=< 2" (50mm)	1" (25mm)
<b>Cooling Systems</b>			
	Chilled water & glycol	all	1" (25mm)
	Condenser water	all	1" (25mm)
	Dual Temperature Water	all	Match heating water
	Glycol Cooling Supply and Return	all	1" (25mm)
	Cold Condensate Drains	all	1" (25mm)
	Condensate Drains from Cooling Coils	all	1" (25mm)
<b>Other Systems</b>			
	Piping Exposed to Freezing with heat tracing	all	3" (75mm)

**3.5 HYDROUS CALCIUM SILICATE PIPE INSULATION SCHEDULE**

	<b>PIPING SYSTEMS</b>	<b>PIPE SIZE &lt;Inch&gt;&lt;mm&gt;</b>	<b>THICKNESS &lt;Inch&gt;&lt;mm&gt;</b>
	Equipment Breeching	all	3" (75mm)

**END OF SECTION**



**Part 1            General**

**1.1            SECTION INCLUDES**

- .1 Pipe and pipe fittings for:
  - .1 Heating water piping system.
  - .2 Glycol water piping system.
  - .3 Chilled water piping system.
  - .4 Condenser water piping system.
  - .5 Equipment drains and overflows.
- .2 Valves:
  - .1 Gate valves.
  - .2 Globe or angle valves.
  - .3 Ball valves.
  - .4 Plug valves.
  - .5 Butterfly valves.
  - .6 Check valves.

**1.2            RELATED SECTIONS**

- .1 Section 08 31 13 - Access Doors And Frames.
- .2 Section 09 91 10 - Painting.
- .3 Section 23 05 16 – Piping Expansion Compensation.
- .4 Section 23 05 20 - Hydronic Specialties.
- .5 Section 23 05 29 – Supports and Anchors.
- .6 Section 23 05 48 - Vibration Isolation.
- .7 Section 23 05 53 - Mechanical Identification.
- .8 Section 23 07 19 - Piping Insulation.
- .9 Section 23 25 00 - Chemical Treatment For Piping.
- .10 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3            REFERENCES**

- .1 ASME -Welding and Brazing Qualifications.
- .2 ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
- .3 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .4 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .5 ASME B31.9 - Building Services Piping.
- .6 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .7 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .8 ASTM B32 - Solder Metal.

- .9 ASTM B88 - Seamless Copper Water Tube.
- .10 AWS A5.8 - Filler Metals for Brazing and Braze Welding.
- .11 AWS D1.1 - Structural Welding Code - Steel.
- .12 AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
- .13 AWWA C110 - Ductile - Iron and Grey -Iron Fittings 3 inch - 48 inch (76 mm - 1219 mm), for Water and Other Liquids.
- .14 AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Pressure Pipe and Fittings.
- .15 AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.

#### **1.4 SYSTEM DESCRIPTION**

- .1 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- .2 All valves must be installed with stems upright or horizontal; not inverted.
- .3 Valve body materials shall be compatible with piping system materials. Valves shall meet all pressure, temperature, and fluid handling requirements of the system.
- .4 A valve drain shall be provided at the base of each riser and at the low points of the system. Manual air vents shall be provided at the top of each riser and at the high points of the system.
- .5 Supply and install check valves on condensate pump discharges and also where indicated on the drawings.
- .6 All valves installed in concealed locations, i.e., ceiling spaces, shall be compactly arranged so that they are easily accessible through common access plates or doors.
- .7 On cooling coils supply and install drain valves with hose end connections at the top of the coil header of headers to allow the coils to be filled with glycol.
- .8 Use grooved mechanical couplings and fasteners only in accessible locations.
- .9 Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- .10 Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- .11 Provide pipe hangers and supports to ASTM B31.9 unless indicated otherwise.
- .12 Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- .13 Use globe or butterfly valves for throttling, bypass, or manual flow control services.
- .14 Use spring loaded check valves on discharge of pumps.
- .15 Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- .16 Use butterfly valves in in heating, chilled and condenser water systems interchangeably with gate and globe valves providing they meet the pressure, temperature, and fluid handling requirements of the system.
- .17 Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

- .18 Use lug end butterfly valves to isolate equipment.
- .19 Use 3/4 inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain. NOTE: Piping containing glycol or other antifreeze solutions to be piped back to the tank.
- .20 Pipes carrying fluids at temperatures greater than 100°C (212°F) or steam at pressures greater than 103 kPa (1 psig) shall not be routed through patient care areas or in ceiling spaces above patient care areas.
- .21 Each piece of equipment shall have isolation valves at the supply and return connections.

## **1.5 SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- .3 Welders Certificate: Include welders certification of compliance with ASME SEC 9 and applicable provincial labour regulations.
- .4 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

## **1.6 PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Record actual locations of valves.

## **1.7 OPERATION AND MAINTENANCE DATA**

- .1 Submit to Section 21 05 00.
- .2 Include valve schedule complete with valve tags, location, service, normally open/normally closed.
- .3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

## **1.8 QUALIFICATIONS**

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Carbon steel pipe and fittings manufactured in China or India will not be permitted.
- .3 All carbon steel pipe and fittings shall be manufactured in Canada or the United States of America. This does not include stainless steel.
- .4 Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.
- .5 Welders: Certify to ASME SEC 9 and applicable provincial labour regulations.

## **1.9 REGULATORY REQUIREMENTS**

- .1 All pressure piping systems for use in Manitoba shall be designed and constructed in accordance with the applicable ANSI/ASME Piping Codes and the Manitoba Labour and Immigration, Steam and Pressure Plants Act.
- .2 Conform to ASME B31.9 code for installation of piping system.

- .3 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.
- .4 Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- .3 Provide temporary protective coating on cast iron and steel valves.
- .4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

#### **1.11 ENVIRONMENTAL REQUIREMENTS**

- .1 Do not install underground piping when bedding is wet or frozen.

#### **1.12 EXTRA MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide two repacking kits for each size and valve type.

### **Part 2 Products**

#### **2.1 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND**

- .1 Steel Pipe: ASTM A53, Schedule 40, black.
  - .1 Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
  - .2 Joints: Threaded, or AWS D1.1, welded.
  - .3 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
- .2 Copper Tubing: ASTM B88, Type L hard drawn. Up to 50mm (2") diameter only.
  - .1 Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
  - .2 Joints: Up to 50mm (2") diameter: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C (430 to 535 degrees F).
- .3 Hose: Composite hose with nitrile liner, braided fibre reinforcing, neoprene cover, 1034 kPa (150 psig) operating pressure at 96 degrees C (205 degrees F).
  - .1 Fittings: Copper.
  - .2 Joints: Nipple with stainless steel clamp.

#### **2.2 CHILLED WATER PIPING, ABOVE GRADE**

- .1 Steel Pipe: ASTM A53, Schedule 40, black.
  - .1 Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.

- .2 Joints: Threaded, or AWS D1.1, welded.
- .3 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
- .2 Copper Tubing: ASTM B88, Type L hard drawn.
  - .1 Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
  - .2 Joints: Up to 50mm (2") diameter: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C (430 to 535 degrees F). Diameters 63mm (2-1/2") to 100mm (4"): Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 640 - 805 degrees C (1190 - 1480 degrees F).

### **2.3 CONDENSER WATER PIPING, ABOVE GROUND**

- .1 Steel Pipe: ASTM A53, Schedule 40, black.
  - .1 Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
  - .2 Joints: Threaded, or AWS D1.1, welded.
  - .3 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
- .2 Copper Tubing: ASTM B88, Type L hard drawn.
  - .1 Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
  - .2 Joints: Up to 50mm (2") diameter: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C (430 to 535 degrees F). Diameters 63mm (2-1/2") to 100mm (4"): Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 640 - 805 degrees C (1190 - 1480 degrees F).

### **2.4 EQUIPMENT DRAINS AND OVERFLOWS**

- .1 Steel Pipe: ASTM A53, Schedule 40 galvanized.
  - .1 Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.
  - .2 Joints: Threaded, or grooved mechanical couplings.
- .2 Copper Tubing: ASTM B88, Type L, annealed.
  - .1 Fittings: ASME B16.22, wrought copper.
  - .2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C (430 to 535 degrees F).

### **2.5 UNIONS, FLANGES, AND COUPLINGS**

- .1 Unions for Pipe 50 mm (2 inches) and Under:
  - .1 Ferrous Piping: 1034 kPa (150 psig) malleable iron, threaded.
  - .2 Copper Pipe: Bronze, soldered joints.
- .2 Flanges for Pipe Over 50 mm (2 inches):
  - .1 Ferrous Piping: 1034 kPa (150 psig) forged steel, slip-on.
  - .2 Copper Piping: Bronze.
  - .3 Gaskets: 1.6 mm (1/16 inch) thick preformed neoprene.

- .3 Grooved and Shouldered Pipe End Couplings:
  - .1 Housing Clamps: Malleable iron to engage and lock, designed to permit some angular deflection, contraction, and expansion.
  - .2 Sealing Gasket: C-shape elastomer composition for operating temperature range from -34 degrees C (-30 degrees F) to 110 degrees C (230 degrees F).
  - .3 Accessories: Steel bolts, nuts, and washers.
- .4 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.6 GATE VALVES

- .1 Up To and Including 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 Red-White/Toyo Rising Stem, Union Bonnet, Solid Wedge Disc  
Class 125: Threaded: 293 Soldered: Use Adaptors  
Class 150: Threaded: 298 Soldered: Use Adaptors  
Class 300: Threaded: 318 Soldered: Use Adaptors
    - .2 Kitz Rising Stem, Screwed Bonnet, Solid Wedge Disc  
Class 125: Threaded: 24 Soldered: 44  
Class 150: Threaded: 25 Soldered: 45  
Kitz Rising Stem, Union Bonnet, Solid Wedge Disc  
Class 150: Threaded: 42, 42T Soldered: 43  
Class 300: Threaded: 37 Soldered: Use Adaptors
    - .3 Red-White/Toyo Non-Rising Stem, Screwed Bonnet, Solid Wedge Disc  
Class 125: Threaded: 280 Soldered: 281  
Class 150: Threaded: 204 Soldered: Use Adaptors
    - .4 Kitz Non-Rising Stem, Screwed Bonnet, Solid Wedge Disc  
Class 125: Threaded: 40 Soldered: 41  
Class 150: Threaded: 46 Soldered: 64
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 Bronze body, bronze trim, bonnet, rising stem, handwheel, solid wedge disc, solder or threaded ends.
- .2 Over 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 Red-White/Toyo 421 Rising Stem, Flanged Ends
    - .2 Kitz 72 Rising Stem, Flanged Ends
    - .3 Red-White/Toyo 415 Non-Rising Stem, Flanged Ends
    - .4 Kitz 75 Non-Rising Stem, Flanged Ends
    - .5 Substitutions: Refer to Section 21 05 00.
  - .2 Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

## 2.7 GLOBE OR ANGLE VALVES

- .1 Up To and Including 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 Red-White/Toyo

- .2 Kitz
- .3 Crane
- .4 Substitutions: Refer to Section 21 05 00.
- .2 Bronze body, bronze trim, union bonnet, rising stem and handwheel, renewable composition disc and bronze seat, solder ends.
- .2 Over 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 Red-White/Toyo
    - .2 Kitz
    - .3 Crane
    - .4 Substitutions: Refer to Section 21 05 00.
  - .2 Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

## 2.8 BALL VALVES

- .1 Up To and Including 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 MAS
    - .2 Red-White/Toyo
    - .3 Kitz
    - .4 Crane
    - .5 Substitutions: Refer to Section 21 05 00.
  - .2 Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle solder ends.
- .2 Over 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 Kitz
    - .2 MAS
    - .3 American 4001
    - .4 American 4000
    - .5 Crane
    - .6 Substitutions: Refer to Section 21 05 00.
  - .2 Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, [or gear drive handwheel for sizes 250 mm (10 inches) and over,] flanged.

## 2.9 PLUG VALVES

- .1 Up To and Including 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 Nordstrom Valves, Inc. MSS SP-78, Type II.
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Cast-iron or bronze body, bronze tapered plug, full port opening, non-lubricated, teflon packing, threaded ends.
  - .3 Operator: One plug valve wrench for every ten plug valves minimum of one.
- .2 Over 50 mm (2 inches):

- .1 Manufacturers:
  - .1 Nordstrom Valves, Inc. MSS SP-78, Type II.
  - .2 Substitutions: Refer to Section 21 05 00.
- .2 Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends.
- .3 Operator: Each plug valve with a wrench with set screw.

## **2.10 BUTTERFLY VALVES**

- .1 Manufacturers:
  - .1 Demco
  - .2 Kitz
  - .3 Mueller
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
- .3 Disc: Stainless Steel.
- .4 Operator: 10 position lever handle. Valves 8" and larger shall have gear operator with position indicator.

## **2.11 SWING CHECK VALVES**

- .1 Up To and Including 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 Red-White/Toyo
    - .2 Kitz
    - .3 Substitutions: Refer to Section 21 05 00.
  - .2 Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.
- .2 Over 50 mm (2 inches):
  - .1 Manufacturers:
    - .1 Red-White/Toyo
    - .2 Kitz
    - .3 Substitutions: Refer to Section 21 05 00.
  - .2 Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

## **2.12 SPRING LOADED CHECK VALVES**

- .1 Manufacturers:
  - .1 Mueller 71 Series
  - .2 M.A. Stewart & Sons Moygro W12A-I6V (single plate)
  - .3 Watts ICV
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.



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**Part 3 Execution**

**3.1 PREPARATION**

- .1 Ream pipe and tube ends. Remove burrs.
- .2 Remove scale and dirt on inside and outside before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.
- .4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- .5 After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

**3.2 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install heating water, glycol, chilled water, and condenser water piping to ASME B31.9.
- .3 Route piping in orderly manner, parallel to building structure, and maintain gradient. Grade hydronic piping up in flow direction or as noted.
- .4 Install piping to conserve building space, and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Sleeve pipe passing through partitions, walls and floors.
- .7 Slope piping and arrange to drain at low points.
- .8 Provide piping on glycol systems from air vents to associated glycol fill tank.
- .9 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
- .10 Install drain valves (ball valves) c/w hose and cap and chain on each pump (pipe to nearest floor drain), at system low points so that entire system can be drained, and at each zone or branch / riser isolation valve so branch or riser can be drained down completely.
- .11 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
- .12 Overhead radiant panel branch connections:
  - .1 Copper soft temper tubing shall be used only for interconnecting panels in each individual room and for branch connections from valves to panels.
  - .2 Use 95-5 tin antimony solder at all joints. Fittings to be Emco smooth bore fittings.
- .13 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
- .14 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- .15 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- .16 Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 10.
- .17 Install valves with stems upright or horizontal, not inverted.

- .18 All hydronic equipment, manifolds, and headers shall be provided with isolation valves at all connections, complete with unions or flanges.
- .19 Isolation valves, complete with unions or flanges, shall be provided at junctions or branches of piped HVAC systems and shall be readily accessible.

### **3.3 Pressure Testing**

- .1 Do not insulate pipe prior to pressure testing. Pressure test in sections if necessary before concealing or insulating pipe.
- .2 Do not introduce water for testing where freezing conditions exist or where piping systems being tested are located above sensitive areas or equipment that may be damaged or contaminated by water leakage.
- .3 Hydraulically test all pipe. Pneumatic testing not permitted without prior approval from the Contract Administrator and the Authority Having Jurisdiction.
- .4 Hydronic pipe testing shall be in accordance with the applicable ASME piping code, the Contractor's registered Quality Assurance Program (for systems where applicable), and all requirements of the Department of Labour .
- .5 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment. Pipe dope, caulking, tape, lead wool, dresser couplings, etc. shall not be used to correct deficiencies. The Contractor shall be responsible for all cleanup related to leakage during flushing, testing, and chemical treatment of piping, including original building piping if included in the testing.
- .6 Test piping system in sections as required by the progress of work.
- .7 Subject piping to a hydrostatic pressure of at least that 1-½ times the operating pressure of the system for a period of at least 12 hours. If leaks are detected, such leaks shall be repaired and the test started over. Record results and submit witnessed (by Contract Administrator or The City's representative) reports to the Contract Administrator.
- .8 Register pressures at the highest system point.
- .9 Provide at least 48 hours (during working days) notice to Contract Administrator or The City's Representative prior to testing to allow the tests to be witnessed.

**END OF SECTION**

**Part 1**

**General**

**1.1**

**SECTION INCLUDES**

- .1 In-line circulators.
- .2 Vertical in-line pumps.
- .3 Close coupled pumps.
- .4 Base mounted pumps.
- .5 Dual drive pumping system.
- .6 Side-stream filters.

**1.2**

**RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-place Concrete.
- .2 Section 23 05 13 - Motors.
- .3 Section 23 05 48 - Vibration Isolation.
- .4 Section 23 07 19 - Piping Insulation.
- .5 Section 23 07 16 - Equipment Insulation.
- .6 Section 23 21 00 - Hydronic Piping.
- .7 Section 23 05 20 - Hydronic Specialties.
- .8 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3**

**REFERENCES**

- .1 UL 778 - Motor-Operated Water Pumps.

**1.4**

**PERFORMANCE REQUIREMENTS**

- .1 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

**1.5**

**SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- .3 Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
- .4 Millwright's Certificate: Certify that base mounted pumps have been aligned.

**1.6**

**PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Record actual locations of hydronic pumps.

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**1.7 OPERATION AND MAINTENANCE DATA**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

**1.8 QUALITY ASSURANCE**

- .1 Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three (3) years documented experience.
- .2 Alignment: Align base mounted pumps by qualified millwright.
- .3 Impeller trimming: Trimming of impeller by qualified millwright

**1.9 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.10 EXTRA MATERIALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Provide one set of mechanical seals for each pump.
- .3 Provide 2 sets of cartridges for each side-stream filter.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Bell & Gossett
- .2 Armstrong
- .3 Taco
- .4 Substitutions: Refer to Section 21 05 00.

**2.2 SYSTEM LUBRICATED CIRCULATORS**

- .1 Type: Horizontal shaft, single stage, direct connected with multiple speed wet rotor motor for in-line mounting, for 1035 kPa (150 psig) maximum working pressure, 107 degrees C (225 degrees F) maximum water temperature.
- .2 Casing: Cast iron with flanged pump connections.
- .3 Impeller: Noryl
- .4 Shaft : Ceramic.
- .5 Bearings: Metal Impregnated carbon (graphite) and ceramic.
- .6 Motor: Impedance protected, [single] [three] speed [, with external speed selector].
- .7 Performance:
  - .1 See Schedule
- .8 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

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**2.3 SYSTEM LUBRICATED CIRCULATORS (Cast Iron Heating and Cooling)**

- .1 Type: Horizontal shaft, single stage, direct connected with speed controlled wet rotor motor for in-line mounting, for 1207 kPa (175 psig) maximum working pressure, 110 degrees C (230 degrees F) maximum water temperature.
- .2 Casing: Cast iron with flanged pump connections.
- .3 Impeller: Stainless Steel
- .4 Shaft : Stainless Steel
- .5 Bearings: Metal Impregnated carbon sleeve
- .6 Motor:
  - .1 Synchronous, permanent-magnet (PM) motor and tested with the pump as one unit.
  - .2 Class F insulation
  - .3 Integrated motor protection shall be verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).
  - .4 On-board thermal overload protection.
- .7 Control
  - .1 MODBUS  
BACnet  
Analog inputs
- .8 Performance:
  - .1 See Schedule
- .9 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

**2.4 VERTICAL IN-LINE PUMPS**

- .1 Type: Vertical, single stage, close coupled, radially split casing, for in-line mounting, for 1200 kPa (175 psig) working pressure at 107 degrees C (225 degrees F).
- .2 Casing: Cast iron, with suction and discharge gauge port, seal flush connection, drain plug, flanged suction and discharge.
- .3 Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
- .4 Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
- .5 Seal: Carbon rotating against a stationary ceramic seat, EPT Tungsten/Carbide seal, 120 degrees C (250 degrees F) maximum continuous operating temperature.
- .6 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.
- .7 Each pump shall be factory tested and name-plated before shipment.
- .8 Pumps shall conform to ANSI/HI standard for Preferred Operating Region (POR) unless otherwise approved by the Contract Administrator. The pump NPSH shall conform to the ANSI/HI standards for Centrifugal and Vertical Pumps for NPSH Margin.

**2.5 IN-LINE PUMPS**

- .1 Close Coupled Pumps

- .1 Armstrong Design Envelope Sensorless 4380 Closed Coupled Type Vertical In-Line Centrifugal pumping unit. The pump shall be radially split, single stage centrifugal type with BF casing with equal size suction and discharge flanges and having separate tapped flush line and pressure gauge connections, Bronze (BS1400 Grade LG1) dynamically balanced impeller, 316SS shaft sleeve, inside type mechanical seal, with carbon rotating face, Sintered Silicon Carbide stationary seat, and EPDM secondary seal. The pump is to be fitted with a factory installed flush line.
- .2 Supply in the flush line to the mechanical seal, a 50 micron cartridge filter alternatively, a cyclone separator when pump differential pressure exceeds 30 PSIG) and floating ball type sight flow indicator suitable for the working pressure encountered. The Mechanical Subcontractor shall change the filters after the system has been flushed and on a regular basis until the pumps are turned over to The City. The driving motor shall be an industry standard, vertical solid shaft, squirrel cage induction type with TEFC enclosure.
- .3 Type: Horizontal shaft, single stage, close coupled, radially split casing, for vertical or horizontal installation, operations at 107 degrees C (225 degrees F) and 1205 kPa (175 psig) working pressure. Working pressures shall not be de-rated at temperatures up to 120 degrees C (250 degrees F).
- .4 Casing: Cast iron, with suction and discharge gauge ports, seal flush connection, drain plug, flanged suction and discharge.
- .5 Impeller: Bronze, fully enclosed, keyed to motor shaft extension.
- .6 Furnished and installed with capacities as shown on plans. Pumps shall be in-line type, close-coupled single stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections.
- .7 The pump internals shall be capable of being services without disturbing piping connections.
- .8 Pump shall be of a maintainable design and for ease of maintenance should use machine fit parts and not press fit components.
- .9 Pump should be designed to allow for true back pull-out access to the pump's working components for ease of maintenance.
- .10 The pumps shall have a solid alloy stainless steel shaft that is integral to the motor. A non-ferrous shaft sleeve shall be employed to completely cover the wetted area under the seal.
- .11 Pump shaft shall connect to a brass impeller. Impeller shall be hydraulically and dynamically balanced, keyed to the shaft and secured by a stainless steel locking capscrew or nut.
- .12 The motor bearings shall support the shaft via heavy-duty grease lubricated ball bearings.
- .13 Seal: Pump shall be equipped with an internally flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Application of an internally flushed mechanical seal shall be adequate for seal flushing without requiring external flushing lines. Seal assembly shall have a brass housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face. .
- .14 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.
- .15 Pump volute: cast iron design, rated for 1205 kPa (175 psig) with integral cast iron flanges drilled for 125# ANSI companion flanges and shall include gauge ports at nozzles, and vent and drain ports.

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- .16 Motor: Complete with integral VFD:
- .1 The driving motor shall be an industry standard, vertical solid shaft, squirrel cage induction type with TEFC enclosure. The variable frequency drive & controls shall be rated UL Type 12 or UL Type 4X and be an integral component of the pumping unit with a TEFC, 575/3/60, motor efficiency NEMA Prem (12.12).
  - .2 The integrated VFD shall be of the VVC-PWM type providing near unity displacement power factor ( $\cos \phi$ ) without the need for external power factor correction capacitors at all loads and speeds. The VFD shall incorporate DC link chokes for the reduction of mains borne harmonic currents and to reduce the DC link ripple current thereby increasing the DC link capacitors lifetime. RFI filters will be fitted as standard to ensure the VFD meets low emission and immunity requirements.
  - .3 VFD and motor protection shall include: motor phase to phase fault, motor phase to ground fault, loss of supply phase, over-voltage, under-voltage, motor over-temperature, inverter overload, over-current.
  - .4 Where selected, VFD shall have Sensorless control software to provide automatic speed control in variable volume systems without the need for pump mounted (internal/external) or remotely mounted differential pressure sensor. The default operating mode under Sensorless control shall be Quadratic Pressure Control (QPC) whereby head reduction with reducing flow will be according to a quadratic control curve, the head at minimum flow being 40% of the design duty head. Control mode setting and minimum/maximum head setpoints shall be user adjustable via a built-in programming interface.
  - .5 If the quantity of pumps in a system is 2 to 4-maximum, including any standby, a Sensorless controller shall be added to a pumping unit and set up at the factory to operate in parallel Sensorless mode. The pump controls, which will be linked on site by the Controls Subcontractor, will automatically stage the units, as appropriate, to maintain the best efficiency pumping and minimum operating cost. The standby unit will be brought into the rotation to exercise and equalize wear. The sequence of controls and staging points will be submitted to the Contract Administrator for approval at the time of order.
  - .6 The VFD shall have the following additional features:
    - .1 Sensorless override for BAS/BMS control signal
    - .2 Manual pump control or closed loop PID control
    - .3 Programmable skip frequencies and adjustable switching frequency for noise and vibration control
    - .4 Auto alarm reset
    - .5 Four programmable digital inputs, two analog inputs, one programmable analog / digital output
    - .6 One volt-free contact
    - .7 One RS485 port for serial communications to building management systems
    - .8 Standard serial communication protocols BACnet MS/TP
  - .7 Environmental Ratings
    - .1 Temperature: 14°F to 113°F up to 3300 ft (-10°C to 45°C up to 1000 m)
    - .2 Max Relative Humidity: 0 to 95%
- .2 Split Coupled Pumps

- .1 Supply and install as shown on plans and specifications, Armstrong Series 4300 Design Envelope IVS pumps. The pumps shall be single stage, single or double suction type, vertical inline design with integrated controls. The seal shall be serviceable without disturbing the motor or the piping connections. The capacities and characteristics shall be as outlined in the plans and specifications. The complete pump unit shall be labeled with ETL listing certification that the product conforms to UL Std 778 and is certified to CSA Std C22.2 No.108.
- .2 Pump casing shall be constructed of ASTM A48 class 30 cast iron with ANSI 125 / PN16 flanges for working pressure below 175 psig (12 bar) at 150°F (66°C) and ASTM A536 ductile iron with ANSI 250 / PN25 flanges for working pressures to 375 psig (25 bar) at 150°F (66°C). The casing shall be hydrostatically tested to 150% maximum working pressure. The casing shall be radially split to allow removal of the rotating element without disturbing the pipe connections. The pump casing shall be drilled and tapped for gauge ports on both the suction and discharge connections and for a drain port at the bottom of the casing. The casing shall have an additional tapping on the discharge connection to allow for the installation of a seal flush line.
- .3 The pump shall have a factory installed vent/flush line to insure removal of trapped air from the casing and mechanical seal cooling. The vent/flush line shall run from the seal chamber to the pump discharge.
- .4 The impeller shall be bronze, fully enclosed type. The impeller shall be dynamically balanced to ANSI Grade G6.3 and shall be fitted to the shaft with a key. Two-plane balancing is required where installed impeller diameter is less than 6 times the impeller width.
- .5 The pump shaft shall be stainless steel.
- .6 The coupling is to be rigid spacer type constructed of high tensile aluminum alloy. The coupling is to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor.
- .7 The pump shall be fitted with an outside balanced type mechanical seal, with Viton elastomers and antimony carbon (or resin-bonded carbon for potable water applications) vs. silicon carbide faces rated up to 250°F (121°C) A 316 stainless steel gland plate shall be provided with a factory installed flush line with manual vent.
- .8 All split coupled pumps shall be provided with a lower seal chamber throttle bushing to ensure seals maintain positively cooling and lubrication.
- .9 If required to improve seal chamber cleanliness, supply in the flush line to the mechanical seal a 50 micron cartridge filter and sight flow indicator, to suit the working pressure encountered.
- .10 Alternately, supply in the flush line to the mechanical seal a maintenance-free sediment separator, with sight flow indicator for pump differential pressures exceeding 30 psig (or 200 kPa).
- .11 The motor frame shall be NEMA TC type. Motor enclosure is to be ODP or TEFC with NEMA Premium Efficiency 12.12 rating. Acceptable motor insulation for variable speed operation is NEMA MG-1 Part 31.
- .12 The variable frequency drive & controls shall be rated UL Type 12 or UL Type 4X and be an integral component of the pumping unit with a 15 hp, TEFC, 575/3/60.
- .13 The integrated VFD shall be of the VVC-PWM type providing near unity displacement power factor (cos Ø) without the need for external power factor correction capacitors at all loads and speeds. The VFD shall incorporate DC link chokes for the reduction of mains borne harmonic currents and to reduce the DC link ripple current thereby increasing the DC link capacitors lifetime. RFI filters



- will be fitted as standard to ensure the VFD meets low emission and immunity requirements.
- .14 VFD and motor protection shall include: motor phase to phase fault, motor phase to ground fault, loss of supply phase, over-voltage, under-voltage, motor over-temperature, inverter overload, over-current.
  - .15 Where selected, VFD shall have Sensorless control software to provide automatic speed control in variable volume systems without the need for pump mounted (internal/external) or remotely mounted differential pressure sensor. The default operating mode under Sensorless control shall be Quadratic Pressure Control (QPC) whereby head reduction with reducing flow will be according to a quadratic control curve, the head at minimum flow being 40% of the design duty head. Control mode setting and minimum/maximum head setpoints shall be user adjustable via a built-in programming interface.
  - .16 If the quantity of pumps in a system is 2 to 4-maximum, including any standby, a Sensorless controller shall be added to a pumping unit and set up at the factory to operate in parallel Sensorless mode. The pump controls which will be linked on site by the Controls Subcontractor, will automatically stage the units, as appropriate, to maintain the best efficiency pumping and minimum operating cost. The standby unit will be brought into the rotation to exercise and equalize wear. The sequence of controls and staging points will be submitted to the Contract Administrator for approval at the time of order.
  - .17 The VFD shall have the following additional features:
    - .1 Sensorless override for BAS/BMS control signal
    - .2 Manual pump control or closed loop PID control
    - .3 Programmable skip frequencies and adjustable switching frequency for noise and vibration control
    - .4 Auto alarm reset
    - .5 Four programmable digital inputs, two analog inputs, one programmable analog / digital output
    - .6 One volt-free contact
    - .7 One RS485 port for serial communications to building management systems
    - .8 Standard serial communication protocol BACnet Native (default)
  - .18 Environmental Ratings
    - .1 Temperature: 14°F to 113°F up to 3300 ft (-10°C to 45°C up to 1000 m)
    - .2 Max Relative Humidity: 0 to 95%
- .3 Parallel Sensorless Pump Controller (where required by manufacturer)
- .1 Mechanical and Electrical Details
    - .1 For Sensorless pumping units, operating in parallel, the pump logic controller shall be Armstrong Parallel Sensorless Pump Controller (PSPC). The PSPC pump logic controller shall be specifically designed for the control of multiple pumps in HVAC hot and/or chilled water systems that involve up to 4-variable speed pumps, with Sensorless Control, in parallel, staged, sequenced, and standby configurations.
    - .2 The PSPC pump logic controller shall allow field adjustments of control parameters as described below.
      - .1 The PSPC controller shall be capable of accepting, processing and displaying appropriate signals from the individual pump controls for the following values;

- 
- .1 System Status
  - .2 Total Sensorless flow
  - .3 Sensorless head
  - .4 Total power
  - .5 Pumps speed
  - .6 Alarm
  - .7 Wire to water efficiency (calculated)
  - .8 Number of pumps running
  - .9 Lead pump number
  - .2 Individual Pump Status
    - .1 Speed Ref (%)
    - .2 Speed (%) (rpm)
    - .3 Run time (hrs)
    - .4 Fault Nbr
    - .5 Run status (running/stopped)
  - .3 Individual Pump IVS-102 control status
    - .1 Current (Amps)
    - .2 Volts (VAC)
    - .3 Power (kW)
    - .4 Head
    - .5 Flow
  - .3 The PSPC pump logic controller shall be suitable for indoor or outdoor applications and shall be capable of being integrated with pumping units for pumping packages approved to UL 778 & CSA STD C22.2 No 108 standards and also suitable for wall mounting with separate Armstrong IVS pumping units and stand-alone IVS102 pump controls.
  - .4 The PSPC controller shall have 3-levels of password security, first level to view only (No password required); the second level is for field adjustable parameters and the third level for factory/commissioning setup parameters.
  - .5 The PSPC controller shall stage the pumping units to ensure optimum pumping energy usage and shall sequence the pumps starting order, including any standby unit.
  - .6 The PSPC controller shall be fed with a power supply from each pumping unit controls in the control 'daisy-chain' so that a loss of power to any pump unit controls will not affect the PSPC controller pumping operation. Should the PSPC controller go off-line, all pumps in auto-mode will operate together to provide the correct system flow needs. Staging of the units will resume as the PSPC controller is brought back online.
  - .7 The PSPC integrated controller shall be capable of being easily integrated on any other pumping unit should the need occur. Simple mounting in pre-designed location and wiring will be all that is required.
  - .2 Performance and Operating Logic
    - .1 The PSPC pump logic controller shall determine the most efficient combination of operating pumps, and pump operating speed based from the individual pump controls input.

- .2 The PSPC pump logic controller shall respond to the system load flow needs by adjusting either the number of operating pumps, or the speed of the operating pumps.
  - .3 The PSPC pump logic controller shall continuously monitor the system requirements and ensure that the operating point is maintained on the PSPC control curve to meet the system needs with optimized pumping energy usage.
  - .4 The PSPC pump logic controller shall sequence the pumps based on a field adjustable interval of operating hours. The controls shall incorporate embedded logic to prevent hunting, pump flow surge, and motor overloading. The controller logic shall incorporate an adjustable PID control loop.
  - .5 Should any pumping unit or pumping unit controller fail, the appropriate alarm signal shall be activated. In the place of the failed assembly, a standby pumping unit shall be operated in variable speed mode, or the next pump will start if there is no standby.
  - .6 The PSPC controller shall have hand-off-automatic (H-O-A) control and should provide the option for a remote on/off signal by a BMS communication signal.
  - .7 The PSPC pump logic controller shall be self-prompting. All messages shall be displayed in plain English. The operator interface shall have multi-fault memory and recall on-screen help functions, and separate user screens for overview, pump and setup.
  - .8 The PSPC pump logic controller shall automatically disable any flow signals that are not within limits and alert the operator of a possible control failure.
  - .9 The PSPC pump logic controller shall have the system design flow, system design head and minimum head limit entered as field adjustable parameters, factory loaded. The default for the minimum head is 40% of the design head.
- .3 Operator Screens
- .1 Source of control: local or remote.
  - .2 PSPC status: on/off.
  - .3 Pump information: running/off/alarm, HOA status, pump ID 1, pump ID 2, stand-by, etc.
  - .4 Individual pump controls information: speed, amps, power, volts AC, flow and head
  - .5 Set point and error of flow and head
  - .6 Individual cumulative pump hours of operation
  - .7 System set-point and error
- .4 Alarm Screens
- .1 Alarms with time stamp
  - .2 Alarm help
  - .3 Diagnostic indicating status (ok or bad) of PLC, memory,
  - .4 network and communication, PLC Software version
- .5 Setup Screens
- .1 Level 0. No password, allows view only access
  - .2 Level 1. Allows modification of all parameters, except pump PID and BMS setup. Allows Restoring previously saved values

- .3 Level 2. Allows modification of all parameters. Allows saving and restoring all parameters
- .4 Levels 1 & 2 are password protected
- .6 BMS communication
  - .1 The PSPC shall be capable of serial communication with a BMS with the following protocol:
    - .1 BACnet MS/TP
  - .2 The following points will be available through the communication protocol:
    - .1 Total Sensorless flow
    - .2 Sensorless head
    - .3 Total real-time power consumption
    - .4 Pump speed
    - .5 Individual pump run status
    - .6 Alarm
    - .7 Wire to water system efficiency
    - .8 Number of pumps operating
    - .9 Lead pump ID
    - .10 Remote start/stop
    - .11 PSPC on/off status
    - .12 Pump controls information: running/off/alarm, HOA, duty 1, duty 2, stand-by, etc.
    - .13 Pump controls information: speed, current, power, Volts AC, flow and head
    - .14 Pump hours of operation
    - .15 Head and flow Set point

## 2.6 SIDE-STREAM FILTRATION SYSTEM

- .1 Manufacturers:
  - .1 General Filtration
  - .2 3M (Cuno).
  - .3 Sumco.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 System: Flow indicator, filter housing with cartridge filter, shut-off valves, and flow control valve.
- .3 Performance: Design flow 0.25 L/s (4 gal/min) with maximum pressure drop of 25.6 kPa (4 psig), based on water.
- .4 Hot Water and Glycol Filter Housing: Stainless steel housing suitable for 105 degrees C (220 degrees F) and 1380 kPa (200 psig) operating conditions.
- .5 Chilled Water Filter Housing: Stainless steel housing suitable for 52 degrees C (125 degrees F) and 860 kPa (125 psig) operating conditions.
- .6 Cartridges: Stringwound cartridge filters, 0.03 mm (30 micron) for start-up and 0.005 mm (5 micron) for system operation.

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**Part 3 Execution**

**3.1 PREPARATION**

- .1 Verify that electric power is available and of the correct characteristics.

**3.2 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Provide the necessary access space around components to allow for servicing, repair, replacement as well as for the balancing technician to take proper readings. Provide no less than minimum as recommended by manufacturer
- .3 Pumps shall be sized on the capacities, heads, motor sizes and RPM specified, impeller size selected shall not be greater than 85% of the maximum size impeller.
- .4 Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 102 mm (4 inches) and over.
- .5 Provide line sized shut-off valve, pump suction fitting and strainer on pump suction, and line sized soft seat check valve and balancing valve or combination pump discharge valve on pump discharge.
- .6 Provide a minimum of 5x suction diameter of pipe on pump suction of pipe size shown on drawings where suction diffusers are not used.
- .7 Provide air cock and drain connection on horizontal pump casings.
- .8 Provide drains for bases and seals, piped to and discharging into floor drains or, in the case of glycol, to a suitable container.
- .9 Provide drain lines with ball valves from strainers and filters to nearest floor drain or, in the case of glycol, to a suitable container.
- .10 Manufacturer approved millwright or agent to check, align, and certify alignment of base mounted pumps prior to start-up.
- .11 Install base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place or as per manufacturer's instructions. Refer to Section 03 30 00.
- .12 Lubricate pumps before start-up.
- .13 Provide side-stream filtration system for systems as shown on schematic diagrams Install across pump with flow from pump discharge to pump suction from pump tapplings.
- .14 Provide flow measurement ports as shown on drawings, on piping schematics, and in locations as directed by the water balancing specialist.
- .15 Provide any pump impeller modifications as recommended by Division 23 05 93 – Testing Adjusting and Balancing.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Cleaning of pipe and fittings.
- .2    Chemical feed equipment.
- .3    Chemical treatment.

**1.2                RELATED SECTIONS**

- .1    Section 25 30 00 - Instruments And Control Elements.
- .2    Section 23 21 00 - Hydronic Piping: Placement of water coupon rack, by-pass (pot) feeder.
- .3    Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3                SUBMITTALS**

- .1    Section 21 05 00: Procedures for submittals.
- .2    Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- .3    Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- .4    Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
- .5    Manufacturer's Field Reports: Submit to Section 01 44 00.
- .6    Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- .7    Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

**1.4                PROJECT RECORD DOCUMENTS**

- .1    Section 21 05 00: Submittals for project closeout.
- .2    Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

**1.5                OPERATION AND MAINTENANCE DATA**

- .1    Section 21 05 00: Submittals for project closeout.
- .2    Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

**1.6                QUALIFICATIONS**

- .1    Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. Company to have local representatives with water analysis laboratories and full time service personnel.

- .2 Installer: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

### **1.7 REGULATORY REQUIREMENTS**

- .1 Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.
- .2 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

### **1.8 MAINTENANCE SERVICE**

- .1 Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.
- .2 Provide regular technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
- .3 Provide laboratory and technical assistance services during this maintenance period.
- .4 Include a training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.
- .5 Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

### **1.9 MAINTENANCE MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide sufficient chemicals for treatment and testing during warranty period.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 GE Water and Process Technologies.
- .2 Substitutions: Refer to Section 21 05 00.

### **2.2 MATERIALS**

- .1 Closed Hot Water, Chilled Water and Glycol Systems Cleaner:
  - .1 Ferroquest FQ7103 (neutral pH cleaner to remove oil, grease, rust and mill scale)
- .2 Closed System Treatment (Hot or Chilled Water):
  - .1 Corrshield MD4102 (molybdate based scale and corrosion inhibitor)
- .1 Existing Systems:
  - .1 Clean and flush... Depending on age and condition of system confirm scope of work with water treatment specialist.

### **2.3 BY-PASS (POT) FEEDER**

- .1 Manufacturers:

- .1 Neptune
- .2 Axiom
- .2 Closed Hot Water, Chilled Water and Glycol Systems:
  - .1 2 gallon chemical pot feeder

## **2.4 SIDE STREAM FILTER SYSTEM**

- .1 Closed Hot Water, Chilled Water and Glycol Systems: Pal LMO-10  $\frac{3}{4}$ " filter housing, STS  $\frac{3}{4}$ " Filtermate flow indicator, provide (40) 10 micron filter cartridges
- .2 Manufacturers:
  - .1 Pal
  - .2 Axiom
  - .3 General Filtration
  - .4 3M (Cuno).
  - .5 Sumco.
  - .6 Substitutions: Refer to Section 21 05 00.
- .3 System: Flow indicator, filter housing with cartridge filter, shut off valves, and flow control valve.
- .4 Performance: Design flow 0.25 L/s (4 gal/min) with maximum pressure drop of 25.6 kPa (4 psig), based on water.
- .5 Hot Water and Glycol Filter Housing: Stainless steel housing suitable for 105 degrees C (220 degrees F) and 1380 kPa (200 psig) operating conditions.
- .6 Chilled Water Filter Housing: Stainless steel housing suitable for 52 degrees C (125 degrees F) and 860 kPa (125 psig) operating conditions.
- .7 Cartridges: Stringwound cartridge filters, 0.03 mm (30 micron) for start up and 0.010 mm (10 Micron) for system operation.
  - .1 Provide 20 cartridges to the project.

## **2.5 WATER SOFTENERS**

- .1 Refer to 22 47 00.

## **2.6 TEST EQUIPMENT**

- .1 Closed System (Hot or Chilled Water ): Provide complete test kit including L6213 molybdate test kit, pH meter and conductivity tester.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Systems to be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- .2 Place terminal control valves in open position during cleaning.
- .3 Section 23 25 00 shall provide
- .4 Verify that electric power is available and of the correct characteristics.



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**3.2 CLEANING SEQUENCE**

- .1 Concentration:
  - .1 As recommended by manufacturer.
- .2 Hot Water, Chilled Water, Glycol Systems
  - .1 Isolate Existing hydronic systems.
  - .2 All systems must be chemically cleaned and flushed before water treatment is added. This includes partial or complete filling for pressure testing.
  - .3 After all components of the piping system have been pressure tested and proven to be in full operational condition and leak free, flush entire system with fresh clean make-up water to remove loose mill scale, sediment and construction debris.
  - .4 Provide drain connections to drain system in one hour. Install totalizing water meter to record capacity in each system
  - .5 All drains for chemical treatment shall be piped to the nearest floor drain.
  - .6 After initial flushing has been completed, clean all strainer screens.
  - .7 Add cleaner to closed systems at concentration levels recommended by the water treatment specialist.
  - .8 After cleaning, drain system as rapidly as possible. Flush system by opening drain valves and opening bypass valve on water make-up to system. Continue flushing until tests show pH, iron, TDS and chloride levels of water leaving system are the same as entering the system. Refill and immediately add water treatment to proper level.

**3.3 INSTALLATION**

- .1 Install to manufacturer's written instructions.

**3.4 CLOSED SYSTEM TREATMENT**

- .1 Provide one bypass feeder and one side stream filter on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- .2 Introduce closed system treatment through bypass feeder when required or indicated by test.
- .3 Change side stream filter cartridges as required or indicated by the flow indicator.

**3.5 QUALITY ASSURANCE**

- .1 Provide physical or photographic evidence that construction screens have been used during the cleaning and flushing process.
- .2 Provide water test results showing acceptable test results performed by qualified personnel as noted in Qualifications section. Provide to Contract Administrator for pipe cleaning, flushing and inhibitor tests. Provide glycol test report.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Metal duct work.
- .2 Casing and plenums.
- .3 Duct cleaning.

**1.2 RELATED SECTIONS**

- .1 Section 01 10 00 - Summary of Work..
- .2 Section 03 30 00 - Cast-in-place Concrete.
- .3 Section 09 91 10 - Painting: Weld priming, weather resistant, paint or coating.
- .4 Section 23 05 29 - Supports And Anchors: Sleeves.
- .5 Section 23 05 93 - Testing, Adjusting, And Balancing.
- .6 Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- .7 Section 23 33 00 - Duct Work Accessories.
- .8 Section 23 36 00 - Air Terminal Units.
- .9 Section 23 37 00 - Air Outlets And Inlets.

**1.3 REFERENCES**

- .1 ASTM A36/A36M - Carbon Structural Steel.
- .2 ASTM A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- .3 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .4 ASTM A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .5 ASTM A568/A568M - General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- .6 ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .7 ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.
- .8 ASTM A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.
- .9 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .10 AWS D9.1 - Sheet Metal Welding Code.
- .11 NBS PS 15 - Voluntary Product Standard for Custom Contact-Moulded Reinforced-Polyester Chemical Resistant Process Equipment.
- .12 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- .13 NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.

- .14 SMACNA - HVAC Air Duct Leakage Test Manual.
- .15 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .16 UL 181 - Factory-Made Air Ducts and Connectors.

#### **1.4 PERFORMANCE REQUIREMENTS**

- .1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

#### **1.5 SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide data for [duct materials] [duct liner] [duct connectors] [\_\_\_\_\_].
- .3 Samples: Submit [two] [\_\_\_\_\_] samples of typical shop fabricated [duct fittings.] [\_\_\_\_\_].
- .4 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

#### **1.6 PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

#### **1.7 QUALITY ASSURANCE**

- .1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .2 Maintain one copy of document on site.

#### **1.8 QUALIFICATIONS**

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.
- .2 Installer: Company specializing in performing the work of this section with minimum three years documented experience.

#### **1.9 REGULATORY REQUIREMENTS**

- .1 Construct commercial kitchen exhaust duct work to NFPA 96 standards.

#### **1.10 ENVIRONMENTAL REQUIREMENTS**

- .1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- .2 Maintain temperatures during and after installation of duct sealants.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating of to ASTM A90.

- .2 Steel Ducts: ASTM A1008, A568.
- .3 Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.
- .4 Insulated Flexible Ducts:
  - .1 Manufacturers:
    - .1 Thermaflex G-KM
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Thermally insulated flexible duct with acoustically rated black CPE core permanently bonded to a coated spring steel wire helix, with fibreglass insulation over fibreglass scrim and polyethylene vapour barrier. Pressure rating of 6" W.G. (positive) for 4" – 20" I.D. Temperature range -20 °F to 200 °F continuous, R-value R-4.2.
  - .3 The ductwork shall meet NFPA Pamphlet 90A paragraph 113 (a) for flame spread and smoke rating and to meet Underwriter's Laboratories of Canada requirements.
  - .4 Flexible air ducts shall conform to UL-181 Standard and NFPA 90A. Flexible air ducts shall have a fire rating of at least one-half hour as measured by UL-181 Standard, paragraph No. 7, Flame Penetration Test.
- .5 Stainless Steel Ducts: ASTM A167, Type 304.
- .6 Stainless Steel Ducts: ASTM A167, Type 316.
- .7 Fasteners: Rivets, bolts, or sheet metal screws.
- .8 Sealant:
  - .1 Manufacturers:
    - .1 Duro-Dyne
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- .9 Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

## 2.2 DUCT WORK FABRICATION

- .1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Unless otherwise indicated fabrication shall conform to standards for duct pressure class rating of +2" w.g. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- .2 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air-foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.
- .3 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- .4 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 100 mm (4 inch) cemented slip joint, brazed or electric welded. Prime coat welded joints.

- .5 Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- .6 All rectangular ducts shall be constructed by breaking the corners and grooving the longitudinal seams using Pittsburgh seam or other approved airtight seam.
- .7 All elbows and transformation pieces shall be constructed using Pittsburgh corner seams or double seam corners. All transverse joints shall be constructed using S-slips, Bar Slips, Drive Slips, etc. where recommended in ASHRAE guide. All slips shall be not less than one gauge heavier than duct material. Open corners will not be accepted.

### **2.3 MANUFACTURED DUCT WORK AND FITTINGS**

- .1 Manufacture to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- .2 Flat Oval Ducts:
  - .1 Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gauges heavier metal than duct.
- .3 Double Wall Insulated Flat Oval Ducts:
  - .1 Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 25 mm(1 inch) thick fibreglass insulation, perforated galvanized steel inner wall; fittings manufactured with solid inner wall.
- .4 PVC Coated Steel Ducts:
  - .1 UL 181, Class 1, galvanized steel duct coated with polyvinyl chloride plastic, 0.1 mm (4 mil) thick on both sides.
- .5 Slab Duct Ventilation System:
  - .1 ASTM A653 galvanized steel, corrugated, in standard sizes with support brackets, connecting couplings, elbows, end caps, spin-in-collar, wall discharge head, and soffit discharge head; designed for installation in cast-in-place concrete floor assemblies.
- .6 Double Wall Insulated Round Ducts:
  - .1 Round spiral lockseam duct with galvanized steel outer wall, 25 mm (1 inch) thick fibreglass insulation, perforated galvanized steel inner wall; fitting with solid inner wall.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .3 Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- .4 No variation of duct sizes will be permitted except by written permission of the Contract Administrator. In the event that additional offsets and changes in direction are required in

- the duct system, these changes shall be made by the Sheet Metal Trade without additional cost to The City. All ductwork shall be to the recommended practices as laid down by the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- .5 Where the width of the duct exceeds 450 mm (18") in its largest dimension such ductwork shall be suitably stiffened by breaking the sheets diagonally.
  - .6 If ductwork is insulated, cross breaking may be omitted providing the ducts are 2 gauges heavier than shown on the above schedule.
  - .7 All laps shall be in the direction of air flow. Rivets and bolts shall be used throughout. All edges and slips shall be hammered down to leave a smooth interior duct.
  - .8 Where low pressure ductwork conflicts with mechanical and electrical piping and it is not possible to divert the ductwork or piping to stay within allowable space limitation, provide duct easements.
  - .9 Easements are not required on pipes 100 mm (4") and smaller outside dimension, unless this exceeds 20% of the duct area. Any irregular or flat shaped intrusions require a duct easement. Hangers and straps in the ductwork shall be parallel to air flow. If this is not possible, provide an easement. If the easement exceeds 25% of the duct area, the duct shall be split into two ducts with the original duct area being maintained. All easements shall be approved by the Contract Administrator before installation.
  - .10 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated duct work, install insulation material inside a metal ring.
  - .11 Locate pitot tube test openings in ductwork at supply fan discharges, on intake of exhaust/and return air fans, in major duct branches and everywhere pitot tube openings are required for proper balancing of air conditioning, ventilation and exhaust systems. Do not place closer than 1829mm (72 inches) to elbows. Space every 150mm (6 inches) across air stream at each location. Refer to drawings for additional opening requirements.
  - .12 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
  - .13 Use crimp joints with or without bead for joining round duct sizes 200 mm (8 inch) and smaller with crimp in direction of air flow.
  - .14 Use only threaded rod for duct support in exposed areas. Strapping not allowed.
  - .15 Use double nuts and lock washers on threaded rod supports.
  - .16 Slope underground ducts to plenums or low pump out points at 1:500. Provide access doors for inspection.
  - .17 Paint buried metal duct work without factory jacket with one coat and seams and joints with additional coat of asphalt base protective coating.
  - .18 Encase buried metal duct work in 75 mm (3 inch) minimum of concrete. Provide adequate tie-down points to prevent ducts from floating during concrete placement. Introduce no heat into ducts for 20 days following placement of concrete.
  - .19 Tape joints of PVC coated metal duct work with PVC tape.
  - .20 Insulate buried supply duct runs over 20 m (70 feet) long with 25 mm (one inch) thick insulation covered with plastic vapour barrier. Refer to Section 23 07 19.
  - .21 Insulated Flexible ductwork: Maximum installed horizontal length: One continuous length at 1500 mm (5'-0"). Use standard sheet-metal elbows at drop points to outlets. Use of the

- flexible duct in lieu of an elbow at the diffuser drop point is not permitted. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- .22 Connect fan powered terminal units to supply ducts with 300 mm (one foot) maximum length of flexible duct. Do not use flexible duct to change direction.
  - .23 Connect diffuser boots or light troffer boots to low pressure ducts with 1.5 m (5 feet) maximum length of insulated flexible duct held in place with strap or clamp.
  - .24 Where interior of duct is visible through grilles, registers or diffusers, paint interior of duct with flat black Tremco paint formulated for galvanized surfaces.
  - .25 Set plenum doors 150 to 300 mm (6 to 12 inches) above floor. Arrange door swings so that fan static pressure holds door in closed position.
  - .26 Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out. Use stainless steel for duct work exposed to view and stainless steel or carbon steel for ducts where concealed.
  - .27 For kitchen hood exhaust ducts, access doors shall be installed at every change in direction in the ductwork, and at intervals not exceeding 3000 mm (10') along the duct run. Access doors shall be installed not less than 38 mm (1½") above the bottom of the duct.
  - .28 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.
  - .29 Open ductwork exposed to the outdoors during construction shall also be weather proofed c/w insulation at sealed ends for any ducts exposed to sub-zero temperatures.
  - .30 Seal ductwork so that it is sufficiently airtight to ensure economical and quiet performance of the system. All ductwork, except where otherwise indicated, shall have seams and joints sealed with Duro-Dyne S-2 duct sealer. Apply duct sealer and duct tape in strict accordance with manufacturer's recommendations, to joints and seams to provide an airtight, watertight installation. Prior to application, ductwork to be dry and free of grease, etc. Use 6mm bead of material along joints. Material, when dry, to have 3.2mm depth extending 25mm on each side of joint or seam.
  - .31 All ductwork located outdoors shall have seams and joints sealed with grey TREMCO 555 acrylic sealant applied with gun and levelled with putty knife. Use material in accordance with manufacturer's printed recommendations.
  - .32 Stainless steel ductwork exposed in finished rooms shall not have duct tape application.
  - .33 Install ductwork free from pulsation, chatter, vibration or objectionable noises.
  - .34 Should any of these defects appear after the system is in operation, correct problems by removing, replacing, or reinforcing the work as directed by the Contract Administrator.

### 3.2 **CLEANING**

- .1 Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- .2 Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into duct work for cleaning purposes.
- .3 Supply and return ducts shall be cleaned in accordance with NADCA *General Specifications for the Cleaning of Commercial Heating, Ventilation, and Air Conditioning Systems*. Verification of HVAC systems cleanliness shall be in accordance with NADCA ACR 2006. Note:

- .1 If visual inspection (Method 1 in NADCA ARC 2006) is inconclusive, surface comparison testing (Method 2 in NADCA ARC 2006) should be used.
- .2 If surface comparison testing is inconclusive, vacuum testing (Method 3 in NADCA ARC 2006) should be used.

**3.3 SCHEDULES**

**3.4 DUCT WORK MATERIAL SCHEDULE**

	<b>AIR SYSTEM</b>	<b>MATERIAL</b>
	Low Pressure Supply (Heating Systems)	Steel
	Low Pressure Supply (System with Cooling Coils)	Steel
	Return and Relief	Steel
	General Exhaust	Steel
	Outside Air Intake	Steel
	Combustion Air	Steel
	Medium and High Pressure Supply	Steel

**3.5 DUCT WORK PRESSURE CLASS SCHEDULE**

	<b>AIR SYSTEM</b>	<b>PRESSURE CLASS</b>
	Supply (Heating Systems)	250 Pa (1 inch)
	Supply (System with Cooling Coils)	500 Pa (2 inch)
	Return and Relief	250 Pa (1 inch)
	General Exhaust	125 Pa (1/2 inch)
	Outside Air Intake	125 Pa (1/2 inch)
	Intake and Exhaust	250 Pa (1 inch)
	Combustion Air	125 Pa (1/2 inch)

**END OF SECTION**



**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Duct silencers.
- .2 Cross-talk silencers.
- .3 Acoustic housings.
- .4 Duct work lagging.
- .5 Acoustical louvres.

**1.2 RELATED SECTIONS**

- .1 Section 07 92 00 - Joint Sealants.
- .2 Section 23 07 13 – Duct Insulation.
- .3 Section 23 31 00 - Duct Work: Connections to silencers.
- .4 Section 23 33 00 - Duct Work Accessories: Flexible duct connections.

**1.3 REFERENCES**

- .1 AABC - National Standards for Total System Balance.
- .2 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .4 AMCA 302 - Application of Sone Ratings for Non-Ducted Air Moving Devices.
- .5 AMCA 303 - Application of Sound Power Level Ratings for Fans.
- .6 ANSI S1.1 - Acoustical Terminology.
- .7 ANSI S1.8 - Preferred Reference Quantities for Acoustical Levels.
- .8 ANSI S1.13 - Measurement of Sound Pressure Levels in Air.
- .9 ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- .10 ARI 575 - Measuring Machinery Sound Within an Equipment Space.
- .11 ASA 16 (ANSI S1.36) - Survey Methods for Determination of Sound Power Levels of Noise Sources.
- .12 ASA 47 (ANSI S1.4) - Specification for Sound Level Meters.
- .13 ASA 49 (ANSI S12.1) - Preparation of Standard Procedures to Determine the Noise Emission from Sources.
- .14 ASHRAE 68 - Laboratory Method of Testing to Determine the Sound Power in a Duct.
- .15 ASHRAE Handbook - Systems Volume, Chapter "Sound and Vibration Control".
- .16 ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission loss of Building Partitions and Elements.
- .17 ASTM E477 - Method of Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .18 ASTM E596 - Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures.

.19 NEBB - Procedural Standards for Measuring Sound and Vibration.

.20 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

#### **1.4 DEFINITIONS**

.1 Submittals and Report: Conform to ANSI S1.1.

#### **1.5 PERFORMANCE REQUIREMENTS**

.1 Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.

#### **1.6 SUBMITTALS**

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate assembly, materials, thicknesses, dimensional data, pressure losses, acoustical performance, layout, and connection details.

.3 Product Data: Provide catalogue information indicating, materials, dimensional data, pressure losses, and acoustical performance. Acoustical performance shall be obtained in accordance with ASTM E477.

.4 Design Data: Provide engineering calculations, referenced to specifications and noted standards indicating that maximum room sound levels are not exceeded.

.5 Manufacturer's Installation Instructions: Indicate installation requirements which maintain integrity of sound isolation.

.6 Manufacturer's Field Reports: Indicate installation is complete and to instructions.

#### **1.7 QUALITY ASSURANCE**

.1 Perform Work to AMCA 300 standards and recommendations of ASHRAE 68.

.2 Maintain one copy of each document on site.

#### **1.8 QUALIFICATIONS**

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

#### **1.9 REGULATORY REQUIREMENTS**

.1 Conform to applicable code for sound levels at property line.

### **Part 2 Products**

#### **2.1 ABSORPTIVE DUCT SILENCERS**

.1 Manufacturers:

.1 Price.

.2 VAW Industries

.3 Vibro-Acoustics

.4 Vibron Limited

.5 Substitutions: Refer to Section 21 05 00.

.2 Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar

- construction. Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .3 Configuration: Rectangular with lined splitters with radiused nose and contoured tails. Contour and radius to be designed for flow velocity requirements (low, medium, high velocity as noted in schedule).
  - .4 Materials:
    - .1 Outer Casing: Minimum 0.8 mm (22 gauge) thick galvanized steel stiffened as required, with mastic filled lock formed seams, slip joints on both ends. Screws or other mechanical fastening systems not acceptable.
    - .2 Inner Casing and Splitters: Minimum 0.5 mm (26 gauge) thick perforated galvanized steel.
    - .3 Fill: shot-free inorganic glass fibre with long, resilient fibers, bonded with thermosetting resin. Glass fibre shall be packed with a minimum 10% compression to eliminate voids and settling; 64 kg/cu m (4 lb/cu ft) density.
    - .4 Fill Liner: Bonded glass fibre matting. 0.0254 mm (1 mil) polymer film.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Support duct silencers independent of duct work with flexible duct connections, lagged with leaded vinyl sheet on inlet and outlet.
- .3 Install cross-talk silencers in wall. Caulk wall penetrations.

#### **3.2 MANUFACTURER'S FIELD SERVICES**

- .1 Prepare and start systems to Quality Assurance clauses in Section 21 05 00.
- .2 Inspect installation periodically to Quality Assurance clauses in Section 21 05 00.
- .3 Provide services of AABC testing agency to take noise measurement. Use meters meeting requirements of ASA 47 (ANSI S1.4).
- .4 After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations, as directed.
- .5 Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements.
- .6 Submit complete report of test results including sound curves.

**END OF SECTION**

**Part 1**

**General**

**1.1**

**SECTION INCLUDES**

- .1 Air turning devices/extractors.
- .2 Backdraft dampers.
- .3 Barometric relief dampers.
- .4 Fire Dampers
- .5 Fire Stop Flaps
- .6 Combination fire and smoke dampers.
- .7 Duct access doors.
- .8 Duct test holes.
- .9 Flexible duct connections.
- .10 Volume control dampers.

**1.2**

**RELATED SECTIONS**

- .1 Section 23 05 48 - Vibration Isolation.
- .2 Section 23 31 00 - Duct Work.
- .3 Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.
- .4 Section 25 30 00 – Instrument and Control Elements
- .5 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3**

**REFERENCES**

- .1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- .2 NFPA 92A - Smoke-Control Systems.
- .3 NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .5 CAN/ULC-S112 Standard Method of Fire Test of Fire-Damper Assemblies
- .6 UL 33 - Heat Responsive Links for Fire-Protection Service.
- .7 UL 555 - Fire Dampers.
- .8 UL 555S - Smoke Dampers.
- .9 CAN/ULC-S112.2, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.

**1.4**

**SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

**1.5**

**PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittals for project closeout.

- .2 Record actual locations of access doors.

## 1.6 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

## 1.7 REGULATORY REQUIREMENTS

- .1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Protect dampers from damage to operating linkages and blades.

## Part 2 Products

### 2.1 AIR TURNING DEVICES/EXTRACTORS

- .1 Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

### 2.2 BACKDRAFT DAMPERS.

- .1 Gravity Backdraft Dampers, Size 450 x 450 mm (18 x 18 inches) or smaller, provided with Air Moving Equipment: Air moving equipment manufacturers standard construction.
- .2 Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 1.5 mm (16 gauge) thick galvanized steel, with centre pivoted blades of maximum 150 mm (6 inch) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.
  - .1 Frame: [Flanged] [Duct mount].

### 2.3 BAROMETRIC RELIEF DAMPERS

- .1 Manufacturers:
  - .1 Greenheck
  - .2 Ruskin
  - .3 Nailor
- .2 Ratings
  - .1 Dampers shall have a maximum differential pressure rating of 2 in.wg (500Pa) and a maximum velocity rating of 2000 fpm (10m/s).
- .3 Construction
  - .1 Frame: Frame shall be 16ga. Galvanized steel.
  - .2 Blades: damper blades shall be .063in thick aluminium.
  - .3 Seals:
    - .1 Blades edge: Seals shall be Vinyl.
    - .2 Jamb: Seals shall be EPDM.
  - .4 Linkage: External, steel tie bars.

- .5 Axles: Plated steel stub axles.
- .6 Bearings: Galvanized Steel press fit.
- .7 Mill finish
- .8 Counterbalance: Blade mounted with adjustable weights
- .9 Mounting: Refer to drawings.

## **2.4 DUCT ACCESS DOORS**

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum 25 mm (one inch) thick insulation with sheet metal cover.
  - .1 Less than 300 mm (12 inches) Square: Secure with sash locks.
  - .2 Up to 450 mm (18 inches) Square: Provide two hinges and two sash locks.
  - .3 Up to 600 x 1200 mm (24 x 48 inches): Three hinges and two compression latches.
  - .4 Larger Sizes: Provide an additional hinge.
- .3 Access doors with sheet metal screw fasteners are not acceptable.
- .4 Doors in insulated ductwork to be double panel construction with a 25mm (1") insulating filler.
- .5 In certain locations where it is inconvenient to swing access doors, removable doors with 4 cam locks will be accepted. However, all such locations shall be approved by the Contract Administrator prior to installation.

## **2.5 DUCT TEST HOLES**

- .1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- .2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation;

## **2.6 FIRE DAMPERS**

- .1 Manufacturers:
  - .1 Price.
  - .2 Nailor.
  - .3 Ruskin.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Depending on the rating of fire separation, rating, construction and testing of the fire damper will conform to most recent issue of all of following:
  - .1 N.B.C.
  - .2 ULC S 112
  - .3 NFPA 252
  - .4 ULC or ULI 10(b)
- .3 Use type 'B' fire dampers, i.e. blades out of air stream, to be used in all ducts passing through fire separations. Combination fire damper-balancing damper, with blades in air stream shall be used on sidewall or return, or floor mounted supply, up to maximum size

of 0.372 sq.m (576 sq.in.). For sidewall return above 0.372 sq.m (576 sq.in.) in size, use a type 'A' fire damper, i.e. blades in air stream.

- .4 Ceiling Dampers: Galvanized steel, 0.76 mm(22 gauge) frame and 1.5 mm (16 gauge) flap, two layers 3.2 mm (0.125 inch) ceramic fibre on top side with locking clip.
- .5 Horizontal Dampers: Galvanized steel, 0.76 mm (22 gauge) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- .6 Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except at all locations unless otherwise indicated on the drawings, and for 250 Pa (1.0 inch) pressure class ducts up to 300 mm (12 inches) in height.
- .7 Multiple Blade Dampers: 1.5 mm (16 gauge) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 3.2 x 12.7 mm (1/8 x 1/2 inch) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- .8 Fusible Links: UL 33, separate at 71 [100] [\_\_\_\_] degrees C, (160 [212] [\_\_\_\_] degrees F) with adjustable link straps for combination fire/balancing dampers.
- .9 Fire dampers in stainless steel exhaust duct systems shall have #316 stainless steel blades, shafts, linkage and casing. Refer to clause 'Stainless Steel Exhaust Ductwork' in this section.

## 2.7 FIRE STOP FLAPS

- .1 Manufacturers:
  - .1 Price.
  - .2 Nailor.
  - .3 Ruskin.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2.
- .3 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .4 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C.
- .5 Thermal blanket: Non-asbestos UL Classified insulation in a fiberglass wrap.

## 2.8 FLEXIBLE DUCT CONNECTIONS

- .1 Manufacturers:
  - .1 Duro-Dyne.
  - .2 Substitutions: Refer to Section 21 05 00.
- .2 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .3 Connector: Fabric crimped into metal edging strip.
  - .1 Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m (30 oz per sq yd).
  - .2 Net Fabric Width: Approximately 75mm (3 inches) wide.
  - .3 Metal: 75 mm (3 inch) wide, 0.6 mm thick (24 gauge) galvanized steel.

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**2.9 COMBINATION FIRE AND SMOKE DAMPERS**

- .1 Manufacturers:
  - .1 Price.
  - .2 Nailor.
  - .3 Ruskin.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Fabricate to NFPA 90A and UL 5555, and ULC S 112.
- .3 Dampers: UL Class 1 multiple blade type fire damper, normally open automatically operated by electric actuator.
- .4 Electro Thermal Link: Fusible link melting at 74 degrees C (165 degrees F); 120 volts, single phase, 60 Hz; UL listed and labeled.

**2.10 VOLUME CONTROL DAMPERS.**

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Splitter Dampers:
  - .1 Material: Same gauge as duct to 600 mm (24 inches) size in either direction, and two gauges heavier for sizes over 600 mm(24 inches).
  - .2 Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  - .3 Operator: Minimum 6 mm (1/4 inch) diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- .3 Single Blade Dampers: Fabricate for duct sizes up to 150 x 760 mm (6 x 30 inch).
- .4 Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 200 x 1825 mm (8 x 72 inch). Assemble centre and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- .5 End Bearings: Except in round duct work 300 mm (12 inches) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- .6 Quadrants:
  - .1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.
  - .2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
  - .3 Where rod lengths exceed 750 mm (30 inches) provide regulator at both ends.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Verify that electric power is available and of the correct characteristics.

**3.2 INSTALLATION**

- .1 Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.



- .2 Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- .3 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 300 x 300 mm (12 x 12 inch) size for all fire dampers. Enlarge duct if necessary to accommodate properly sized access door.
- .4 Generally access doors at heating coils shall approximate width of coil for ease of cleaning.
- .5 At smoke detectors, provide 450mm x 450mm (18 x 18 inch) access doors.
- .6 Provide duct test holes where indicated and required for testing and balancing purposes.
- .7 Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- .8 Install smoke dampers and combination smoke and fire dampers to NFPA 92A. Coordinate electrical requirements with Electrical Division.
- .9 Demonstrate re-setting of fire dampers to The City's representative.
- .10 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators. Refer to Section 23 05 48. For fans developing static pressures of 1250 Pa (5.0 inches wg) and over, cover connections with leaded vinyl sheet, held in place with metal straps.
- .11 Use splitter dampers only where indicated.
- .12 Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 36 00.
- .13 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- .14 Do not locate single blade volume dampers immediately behind diffusers and grilles. This application does not allow uniform airflow across the outlet face.
- .15 To minimize generated duct noise, locate volume dampers at least two duct diameters from a fitting and as far away as possible from the outlet or inlet.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Diffusers.
- .2 Registers/grilles.
- .3 Door grilles.
- .4 Louvers.
- .5 Louvered penthouses.
- .6 Roof hoods.
- .7 Goosenecks.

**1.2 RELATED SECTIONS**

- .1 Section 09 91 10 - Painting: Painting of duct work visible behind outlets and inlets.
- .2 Section 08 71 00: Placement of door grilles.

**1.3 REFERENCES**

- .1 ADC 1062 - Air Distribution and Control Device Test Code.
- .2 AMCA 500 - Method of Testing Louvers for Ratings.
- .3 AMCA 511 – Certified Ratings Program
- .4 AMCA 5000 - Method of Testing Dampers for Ratings.
- .5 ARI 650 - Air Outlets and Inlets.
- .6 ASHRAE 70 - Method of Testing for Rating the Performance of Outlets and Inlets.
- .7 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- .8 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

**1.4 SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

**1.5 PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Record actual locations of air outlets and inlets.

**1.6 QUALITY ASSURANCE**

- .1 Test and rate air outlet and inlet performance to ADC Equipment Test Code 1062 and ASHRAE 70.
- .2 Test and rate louver performance to AMCA 500
- .3 Certified AMCA 511 – Certified Ratings Program

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**1.7 QUALIFICATIONS**

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Unless otherwise listed:
- .1 Price Industries.
  - .2 Nailor Industries
  - .3 Titus
  - .4 Ventex.
- .2 Substitutions: Refer to Section 21 05 00.

**2.2 ROUND CEILING DIFFUSERS**

- .1 Type: Round, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern.
- .2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

**2.3 SQUARE CEILING DIFFUSERS**

- .1 Type: Square, stamped diffuser to discharge air in 360 degree pattern.
- .2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

**2.4 RECTANGULAR DIRECTIONAL CEILING DIFFUSERS**

- .1 Type: Square and rectangular, adjustable pattern, multi-louvered diffuser to discharge air in one-way, two-way, three-way, or four-way pattern as indicated on the schedule.
- .2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

**2.5 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES**

- .1 Type: Fixed grilles of 13 x 13 x 13 mm (1/2 x 1/2 x 1/2 inch) louvers.
- .2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

**2.6 CEILING SLOT DIFFUSERS**

- .1 Type: Continuous slot, with adjustable vanes for left, right, or vertical discharge. Refer to schedule for slot width and number of slots.
- .2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

**2.7 WALL SUPPLY REGISTERS/GRILLES**

- .1 Type: Streamlined and individually adjustable blades, 19 mm (3/4 inch) minimum depth, 19 mm (3/4 inch) maximum spacing with spring or other device to set blades.
- .2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

**2.8 WALL EXHAUST AND RETURN REGISTERS/GRILLES**

- .1 Type: Streamlined blades, 19 mm (3/4 inch) minimum depth, 19 mm (3/4 inch) maximum spacing, horizontal face.

- .2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

## **2.9 LINEAR WALL REGISTERS/GRILLES**

- .1 Type: Narrow Spacing Streamlined blades with 3.2 x 19 mm (1/8 x 3/4 inch) on 6 mm (1/4 inch) centres. Refer to schedule for deflection angle.
- .2 Type: Wide Spacing Streamlined blades, 3.2 x 19 mm (1/8 x 3/4 inch) on 12 mm (1/2 inch) centres. Refer to schedule for deflection angle.
- .3 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

## **2.10 LINEAR FLOOR SUPPLY REGISTERS/GRILLES**

- .1 Type: Narrow Spacing Streamlined blades, 3.2 x 19 mm (1/8 x 3/4 inch) on 6 mm (1/4 inch) centres. Refer to schedule for deflection angle.
- .2 Type: Wide Spacing Streamlined blades, 3.2 x 19 mm (1/8 x 3/4 inch) on 12 mm (1/2 inch) centres. Refer to schedule for deflection angle.
- .3 Type: Pencil-proof Spacing Streamlined blades, 3.2 x 19 mm (1/8 x 3/4 inch) on 11 mm (7/16 inch) centres. Refer to schedule for deflection angle.
- .4 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

## **2.11 DOOR GRILLES**

- .1 Type: V-shaped louvers of 0.90 mm (20 gauge) thick steel, 25 mm (one inch) deep on 13 mm (1/2 inch) centres.
- .2 Frame: 0.90 mm (20 gauge) steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.
- .3 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

## **2.12 LOUVERS**

- .1 100 mm (4 inch) Fixed Blade Louver:
- .1 Type: 100 mm (4 inch) deep with blades on 39 degree slope with centre baffle and return bend, heavy channel frame, aluminum birdscreen with 13 mm (1/2 inch) square mesh for exhaust and 19 mm (3/4 inch) for intake.
  - .2 Fabrication: 2.1 mm (0.081 inch) extruded aluminum, welded assembly, with factory baked enamel finish - custom colour to be selected by the architect.
  - .3 Mounting: Refer to schedules for mounting options.
- .2 150 mm (6 inch) Fixed Blade Louver:
- .1 Type: 150 mm (6 inch) deep with blades on 45 degree slope with centre baffle and return bend, heavy channel frame, aluminum birdscreen with 13 mm (1/2 inch) square mesh for exhaust and 19 mm (3/4 inch) for intake.
  - .2 Fabrication: 2.1 mm (0.081 inch) extruded aluminum, welded assembly, with factory baked enamel finish - custom colour to be selected by the architect.
  - .3 Mounting: Refer to schedules for mounting options.

## **2.13 PENTHOUSE LOUVER**

- .1 100 mm (4 inch) Fixed Blade Louver:
- .1 Type: All welded assembly with 100 mm (4 inch) deep with blades on 39 degree slope, mitred corners, sheet aluminum roof, with factory baked enamel finish - custom colour to be selected by the architect.

- .2 Birdscreen with 13 mm (1/2 inch) square mesh for exhaust and 19 mm (3/4 inch) for intake.
- .2 150 mm (6 inch) Fixed Blade Louver:
  - .1 Type: All welded assembly with 150 mm (6 inch) deep with blades on 45 degree slope, mitred corners, sheet aluminum roof, with factory baked enamel finish - custom colour to be selected by the architect.
  - .2 Birdscreen with 13 mm (1/2 inch) square mesh for exhaust and 19 mm (3/4 inch) for intake.

## **2.14 ROOF INTAKE OR RELIEF HOODS**

- .1 Manufacturers:
  - .1 Cook
  - .2 Greenheck
  - .2 Substitutions: Refer to Section 21 05 00.
- .2 Manufactured air inlet or exhaust hoods to meet SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .3 Product Requirements:
  - .1 Bolted and welded construction utilizing corrosion resistant fasteners.
  - .2 Hood construction: minimum 18 gauge aluminum, bolted to a minimum 8 gauge aluminum support structure.
  - .3 A radius throat must be provided for optimum performance.
  - .4 Lifting lugs shall be provided to help prevent damage from improper lifting.
  - .5 A rain gutter shall be provided to prevent rain infiltration.
  - .6 The base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of 1/2" galvanized mesh shall be mounted in the hood.
- .4 Curb:
  - .1 Factory-supplied or field-constructed roof curb to match.
  - .2 Minimum 18 gauge galvanized steel or 0.080 aluminum, c/w wood nailers, continuously welded corners, 75 mm (3 inch) cant, 38 mm (1-1/2 inches) thermal insulation.
- .5 Mount unit on minimum 300 mm (12 inch) high curb base with insulation between duct and curb. Curb height to ensure minimum 450 mm (18") clear from roof surface to intake. Refer to drawings for additional curb height requirements.

## **2.15 GOOSENECKS**

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, of minimum 1.20 mm (18 gauge) galvanized steel.
- .2 Mount on minimum 300 mm (12 inch) high curb base.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.

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- .2 Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
  - .3 Install diffusers to duct work with air tight connection.
  - .4 All diffusers, grilles and registers shall be free of fluttering, chattering and vibration. A felt or sponge rubber gasket shall be provided behind each outlet or inlet and adequate fastenings provided to prevent leakage between the outlet and duct, wall or ceiling.
  - .5 In all cases where linear diffusers are required to run continuous from one wall to another or between bulkheads, beams or other fascia the schedule size of the diffuser shall be confirmed by site measurements prior to final assembly.
  - .6 Floor grilles to be set flush with floor coverings except carpet. Frame to lap over carpet.
  - .7 Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
  - .8 Paint ductwork visible behind air outlets and inlets matte black.
  - .9 Care should be taken to install diffusers as per the reflected ceiling plans where available so that the diffusers will fit properly in the ceiling suspension system. The sheet metal subcontractor shall co-ordinate this work with the Contractor, the suspended ceiling subtrade and electrical subtrade.
  - .10 Should there be any conflict in the location of grilles, registers and diffusers with lights, etc. the matter shall be referred to the Contract Administrator for directive. If requested by the Contract Administrator, the subcontractor shall relocate grilles, diffusers and registers and ductwork attached, within two feet of locations as indicated on the drawings, without extra cost to The City.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Fabricated breechings.
- .2      Manufactured chimneys for gas fired equipment.
- .3      Vent dampers.
- .4      Manufactured double wall chimneys for fuel fired equipment.

**1.2                RELATED SECTIONS**

- .1      Section 23 05 13 - Motors: Inducer draft fan motor.
- .2      Section 23 07 16 - Equipment Insulation: Breeching insulation.
- .3      Section 23 52 16 – Boilers
- .4      Section 25 50 02 - Digital Control Equipment.
- .5      Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3                REFERENCES**

- .1      ANSI Z21.66 - Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
- .2      ANSI Z21.67 - Mechanically Actuated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
- .3      ANSI Z21.68 - Thermally Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
- .4      ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .5      ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .6      ASTM A1011/A1011M - Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- .7      CSA B149.1 Natural Gas and Propane Installation Code
- .8      ASTM C401 - Classification of Alumina and Alumina-Silicate Castable Refractories.
- .9      NEMA MG1 - Motors and Generators.
- .10     NFPA 54 (ANSI Z223.1) - The National Fuel Gas Code.
- .11     SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .12     UL 103 - Standard for Factory Built Chimneys for Residential Type and Building Heating Appliances.
- .13     UL 127 - Standard for Factory-Built Fireplaces.
- .14     UL 378 - Standard for Safety for Draft Equipment.
- .15     UL 441 - Standard for Safety for Gas Vents.
- .16     UL 641 - Type L Low-Temperature Venting Systems.
- .17     UL 959 (ANSI Z181.1) - Medium Heat Appliance Factory Built Chimneys.

- .18 UL 1738 - Standard for Safety for Venting Systems For Categories II, III and IV Gas-Burning Appliances
- .19 UL 2561 - Standard for Safety for 1400 Degree Fahrenheit Factory-Built Chimneys
- .20 CAN/ULC-S605 - Standard for Gas Vents
- .21 CAN/ULC-S609 - Standard for Low Temperature Vents Type L
- .22 CAN/ULC S636 - Standard For Type BH Gas Venting Systems

#### **1.4 DEFINITIONS**

- .1 Breeching: Vent Connector.
- .2 Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- .3 Smoke Pipe: Round, single wall vent connector.
- .4 Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- .5 Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

#### **1.5 DESIGN REQUIREMENTS**

- .1 Factory built vents and chimneys used for venting natural draft appliances to NFPA 211, UL listed and labeled.

#### **1.6 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations.
- .3 Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
- .4 Section 21 05 00: Submittals for information.
- .5 Submit manufacturer's installation instructions: Indicate assembly, support details, and connection requirements.
- .6 Manufacturer's Certificate: Certify that refractory lined metal stacks meet or exceed specified requirements.

#### **1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years documented experience approved by manufacturer.
- .3 Design stacks under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the Province of Manitoba.

#### **1.8 REGULATORY REQUIREMENTS**

- .1 Conform to applicable code CSA B149.1, NFPA 54 (ANSI Z223.1) code for installation of natural gas burning appliances and equipment.



- .2 Conform to applicable code CSA B149.1, NFPA 58 (ANSI Z223.1) code for installation of propane burning appliances and equipment.
- .3 Conform to applicable code CSA B139, NFPA 31 (ANSI Z95.1) for installation of oil burning appliances and equipment.
- .4 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## Part 2 Products

### 2.1 CPVC FLUE GAS VENT

- .1 Chlorinated Polyvinyl chloride (CPVC) Type BH Class II B 90 degree C flue gas vent and fittings, manufactured to ULC S636.
- .2 Joints:
  - .1 Solvent weld using approved and listed solvent.

### 2.2 DOUBLE WALL METAL STACKS – AIR GAP

- .1 Manufacturers:
  - .1 Schebler Chimney Systems Model eVent
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 [ ] Model [ ].
    - .2 [ ] Model [ ].
    - .3 [ ] Model [ ].
  - .3 Substitutions: Refer to Section 21 05 00.
- .2 Provide double wall metal stacks, tested to [UL 11335 and] ULC S636 and UL listed, for use with building heating equipment, in compliance with NFPA 211 and CSA B149.1.
- .3 Fabricate with 25 mm (1 inch) minimum air space between walls. Construct inner jacket of 0.6 mm (24 gauge) AL29-4L [Type 304] [Type 316] stainless steel. Construct outer jacket of [aluminum coated steel] [[Type 304] [Type 316] stainless steel] 0.75 mm (22 gauge) for sizes 125 mm to 1200 mm (5 inches to 48 inches).
- .4 Accessories, UL labeled:
  - .1 Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.
  - .2 Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.
  - .3 Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

### 2.3 DOUBLE WALL METAL STACKS - INSULATED

- .1 Manufacturers:
  - .1 Schebler Chimney Systems Model eVent Plus2
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 [ ] Model [ ].

- .2 [ \_\_\_\_\_ ] Model [ \_\_\_\_\_ ].
- .3 [ \_\_\_\_\_ ] Model [ \_\_\_\_\_ ].
- .3 Substitutions: Refer to Section 21 05 00.
- .2 Provide double wall metal stacks, tested to [UL 11335 and ]ULC S636 and UL listed, for use with building heating equipment, in compliance with NFPA 211 and CSA B149.1.
- .3 Fabricate with 50mm (2") ceramic fiber insulation between walls. Construct inner jacket of 0.9 mm (20 gauge) [AL29-4L] [Type 304] [Type 316] stainless steel for sizes up to 950mm (38") and 1.2mm (18 gauge) on larger sizes. Construct outer jacket of [aluminum coated steel] [[Type 304] [Type 316] stainless steel] 0.9 mm (20 gauge) for sizes up to 950mm (38") and 1.2mm (18 gauge) on larger sizes. Fittings over 600mm (24") in diameter shall be 1.2mm (18 gauge).
- .4 Accessories, UL labeled:
  - .1 Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.
  - .2 Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.
  - .3 Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

### Part 3 Execution

#### 3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Install to CSA B149.1
- .3 Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- .4 Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 4 m (12 foot) spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.
- .5 Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.
- .6 Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- .7 Maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.
- .8 Level and plumb chimney and stacks.
- .9 Clean breechings, chimneys, and stacks during installation, removing dust and debris.
- .10 At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

**END OF SECTION**

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**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Boilers.
- .2 Controls and boiler trim.
- .3 Water Connections.
- .4 Fuel connection.
- .5 Venting
- .6 Condensate neutralizer

**1.2 RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-place Concrete.
- .2 Section 23 05 20 - Hydronic Specialties.
- .3 Section 25 50 02 - Digital Control Equipment
- .4 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3 REFERENCES**

- .1 AGA - Directory of Certified Appliances and Accessories.
- .2 AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .3 ASME SEC 4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.
- .4 ASME SEC 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.
- .5 CSA 4.9/ANSI Z21.13 - Gas Fired Low Pressure Steam and Hot Water Boilers.
- .6 CSA B51 – Boiler, pressure vessel and pressure piping code
- .7 CSA B149 - Natural Gas and Propane Code
- .8 HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.
- .9 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- .10 NFPA 54 (AGA Z223.1) - National Fuel Gas Code.
- .11 NFPA 58 - Liquefied Petroleum Gas Code.
- .12 UL - Gas and Oil Equipment Directory.

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements.
- .3 Section 21 05 00: Submittals for information.
- .4 Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

- .5 Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.
- .6 Section 21 05 00: Submittals for project closeout.
- .7 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

## **1.5 QUALIFICATIONS**

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years of experience.

## **1.6 REGULATORY REQUIREMENTS**

- .1 Conform to NFPA 70 for internal wiring of factory wired equipment.
- .2 I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.
- .3 Conform to ASME SEC 4 for boiler construction.
- .4 Units: ULC labeled. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction and tested to UL 795 Commercial-Industrial Gas Heating Equipment.
- .5 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## **1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

## **1.8 WARRANTY**

- .1 Section 21 05 00: Submittals for project closeout.
- .1 Warranty Period for Water-Tube Condensing Boilers:
  - .1 Leakage and Materials: 10 years from date of Substantial Completion.
  - .2 Heat Exchanger Damaged by Thermal Stress and Corrosion: Non-prorated for 10 years from date of Substantial Completion.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Buderus SSB 1000TL
- .2 Substitutions:
  - .1 Viessmann Manufacturing C. (US) Inc.
  - .2 Lochinvar LLC
- .3 Refer to Section 21 05 00.

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## 2.2 MANUFACTURED UNITS

- .1 Hot water natural draft boiler with horizontal grid, finned tube heat exchanger, gas burning system, refractory combustion chamber, controls, and boiler trim
- .2 Electrical Characteristics:
  - .1 Refer to Schedule
  - .2 Refer to Section 26 05 80.

## 2.3 FABRICATION

- .1 Description: Factory-fabricated, assembled, and pressure tested, water-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; water supply, and condensate drain connections. Each boiler shall be assembled with required wiring and piping as a self-contained unit.
- .2 Heat Exchanger: Plasma welded 316L dual tube stainless steel heat exchanger and burner tube with high quality condensing heating surfaces. Each watertube shall be at least 7/8" ID. Stainless steel heat exchangers shall be inspected and tested to ASME Section IV requirements and shall bear the ASME section IV seal of approval. Only boilers employing nonferrous materials on all flue gas passes will be considered.
- .3 "Near condensing" copper fin designs, cast iron, cast aluminum, or secondary condensing exchangers will not be considered.
- .4 Pressure Vessel: Carbon steel with welded heads and tube connections, counter-flow design with low- and high-temperature returns. The pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The pressure vessel shall contain a volume of water no less than 20.0usg for SSB 1000TL

## 2.4 FUEL BURNING SYSTEM

- .1 Burner:
  - .1 Natural Gas, premixed burner.
  - .2 The burner shall operate with a 5:1 turn down on each module; SSB1000TL shall operate with a minimum 10:1 turndown ratio,
- .2 Blower: Centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber.
  - .1 Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - .2 Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- .3 Gas Train: The boiler shall be supplied with two gas valves designed with negative pressure regulation and shall be capable of the following minimum turndown ratios:
  - .1 SSB1000TL – 10:1 turndown, minimum input: 102,400 btu/h, max input: 1,024,000 btu/h
- .4 Hydraulic Manifold: The Boiler(s) hydraulic manifold piping (water, gas and exhaust/ air) shall be factory installed and self-contained within the Boiler(s) outer cabinet.
- .5 The boiler shall have a minimum of 86 sqft/1000 MBH of effective fireside heating surface.

- .6 Ignition: Pilot ignition with 100 percent main-valve shutoff with electronic flame supervision.
- .7 High Altitude: Boiler shall operate at altitudes up to 2,000 feet above sea level without additional parts or adjustments.
- .8 Casing:
  - .1 Jacket: Sheet metal, with snap-in or interlocking closures.
  - .2 Finish: Electrostatic powder-coated protective finish.
  - .3 Insulation: Minimum 10mm thick, glass fiber insulation surrounding the heat exchanger.
  - .4 Combustion Chamber and Other Flue Passage Access: Full-sized front access
  - .5 Access: Side panels easily removed.

## **2.5 TRIM**

- .1 Include devices sized to comply with ANSI B31.9, "Building Services Piping."
- .2 Boiler(s) shall be equipped with a multi-speed circulator pump on each module.
- .3 Aquastat Controllers: Operating, firing rate, and high limit.
- .4 Safety Relief Valve: ASME rated.
- .5 Low Water Cut-off: Manual reset whenever boiler water level falls below safe level.
- .6 Pressure and Temperature Gage: Combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.
- .7 Drain Valve: Minimum NPS 3/4 hose-end gate valve.

## **2.6 VENTING**

- .1 The exhaust vent must be UL Listed for use with Category II, III and IV appliances and compatible with operating temperatures up to 230°F, positive pressure, condensing flue gas service. UL listed vents are PVC, CPVC, Polypropylene and AL 29-4C stainless steel.
- .2 Follow guidelines specified in manufacturer's venting guide.

## **2.7 CONDENSATE NEUTRALIZER**

- .1 Provide refillable neutralization unit. Neutralization condensate released by the unit will be non-corrosive, and a safe pH level above 6.5. Standard of Acceptance is AXIOM NT20
- .2 Tank shall be designed for a maximum appliance sizes up to 3.0 MBTU (3,000,000 btu/hr) input. Multiple units required for input sizes over 3.0 MBTU (3,000,000 btu/hr)
- .3 System shall include 20 litre (5.3 U.S. gallon) tank made from one-piece seamless polyethylene construction with 125mm (5") fill/access opening, 63mm (1-1/2") FIP inlets on the top and the side, 63mm (1-1/2") side outlet, and 63mm (1-1/2") FIP top vent.
  - .1 ACCESSORIES
    - .1 Tank Mounting Shelf
    - .2 40 lbs. of Neutralizing Media

## **2.8 CONTROLS**

- .1 Boiler(s) shall be equipped with an integrated 7" color touch-screen controller that shall monitor and control all combustion process functions, control of the boiler water

- temperature to a value required by the connected components and shall display current water temperatures or fault conditions with changes in operation status.
- .2 The boiler shall have multiple heating parameters designed for the most common applications with options including:
- 0 – Heating demand (end switch / Thermostat)
  - 1 – Weather compensations with heating demand
  - 2 – Weather compensation with full outdoor temperature reset
  - 3 – Permanent heat demand
  - 4 – Analog input of setpoint
- .3 The boiler shall have multiple domestic hot water heating parameters designed for the most common applications with options including:
- 0 – No DHW
  - 1 – Indirect Tank with Sensor
  - 2 – Indirect Tank with Aquastat
- .4 The boiler control shall have multiple circulator pump parameters designed for the most common applications with options including:
- 0 – 1 Heating DHW
  - 1 – 1 three-way valve to operate DHW
  - 2 – 1 System, 1 Heating, 1 DHW
  - 3 – 1 System, 1 Heating, 1 three-way valve to operate DHW
  - 4 – 1 System, 1 Heating, DHW controlled by others
- .5 Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

### **Part 3 Execution**

#### **3.1 BOILER INSTALLATION**

- .1 Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- .2 Install gas-fired boilers according to NFPA 54.
- .3 Assemble and install boiler trim.
- .4 Install electrical devices furnished with boiler but not specified to be factory mounted.
- .5 Install control wiring to field-mounted electrical devices.

#### **3.2 CONNECTIONS**

- .1 Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- .2 All external hydraulic connections shall be able to be connected in any configuration on either the left or right side of the Boiler(s) in order to allow for maximum installation flexibility and site requirements.
- .3 Install piping adjacent to boiler to allow service and maintenance.
- .4 Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- .5 Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

- .6 Connect hot-water piping to supply- and return-boiler connections with shutoff valve and union or flange at each connection.
- .7 Install piping from safety relief valves to nearest floor drain.
- .8 Boiler Venting:
  - .1 Install flue venting for SSB1000TL: PP, Stainless Steel, AL29-4C
  - .2 Connect venting full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys and Stacks."
- .9 Provide for connection to electrical service. Refer to Section 26 05 80.
- .10 Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- .11 Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.3 FIELD QUALITY CONTROL**

- .1 Perform tests and inspections and prepare test reports.
  - .1 Manufacturer's Field Service: Engage a factory-authorized service representative or technician to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- .2 Tests and Inspections:
  - .1 Perform installation and startup checks according to manufacturer's written instructions.
  - .2 Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
  - .3 Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
  - .4 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    - .1 Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
    - .2 Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- .3 Remove and replace malfunctioning units and retest as specified above.

### **3.4 DEMONSTRATION**

- .1 Train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Section "Demonstration and Training."

### **3.5 SCHEDULES**

- .1 Refer to schedule on drawing.

**END OF SECTION**



**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Plate type heat exchangers.
- .2    Accessories and trim.

**1.2                RELATED SECTIONS**

- .1    Section 23 05 20 - Hydronic Specialties.
- .2    Section 23 21 00 - Hydronic Piping.
- .3    Section 25 50 02 - Digital Control Equipment
- .4    Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3                REFERENCES**

- .1    ASME SEC 8 - Boilers and Pressure Vessels Code.

**1.4                SUBMITTALS FOR REVIEW**

- .1    Section 21 05 00: Submittal procedures.
- .2    Product Data: Provide data with dimensions, locations, and size of tappings and performance data.
- .3    Shop Drawings: Indicate dimensions, locations, and size of tappings and performance data.

**1.5                SUBMITTALS FOR INFORMATION**

- .1    Section 21 05 00: Submittals for information.
- .2    Design Data: Indicate in sufficient detail to verify that heat exchangers meet or exceed specified requirements.
- .3    Test Reports: Indicate tube bundle pressure tests.
- .4    Certificates: Certify that Products meet or exceed specified requirements.
- .5    Manufacturer's Instructions: Indicate installation and support requirements.

**1.6                SUBMITTALS AT PROJECT CLOSEOUT**

- .1    Section 21 05 00: Submittals for project closeout.
- .2    Operation and Maintenance Data: Include start up and shut down instructions, assembly drawings, and spare parts lists.
- .3    Warranty: Submit manufacturer warranty and ensure forms have been completed in The City's name and registered with manufacturer.

**1.7                REGULATORY REQUIREMENTS**

- .1    Conform to ASME Boilers and Pressure Vessels Code, SEC 8 for manufacture of tubular heat exchangers and heat exchanger shells and plate and frame type heat exchangers.

**1.8                DELIVERY, STORAGE, AND HANDLING**

- .1    Section 21 05 00: Transport, handle, store, and protect products.

- .2 Protect internals from entry of foreign material by temporary caps on flanged openings.

### **1.9 WARRANTY**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide five year manufacturer warranty on all heat exchangers.

### **1.10 EXTRA MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide two sets of replacement gaskets.
- .3 Provide one set of wrenches for disassembly of plate type heat exchangers.

## **Part 2 Products**

### **2.1 PLATE AND FRAME TYPE HEAT EXCHANGER**

- .1 Manufacturer:
  - .1 Bell & Gossett
  - .2 Armstrong
  - .3 Taco
- .2 Other acceptable manufacturers offering equivalent products.
  - .1 Substitutions: Refer to Section 21 05 00.
- .3 Frames: Carbon steel with baked epoxy enamel paint, zinc plated carbon steel side bolts and aluminum shroud/splash guard.
- .4 Plates: Stainless steel Type 304 stainless steel, plate thickness 0.4 mm. double walled for domestic application.
- .5 Gaskets: Nitrile rubber.
- .6 Nozzles: 860 kPa (125 psi) rated lined flange type.
- .7 Fouling Factor: 0 (0) m<sup>2</sup>,°C/W (hr,ft<sup>2</sup>,°F/Btu)
- .8 Unless otherwise noted connections shall be flanged type.
- .9 Performance:
  - .1 Refer to schedule on drawings.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install to manufacturers written instructions.
- .2 Support heat exchangers on welded steel pipe and angle floor stand on concrete housekeeping pad.
- .3 Pitch shell to completely drain condensate.
- .4 Pipe relief valves to nearest floor drain.
- .5 Pipe drain valves to nearest floor drain.

**3.2 WATER TO WATER HEAT EXCHANGER TRIM**

- .1 Water Inlets and Outlets: Thermometer wells, pressure gauge tapings.
- .2 Heated Water Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure and temperature relief valve, valved drain; refer to Section 23 05 20.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Chiller package.
- .2 Charge of refrigerant and oil.
- .3 Controls and control connections.
- .4 Chilled water connections.
- .5 Condenser water connections.
- .6 Refrigerant connections.
- .7 Auxiliary water connections.
- .8 Starters.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 13 - Motors.
- .2 Section 23 05 48 - Vibration Isolation.
- .3 Section 23 05 93 - Testing, Adjusting, And Balancing.
- .4 Section 23 21 00 - Hydronic Piping.
- .5 Section 23 21 23 - HVAC Pumps.
- .6 Section 23 23 00 - Refrigerant Piping And Specialties.
- .7 Section 23 63 13 - Refrigerant Condensers - Air Cooled.
- .8 Section 23 63 14 - Condensing Units - Air Cooled.
- .9 Section 23 65 13 - Cooling Towers - Forced Draft.
- .10 Section 25 90 00 - Sequence Of Operation.
- .11 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3 REFERENCES**

- .1 ARI 550/590: Water Chilling Packages Using the Vapor Compression Cycle.
- .2 ASME SEC 8 - Boiler and Pressure Vessel Code.
- .3 CAN/CSA-B52 – Mechanical refrigeration Code.

**1.4 PERFORMANCE REQUIREMENTS**

- .1 This section is based on specific selections of equipment. These selections relate to the selection of related equipment 23 21 23 - HVAC Pumps. In substituting equipment, ensure that performance selection criteria matches that specified or that the selection of related equipment is acceptable or is revised to suit.

**1.5 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate valves, strainers, and thermostatic valves required for complete system.

- .3 Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

**1.6 SUBMITTALS FOR INFORMATION**

- .1 Section 21 05 00: Submittals for information.
- .2 Submit manufacturer's installation instructions.
- .3 Manufacturer's Certificate: Certify that components of package not provided by manufacturer have been selected to manufacturer's requirements.

**1.7 SUBMITTALS AT PROJECT CLOSEOUT**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.

**1.8 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years of experience.

**1.9 REGULATORY REQUIREMENTS**

- .1 Provide certification of inspection for conforming authority having jurisdiction approval.
- .2 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.10 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- .3 Protect units from physical damage.

**1.11 WARRANTY**

- .1 Each unit's parts are warranted to be free from manufacturing defects for up to 1 year from the date of installation.
- .2 Each Unit's compressor is warranted for 1 year from the date of start up. Start up must be done within 90 days of installation. Otherwise the warranty will start from the date of installation.
- .3 Valves, storage tank, expansion tank and control are warranted to be free from defects for up to 1 year from the date of installation.

**1.12 MAINTENANCE SERVICE**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide service and maintenance of complete assembly for [one year] [\_\_\_\_\_] from Date of Substantial Completion.

**1.13 MAINTENANCE MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.

- .2 Provide [two] [\_\_\_\_] containers of [lubricating oil] [refrigerant].

#### **1.14 EXTRA MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.

### **Part 2 Products**

#### **2.1 MANUFACTURERS**

- .1 AERMEC shall be the basis of the design using WWM water to water modular Chiller
- .2 Substitutions: Refer to Section 21 05 00.

#### **2.2 MANUFACTURED UNITS**

- .1 Description: Factory-assembled and performance-tested water chiller complete with base and frame, compressors, evaporator, condenser, electrical power, controls, and accessories.

Water to water modular unit should have following characteristics:

- .1 Water to water modular unit should have 15hp compressor, more capacity is not acceptable.
  - .2 Unit should have option to link together side by side, back to back, and stacked to combine up to 32 units to minimize overall footprints with capacity of 960 tons.
  - .3 Unit's chassis should be able to disconnect from hydronic connections for servicing, maintenance or replacements without impacting the operation of the remaining units by manual isolation valves.
  - .4 Unit should be completely enclosed and sound proof.
  - .5 Each module should have its own electrical panel and control logic.
  - .6 Each module should manage and log its own alarms.
  - .7 Unit should be able to have single point power connection.
  - .8 Unit should be able to pass through elevator doors with 31.5 inches width.
  - .9 Unit should have at least 2 refrigeration circuits (15 tons each) and 1 to 2 compressors per circuit.
  - .10 Unit should have anti-freeze electric heater as standard on Brazed plate heat exchangers.
  - .11 To connect multiple modules, the unit should have clearance from the front only.
  - .12 To control multiple units, multicontroller should be able to control up to 9 units together.
  - .13 Unit should include butterfly valves for variable flow.
  - .14 Hydraulic connections of modules should be link together by grooved pipe connections.
  - .15 Each unit shall have its own disconnect
- .2 Cabinet:
    - .1 Base and Support Structure: Made up from hot galvanized sheet steel elements with suitable thickness. Designed in a way to allow total accessibility to all the internal components. All panels are covered with sound-absorbent material.
    - .2 Finish: All parts painted with polyester powder paints (RAL9002), resistant to atmospheric agents.

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- .3 Compressors:
    - .1 Description: High efficiency scroll hermetic compressors activated by a 2-pole electric motor with internal heat protection.
    - .2 Two compressors
    - .3 Each compressor supplied with an electric resistance on the oil sump as standard.
    - .4 Capacity Control: On-off compressor cycling.
    - .5 Vibration Isolation: Mount individual compressors on vibration isolators.
    - .6 Compressors must be enclosed in acoustically insulated compartment.
  - .4 Refrigeration:
    - .1 Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.
    - .2 Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
    - .3 Refrigerant Circuit: Shall include a thermal-expansion valve, a discharge check valve, a mechanical dehydrator filter, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
    - .4 Each unit shall have two refrigeration circuits.
  - .5 Evaporator:
    - .1 Brazed Plate:
    - .2 Type 316 stainless-steel construction.
    - .3 Externally insulated with closed cell material to reduce thermal dispersions.
    - .4 Heater: Factory-installed and wired electric heater with integral controls designed to protect the evaporator.
  - .6 Condenser:
    - .1 Brazed Plate:
    - .2 Type 316 stainless-steel construction.
    - .3 Externally insulated with closed cell material to reduce thermal dispersions.
    - .4 Heater: Factory-installed and wired electric heater with integral controls designed to protect the condenser.
  - .7 Modularity:
    - .1 Each module shall be designed to be able to be installed as one unit up to 32 units.
    - .2 WWM shall be able to be linked together side by side, back to back, stacked on top of one another or a combination of different orientations.
    - .3 Equipped with motorized hydronic valves and factory mounted flow switches for operation with variable flow and constant flow systems.
  - .8 Electrical Power:
    - .1 Factory installed and wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to each unit.
    - .2 Electric control board access door with interlock system.
    - .3 Wiring shall be numbered and color-coded to match wiring diagram.
    - .4 Factory wiring must be supplied with the unit.

- .5 Provide each motor with overcurrent protection.
- .6 Phase-Failure and Undervoltage protection.
- .9 Electronic adjustment (Cocontrols):
  - .1 Each unit shall be provided with a control panel and display. Transducers, sensors and all the safety components are connected to the board.
  - .2 The software and parameters are memorized permanently on FLASH memory, allowing their storage even in case of lack of power supply.
  - .3 The microprocessor has the following functions:
    - .1 local or remote ON/OFF with digital inlet (external contact without voltage);
    - .2 Proportional+integral control based on the outlet water temperature, complete with "Switching Hysteresis" self-adapting work differential to always ensure the correct work schedule, even with low water flow rate. For example , in input control summer mode ,the software will use these parameters:
      - .1 Cooling set point
      - .2 Cooling differential (KP)
      - .3 Integral(if at zero it is disabled)
      - .4 Neutral zone differential
    - .3 Management of operating times: stand-by between peaks, stand-by between switch off and switch on, minimum operation time, etc;
    - .4 Management of any anomalies by alarms display ,historical alarms,cumulative faults block signal;
    - .5 Autostart after blackout
    - .6 Differential pressure switch and /or Flow switch management;
    - .7 Display of all main parameters (temperatures, pressures) regarding the operation of the machine;
    - .8 Double set-point , both summer and winter, for the temperature of the water produced, pre-set at the menu;
    - .9 Automatic compensation of set points on the basis of an external probe;
    - .10 Separate control of individual compressors; Rotation of the compressors depending on working hours;
    - .11 Pump management and rotation;
  - .4 Compatible with BACnet protocol (Aerbac accessory)
  - .5 The connection to the serial supervision assistance line in accordance with the RS485 standard is performed through the serial boards, ACCESSORY AER485P1 and the communication protocol. The terminal, which is always controlled by microprocessor, is equipped with a display, a keypad and a set of LEDs, and is used for programming check parameters( Set Points, differential band, alarm threshold) and for fundamental user operations(ON/OFF, display of controlled values).
  - .6 The terminal does not need to be connected to the PGD1 for normal controller operation, and is necessary only when initially programming the basic parameters.
  - .7 Each chiller must provide)-10VDC signal from the unit controller to modulating 3 way valve or pump on the geothermal source side to control condensation and evaporating pressures.
- .10 Insulation:



- .1 Material: Closed-cell, flexible elastomeric, thermal insulation
- .2 Factory-applied insulation over cold surfaces of water chiller components.
  - .1 Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
- .3 Apply protective coating to exposed surfaces of insulation.
  
- .11 Noise level:
  - .1 Sound Power level from the chiller, in accordance with EN ISO 9614-2.
  
- .12 Operating limits:
  - .1 The machine shall be able to produce chilled water with evaporator outlet temperature from 39.2°F to 64.4°F, with condenser water outlet temperature from 77°F to 131°F.
  
- .13 Hydraulic connections:
  - .1 The hydraulic connections shall be made with Victaulic pipes supplied as standard but independent kit to simplify maintenance.
  - .2 Manual isolation valve at headers shall be able to remove the modules without impacting the other chillers.
  
- .14 Quality control
  - .1 Chillers shall be manufactured in an ISO 9001 certified facility.
  - .2 Each unit shall be factory performance tested, full load efficiency and full load capacity. Test reports shall be made available upon request.
  
- .15 Accessories:
  - .1 For Hydraulic header kits, should have option of 6" headers kit-PN21 standard carbon steel pipes, besides 6" headers kit-PN21 schedule 40 carbon steels.
  - .2 Standard unit should have 10 kA rated electrical panel and should have option of SCCR of 65kA.
  - .3 Unit should have option of set of 2 water strainers (one for chilled water and one for hot water).

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 All units, controls and piping components shall be stored and handled according to the manufacturer's recommendation.
- .3 All outdoor units, indoor units, refrigerant branch units, controls and piping components shall be stored and handled according to the manufacturer's recommendation.
- .4 Provide for connection to electrical service. Refer to Section 26 05 80.
- .5 Align chiller on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.
- .6 Provide connections to chilled water piping. Refer to Section 23 21 00.

- .1 On inlet, provide:
  - .1 Thermometer well for temperature controller.
  - .2 Thermometer.
  - .3 Strainer.
  - .4 Flow switch.
  - .5 Flexible pipe connector.
  - .6 Pressure gauge.
  - .7 Shut-off valve.
- .2 On outlet, provide:
  - .1 Thermometer.
  - .2 Flexible pipe connector.
  - .3 Pressure gauge.
  - .4 Shut-off Valve
- .7 Provide connection to condenser water piping. Refer to Section 23 21 00.
  - .1 On inlet, provide:
    - .1 Thermometer well for temperature limit controller.
    - .2 Thermometer.
    - .3 Strainer.
    - .4 Flow switch.
    - .5 Flexible pipe connector.
    - .6 Pressure gauge.
    - .7 Shut-off valve.
  - .2 On outlet, provide:
    - .1 Thermometer.
    - .2 Flexible pipe connector.
    - .3 Pressure gauge.
    - .4 Shut-off Valve
- .8 Arrange piping for easy dismantling to permit tube cleaning.
- .9 Provide refrigerant piping connections to air cooled condensing units. Refer to Section 23 23 00 and Section 23 63 14.
- .10 Provide piping from chiller safety relief valve to outdoors. Size as recommended by manufacturer.

### **3.2 MANUFACTURER'S FIELD SERVICES**

- .1 Section 21 05 00: Prepare and start systems.
- .2 Supply service of factory trained representative to supervise testing, dehydration and charging of machine, start-up, and instruction on operation and maintenance to The City.
- .3 Supply initial charge of refrigerant and oil.

### **3.3 DEMONSTRATION AND INSTRUCTIONS**

- .1 Section 21 05 00: Demonstrating installed work.
- .2 Demonstrate system operations and verify specified performance. Refer to Section 23 05 93.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Cooling tower.
- .2 Controls.
- .3 Ladder and handrails.

**1.2 RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-place Concrete.
- .2 Section 22 10 00 - Plumbing Piping.
- .3 Section 23 05 13 - Motors.
- .4 Section 23 05 48 - Vibration Isolation.
- .5 Section 23 21 00 - Hydronic Piping.
- .6 Section 23 21 23 - Hvac Pumps.
- .7 Section 23 64 00 - Water Chillers - Packaged.
- .8 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3 REFERENCES**

- .1 AFBMA 9 - Load Rating and Fatigue Life for Ball Bearings.
- .2 AFBMA 11 - Load Rating and Fatigue Life for Roller Bearings.
- .3 ASME PTC-23 - Atmospheric Water Cooling Equipment.
- .4 Cooling Tower Institute (CTI) - Certification Standard STD-201 for Commercial Water Cooling Towers.
- .5 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

**1.4 PERFORMANCE REQUIREMENTS**

- .1 Capacity: Refer to Schedule on drawings.
- .2 This section is based on specific selections of equipment. These selections relate to the selection of related equipment. In substituting equipment, ensure that performance selection criteria matches that specified or that the selection of related equipment is acceptable or is revised to suit.

**1.5 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.
- .3 Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
- .4 Submit manufacturer's installation instructions.

- .5 Manufacturer's Certificate: Certify that cooling tower performance, based on CTI STD-201, meet or exceed specified requirements, and submit performance curve plotting leaving water temperature against wet bulb temperature.

## **1.6 SUBMITTALS AT PROJECT CLOSEOUT**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.
- .3 Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
- .4 Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.
- .5 Manufacturer's Certificate: Certify that cooling tower performance, based on ASME PTC 23 meets or exceeds specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.
- .6 Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- .7 Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.
- .8 Warranty: Submit manufacturer's warranty and ensure forms have been filled out in The City's name and registered with manufacturer.

## **1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years of experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section approved by manufacturer.

## **1.8 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

## **1.9 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Factory assemble entire unit. For shipping, disassemble into large sub-assemblies to minimize field work required for re-assembly.
- .3 Comply with manufacturer's installation written instructions for rigging, unloading, and transporting units.

## **1.10 WARRANTY**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide a one year warranty to include coverage for defects in material and workmanship labor only.
- .3 Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of five (5) years; or seven (7) if motor space heater is properly wired.

- .4 Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of seven (7) with EnduraDrive Fan System from date of shipment.

.5

### 1.11 EXTRA MATERIALS

- .1 Maintenance Materials: Furnish the following for The City's use in maintenance of project.
  - .1 See Section 016000 - Product Requirements, for additional provisions.
  - .2 Extra Fan Belts: One set, matched, for each unit.
  - .3 Extra Spray Nozzles: One nozzle kits for each cell.
  - .4 Extra Access Door Gaskets: One for each door.
  - .5 Extra Valve Seats: One for each make-up valve and control valve.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Basis of Design: Baltimore Aircoil Company
  - .1 Baltimore Aircoil Company; FXV-0809B-24D-J.
- .2 Substitutions: Refer to Section 21 05 00.

### 2.2 MANUFACTURED UNITS

- .1 Provide units for outdoor use, factory assembled, sectional, cross flow, vertical discharge, induced draft type, with sump, fan, surface sections, drift eliminators, and motor.

### 2.3 COMPONENTS

- .1 Cold Water Basin:
  - .1 Tri-layer protection system consisting of G-235 galvanized steel, a thermosetting hybrid polymer, and a polyurethane liner factory applied to all submerged surfaces. A welded Type 316 stainless steel basin is an acceptable alternative.
- .2 Casing Panels and Framework:
  - .1 Casing panels will be constructed of corrosion and UV-resistant fiberglass reinforced polyester (FRP) or Type 304 stainless steel to minimize maintenance requirements and prolong equipment life.
- .3 Fans: Multi blade, axial type, with belt drive, bearings with ABMA STD 9 or ABMA STD 11 L-10 life at 80,000 hours, with extended grease fittings.
- .4 Motors and Drives:
  - .1 Single speed (1800 rpm) mounted on adjustable steel base. Refer to Section 23 0513.
  - .2 Fan Drive System:
    - .1 Belt Drive: Designed for minimum 150 percent motor nameplate power.
- .5 Fan Guard: Welded steel rod and wire guard, hot dipped galvanized after fabrication.
- .6 Safety Railing and Ladders: Provide with safety cage from grade to fan deck.
- .7 Heat Transfer Coils:
  - .1 Wet Coils:

- .1 Galvanized Steel: The coil shall be constructed of continuous serpentine all prime surface steel, be pneumatically tested at 375 psig (2,685 kPa), and be hot-dip galvanized after fabrication. The coil shall be designed for free drainage of fluid and shall be ASME B31.5 compliant. Maximum allowable working pressure shall be 300 psig (280 psig for coils supplied with a CRN).
- .8 Distribution Section: Polyvinyl chloride piping header and branches with ABS plastic spray nozzles.
- .9 Fill:
  - .1 Polyvinyl chloride plastic with flame spread index of 25 or less, when tested in accordance with ASTM E84.
  - .2 Fungal Resistance: No growth when tested according to ASTM G21.
- .10 Drift Eliminators: Three pass PVC, drift loss limited to 0.005 percent of total water circulated.
- .11 Basin Water Level Control: PVC, balanced piston type make-up valve with plastic float.
- .12 Electronic water level control with NEMA 4 enclosure, solid state controls, stainless steel water level sensing electrodes. Stainless steel mounting hardware.
- .13 Hardware: Galvanized steel nuts, bolts, washers, and tappers; assembled with phenolic epoxy coated, corrosion resistant washer head fasteners.
- .14 Galvanized Steel Sheet Components: Hot-dipped galvanized, ASTM A653/A653M, with G235/Z700 coating, and finished with zinc chromatized aluminum paint.

## 2.4 PERFORMANCE REQUIREMENTS

- .1 This section is based on specific selections of equipment, and these selections relate to selection of related equipment, Section 232123 - Hydronic Pumps and Section 236433 - Modular Water Chillers. In substituting equipment, ensure that performance selection criteria matches that specified or that the selection of related equipment is acceptable or is revised to suit.
- .2 Capacity:
  - .1 Water Flow: 270 gpm.
  - .2 Entering Water Temperature: 95 degrees F.
  - .3 Leaving Water Temperature: 85 degrees F.
  - .4 Entering Air WB Temperature: 75 degrees F
  - .5 Ambient Air DB Temperature/Switchpoint: 40 degrees F.
- .3 Electrical Characteristics:
  - .1 7.5 hp.
  - .2 575 volts, single phase, 60 Hz.
  - .3 Refer to Section 260583.
- .4 Motor: Refer to Section 23 0513.
- .5 Disconnect Switch: Factory mount disconnect switch in control panel.

## 2.5 ACCESSORIES

- .1 Electric Immersion Heaters: In pan suitable to maintain temperature of water in pan at 20 degrees F (-28.9 degrees C) and wind velocity is 15 mph (25 kph); immersion thermostat and float control operate heaters on low temperature when the pan is filled. Heaters will be constructed of copper.

- .2 Basin Sweeper Piping: The cold water basin of the cooling tower shall be equipped with PVC sump sweeper piping with plastic eductor nozzles.
- .3 Electric Temperature Controller: In pan; with sensor to cycle fans. Coordinate with other disciplines.
- .4 Time Delay Relay: Limits fan motor starts to not more than six per hour. Coordinate with other disciplines.
- .5 Vibration Switch: Provide a mechanical local reset vibration switch. The mechanical vibration cutout switch will be guaranteed to trip at a point so as not to cause damage to the cooling tower. To ensure this, the trip point will be set in a frequency range of 0 to 3,600 RPM and a trip point of 0.2 to 2.0 g's.
- .6 Access Packages: See submittal documents for access package requirements. Platforms and ladders must ship assembled from cooling tower manufacturer.
- .7 Fan Deck Ladder with Handrails: An aluminum ladder with galvanized steel safety cage and safety gate will be provided for access to the fan deck. Access door or service platforms are not acceptable. 1-1/4 inch (32 mm) galvanized steel pipe handrail shall be provided around the perimeter of the cooling tower cells. The handrails shall be provided with knee and toe rails and shall conform to OSHA requirements applicable at the time of shipment.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one eight hour day per tower.
- .3 Install tower on structural steel beams as instructed by manufacturer.
- .4 Install tower on vibration isolators. Refer to Section 230548.
- .5 Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. Refer to Section 232113.
- .6 Connect make-up water piping with flanged or union connections to tower. Pitch to tower. Refer to Section 221005.
- .7 Connect overflow, bleed, and drain, to floor drain.

#### **3.2 FIELD QUALITY CONTROL**

- .1 See Section 014000 - Quality Requirements, for additional requirements.
- .2 Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.
- .3 Test for capacity under actual operating conditions in accordance with CTI ATC-105 and verify specified performance.

#### **3.3 MANUFACTURER'S FIELD SERVICES**

- .1 Section 21 05 00: Prepare and start systems.
- .2 Inspect tower after installation and submit report prior to start-up, verifying installation is to specifications and manufacturer's recommendations.



- .3 Supervise rigging, hoisting, and installation as appropriate.
- .4 Start-up tower in presence of and instruct The City's operating personnel.

**3.4 SCHEDULES**

- .1 Start-up tower in presence of and instruct The City's operating personnel.

**3.5 SCHEDULES**

- .1 Refer to drawings.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Reversing core energy recovery ventilators

**1.2 RELATED WORK**

- .1 Section 23 05 13 - Motors.
- .2 Section 23 05 29 – Supports and Anchors.
- .3 Section 23 05 48 - Vibration Isolation.
- .4 Section 23 05 53 – Mechanical Identification.
- .5 Section 23 05 93 – Testing, Adjusting, And Balancing.
- .6 Section 23 07 13 - Duct Insulation.
- .7 Section 23 31 00 - Duct Work.
- .8 Section 23 33 00 - Duct Work Accessories.
- .9 Section 23 34 16 – Centrifugal Fans.
- .10 Section 23 40 00 – Air Cleaning Devices.
- .11 Section 23 73 23 - Air Handling Units.
- .12 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3 REFERENCES**

- .1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- .2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- .3 AHRI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment
- .4 AHRI 1060 - Performance rating of Air-to-Air Heat Exchangers for Energy Recovery Equipment.
- .5 AMCA 99 - Standards Handbook.
- .6 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .7 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- .8 AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.
- .9 CAN/CSA C439 - Standard laboratory methods of test for rating the performance of heat/energy-recovery ventilators
- .10 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .11 UL 723 – Test for Burning Characteristics of Building Materials (ASTM E84/NFPA 255)

**1.4 SUBMITTALS**

- .1 Section 21 05 00: Common Work for Mechanical.
- .2 Shop Drawings: Indicate assembly of heat recovery units and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- .3 Manufacturer's Installation Instructions.

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**1.5 OPERATION AND MAINTENANCE DATA**

- .1 Section 21 05 00: Common Work for Mechanical.
- .2 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

**1.6 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years of experience.

**1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Section 21 05 00: Common Work for Mechanical.
- .2 Protect motors, shafts, and bearings from weather and construction dust.

**1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Do not operate equipment for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

**1.9 EXTRA MATERIALS**

- .1 Section 21 05 00: Common Work for Mechanical.
- .2 Provide two sets of filters.

**Part 2 Products**

**2.1 REVERSING CORE ENERGY RECOVERY VENTILATORS**

- .1 Manufacturers
  - .1 Price RegenCore Alternating Mass Exchanger Energy Recovery Units
  - .2 Acceptable Alternates
    - .1 Tempeff
    - .2 BKM
    - .3 Southampton
- .2 Substitutions: Not Permitted
- .3 General
  - .1 Basis of Design: Price Industries, Inc.
    - .1 High Effectiveness Energy Recovery Unit Price Model PRC
  - .2 General Product Information:
  - .3 Furnish and install Price PRC energy recovery units, as indicated on the plans with capacities and characteristics as listed in the schedule and the specifications that follow.
- .4 Unit Construction
  - .1 The cabinet shall use Thermoshield construction
  - .2 General:

- .1 The units casing shall be designed for sustainable developments with a long lasting service life. It shall:
  - .2 Include recycled and recyclable material.
  - .3 Be light in weight and high in strength.
  - .4 Support low energy loss.
  - .5 Be fire resistant.
  - .6 Have a high degree of UV reflectivity.
  - .7 Be resistant to corrosion.
  - .8 Be air tight.
  - .9 Be manufactured for low VOC production.
- .3 Cabinet Material:
  - .1 The entire cabinet with the exception of hinges and hardware shall be constructed of marine grade aluminum.
  - .2 The entire cabinet shall reduce galvanic corrosion within the system by:
    - .1 Minimizing the use of dissimilar metals.
    - .2 Ensuring anodic materials are larger in surface area than contacted cathodic materials.
  - .3 Both external and internal steel supports are not permitted.
- .4 Cabinet Construction:
  - .1 All areas of the unit in contact with treated air shall have double wall construction, with a marine grade aluminum liner.
  - .2 The unit frame and panel components shall be constructed with a double thermal break. The balance to be at minimum a single thermal break.
  - .3 The cabinet will be designed to minimize fastener penetration through the inner and outer wall. Through penetrations that cannot be eliminated shall be water sealed on the outer wall and vapor sealed on the inner wall.
  - .4 The unit shall include an integral base constructed from marine grade aluminum and include lifting points.
- .5 Finish
  - .1 All marine grade aluminum cabinet surfaces shall be unpainted.
- .6 Insulation:
  - .1 The cabinet insulation shall have the following characteristics:
    - .2 The insulation R-value shall be a minimum of R14.
    - .3 The insulation shall have a flame spread and smoke development index of 0, when tested according to ASTM E84, CAN/ULC S102, and UL723.
    - .4 The insulation shall be chemically inert, water resistant, and shall not rot or sustain vermin.
    - .5 The insulation shall be corrosion resistant when tested according to ASTM C795 and ASTM C665
    - .6 The insulation shall not promote the growth of fungi or mildew, when tested according to ASTM C1338.
    - .7 The insulation shall display low moisture sorption when tested according to ASTM C1104.
    - .8 The insulation shall have a VOC content of 0, and shall be non-off-gassing.
- .7 Component Access:

- 
- .1 Units shall be designed so that all components can easily be removed through access doors and removable panels, with the exception of heating components.
  - .2 Dismantling of the structural components of the unit shall not be required for component service or replacement with the exception of heating components.
  - .3 All access doors and removable panels on the air handling section shall be gasketed and close against positive pressure.
    - .1 All access doors and removable panels will include a pressure relief latch.
  - .8 Drain Pan:
    - .1 The units shall be supplied with cleanable, positive draining, drain pan(s).
    - .2 The drain pan(s) shall be marine grade aluminum. Alternative materials shall not be acceptable in order to prevent the potential for galvanic corrosion.
    - .3 The drain pan(s) shall be designed as necessary to prevent carryover of water droplets beyond the drain pan to 0.0044 oz/ft<sup>2</sup> (1.5 mL/m<sup>2</sup>) of face area per hour under peak sensible and peak dew-point conditions, accounting for both latent load and a coil face velocity 20% above the design velocity.
  - .9 Hardware:
    - .1 All hardware, hinges, handles and fasteners shall be non-corrosive.
    - .2 All external hardware, handles and fasteners, shall be non-corrosive aluminum.
    - .3 All internal fasteners used on insulated panels shall be non-corrosive aluminum.
  - .10 Electrical Panels:
    - .1 All electrical panels located in the air handler shall have sealed and insulated doors.
  - .5 Components
    - .1 Supply/Return Fans:
      - .1 The energy recovery unit shall be provided with direct-drive airfoil plenum supply and return fans. The fan assemblies shall be dynamically balanced and selected at speed below critical RPM.
      - .2 The fan and motor shall be mounted internally on a steel base-frame complete with spring vibration type isolators. The unit casing shall include a hinged access door to permit access to the motor, drive, and bearings.
      - .3 The motor shafts shall be steel construction, and shall be solid, ground and polished, keyed, and protectively coated with lubricating oil. Hollow shafts shall not be acceptable.
    - .2 Electrical:
      - .1 The air handler shall bear an ETL, UL, or CSA listing label. The electrical components shall be CSA, UL or CE listed, as applicable.
      - .2 The unit shall be supplied with a single point power supply connection.
      - .3 Terminal lugs shall be provided in accordance with the branch circuit conductor quantities, sizes, and materials indicated.

- .4 All wires shall be tagged and cross-referenced to the wiring diagram for ease of troubleshooting.
- .5 Fan motors shall be premium efficiency totally-enclosed fan-cooled (TEFC), driven with a variable-frequency drive (VFD). Electrical characteristics shall be as shown in the equipment schedule.
- .3 Filters:
  - .1 The unit shall be supplied with filters supported in racks, which shall be accessible through hinged and latching access-doors on at least one side of the unit.
  - .2 The filter media shall be UL 900 listed, Class I or Class II.
  - .3 Filters shall be mounted in a flat or angled arrangement with 4 inch, 100 millimeter pleated panel filters.
- .4 Energy Recovery Cores:
  - .1 Unit shall be equipped with Price RegenCore™ Energy Recovery Technology. The unit shall have sensible effectiveness of 90 percent (plus or minus 5 percent) in winter and up to 80 percent in summer. The unit shall also provide up to 70 percent latent recovery.
  - .2 Unit shall accomplish energy recovery without a defrost cycle down to -40 degrees Fahrenheit (-40 degrees Celcius). Devices employing defrost cycles that bypass the heat recovery device or reduce the effectiveness shall not be acceptable.
  - .3 The energy recovery cores shall consist of 0.032 inch thick type 1100 aluminum alloy plates.
- .5 Dampers:
  - .1 The unit shall be supplied with a switchover damper system comprised of four multi-section, low-leakage, AMCA certified dampers.
  - .2 The dampers shall meet the following requirements:
    - .1 AMCA Leakage Class 1A at 1 inch water gauge static pressure differential.
    - .2 AMCA Leakage Class 1 at 4 inches water gauge static pressure differential.
  - .3 The dampers shall be operated by CSA-listed electric motors. The motors shall drive the dampers full-open to full-closed and full-closed to full-open in less than 0.75 seconds.
  - .4 The damper blades shall be aluminum for long life expectancy, and shall be insulated and thermally-broken dampers, as required to meet the job requirements.
  - .5 The switchover damper system shall be capable of closing off outside-air to the building without needing additional shut-off dampers. Energy recovery units employing single blade dampers shall include external shut-off dampers.
  - .6 The unit dampers shall be capable of positioning to allow 100 percent recirculation of air without using the heat recovery device for off-peak or unoccupied heating modes. Units incapable of these operations shall not be acceptable.
- .6 Microprocessor-Based Controls:
  - .1 The unit shall have a Carel microprocessor control system designed to provide precision dew point and dry bulb control by controlling the variable capacity cooling, variable capacity reheat and the variable capacity heat (if required).

- .2 The controller shall have a backlit LCD screen and shall be menu driven. The screen commands and outputs shall be in plain English. Alpha Numerical codes shall not be acceptable.
- .3 The controller shall have battery back-up protecting all user settings in the event of a power outage.
- .4 The controller shall work in ambient conditions from 10 to 125 °F (-12 to 52 °C) and 95% relative humidity (RH) non-condensing.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 The energy recovery unit shall be installed in accordance with the manufacturer's installation instructions and all applicable building codes.

#### **3.2 Environmental Requirements**

- .1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

#### **3.3 Maintenance**

- .1 Refer to Section 01 70 00 - Execution and Closeout Requirements for additional requirements relating to maintenance service.
- .2 A separate maintenance contract shall be provided for specified maintenance service.

**END OF SECTION**

**Part 1**

**General**

**1.1**

**SECTION INCLUDES**

- .1 Packaged air handling units.
- .2 Heating coils.
- .3 Cooling coils.
- .4 Mixing boxes.
- .5 Filter sections.
- .6 Combination filter/mixing boxes.

**1.2**

**RELATED SECTIONS**

- .1 Section 22 10 00 - Plumbing Piping: Equipment drains.
- .2 Section 23 05 13 - Motors.
- .3 Section 23 05 16 - Piping Expansion Compensation.
- .4 Section 23 05 48 - Vibration Isolation.
- .5 Section 23 07 13 - Duct Insulation.
- .6 Section 23 31 00 - Duct Work.
- .7 Section 23 33 00 - Duct Work Accessories: Flexible duct connections.
- .8 Section 23 34 16 - Centrifugal Fans.
- .9 Section 23 40 00 - Air Cleaning Devices.
- .10 Section 23 82 16 - Air Coils.
- .11 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3**

**REFERENCES**

- .1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- .2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- .3 AMCA 99 - Standards Handbook.
- .4 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .5 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- .6 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- .7 AMCA 500 - Method of Testing Louvres for Ratings.
- .8 AMCA 5000 - Method of Testing Dampers for Ratings.
- .9 ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- .10 ARI 430 - Fabrication of Central Station Air Handling Units.
- .11 ARI 435 - Application of Central-Station Air-Handling Units.
- .12 ARI 610 - Central System Humidifiers for Residential Applications.
- .13 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .14 UL 900 - Air Filter Units.



- .15 Manitoba Energy Code for Buildings
- .16 NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- .17 ASHRAE 90.1 Energy Code.
- .18 ASTM B117 - Standard Practice for Operating Salt Spray Apparatus.
- .19 NEMA MG1 - Motors and Generators.
- .20 UL 723 - Test for Surface Burning Characteristics of Building Materials.
- .21 UL 900 - Test Performance of Air Filter Units.
- .22 UL 94 - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.
- .23 AHRI Standard 1060 - Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.

#### **1.4 SUBMITTALS**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements. Computer generated fan curves for each air handling unit shall be submitted with specific design operating point noted. A computer generated psychometric chart shall be submitted for each cooling coil with design points and final operating point clearly noted. Sound data for discharge, radiated and return positions shall be submitted by octave band for each unit. Calculations for required baserail heights to satisfy condensate trapping requirements of cooling coil shall be included..
- .3 Product Data:
  - .1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
  - .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
  - .3 Provide fan curves with specified operating point clearly plotted.
  - .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
  - .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .4 Manufacturer's Installation Instructions.

#### **1.5 OPERATION AND MAINTENANCE DATA**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

- .3 All indoor units, painted or unpainted, shall be completely shrink-wrapped from the factory for protection during shipment. Tarping of bare units is unacceptable.
- .4 Inspect for transportation damage and store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish. Store in clean dry place and protect from weather and construction traffic.

## 1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

## 1.8 EXTRA MATERIALS

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide one set for each unit of fan belts and filters.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Engineered Air
- .2 Substitutions: Refer to Section 21 05 00

### 2.2 GENERAL DESCRIPTION

- .1 Units shall ship in the number of sections necessary to meet project requirements and shall ship in as many splits as specified in selection software. Split options as follows:
  - .1 Shipped in sections — shipping split.
  - .2 Shipped assembled — base rail break (ship attached).
  - .3 Shipped assembled — solid base rail.
- .2 Unit shall be factory-supplied, central station air handler. The air-handling unit may consist of a fan with the following factory-installed components as indicated on the equipment schedule.
  - .1 Mixing Box Section:
    - .1 No filter tracks
    - .1 Exhaust Box Section.
    - .2 Filter Section:
      - .1 Side loading 12-in. bag/cartridge filters with 2-in. pre-filters.
    - .3 Coil Section:
      - .1 Chilled water coil.
      - .2 Hot water coil.
  - .3 Fan Section:
    - .1 Horizontal draw-thru (supply, return).

### 2.3 UNIT CONSTRUCTION

- .1 Construction:
  - .1 Unit shall be constructed of a complete frame with easily removable panels. Removal of any panel shall not affect the structural integrity of the unit.

- .2 All units shall be supplied with 14-gage or heavier, G-90 galvanized steel base rails. Bolt-on legs are NOT acceptable. Perimeter lifting lugs for overhead lifting shall be provided on each shipping section. Slinging units in place of lifting lugs shall not be acceptable.
- .3 Unit shall be thermally broken to minimize the conduction path from the inside of the casing to the outside.
- .4 Casing panels (top, sides, and bottom) shall be constructed of galvanized steel, 18 gauge, and shall have one of the following interior finishes as specified:
  - .1 G-90 pre-coated galvanized steel with a silver zeolite antimicrobial material registered by the US EPA (Environmental Protection Agency) for use in HVAC applications.
  - .2 Aluminum diamond treadplate floors
- .5 Casing panels (top, sides, and bottom) shall be one piece, double-wall construction with foam insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.
- .6 Casing deflection shall not exceed a L/240 ratio when subject to an internal pressure of  $\pm 8$ -in. wg and shall exhibit no permanent deformation at  $\pm 9$ -in. wg. L is defined as the longest linear panel or cabinet length (measured to AHRI 1350 Cd level 2).
- .7 Casing leakage rate shall be less than 1% at 8 in. wg of nominal unit airflow or 50 cfm, whichever is greater. Leakage rate shall be tested and documented on a routine basis on random production units. Optionally, factory witness leak testing and/or test reports shall be available.
- .8 Side panels shall be easily removable for access to unit and shall seal against a full perimeter automotive style gasket to ensure a tight seal.
- .9 The panel retention system shall comply with UL 1995 which states all moving parts (for example, fan blades, blower wheels, pulleys, and belts) that, if accidentally contacted, could cause bodily injury, shall be guarded against accidental contact by an enclosure requiring tools for removal.
- .10 Accessibility options shall be as follows:
  - .1 Hinged, lockable double-wall access door on either side with removable access panel(s) on the other side.
    - .1 Fan supports, structural members, panels, or flooring shall not be welded, unless aluminum, stainless steel, or other corrosion-resistant material is used. Painted welds on unit exterior steel or galvanized steel are not acceptable.
    - .2 All coil sections shall be doublewall construction with foam insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13. Single height coil sections shall have removable frame sections to facilitate vertical coil extraction.
    - .3 Blow-thru sections shall have a diffuser plate as an integral part of the fan section.
- .11 Access Doors:
  - .1 Access doors shall be one piece, hinged, lockable double-wall construction with foam insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.
- .12 Drain Pans:
  - .1 Drain pans shall be foam insulated double-wall galvanized or stainless steel construction (18 gauge optional). The pan shall be sloped toward the drain connection. Drain pan shall have 1 1/2-in. MPT connection

exiting through the hand side or opposite side of the casing as specified. One drain outlet shall be supplied for each cooling coil section. Drain pan shall allow no standing water and comply with ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers). Standard 62.1-2010. Where 2 or more coils are stacked in a coil bank, intermediate drain pans shall be provided and the condensate shall be piped to the bottom drain pan. The bottom coil shall not serve as a drain path for the upper coil.

## 2.4

### FANS

#### .1 General:

.1 Forward-curved fan sections shall have one double-width double-inlet (DWDI) fan wheel and scroll. They shall be constructed of galvanized steel with baked enamel. They shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fans shall have an AMCA class rating corresponding to the static pressure at which the fan is designed to operate (Class I or II). Completed fan assembly shall be dynamically balanced in accordance with AHRI Guideline G and ANSI S2.19 at design operating speed using contract drive and motor if ordered.

.1 Fan assembly vibration shall not exceed 0.248 in. per second when mounted on active isolators. Vibration shall be measured in both vertical and horizontal directions at the specified fan operating speed using specified motor. For testing purposes, accelerometers shall be mounted on the motor near the bearing locations and removed before shipment

.2 All fan sled components shall provide corrosion protection to pass 100-hour salt spray test per ASTM B-117.

.3 Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected with a maximum operating speed 25% below the first critical.

.4 Belt drive fan motor shall be mounted within the fan section casing on slide rails equipped with adjusting screws. Motor shall be premium efficiency, open drip-proof or totally enclosed fan cooled NEMA (National Electrical Manufacturers Association) Design A or B with size and electrical characteristics as shown on the equipment schedule. Motor shall be mounted on a horizontal flat surface and shall not be supported by the fan or its structural members. All three-phase motors shall have a  $\pm 10\%$  voltage utilization range and a 1.15 minimum service factor. Motor shall be compliant with the Energy Independence and Security Act (EISA) of 2007 where applicable. Single-phase motors shall be available up to and including 5 hp.

#### .2 Performance Ratings:

.1 Fan performance shall be rated and certified in accordance with AHRI Standard 430, latest edition.

#### .3 Sound Ratings:

.1 Manufacturer shall submit first through eighth octave sound power for fan discharge and casing radiated sound. Sound ratings shall be tested in accordance with AHRI 260.

#### .4 Mounting:

.1 Fan scroll, wheel, shaft, bearings, drives, and motor shall be mounted on a common base assembly. The base assembly is isolated from the outer casing with factory-installed isolators and rubber vibration absorbent fan discharge seal.

A canvas style duct connection between fan discharge and cabinet is not acceptable. Units shall use 2-in. deflection spring isolators.

- .5 Fan Accessories:
  - .1 Forward-curved fans:
    - .1 Flexible Connection:
  - .2 The base assembly is isolated from the outer casing with factory-installed isolators and rubber vibration absorbent fan discharge seal. A canvas style duct connection between fan discharge and cabinet is not acceptable.

## 2.5 BEARINGS AND DRIVES

- .1 Bearings:
  - .1 Self-aligning, grease lubricated, anti-friction with lubrication fittings extended to drive side of fan section. Optional grease fittings extended to the exterior of the casing are available. All bearing life calculations shall be done in accordance with ABMA 9 for ball bearings and ABMA 11 for roller bearings.
    - .1 Size 03 to 110 forward-curved fans: Cartridge type bearings for Class I fans. Heavy-duty pillow block type, self-aligning, regreasable ball or roller type bearings selected for a minimum average life (L50) of 200,000 hours or optionally for an (L50) of 500,000 hours.
- .2 Shafts:
  - .1 Fan shafts shall be solid steel, turned, ground, polished and coated with a rust inhibitor.
- .3 V-Belt Drive:
  - .1 Drive shall be designed for a minimum 1.2 service factor as standard with a 1.5 service factor option and/or a factory-supplied extra set of belts. Drives shall be fixed pitch with optional variable pitch for motors 15 hp and less. All drives shall be factory mounted, with sheaves aligned and belts properly tensioned.

## 2.6 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- .1 Motor:
  - .1 TEFC, refer to 23 05 13 Motors for additional information
  - .2 Refer to schedules for motor sizes
- .2 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

## 2.7 COILS

- .1 All water, steam and direct expansion (DX) refrigerant coils shall be provided to meet the scheduled performance. All coil performance shall be certified in accordance with AHRI Standard 410. All water and direct expansion coils shall be tested at 450 psig air pressure. Direct expansion coils shall be designed and tested in accordance with ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration (latest edition). Factory-supplied 1/2-in. OD coils shall be covered under the standard product one-year limited warranty. All steam coils, integral face and bypass coils and 5/8-in. OD coils shall be warranted for a period not in excess of 12 months from their shipment from the manufacturer. Coil epoxy coating shall be covered under a 5-year limited warranty from the date of shipment from the manufacturer.
- .2 General Fabrication:

- .1 All water and refrigerant coils shall have minimum 1/2-in. OD copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.016 inches. Optional tube wall thickness of 0.025 in. shall be supplied, if specified.
- .2 Aluminum plate fin type with belled collars. Fin type shall be sine wave construction.
- .3 Aluminum-finned coils shall be supplied with die-formed casing and tube sheets of mill galvanized steel or stainless steel as specified.
- .3 Hydronic Heating and Cooling Coils:
  - .1 Headers shall be constructed of steel with steel MPT connections. Headers shall have drain and vent connections accessible from the exterior of the unit. Optional non-ferrous headers and red brass MPT connections shall be supplied if specified.
  - .2 Configuration: Coils shall be drainable, with non-trapping circuits. Coils will be suitable for a design working pressure of 300 psig at 200°F.

## 2.8 FILTERS

- .1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.
- .2 The filter modules shall be designed to slide out of the unit. Side removal 2" (50mm) filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.
- .3 2"(50mm) and 4"(100mm) Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Permanent re-usable metal enclosing frame required on outside air filter sections. The filter media shall have a minimum of 2" MERV 8 in the Exhaust Airstream and 4" MERV 13 in the Supply Airstream.
- .4 Filter media shall meet UL Class 2 standards.

## 2.9 DAMPERS

- .1 Factory-supplied dampers shall be warranted to be free from defects in material and workmanship for a period of 12 months after being installed or placed in service, but in no instance shall the period of warranty be longer than 18 months from the date of the original shipment by the manufacturer.
- .2 Mixing boxes and exhaust boxes shall have parallel or opposed blades and interconnecting outside-air and return-air dampers. Bottom damper locations shall be optionally available with a tool screen to prevent most objects from falling through a bottom damper opening.
- .3 Damper blades shall be constructed of galvanized steel, with blade seals and stainless steel jamb seals. Blades shall be mechanically fastened to axle rods rotating in self-lubricating synthetic bearings. Maximum leakage rate shall be 4 cfm/ft<sup>2</sup> at 1 in. wg differential pressure.
- .4 Mixing Box shall be controlled through the DDC system.

## 2.10 CONTROLS/WIRING

- .1 All controls, low-limit, high limit safeties installed and wired by the Controls Subcontractor.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Install to manufacturer's written instructions.
- .2            Install to ARI 435.
- .3            Install assembled unit on vibration isolators. Refer to Section 23 05 48.

**END OF SECTION**

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**Part 1            General**

**1.1                Scope**

- .1      Furnish and install where indicated, factory-assembled, enclosed swimming pool environmental control/ energy recovery system. System shall include,
- .2      Furnish and install, where indicated, a factory-assembled, fully-enclosed, packaged environmental control system with energy recovery feature(s) designed for natatorium environment control
- .3      Features shall include:
  - .1          Dehumidification by means of a direct expansion evaporator coil
  - .2          Space heating by means of a packaged hot water coil
  - .3          Cooling mode with heat rejection to a fluid loop by means of a brazed plate heat exchanger
  - .4          Packaged minimum exhaust fan
  - .5          Integral minimum outdoor air connection
  - .6          Heat recovery by means of a glycol run-around loop between the minimum exhaust and minimum outdoor air streams
  - .7          Unit to arrive on site in sections and re-assembled on site by Subcontractor. Once re-assembled, Subcontractor must also provide glycol in the field.
  - .8          Unit to have no access on one side.

**1.2                Quality and Safety Assurance**

- .1      The complete unit shall be listed by an industry recognized, third-party, safety code agency under the title of "Special Purpose Air Conditioners" and carry the appropriate label.
- .2      The system shall be ETL listed
- .3      The system shall be completely assembled, wired, piped, and test-run at the factory prior to shipping. All controls shall be factory adjusted to satisfy the design conditions. A factory test report shall be available, upon request
- .4      Manufacturer shall have a minimum of five-plus years prior experience making similar equipment as described in this specification.
- .5      Wherever possible, the system shall have a mechanical vestibule where the electrical panel, compressor(s), pool water heat exchanger(s), receiver(s) and most of the refrigeration controls are out of the process air stream
- .6      Warranty: The entire system shall have a 24-month limited parts warranty from the factory ship date
  - .1          A 1-year labour warranty shall be provided by the manufacturer when the system is connected to the factory via an Internet monitoring system from the date of initial commissioning
  - .2          The compressor(s) shall have a 5-year warranty from the factory ship date



- .7 When connected to a network with Internet access, the system shall have remote service capability with the ability for field service technicians to receive service and trouble alerts by e-mail and make parameter adjustments via a browser interface on any Internet-capable device

### **1.3 Intent**

- .1 It is the intent of this section of the specifications to provide a complete, operable, adjusted natatorium dehumidification system as shown and scheduled on the plans.

### **1.4 Basis of Design**

- .1 Base Bid/Alternate
- .1 Unit shall be base bid with Dectron and LD Series.
  - .2 If alternate equipment is proposed the bid shall indicate revised layout including details on supply/return air connections, piping connections, ventilation/exhaust connections, power/control wiring connections.
  - .3 10 day prior: alternate equipment shall include Full Compliance Disclosure (by paragraph and schedule) to be submitted to the Contract Administrator ten days prior to the bid and approved by the Contract Administrator in writing prior to the bid. Full Disclosure shall clearly list and define any exceptions or deviations to the specified equipment and specified performance, and any items, which exceed the specifications. Alternate equipment Manufacturer shall include a full disclosure of the unit's energy recovery features including unit's reheat capabilities, pool water heating capabilities and recovery of pool water evaporation energy.
  - .4 Where the intent of the specification is met but with different construction materials or methods, the difference shall be completely defined by paragraph in the Full Disclosure. The Full Disclosure shall include complete documented data.
  - .5 Manufacturer shall submit the following bidder's checklist with his proposal to the Mechanical Subcontractor. It shall be the Mechanical Subcontractor's responsibility to provide any modifications to the equipment to make the unit conform to the specification.
- .2 Alternate equipment Checklist:
- .1 Service Vestibule with compressors out of the air stream
  - .2 Refrigerant pressure transducers used for active control of the refrigeration system and no manifold gauges needed to service the equipment
  - .3 Fully dipped airside coils for corrosion protection
  - .4 Fully modulating reheat coil for stable space temperature control from the DX system. Coil sized for rejecting 100% of all compressors heat.
  - .5 All fans direct drive with VFD or ECM
  - .6 Each evaporator coil provided with a baked powder painted IAQ Aluminum drain pan
  - .7 Two speed fluid cooler or outdoor condenser fans
  - .8 Cabinet 2" double walled with fully painted inner metal liner
  - .9 Fluid cooled unit with Heat rejection outdoors via a fluid cooler
  - .10 Heat recovery from the minimum exhaust air stream used to directly preheat the incoming minimum outdoor air stream

- .11 Web-based interface capable of live interface with unit from smart phone with logging/trending data for up to 20 variables in one minute intervals per 24 hour period for factory service instant access
- .12 Unit controller holds memory of basic refrigerant system info for 2 years of hourly data and 5 days of one-minute interval data
- .13 Standard fully dipped coating on all air side coils: corrosion resistance and hydrophilic (decreasing water carryover and increasing
- .14 Indirect fired gas heater packaged inside the unit

## **Part 2 Product**

### **2.1 General**

- .1 The natatorium control system shall include:
  - .1 Mechanical process dehumidification
  - .2 Indoor cabinet configuration
  - .3 Packaged fluid cooled condensing brazed plate heat exchanger for AC heat rejection
  - .4 A packaged hot water heating coil, sized as specified by the Contract Administrator to meet the skin losses and outdoor air heating loads
  - .5 Air filtration via MERV-8 2-inch pleated panel filters for return and outdoor air
  - .6 Minimum exhaust fan(s)
  - .7 Heat recovery between the minimum exhaust air and outdoor air streams and via a glycol run around loop
  - .8 A service vestibule where the compressor, refrigeration specialties, control valves and all electronics are outside of process air stream

### **2.2 Sequence of Operation**

- .1 The system shall be designed and sized to maintain the specified space conditions
- .2 System Startup
  - .1 Power is turned on or the system is restarted
  - .2 After a short initial delay to allow the sensors to stabilize, the blower starts and operates continuously
  - .3 Based on sensor feedback, the system shall begin or resume operation based on the sequence below
- .3 Airside Configuration
  - .1 The system continuously delivers the specified supply air volume to the natatorium
  - .2 The minimum exhaust air volume is set to meet the schedule.
  - .3 The minimum outdoor air volume is set to meet the schedule.
- .4 Dehumidification Mode
  - .1 The return air relative humidity is above the humidity setpoint
  - .2 Return air dewpoint is above dewpoint setpoint.

- .3 The compressor enters the Compressor Start sequence
- .4 If the system cannot maintain the relative humidity below setpoint, the second compressor circuit will start
- .5 Compressor waste heat is rejected into a glycol fluid loop which feeds the reheat coils and the air conditioning air-cooled heat exchanger in parallel.
- .6 The reheat coils are fully modulating (0-100%). The reheat output will modulate to maintain the space temperature at set point year-round
- .5 Air Conditioning Mode
  - .1 The return air temperature is above the room temperature setpoint
  - .2 The compressor starts, if not already operating in Dehumidification Mode
  - .3 100% of compressor heat is rejected at the outdoor air-cooled heat exchanger on a summer design day. On off-peak days, the air reheat output will modulate to maintain the space temperature at the set point
  - .4 If the system cannot maintain the return air temperature setpoint, the second compressor will start
- .6 Space Heating Mode
  - .1 The return air temperature is below the room temperature setpoint
  - .2 The microprocessor space heating output signal (0-10 volts) is sent to the heating coil controller. The signal output will regulate based on the return air temperature
- .7 Exhaust Air Heat Recovery Mode
  - .1 The minimum outdoor air damper and minimum exhaust fan(s) are tied to the system's occupancy schedule and will operate as programmed
  - .2 Once the outdoor air temperature falls below the heat recovery setpoint (65 °F by default; field-adjustable) the glycol pump shall circulate a glycol mixture between the exhaust air and the outdoor air heat recovery coils, recovering heat from the space condition exhaust air and using it to preheat the incoming outside air
- .8 Freeze Protection
  - .1 The supply air temperature falls below the freezestat setpoint or the optional freezestat sensor indicates a freezestat condition
  - .2 Exhaust fan(s) are stopped and outdoor air damper(s) are fully closed
  - .3 When the freezestat alarm is tripped, it must be manually cleared by the operator

## **2.3 Cabinet**

- .1 The system shall be designed and configured for indoor installation with a 2" double-walled cabinet including painted inner liner
  - .1 Infill panels and doors shall be constructed with 18 gauge G90 galvanized steel exterior and 18 gauge mil aluminum finish interior suitable for chlorine and pool chemical resistance.
  - .2 The structural base frame shall be 3/16" steel channel base with 12-gauge steel cross bracing.
- .2 Cabinet Construction: All cabinet 16, 20 and 24 gauge sheet metal shall be galvanized G90 steel or Galvalume™ alloy with mill-applied zinc phosphate primer followed by an exterior grade white silicone modified polyester top coat. The sheet metal is engineered to

form a cabinet with maximum strength and rigidity. All seams shall be caulked with silicone to prevent air and water leakage or infiltration

- .1 Base Rails: The cabinet shall have a base frame comprised of 2 layers of 10 gauge mill galvanized G90 steel. Lifting lugs shall be provided on the base frame for rigging the system
  - .2 The cabinet walls shall be of double-wall construction using 20 gauge pre-painted steel with a fully painted inner metal liner and 2 inches of fiberglass insulation
  - .3 The cabinet floor shall be comprised of a 16-gauge galvanized steel panel with a 20-gauge pre-painted steel inner liner, 2-inch double wall engineered with structural bending for maximum rigidity and be mechanically fastened to the base frame of the unit
  - .4 The cabinet roof shall be 20-gauge pre-painted steel, 2-inch double wall engineered with structural bending for maximum rigidity and be mechanically fastened to the base walls of the unit
  - .5 The cabinets shall be mechanically assembled with stainless steel 5/32" sealed blind rivets. Where bolts are required bright zinc plated bolts shall be used
  - .6 Access doors shall be supported on multiple hinges, held shut by compression latches for quick access. Doors shall be provided for entrance to all sections housing components requiring routine maintenance. Full height access doors shall have "hold back" latches to prevent door closure during the performance of service procedures
  - .7 Access doors shall be mounted on multiple combination hinge/latch mechanisms which swing either direction 180 degrees and lifts off. Doors shall be provided for entrance to all sections housing components requiring routine maintenance. Doors shall be secured with minimum two tool-operated latches and sealed against the frame with rubber gasket material.
  - .8 The system shall have non-corroding protective mesh screens covering internal fan blades, protective grates covering all floor access ports
- .3 Outdoor Air Intake:
- .4 Insulation: The unit shall be insulated per the following standards:
- .1 All exterior cabinet sections shall be insulated with two (2) inch thick fiberglass inside the double walled cabinet
  - .2 Fire resistant rating to conform to NFPA Standard 90A and 90B
  - .3 Sound attenuation coefficient shall not be less than 1.02 at a frequency of 1,000 Hz as per ASTM Standard C423
  - .4 Thermal conductivity shall not exceed 0.26 Btu/hr-sqft-ft at 75 °F
- .5 Cabinet configuration shall include:
- .1 A filter rack with separate access doors shall be provided for the return air and minimum outdoor air streams
  - .2 Mechanical vestibule: The unit shall have the compressor, receiver, solenoid valves and the electrical panel in a separate compartment out of the processed air stream. All components shall be serviceable while the unit is in operation without disturbing the airflow
  - .3 Electrical panel: The unit shall have a built-in electrical control panel in a separate compartment in order not to disturb the airflow within the dehumidifier

during electrical servicing. All electrical components shall be mounted on a 16 gauge galvanized sub-panel

## 2.4 Filters

- .1 Wherever possible, air filters shall be standard sized, replaceable, off-the-shelf filters including:
  - .1 Return Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure on a face loading rack
    - .1 Supply Air: 2-inch MERV 8, 30% pleated filters with rust-free non-metallic structure on face loading rack.
  - .2 Exhaust Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure
    - .1 Exhaust Air: 2-inch MERV 8, 30% pleated filters with rust-free non-metallic structure.
  - .3 Outside Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure
    - .1 Outside Air: Washable, aluminum media type with aluminum U-channel frame wrapped around the perimeter of crimped layers of aluminum media. The frame is designed with drain holes to ensure removal of excess water.

## 2.5 Coils

- .1 Evaporator/dehumidifier coils shall be designed for maximum moisture removal capacity
  - .1 Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion protection. Coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases
  - .2 Coil shall have galvanized casing and end plates
  - .3 Aluminum fin and copper tubes mechanically bonded to assure high heat transfer.
- .2 Air reheat coils shall be sized for variable heat transfer into the air with a capacity of 100% of the compressors total required heat of rejection
  - .1 Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion protection. Coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases
  - .2 Coil shall have galvanized casing and end plates
  - .3 Aluminum fin and copper tube joints mechanically bonded to assure high heat transfer
- .3 Heat Recovery Coils
  - .1 The unit shall have heat recovery between the minimum exhaust and outdoor air streams per specifications
  - .2 The heat recovery coils shall be sized for heat transfer between the two air streams
  - .3 The heat recovery fluid circulating between coils shall be glycol. The module shall be a complete package and independent circuit that includes a circulating pump, fill valves and expansion tank

- .4 Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion protection. Coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases
- .5 Aluminum fin and copper tube joints mechanically bonded to assure high heat transfer

## 2.6 Drain Pans

- .1 Each evaporator coil shall be provided with a positive draining, compound-sloped, baked powder paint coated aluminum drain pan with fully-welded corners to ensure zero water retention

## 2.7 Blowers and Blower Motors

- .1 Supply blowers:
  - .1 The direct driven supply air blower wheel shall be a single width/single inlet airfoil plenum type, secured a machined, ground and polished solid steel shaft. The wheel shall be G90 galvanized steel with baked powder paint coating. The shaft shall be coated with a rust inhibitor
  - .2 The complete blower assembly shall be statically and dynamically balanced on precision electronic balancers
  - .3 The blower assembly shall be mounted on a 1" deflection spring isolated rack
  - .4 The fan inlets shall be equipped with accidental contact protection screen
  - .5 Motor(s) shall be Premium efficiency painted cast iron construction TEFC, NEMA MG1-PART 31 Inverter Duty 15:1 Constant Torque Severe Duty with a service factor 1.25. Motors shall be 6 Pole 1200 RPM synchronous speed with HOA switch with motor safeties against overloading at 60 Hz operation directly on mains. Motors shall have double lip seals on both ends with re-greasable bearings 254T frame and larger with Polyurea grease
  - .6 The motor shall be provided with a low motor noise and high starting torque VFD for air balancing purposes. The VFD shall have a drive efficiency of 96 to 98% with displacement power factor of 0.98, output maximum frequency of 400 Hz with torque boost. The VFD shall have protective features including: torque limit, heat sink over-temperature, current-limiting DC bus fuse, electronic motor overload with phase-to-phase and ground fault short circuit protection; current limit, over/under torque protection, over/under voltage protection, short circuit current rating of 30kA rms symmetrical and 100kA rms symmetrical
- .2 Exhaust blowers:
  - .1 The packaged exhaust blower (EF1) shall be sized to maintain the negative pressure requirement in the space during normal operation and its operation tied to the system's occupancy scheduler
  - .2 The blower shall be impeller plenum fan complete with backward curved, three-dimensional, profiled blades made of high performance composite material. The blower shall be completely corrosion resistant and be maintenance free a direct drive via a direct current (DC) electronic commuted (EC) motor. The EC-Motor shall have zero slippage design and have continuously variable speed control when connected to the unit's controller
  - .3 The fan assembly shall be balanced in Class G 6.3 acc DIN ISO 1940, dynamic on two levels

- .4 The fan assembly shall be suitable for ambient temperatures of  $-40^{\circ}\text{C}$  to max.  $+70^{\circ}\text{C}$
- .5 Thermal contacts installed in the windings compliant with THCL 155
- .6 Drive motor in external rotor principle, sealed in protection class IP54 with moisture protection impregnation of the windings, topical protection
- .7 High corrosion resistance design with high quality and reliability
- .8 The exhaust fan shall be controlled from an end switch on the power open of the exhaust air damper
- .9 Shall be packaged with the heat recovery module

## **2.8 Dampers**

- .1 Internal dampers shall be made from extruded anodized aluminium with a parallel blade configuration and neoprene double-seal tips to minimize leakage. Damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant
  - .1 The system shall be provided with normally closed outside air and exhaust air dampers equipped with spring-return actuators. The dampers adjust between 0% to 100% open position.
  - .2 The outdoor air and exhaust air dampers shall be of opposed blade configuration. Dampers shall have 0.750-inch insulated blades made from extruded anodized aluminium with neoprene double-seal tips to minimize leakage. Damper leakage shall be less than 1% of maximum flow at 4-inch water column differential. Damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant

## **2.9 Compressors**

- .1 Hermetic, scroll action compressor, suction gas cooled, suitable for refrigerant R-410A
- .2 The compressor(s) shall be mounted on rubber-in-shear isolators to limit the transmission of noise and vibration
- .3 The compressor(s) shall be equipped with removable crankcase heater(s) for liquid migration protection
- .4 The compressor(s) shall be located outside the conditioned air stream in the system's service vestibule
- .5 Compressors shall have a 3-year warranty extension for a total of 5 years coverage
- .6 The compressor manufacturer must have a wholesale outlet for replacement parts in the nearest major city

## **2.10 Refrigeration Circuit**

- .1 The system shall consist of two factory sealed refrigeration circuits for dehumidification and sensible cooling. No site refrigeration work shall be required
- .2 Each refrigeration circuit shall have pressure transducers monitoring the refrigerant discharge (high) and suction (low) pressures. The refrigeration circuit shall be accessible for diagnostics, adjustment and servicing without the need for service manifold gauges

- .3 All refrigeration circuits shall have solenoid control valves, check valves, a liquid line filter-drier, liquid and moisture indicator, thermostatic expansion valve and a pump down solenoid valve
- .4 The system shall have an externally adjustable balanced port design mechanical thermostatic expansion valve. The valve shall have a removable power head
- .5 Tamper proof, hermetically sealed non-adjustable high and low pressure switches and refrigeration service valves shall be installed using Schrader type valves. Refrigeration service valves shall be located outside of the airstream
- .6 The receiver shall have two refrigerant level (maximum and minimum) indicating sight glasses
- .7 The suction line shall be fully insulated with 0.500-inch closed cell insulation

## **2.11 Control Panel**

- .1 The Electrical Subcontractor shall be responsible for external power wiring and disconnect switch fusing. Power block terminals shall be provided
- .2 Shall be mounted inside the service vestibule outside of the process air stream
- .3 Blower motors shall be protected with thermal trip overloads
- .4 The system shall have a voltage monitor with phase protection
- .5 Available dry contacts shall include:
  - .1 Alarm
  - .2 Blower interlock
  - .3 Stage 1 & 2 heating
  - .4 Outdoor air damper control
  - .5 Remote exhaust fan #1
  - .6 Remote exhaust fan #2
  - .7 Outdoor-air cooled equipment
  - .8 System on
  - .9 Heat recovery
- .6 Terminals shall be provided to send 24-volt power to the outdoor air cooled condenser or fluid cooler fan contactor
- .7 All wiring shall be installed in accordance with UL or CSA safety electrical code regulations and shall be in accordance with the NFPA All components used in the system shall be UL or CSA listed
- .8 Wiring diagrams shall be located near the electrical panel(s) on the system. These diagrams shall provide colour-coding and wire numbering for easy troubleshooting. All wires shall be contained in a wire duct.
- .9 The compressor(s) shall have a time delay on start to prevent short cycling
- .10 An airflow switch and a dry contact for alarm(s) shall be provided



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## **2.12 Auxiliary Air Heating**

- .1 The packaged hot water coil shall be sized to meet the scheduled heating capacity and have the following characteristics:
  - .1 Modulating (0-10V) auxiliary air heat control by means of a factory mounted and wired three-way control valve
  - .2 Auxiliary air heating coil tubes, fins, headers, casing and end-plates shall be fully protected by a polyester/enamel coating for maximum corrosion protection. The protective coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salts and gases
  - .3 Coil casing and end-plates shall be made of galvanized steel
  - .4 Fin and tube joints shall be mechanically bonded to ensure high heat transfer
  - .5 Fins shall be made of aluminium
  - .6 Tubes shall be made of copper
  - .7 The maximum loop operating pressure shall not be less than 250 psig

## **2.13 Air Conditioning**

- .1 Water-cooled air conditioning
  - .1 The system shall be equipped with an air conditioning mode where all excess compressor heat is rejected to a fluid loop. The fluid cooled heat exchangers shall be capable of rejecting 100% of the compressor heat to the water loop at summer design conditions. The heat exchanger shall be a corrosion resistant, stainless steel brazed plate-type heat exchanger with counter flow design. The heat exchanger shall be UL or CSA listed and comply with BOCA code P.1505.12.2
  - .2 Each refrigeration circuit shall include refrigerant valves, a receiver with pressure relief valve set at 650 psig, pressure control valve and pressure differential valve
  - .3 Maximum fluid loop operating pressure: 250 psig

## **2.14 Factory Performance Testing**

- .1 A. The system shall be thoroughly tested under factory test conditions. A copy of the original test report shall be available to the Contract Administrator upon request
- .2 Microprocessor controls shall be factory adjusted and pre-set to the design conditions during testing

## **Part 3 Execution**

### **3.1 Product Delivery, Acceptance, Storage and Handling**

- .1 Perform a thorough physical inspection of the system upon delivery from the shipment carrier
- .2 Identify and immediately report any physical damage to manufacturer
- .3 If the system is to be stored prior to installation, store in a clean, dry place protected from weather, dirt, fumes, water, construction and physical damage
- .4 Handle the system carefully during installation to prevent damage

- .5 Damaged systems or components shall not be installed. Contact the manufacturer for RMA instructions
- .6 Comply with the manufacturer's rigging and installation instructions for unloading the system and moving it into position

### **3.2 Connections**

- .1 Where installing piping adjacent to the system, allow space for service and maintenance
- .2 Duct connections: drawings indicate the general arrangements of the ducts. Connect the system to ducts with flexible duct connectors. Comply with code requirements for flexible duct connectors
- .3 Electrical connections: comply with code requirements for power wiring, switches and motor controls in electrical sections

### **3.3 Installation**

- .1 The agency responsible for start-up should work in accordance with the specifications and in accordance with the manufacturer's instructions and only by workers experienced in this type of work

### **3.4 Start Up**

- .1 Detailed instructions for start up as provided by the manufacturer must be followed
- .2 Installing Subcontractor must contact the manufacturer prior to start up to confirm start up procedures
- .3 Remote Internet access and control must be initiated and confirmed by the factory prior to start up for extended labour warranty to be in effect

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Packaged roof top unit.
- .2    Unit controls.
- .3    Maintenance service.

**1.2                RELATED SECTIONS**

- .1    Section 23 05 48 - Vibration Isolation.
- .2    Section 23 40 00 - Air Cleaning Devices.
- .3    Section 25 30 00 - Instruments And Control Elements: Installation of thermostats and other controls components.
- .4    Section 25 50 02 - Digital Control Equipment: Control components, time clocks.
- .5    Section 26 05 80 - Equipment Wiring:
  - .1    Installation and wiring of thermostats and other controls components; wiring from unit terminal strip to remote panel.
  - .2    Electrical characteristics and wiring connections.
- .6    Section 28 31 00 - Fire Alarm.

**1.3                REFERENCES**

- .1    ARI 210/240 - Unitary Air-Conditioning and Air Source Heat Pump Equipment.
- .2    ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- .3    ARI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
- .4    ASHRAE 52.1 – Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- .5    ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .6    CSA-B149.1 – Natural Gas and Propane Code Handbook.
- .7    NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- .8    NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

**1.4                SUBMITTALS FOR REVIEW**

- .1    Section 01 33 00: Procedures for submittals.

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- .2 Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
  - .3 Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
  - .4 Section 01 33 00: Submittals for information.
  - .5 Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.
  - .6 Section 01 78 10: Submittals for project closeout.
  - .7 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- 1.5 QUALITY ASSURANCE**
- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
  - .2 ARI Compliance:
    - .1 Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
    - .2 Comply with ARI 270 for testing and rating sound performance for RTUs.
  - .3 NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- 1.6 REGULATORY REQUIREMENTS**
- .1 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.
- 1.7 DELIVERY, STORAGE, AND PROTECTION**
- .1 Section 01 61 00: Transport, handle, store, and protect products.
  - .2 Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.
- 1.8 WARRANTY**
- .1 Section 01 78 10: Submittals for project closeout.
  - .2 Warranty Period:
    - .1 Compressors: Manufacturer's standard, minimum five years from date of Substantial Completion.
    - .2 Gas Furnace Heat Exchangers: Manufacturer's standard, minimum 10 years from date of Substantial Completion.
    - .3 Solid-State Ignition Modules: Manufacturer's standard, minimum one year from date of Substantial Completion.

- .4 Control Boards: Manufacturer's standard, minimum one year from date of Substantial Completion.

### **1.9 MAINTENANCE SERVICE**

- .1 Section 01 78 10: Submittals for project closeout.
- .2 Provide service and maintenance of packaged roof top units for one year from Date of Substantial Completion.
- .3 Provide maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.
- .4 Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.
- .5 Submit copy of service call work order or report, and include description of work performed.

### **1.10 EXTRA MATERIALS**

- .1 Section 01 78 10: Submittals for project closeout.
- .2 Provide one set of filters.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Carrier Model 48 GCT.
- .2 Other acceptable manufacturers offering equivalent products.
  - .1 Trane
  - .2 Daikin
- .3 Substitutions: Refer to Section 01 62 00.

### **2.2 AIR CONDITIONING UNITS**

- .1 General: Roof mounted units having gas burner and electric refrigeration.
- .2 Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.
- .3 Electrical Characteristics:
  - .1 Refer to Section 26 05 80.
- .4 Disconnect Switch: Factory mount disconnect switch in control panel.

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**2.3 FABRICATION**

- .1 Cabinet: Galvanized steel with baked enamel finish, access doors or removable access panels shall be permanently attached, and recessed into the panel.
- .2 Insulation: 1/2 inch thick neoprene coated glass fibre with edges protected from erosion.
- .3 Heat Exchangers: Aluminized steel, of welded construction.
- .4 Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on adjustable fan base resiliently mounted.
- .5 Air Filters: Minimum arrestance to ASHRAE 52.1, and minimum efficiency reporting value (MERV) to ASHRAE 52.2:
  - .1 Two inch thick glass fibre disposable media in metal frames; minimum percent arrestance, and MERV 8.

**2.4 BURNER**

- .1 Gas Burner: Induced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.
- .2 Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.
- .3 High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- .4 Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, with provisions for continuous fan operation.

**2.5 EVAPORATOR COIL**

- .1 Coil: Copper tube aluminum fin coil assembly with galvanized drain pan and connection.
- .2 Fixed orifice metering system.

**2.6 COMPRESSOR**

- .1 Hermetic scroll compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.
  - .1 Five minute timed off circuit to delay compressor start.
  - .2 Outdoor thermostat to energize compressor above 60 degrees F ambient.

**2.7 CONDENSER COIL**

- .1 Coil: Copper tube aluminum fin assembly with subcooling rows and coil guard.
- .2 Fans: Direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.

- .3 Hail Guard.

## **2.8 MIXED AIR CASING**

- .1 Dampers: Outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper to fall to closed position. Relief dampers may be gravity balanced.
- .2 Damper Operator: 24 volt with gear train sealed in oil with spring return on units
- .3 Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position. Provide an economizer capable of introducing and relieving 100% outside air with barometric relief. Economizer control to be enthalpy control.

## **2.9 OPERATING CONTROLS**

- .1 Terminal strip on unit for connection of operating controls to remote panel by others. Allow for two stages of heating and two stages cooling.
- .2 Low limit thermostat in supply air to close outside air damper and stop supply fan.
- .3 Economizer Outdoor-Air Damper Operation:
  - .1 Occupied Periods: Open to fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Permit air-side economizer operation when outdoor air is less than 15 deg C (60 deg F). mixed-air temperature and select between outdoor-air and return-air enthalpy to adjust mixing dampers. During economizer cycle operation, lock out cooling.
  - .2 Unoccupied Periods: Close outdoor-air damper and open return-air damper.
  - .3 Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Adjust for temperature and provide output range from 2- to 10-V dc or 4 to 20 mA.
- .4 Interface Requirements for HVAC Instrumentation and Control System: Provide BACnet compatible interface for central HVAC control workstation for:
  - .1 scheduled operation,
  - .2 indication of fault,
  - .3 set point adjustment,
  - .4 monitoring of supply fan start, stop, and operation,
  - .5 data inquiry for outdoor air damper position, supply- and room-air temperature and humidity,
  - .6 monitoring of occupied and unoccupied operations.

## **2.10 PERFORMANCE**

- .1 Refer to schedule

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Section 01 10 00: Verification of existing conditions prior to beginning work.

- .2 Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- .3 Verify that proper power supply is available.

### **3.2 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install to NFPA 90A & NFPA 90B.
- .3 Mount units on factory built roof mounting curb adaptor and coordinate. Secure RTUs to upper curb rail.
- .4 Install condensate drain, matching connection size, with trap and direct to roof, complete with concrete splash pad.
- .5 Install ducts to termination at top of roof curb. Remove roof decking only as required for passage of ducts; do not cut out decking under entire roof curb.
- .6 Connect gas piping to burner, full size of gas train inlet, with union and shutoff valve with sufficient clearance for burner removal and service.

### **3.3 MANUFACTURER'S FIELD SERVICES**

- .1 Prepare and start systems to Section 01 43 00.
- .2 Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

**END OF SECTION**



**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Finned tube radiation.
- .2 Unit heaters.
- .3 Cabinet unit heaters.
- .4 Fan-coil units.
- .5 Hydronic Radiant Panels

**1.2 RELATED SECTIONS**

- .1 Section 23 05 13 - Motors.
- .2 Section 23 05 20 - Hydronic Specialties.
- .3 Section 23 21 00 - Hydronic Piping.
- .4 Section 23 63 14 – Condensing Units – Air Cooled.
- .5 Section 25 90 00 - Sequence Of Operation.
- .6 Section 26 05 80 - Equipment Wiring:
  - .1 Electrical characteristics and wiring connections.
  - .2 Installation of room thermostats.
  - .3 Electrical supply to units.

**1.3 REFERENCES**

- .1 AFBMA 9—Load Ratings and Fatigue Life for Ball Bearings
- .2 AMCA 99—Standards Handbook
- .3 AMCA 210—Laboratory Methods of Testing Fans for Rating Purposes
- .4 AMCA 300—Test Code for Sound Rating Air Moving Devices
- .5 AMCA 500—Test Methods for Louver, Dampers, and Shutters
- .6 AHRI 430—Central-Station Air-Handling Units.
- .7 AHRI 435—Application of Central-Station Air-Handling Units
- .8 ASTM B117—Standard Practice for Operating Salt Spray Apparatus
- .9 NEMA MG1—Motors and Generators
- .10 CSA C22.1 – Canadian Electrical Code
- .11 SMACNA—HVAC Duct Construction Standards - Metal and Flexible
- .12 UL 723—Test for Surface Burning Characteristics of Building Materials
- .13 UL 900—Test Performance of Air Filter Units
- .14 UL 1995—Standard for Heating and Cooling Equipment
- .15 UL 94—Test for Flammability of Plastic Materials for Parts in Devices and Appliances

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**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide typical catalogue of information including arrangements.
- .3 Shop Drawings:
  - .1 Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
  - .2 Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
  - .3 Indicate mechanical and electrical service locations and requirements.,

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Section 21 05 00: Submittals for information.
- .2 Manufacturer's Instructions: Indicate installation instructions and recommendations.

**1.6 SUBMITTALS AT PROJECT CLOSEOUT**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
- .3 Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- .4 Warranty: Submit manufacturer warranty and ensure forms have been completed in The City's name and registered with manufacturer.

**1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

**1.8 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.9 WARRANTY**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide one year manufacturer's warranty for fin-tube radiation.
- .3 Provide two year manufacturer's warranty for unit heaters.

**1.10 EXTRA MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.

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**Part 2            Products**

**2.1                FINNED TUBE RADIATION**

- .1        Manufacturer: Rittling
- .2        Other acceptable manufacturers offering equivalent products.
  - .1        Substitutions: Refer to Section 21 05 20.
- .1        Heating Elements: 20 mm (3/4 inch) or 25 mm (1 inch) or 32 mm (1-1/4 inch), as scheduled, ID seamless copper tubing, mechanically expanded into evenly spaced aluminum fins sized 106 x 106 mm (4-1/4 x 4-1/4 inches), suitable for soldered fittings.
- .2        Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- .3        Enclosures: 1.2 mm (0.0478 inch) steel up to 450 mm (18 inches) in height, 1.5 mm (0.0598 inch) steel over 450 mm (18 inches) in height, with easily jointed components for wall to wall installation. Support rigidly, on wall or floor mounted brackets at least 1000 mm (3 feet) on centre maximum. Refer to equipment schedule on drawings for exact type.
- .4        Finish: Factory applied powder coated finish, as selected by the architect.
- .5        Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 150 x 175 mm (6 x 7 inch) minimum size, integral with cabinet.
- .6        Capacity: As scheduled, based on 18 degree C (65 degree F) entering air temperature, 65 degree C (150 degree F) average water temperature.

**2.2                UNIT HEATERS**

- .1        Manufacturer: Rittling Model Regency RH series.
- .2        Other acceptable manufacturers offering equivalent products.
  - .1        Substitutions: Refer to Section 21 05 20.
- .3        Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- .4        Casing: 1.2 mm (0.0478 inch) steel with threaded pipe connections for hanger rods.
- .5        Finish: Factory applied textured gray epoxy powder coating.
- .6        Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- .7        Air Outlet: Adjustable pattern diffuser on projection models and two way louvres on horizontal throw models.
- .8        Motor: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models.
- .9        Control: Local disconnect switch.
- .10       Capacity: As scheduled
- .11       Electrical Characteristics:
  - .1        As scheduled.
  - .2        Refer to Section 26 05 80.

**2.3 CABINET UNIT HEATERS**

- .1 Manufacturer: Sigma.
- .2 Other acceptable manufacturers offering equivalent products.
  - .1 Substitutions: Refer to Section 21 05 20.
- .3 Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 1380 kPa(100 psi) and 104 degrees C(220 degrees F).
- .4 Cabinet: 1.5 mm(0.0598 inch) steel with exposed corners and edges rounded, easily removed panels, glass fibre insulation and integral air outlet and inlet grilles.
- .5 Finish: Factory applied baked enamel, from manufacturer's standard colour offering, on visible surfaces of enclosure or cabinet.
- .6 Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- .7 Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- .8 Control: Multiple speed switch, factory wired, located in cabinet.
- .9 Filter: Easily removed 25 mm(1 inch) thick glass fibre throw-away type, located to filter air before coil.
- .10 Capacity: As scheduled.
- .11 Electrical Characteristics:
  - .1 As scheduled.
  - .2 Refer to Section 26 05 80.

**2.4 FAN-COIL UNITS**

- .1 Manufacturer: [\_\_\_\_\_] Model [\_\_\_\_\_].
- .2 Other acceptable manufacturers offering equivalent products.
  - .1 [\_\_\_\_\_] Model [\_\_\_\_\_].
  - .2 [\_\_\_\_\_] Model [\_\_\_\_\_].
  - .3 [\_\_\_\_\_] Model [\_\_\_\_\_].
  - .4 Substitutions: [Refer to Section 21 05 00.] [Not permitted.]
- .3 Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 1380 kPa (200 psi) and 104 degrees C (220 degrees F). [Provide drain pan under cooling coil, easily removable for cleaning, with drain connection.]
- .4 Cabinet: 1.5 mm(0.0598 inch) steel with exposed corners and edges rounded, easily removed panels, glass fibre insulation [and integral air outlet] [and integral air outlet and inlet grilles].
- .5 Finish: Factory apply baked [primer coat] [enamel of [\_\_\_\_\_] colour [as selected]] on visible surfaces of enclosure or cabinet.
- .6 Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- .7 Motor: Tap wound multiple speed [permanent split capacitor] [shaded pole] with sleeve bearings, resiliently mounted.
- .8 Control: Multiple speed switch, factory wired, located in cabinet.

- .9 Filter: Easily removed 25 mm(1 inch) [thick glass fibre throw-away [permanent washable] type, located to filter air before coil.
- .10 Mixing Dampers: Where indicated, mixing sections with dampers. Refer to Section 25 90 00 for operating sequence.
- .11 Capacity: As Scheduled, based on 18 degrees C (65 degrees F) entering air temperature, [82 degree C (180 degree F) average water temperature] [6.9 kPa (1 psig) steam].
- .12 Electrical Characteristics:
  - .1 [ ] W.
  - .2 [ ] volts, [single] [three] phase, 60 Hz.
  - .3 Refer to Section 26 05 80.

## 2.5 HYDRONIC RADIANT PANELS

- .1 Manufacturers:
  - .1 TWA
  - .2 Price Industries
  - .3 Engineered Air
- .2 Other acceptable manufacturers offering equivalent products.
  - .1 Substitutions: Refer to Section 21 05 00
- .3 Extruded Ceiling Panels:
  - .1 Constructed of modular 150 mm (6 inch) wide aluminum extruded planks with interlocking edges;
    - .1 Planks are to be manufactured and assembled to configurations indicated on plans, exact dimensions to be confirmed with Contract Administrator prior to shop drawings;
    - .2 Some panels may be special, requiring field cutting. Manufacturer shall cut back tubing to accommodate field cutting but allow maximum heating output from remaining section of panel;
    - .3 Some sections may be filler panels without piping;
  - .2 Tube saddle incorporated into plank extrusion;
  - .3 Tubing to be clipped to saddle, clips to be non-conducting, dielectric;
  - .4 Cross brace entire assembly with structural members, aluminium support channel to be provided from factory;
  - .5 Provide with extruded frame for installation in drywall or suspended ceiling application.
- .4 Formed Ceiling Panels:
  - .1 600 x 1200 mm (24 x 48 inch) 1.02mm (18 ga.) aluminum pans;
  - .2 Tube saddle extrusion fastened directly to pan;
  - .3 Tubing to be clipped to saddle, clips to be non-conducting, dielectric;
- .5 Pipe Coil:
  - .1 16 mm (5/8 inch) O.D. copper tube
  - .2 Tubing to be thermally bonded to extrusion with non-hardening heat conductive thermal paste
  - .3 Provide return bends for two water connections to each panel.

- .6 Insulation
  - .1 Insulation is to be supplied by Mechanical Subcontractor;
  - .2 Minimum 25mm (1.0 inches) thick;
  - .3 ASTM C1071; flexible, inorganic glass fibre bonded by a thermosetting binder, non-combustible blanket, with no edge coating;
    - .1 'C' Value: ASTM C177, maximum 1.42 at 24 degrees C (0.24 at 75 degrees F).
    - .2 Maximum Service Temperature: 121 degrees C (250 degrees F).
    - .3 Minimum 50% Certified Recycled Content.
    - .4 Does not exceed 25 Flame and 50 Smoke spread ratings when tested in accordance with ASTM E 84, CAN/ULC S102-M88, NFPA 255 and UL 723
    - .5 Adhesive:
      - .1 ASMT C916 compliant
      - .2 Waterproof, ASTM E162 fire-retardant type.
- .7 Configure panels within T-bar ceiling module
- .8 Configure panels within dry wall as per drawings.
- .9 Heating Capacity: As scheduled, based on 82 degrees C (180 degrees F) average water temperature, 21 degrees C (70 degrees F) space temperature.
- .10 Accessories:
  - .1 Provide with hose kits, 450 mm (18") minimum length:
    - .1 Return side hose: control valve, shutoff valve, manual air vent, and [automatic] balancing valve;
    - .2 Supply side hose: shutoff valve, and strainer with blowdown and pressure tap.
    - .3 Connection to radiant panel by threaded or sweat connections.
  - .2 Provide "pig tail" looped connection or other flexible connection between radiant panels.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.
- .3 Protection: Provide finished cabinet units with protective covers during balance of construction.
- .4 Finned Tube Radiation: Locate on outside walls and run cover wall-to-wall unless otherwise indicated in rooms where finned tube is indicated on drawings. Centre elements under windows if applicable, unless noted otherwise. Where multiple windows occur over units, divide element into equal segments centred under each window, unless noted otherwise. Align cabinet joints with window mullions, unless noted otherwise. Install wall angles where units butt against walls.
- .5 Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

- .6 Cabinet Unit Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.
- .7 Fan-Coil Units: Install as indicated. Coordinate to assure correct recess size for recessed units.
- .8 Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.
- .9 Hydronic Radiant Panels:
  - .1 Install with hose kits to supply/return piping.
  - .2 Install radiant panel level and plumb. Maintain sufficient clearance for normal services, maintenance, or in accordance with construction drawings.
  - .3 Complete installation and startup checks according to manufacturer's written instructions and perform pressure testing.
  - .4 Coordinate installation with acoustic tile ceiling grid. Where panel is installed against wall surfaces, provided with grid track.
  - .5 Completely cover exposed topside of panel with insulation blanket. Cut insulation around upturned piping connectors.
  - .6 Suspend panels with hanger wire from deck above.
- .10 Units with Cooling Coils: Connect drain pan to condensate drain.

### **3.2 CLEANING**

- .1 After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- .2 Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials provided by manufacturer.
- .3 Install new filters.

### **3.3 SCHEDULES**

- .1 Refer to schedules on drawings.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Air supply system
- .2 Thermostats.
- .3 Humidistats.
- .4 Control valves.
- .5 Combination Control and Automatic Flow Valves:
- .6 Dampers Motorized
- .7 Damper operators.
- .8 Time clocks.
- .9 Miscellaneous accessories.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 19 - Gages And Meters: Thermometer sockets, gauge taps.
- .2 Section 23 05 48 - Vibration Isolation.
- .3 Section 23 21 00 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, gauge taps.
- .4 Section 23 33 00 - Duct Work Accessories: Installation of automatic dampers.
- .5 Section 25 50 02 - Digital Control Equipment.
- .6 Section 25 90 00 - Sequence Of Operation.
- .7 Section 26 27 26 - Wiring Devices: Elevation of exposed components.
- .8 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3 REFERENCES**

- .1 AMCA 500 - Test Methods for Louvres, Dampers and Shutters.
- .2 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 ASTM B32 - Solder Metal.
- .4 ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .5 ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- .6 NEMA DC 3 - Residential Controls - Electric Wall-Mounted Room Thermostats.
- .7 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.



- .3 Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

## **1.5 SUBMITTALS FOR INFORMATION**

- .1 Section 21 05 00: Submittals for information.
- .2 Manufacturer's Instructions: Provide for all manufactured components.

## **1.6 SUBMITTALS AT PROJECT CLOSEOUT**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
- .3 Revise shop drawings to reflect actual installation and operating sequences.
- .4 Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- .5 Warranty: Submit manufacturer's warranty and ensure forms have been filled out in The City's name and registered with manufacturer.

## **1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Manufacturer shall be Johnson Metasys Controls.
- .2 Installer Qualifications: Company specializing in performing the work of this section
- .3 The Installer shall have an established working relationship with the Control System Manufacturer, and be the authorized representative of the Manufacturer at bid time.
- .4 The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
- .5 All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off-the-shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the Engineer in writing. Spare parts shall be available for at least 5 years after completion of this Contract.

## **1.8 REGULATORY REQUIREMENTS**

- .1 All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, provincial, and national authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:
  - .1 Canadian Electric Code (CEC)
  - .2 National Building Code (NBC)
  - .3 ASHRAE 135
  - .4 Underwriters Laboratories UL916

## **1.9 WARRANTY**

- .1 Section 21 05 00: Submittals for project closeout.

- .2 Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to The City. The Contractor shall respond to The City's request for warranty service within 24 hours during normal business hours.
- .3 All work shall have a single warranty date, even when The City has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period
- .4 At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Engineer, the Engineer shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty.
- .5 Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the Contractor shall be provided at no charge during the warranty period. Any upgrades or functional enhancements associated with the above mentioned items also can be provided during the warranty period for an additional charge to The City by purchasing an in-warrant technical support agreement from the Contractor. Written authorization by The City must, however, be granted prior to the installation of any of the above-mentioned items.
- .6 Exception: The Contractor shall not be required to warrant reused devices, except for those that have been rebuilt and/or repaired. The Contractor shall warrant all installation labour and materials, however, and shall demonstrate that all reused devices are in operable condition at the time of Contract Administrator review.

#### **1.10 MAINTENANCE SERVICE**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide service and maintenance of control system from Date of Substantial Completion.
- .3 Provide complete service of controls systems, including call backs. Make minimum of two complete normal inspections of approximately four (4) hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

#### **1.11 SYSTEM AND COMPONENT PERFORMANCE**

- .1 Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
- .2 Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
- .3 Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
- .4 Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
- .5 Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
- .6 Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds

- .7 Object Scan. All changes of state and change of analog values will be transmitted over the high-speed Ethernet network such that any data used or displayed at a controller or workstation will have been current within the previous 2 seconds
- .8 Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
- .9 Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
- .10 Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

**Table 1**  
**Reporting Accuracy**

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15°C (±0.25°F)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)

**Table 2**  
**Control Stability and Accuracy**

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

**Part 2 Products**

**2.1 CARBON DIOXIDE SENSOR**

- .1 Acceptable manufacturers.

- .1 DCS Airsense
- .2 Substitutions: Refer to Section 21 05 00.
- .2 Non-dispersive infrared (NDIR), Diffusion with a Measurement Range 0-2000 ppm
  - .1 Repeatability  $\pm 20$  ppm CO<sub>2</sub> Measurement Accuracy  $\pm 30$  ppm  $\pm 2\%$  of reading,
  - .2 Power Requirements 18 - 30 VDC or 18 - 28 Vrms AC
  - .3 Operating Temperature Range 0 - 50 °C
  - .4 Operating Humidity Range 0 - 99% RH, non-condensing
  - .5 Voltage Output (linear) 0 - 10 VDC full-scale standard
  - .6 Optional Current Output (linear) 4-20 mA RLOOP < 600  $\Omega$
  - .7 Dimensions 4.5 x 2.8 x 0.9 inches
- .3 Model 308 – Wall or Duct Mount – No display
- .4 Model 350 – Wall or Duct Mount – With display

## 2.2 CONTROL PANELS

- .1 Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- .2 NEMA 250, general purpose utility enclosures with enamelled finished face panel.
- .3 Provide common keying for all panels.

## 2.3 CONTROL VALVES

- .1 Acceptable manufacturers.
  - .1 Belimo
  - .2 Siemens
  - .3 Honeywell
  - .4 Schneider Electric
  - .5 Johnson Controls
  - .6 Substitutions: Refer to Section 21 05 00.
- .2 Ball Valves:
  - .1 Bronze body, Stainless Steel trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.
  - .2 Rate for service pressure exceeding 860 kPa at 121 degrees C (125 psig at 250 degrees F).
  - .3 Two way valves with equal percentage characteristics, three way valves with linear characteristics. Size two way valve operators to close valves against pump shut off head.
  - .4 Size for 20 kPa (3 psig) maximum pressure drop at design flow rate unless otherwise noted.
- .1 Globe Pattern:
  - .1 Manufacturer: Siemens Model Powermite/Flowrite 599.
  - .2 Other acceptable manufacturers offering equivalent products.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .3 Up to 2 inch (50 mm): Bronze body, brass trim, stainless steel rising stem, all metal plug and seat, EDPM packing, screwed ends.

- .4 Over 2 inches (50 mm): Cast Iron body, stainless steel trim, rising stem, plug-type disc, EDPM packing, flanged ends, renewable seat and disc.
- .5 Hydronic Systems:
  - .1 Rate for service pressure of 860 kPa at 121 degrees C (125 psig at 250 degrees F).
  - .2 Replaceable plugs and seats of brass.
  - .3 Size for 20 kPa (3 psig) maximum pressure drop at design flow rate unless otherwise noted.
  - .4 Two way valves with equal percentage characteristics, three way valves with linear characteristics. Size two way valve operators to close valves against pump shut off head.
- .2 Butterfly Pattern:
  - .1 Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
  - .2 Disc: Stainless Steel.
  - .3 Hydronic Systems:
    - .1 Rate for service pressure of 860 kPa at 121 degrees C (125 psig at 250 degrees F).
    - .2 Size for 20 kPa (3 psig) maximum pressure drop at design flow rate unless otherwise noted.
- .3 Valve Operators:
  - .1 General: Provide smooth proportional control with sufficient power for full shut off at maximum pump differential pressure or maximum head pressure development from the pump, elevation and system pressure.
  - .2 Spring return to normal position as indicated on freeze, fire, or temperature protection.
  - .3 Number: Sufficient to achieve unrestricted movement throughout actuation range.
  - .4 Operators (2 Position): Synchronous motor with enclosed gear train, dual return springs, valve position indicator; 24 v DC. Valves: spring return to normal position for temperature protection.
  - .5 Operators (Modulating): Self contained, linear motorized actuator with approximately 19 mm(3/4 inch) stroke, 60 second full travel with transformer and SPDT contacts: 24 v DC,.
- .4 Combination Control and Automatic Flow Control Valve:
  - .1 Griswold Model Automizer.
  - .2 Other Acceptable Manufacturers:
    - .1 Hays Fluid Control.
  - .3 Substitutions: Not permitted.
  - .4 Integral Control / Flow Rate Limiting Valve
    - .1 Valve shall consist of a dynamic flow limiting device, an integral, electrically actuated two-way control valve, and manual isolation ball valve.
  - .5 Actuated Ball Valve
    - .1 Valve housing shall consist of forged brass, rated at no less than 360 psi at 250°F.
    - .2 Flow Control: equal percentage.

- .3 Valve ball shall consist of Stainless steel.
- .4 Stem shall be removable/replaceable without removing valve from line and shall include both teflon seals and EPDM O-ring.
- .5 Valve shall have EPDM O-Rings behind ball seals to allow for a minimum close-off pressure of 100 psi with 35 in-lbs of torque for 1/2" to 1-1/2" sizes.
- .6 Valve shall be available with unique Cv values.
- .7 Valve shall be available with fixed end female or fixed end sweat connections.
- .6 Flow Limiting Valve
  - .1 Flow regulation cartridge assembly shall be precision ground, all AISI 300 series stainless steel; shall be available in four PSID control ranges; minimum range shall be capable of being actuated by less than 1.5 PSID; and shall be capable of controlling flow to within  $\pm 5\%$  of rated flow.
  - .2 Flow regulation unit shall be readily accessible, for changeout or maintenance.
- .7 Valve Actuator
  - .1 Control valve actuator shall be analog modulating (4-10 mA or 2-10 V), floating (tri-state), Pulse Width Modulation, or two position as indicated in control sequence.
  - .2 Actuator shall provide minimum torque required for full valve shutoff position.
  - .3 Actuators shall be supplied with on-board terminal strip and conduit connection.
  - .4 A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements The control valve actuator furnished by the Controls Subcontractor under this section.
- .8 Accessories
  - .1 Identification tags shall be available for all valves; tags shall be indelibly marked with Cv, model number, location; tags shall be 3" x 3" aluminum.

## 2.4 DAMPERS - MOTORIZED

- .1 Tamco Model 1500 or 9000 SC (Insulated).
- .2 Other Acceptable Manufacturers:
  - .1 Alumavent
  - .2 Substitutions: Refer to Section 01 62 00.
- .3 Performance: Test to AMCA 500.
- .4 Frames: Extruded aluminum, welded or riveted with corner reinforcement, minimum 2.0 mm (0.081 inch) thick. Damper frame is 100mm (4 inch) deep.
- .5 All dampers for duct sizes with a dimension (either width or height) 300 mm (12 inches) or less shall be flanged to the duct. In-duct frames not allowed.
- .6 Blades: Extruded aluminum air foil profile, maximum blade size 150 mm (6 inches) wide, maximum blade length section 1200 mm (48 inches).
- .7 Insulation : Internally insulated with expanded polyurethane foam and are thermally broken. Complete blade has an insulating factor of R-2.29 and a temperature index of 55.
- .8 Blade Seals: Extruded silicone mechanically attached, field replaceable.

- .9 Frame/Jamb Seals: Extruded silicone mechanically attached, field replaceable.
- .10 Bearings: Celcon inner bearing fixed to a 7/16" (11.11 mm) aluminum hexagon blade pivot pin, rotating within a polycarbonate outer bearing inserted in the frame,
- .11 Linkage: Installed in frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
- .12 Leakage: Class 1A at 0.25 kPa (1 in. w.g.) static pressure differential. Class 1 at 1 kPa (4 in. w.g.) static pressure differential. Standard air leakage data is certified under the AMCA Certified Ratings Program.
- .13 Maximum blade length Static Pressure: 1.0 kPa (4 inches wg)
- .14 Temperature Limits: -40 to 100 degrees C (-40 to 212 degrees F).

## 2.5 DAMPER OPERATORS

- .1 General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
- .2 Electric Operators:
  - .1 Acceptable manufacturers.
    - .1 Belimo
    - .2 Siemens
    - .3 Honeywell
    - .4 Schneider Electric
    - .5 Johnson Controls
  - .2 Substitutions: Refer to Section 21 05 00.
  - .3 Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch minimum position potentiometer
  - .4 Number: Sufficient to achieve unrestricted movement throughout damper range.

## 2.6 HUMIDISTATS

- .1 Humidistats: (Crawlspace)
  - .1 Manufacturer: Honeywell Model H46.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 Line voltage, wall mounted
  - .3 Throttling range: Adjustable 4-6 percent relative humidity.
  - .4 Operating range: 20 to 80 percent.
  - .5 Maximum temperature: 43 degrees C (110 degrees F).
  - .6 Cover: Set point indication [Concealed set point].
- .2 Room Humidistats:
  - .1 Manufacturer: Honeywell Model H76.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 Wall mounted, proportioning type.
  - .3 Throttling range: Adjustable 2, 3 or 5 percent relative humidity.
  - .4 Operating range: 20 to 80 percent.
  - .5 Maximum temperature: 43 degrees C (110 degrees F).

- .6 Cover: Concealed set point.
- .3 Limit Duct Humidistat:
  - .1 Insertion, two position type.
  - .2 Throttling range: Adjustable 2 percent relative humidity.
  - .3 Operating range: 20 to 80 percent.
  - .4 Maximum temperature: 65 degrees C (150 degrees F).

## 2.7 INPUT/OUTPUT SENSORS

- .1 Temperature:
  - .1 Resistance temperature detectors with resistance tolerance of plus or minus 0.1 percent at 21 degrees C (70 degrees F), interchangeability less than plus or minus 0.2 percent, time constant of 13 seconds maximum for fluids and 200 seconds maximum for air.
  - .2 Measuring current maximum 5 mA with maximum self-heat of 0.017 degrees C/mW(0.031 degrees F/mW) in fluids and 0.008 degrees C/mW(0.014 degrees F/mW) in air.
  - .3 Provide 3 lead wires and shield for input bridge circuit.
  - .4 Use insertion elements in ducts not affected by temperature stratification or smaller than one square metre. Use averaging elements where larger or prone to stratification sensor length 2.5 m(8 feet) or 5 m(16 feet) as required.
  - .5 Insertion elements for liquids: with brass socket, minimum insertion length of 60 mm(2-1/2 inches).
  - .6 Room sensors: Locking cover.
  - .7 Outside air sensors: Watertight inlet fitting, shielded from direct rays of sun.
  - .8 Room security sensors: Stainless steel cover plate with insulated back and security screws.
- .2 Humidity Sensors:
  - .1 Elements: Accurate within 5 percent full range with linear output.
  - .2 Room Sensors: With locking cover, span of 10 to 80 percent relative humidity
  - .3 Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 100 percent relative humidity.
- .3 Static Pressure Sensors:
  - .1 Unidirectional with ranges not exceeding 150 percent of maximum expected input.
  - .2 Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 5 to 40 degrees C (40 to 100 degrees F).
  - .3 Accuracy: One percent of full scale with repeatability 0.3 percent.
  - .4 Output: 0 - 5 vdc with power at 12 to 28 vdc.
- .4 Equipment Operation Sensors:
  - .1 Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 1250 Pa (0 to 5 inches wg).
  - .2 Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 50 to 400 kPa (8 to 60 psi).
  - .3 Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.



- .5 Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.
- .6 Digital to Pneumatic Transducers:
  - .1 Manufacturer: Honeywell Model RP7517.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 Convert [plus or minus 12 vdc pulse width modulation outputs] continuous proportional current or voltage to 0 to 138 kPa (0 to 20 psi).

## 2.8 THERMOSTATS (DDC)

- .1 Digital Room Thermostats (Commercial):
  - .1 Digital display
  - .2 Humidity Sensing
  - .3 CO2 Sensing
- .2 Line Voltage Thermostats: (Crawlspace)
  - .1 Manufacturer: Honeywell Model T651.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 Dead band: Maximum 1 degree C (2 degrees F).
  - .3 Cover: Locking with set point adjustment, with thermometer
  - .4 Rating: Motor load.
- .3 Line Voltage Thermostats: (Baseboard)
  - .1 Manufacturer: Honeywell Model T410.
    - .1 Substitutions: Refer to Section 21 05 00.
  - .2 Dead band: Maximum 2 degree C (3 degrees F).
  - .3 Cover: Locking with set point adjustment , with thermometer
- .4 Room Thermostat Accessories:
  - .1 Insulating Bases: For thermostats located on exterior walls.
  - .2 Thermostat Guards: [Metal] Locking transparent plastic mounted on separate base.
  - .3 Adjusting Key: As required for device.
  - .4 Aspirating Boxes: Where indicated for thermostats requiring flush installation.
- .5 Outdoor Reset Thermostat:
  - .1 Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable set point.
  - .2 Scale range: -23 to 56 degrees C (-10 to 70 degrees F).
- .6 Immersion Thermostat:
  - .1 Remote bulb or bimetallic rod and tube type, proportional action with adjustable set point and adjustable throttling range.
- .7 Airstream Thermostats:
  - .1 Remote bulb or bimetallic rod and tube type, proportional action with adjustable set-point in middle of range and adjustable throttling range.
  - .2 Averaging service remote bulb element: 2.3 m(7.5 feet).
- .8 Electric Low Limit Duct Thermostat (Freeze Stat):

- .1 Snap acting, single pole, single throw, manual reset switch which trips if temperature sensed across any 300 mm(12 inches) of bulb length is equal to or below set point,
- .2 Provide one thermostat for every 1.86 sq m(20 sq ft) of coil surface.
- .9 Electric High Limit Duct Thermostat:
  - .1 Snap acting, single pole, single throw, automatic reset switch which trips if temperature sensed across any 300 mm(12 inches) of bulb length is equal to or above set point,
  - .2 Provide one thermostat for every 1.86 sq m(20 sq ft) of coil surface.

## **2.9 TIME CLOCKS**

- .1 Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.
- .2 Solid state programmable time control with multiple separate programs, 24 hour battery carry over duty cycling, individual on/off/auto switches for each program, 7 day programming, 365 day calendar with 20 programmable holidays choice of fail safe operation for each program, system fault alarm.

## **2.10 TRANSMITTERS**

- .1 Building Static Pressure Transmitter:
  - .1 One pipe, differential type with temperature compensation, scale range 2.5 to 1500 kPa (0.01 to 6.0 inch wg) positive or negative, and sensitivity of 0.125 kPa (0.0005 inch wg). Transmit electronic pneumatic signal to receiver with matching scale range.
- .2 Pressure Transmitters:
  - .1 One pipe direct acting [indicating type] for gas, liquid, or steam service, range suitable for system, proportional electronic output.
- .3 Temperature Transmitters:
  - .1 One pipe, directly proportional output signal to measured variable, linearity within plus or minus 1/2 percent of range for 93 degrees C (200 degree F) span and plus or minus 1 percent for 10 degrees C (50 degree F) span, with 10 degree C (50 degrees F) [38 degree C (100 degrees F)] [93 degree C (200 degrees F)] temperature range, compensated bulb, averaging capillary, or rod and tube operation on 138 kPa (20 psig) input pressure and 20 to 100 kPa (3 to 15 psig) output.
- .4 Humidity Transmitters:
  - .1 One pipe, directly proportioned output signal to measured variable, linearity within plus or minus 1 percent for 70 percent relative humidity span, capable of withstanding 95 percent relative humidity without loss of calibration.

## **2.11 RELAYS.**

- .1 Control Relays. Control relays shall be plug-in type, ULC/CSA listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
- .2 Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable  $\pm 100\%$  from setpoint shown.

Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

**2.12 CURRENT TRANSFORMERS.**

- .1 AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
- .2 Transformers shall be available in various current ratios and shall be selected for  $\pm 1\%$  accuracy at 5 A full-scale output.
- .3 Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

**2.13 VOLTAGE TRANSFORMERS.**

- .1 AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
- .2 Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide  $\pm 0.5\%$  accuracy at 24 Vac and 5 VA load.
- .3 Windings (except for terminals) shall be completely enclosed with metal or plastic.

**2.14 CURRENT SWITCHES.**

- .1 Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Section 21 05 00: Verification of existing conditions before starting work.
- .2 Verify that systems are ready to receive work.
- .3 Beginning of installation means installer accepts existing conditions.
- .4 Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- .5 Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- .6 Ensure installation components are complementary to installation of similar components.
- .7 Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- .8 The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the Contractor's work, and the plans and the work of others — the Contractor shall report these discrepancies to the Contract Administrator and shall obtain written instructions for any changes necessary to accommodate the Contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by — and at the expense of — this Contractor.

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### **3.2 INSTALLATION**

- .1 Install to manufacturers written instructions.
- .2 Check and verify location of thermostats [humidistats] CO2 Detectors and other exposed control sensors with plans and room details before installation. Locate 1 500 mm(60 inches) [1 200 mm (47 inches)] [1 050 mm (42 inches)] above floor. Align with lighting switches and humidistats.
- .3 Mount freeze protection thermostats using flanges and element holders.
- .4 Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun and wind shield.
- .5 Provide separable sockets for liquids and flanges for air bulb elements. Refer to Section 23 05 19.
- .6 Provide thermostats in aspirating boxes in front entrances [gymnasiums] [high security areas] [and where indicated].
- .7 Provide guards or password protection on thermostats in entrances and other public areas.
- .8 Provide valves with position indicators and with pilot positioners where sequenced with other controls.
- .9 Provide isolation (two position) dampers of parallel blade construction.
- .10 Provide control (modulating position) dampers of opposed blade construction.
- .11 Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- .12 Coordinate location of the differential pressure sensor as shown on the drawings. If not shown on the drawings locate the pressure sensor at the furthest and most flow demanding pipe branch in the system. Show location on shop drawings and on GUI.
- .13 Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- .14 Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position for equipment not signalled by fire alarm system.
- .15 Install "hand/auto" selector switches to override automatic interlock controls when switch is in "hand" position for equipment signalled by fire alarm system.
- .16 Provide conduit and electrical wiring to Section 26 05 80. Electrical material and installation to appropriate requirements of Division 26.

### **3.3 MANUFACTURER'S FIELD SERVICES**

- .1 Section 21 05 00: Prepare and start systems.
- .2 Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

### **3.4 DEMONSTRATION AND INSTRUCTIONS**

- .1 Section 21 05 00: Demonstrating installed work.
- .2 Demonstrate complete and operating system to The City.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Control equipment.
- .2 Software.

**1.2 RELATED SECTIONS**

- .1 Section 25 30 00 - Instruments And Control Elements.
- .2 Section 25 50 01 - Analog Control Equipment.
- .3 Section 25 90 00 - Sequence Of Operation.
- .4 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.
- .5 REFERENCES
- .6 NEMA EMC1 - Energy Management Systems Definitions.
- .7 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- .8 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- .9 ASHRAE Standard 135-2012 -- BACnet®--A Data Communication Protocol for Building Automation and Control Networks

**1.3 SYSTEM DESCRIPTION**

- .1 Automatic temperature control field monitoring and control system using field programmable micro-processor based units with communications to Building Management System specified in Section 25 30 00.
- .2 Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- .3 Include computer software operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- .4 Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units.
- .5 Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- .6 Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide data for each system component and software module.
- .3 Shop Drawings:
  - .1 Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
  - .2 List connected data points, including connected control unit and input device.

- .3 Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
- .4 Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- .5 Indicate description and sequence of operation of operating, user, and application software.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Section 21 05 00: Submittals for information.
- .2 Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.

**1.6 SUBMITTALS AT PROJECT CLOSEOUT**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
  - .1 Revise shop drawings to reflect actual installation and operating sequences.
  - .2 Include data specified in "Submittals" in final "Record Documents" form.
- .3 Operation and Maintenance Data:
  - .1 Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
  - .2 Include keyboard illustrations and step-by-step procedures indexed for each operator function.
  - .3 Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- .4 Warranty: Submit manufacturers warranty and ensure forms have been filled out in The City's name and registered with manufacturer.

**1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented install experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with documented experience and approved by manufacturer.
- .3 Design system software under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the Province or Territory where the Project is located.

**1.8 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.9 WARRANTY**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Correct defective Work within one year period after Substantial Completion.
- .3 Provide five year manufacturer's warranty for field programmable micro-processor based units.

**1.10 MAINTENANCE SERVICE**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Provide service and maintenance of energy management and control systems for one year from Date of Substantial Completion.
- .3 Provide four complete inspections per year, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.
- .4 Provide complete service of systems, including call backs.

**1.11 EXTRA MATERIALS**

- .1 Section 21 05 00: Submittals for project closeout.

**1.12 PROTECTION OF SOFTWARE RIGHTS**

- .1 Prior to delivery of software, The City and the party providing the software will enter into a software license agreement with provisions for the following:
  - .1 Limiting use of software to equipment provided under these specifications.
  - .2 Limiting copying.
  - .3 Preserving confidentiality.
  - .4 Prohibiting transfer to a third party.

**Part 2 Products**

**2.1 APPROVED AGENCIES**

- .1 Johnson Controls Inc.

**2.2 OPERATOR STATION**

- .1 All workstations shall be new. The requirements below are a minimum standard.
- .2 Work Station: Minimum Requirements
  - .1 Configuration: PC with Intel iCore based microcomputer system or better.
  - .2 Minimum memory: 4 Gb RAM.
  - .3 Display: (22 inch) LED monitor
  - .4 Keyboard: Low profile, detachable, having Qwerty layout plus a 10 key numeric keypad, dedicated function keys.
  - .5 CD/DVD Drive:
  - .6 USB 2.0 & 3.0: Minimum two in front, two in back
  - .7 Hard disk drive: 500 Gb.
  - .8 Mouse: Software supported mouse with support software including self building menus and displays of system operations and functions.
  - .9 Network: Internal type 1000 Mbps
  - .10 Modem: Internal type modem or proprietary data modem with cables and communication interfaces required to provide the specified functions, minimum 56,000 bps rate.
  - .11 Printer: Support colour printer.
  - .12 Operating System: Windows 7 or later.
- .3 Printer:



- .1 Ink jet type, colour, capable of printing portrait or landscape, A3(11 x 17 inch) maximum paper size.
- .2 Paper: Minimum 50 sheets.
- .4 System Support: Minimum ten (10) work stations connected to multi-user, multi-tasking environment with concurrent capability to:
  - .1 Access DDC network.
  - .2 Access or control same control unit.
  - .3 Access or modify same control unit data base.
  - .4 Archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed.
  - .5 Develop and edit data base.
  - .6 Implement and tune DDC control.
  - .7 Develop graphics.
  - .8 Control facility.

### 2.3 CONTROL UNITS

- .1 Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.
- .2 Battery Backup: For minimum of 48 hours for complete system including RAM without interruption, with automatic battery charger.
- .3 Control Units Functions:
  - .1 Monitor or control each input/output point.
  - .2 Completely independent with hardware clock/calendar and software to maintain control independently.
  - .3 Acquire, process, and transfer information to operator station or other control units on network.
  - .4 Accept, process, and execute commands from other control unit's or devices or operator stations.
  - .5 Access both data base and control functions simultaneously.
  - .6 Record, evaluate, and report changes of state or value that occur among associated points. Continue to perform associated control functions regardless of status of network.
  - .7 Perform in stand-alone mode:
    - .1 Start/stop.
    - .2 Duty cycling.
    - .3 Automatic Temperature Control.
    - .4 Demand control via a sliding window, predictive algorithm.
    - .5 Event initiated control.
    - .6 Calculated point.
    - .7 Scanning and alarm processing.
    - .8 Full direct digital control.
    - .9 Trend logging.
    - .10 Global communications.
    - .11 Maintenance scheduling.
- .4 Data Communication Protocol

- 
- .1 BACnet
  - .5 Global Communications:
    - .1 Broadcast point data onto network, making that information available to all other system control units.
    - .2 Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.
  - .6 Input/Output Capability:
    - .1 Discrete/digital input (contact status).
    - .2 Discrete/digital output.
    - .3 Analog input.
    - .4 Analog output.
    - .5 Pulse input (5 pulses/second).
    - .6 Pulse output (0-655 seconds in duration with 0.01 second resolution).
  - .7 Monitor, control, or address data points. Include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control unit's with minimum 30 percent spare capacity.
  - .8 Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.
  - .9 Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard wired LAN, or 60 seconds over voice grade phone lines.
  - .10 Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:
    - .1 Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from work station.
    - .2 Control output points but change only data base state or value; leave external field hardware unchanged.
    - .3 (1) Enable control actions on output points but change only data base state or value.
  - .11 Local display and adjustment panel: Portable control unit, containing digital display, and numerical keyboard. Display and adjust:
    - .1 Input/output point information and status.
    - .2 Controller set points.
    - .3 Controller tuning constants.
    - .4 Program execution times.
    - .5 High and low limit values.
    - .6 Limit differential.
    - .7 Set/display date and time.
    - .8 Control outputs connected to the network.
    - .9 Automatic control outputs.
    - .10 Perform control unit diagnostic testing.
    - .11 Points in "Test" mode.

## **2.4 LOCAL AREA NETWORKS (LAN):**

- .1 Provide communication between control units over local area network (LAN).
- .2 LAN Capacity: Not less than the require stations or nodes to complete the installation.
- .3 Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
- .4 LAN Data Speed: Minimum 1000 Mbps.
- .5 Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
- .6 Transmission Median: Ethernet Cat 6 or single pair of solid 24 gauge twisted, shielded copper cable(MS/TP).
  - .1 MS/TP
    - .1 Daisy chain maximum, 20 nodes/controls
    - .2 Baud Rate: Minimum of 57600 bps
- .7 Network Support: Less than 3 seconds for global point to be received by any station. Automatically reconfigure if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

## **2.5 OPERATING SYSTEM SOFTWARE**

- .1 Input/Output Capability From Operator Station:
  - .1 Request display of current values or status in tabular or graphic format.
  - .2 Command selected equipment to specified state.
  - .3 Initiate logs and reports.
  - .4 Change analog limits.
  - .5 Add, delete, or change points within each control unit or application routine.
  - .6 Change point input/output descriptors, status, alarm descriptors, and engineering unit descriptors.
  - .7 Add new control units to system.
  - .8 Modify and set up maintenance scheduling parameters.
  - .9 Develop, modify, delete or display full range of colour graphic displays.
  - .10 Automatically archive select data even when running third party software.
  - .11 Provide capability to sort and extract data from archived files and to generate custom reports.
  - .12 Support two printer operations.
    - .1 Alarm printer: Print alarms, operator acknowledgements, action messages, system alarms, operator sign-on and sign-off.
    - .2 Data printer: Print reports, page prints, and data base prints.
  - .13 Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
  - .14 Print selected control unit data base.
- .2 Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.
- .3 Data Base Creation and Support: Use standard procedures for changes. Automatically check work station data base files upon connection and verify data base match.  
Minimum capability:

- 
- .1 Add and delete points.
  - .2 Modify any point parameter.
  - .3 Change, add, or delete English language descriptors.
  - .4 Add, modify, or delete alarm limits.
  - .5 Add, modify, or delete points in start/stop programs, trend logs, etc.
  - .6 Create custom relationship between points.
  - .7 Create or modify DDC loops and parameters.
  - .8 Create or modify override parameters.
  - .9 Add, modify, and delete any applications program.
  - .10 Add, delete, develop, or modify dynamic colour graphic displays.
- .4 Dynamic Colour Graphic Displays:
- .1 Utilizes custom symbols or system supported library of symbols.
  - .2 Sixteen (16) colours.
  - .3 Sixty (60) outputs of real time, live dynamic data per graphic.
  - .4 Dynamic graphic data.
  - .5 1,000 separate graphic pages.
  - .6 Modify graphic screen refresh rate between 1 and 60 seconds.
- .5 Operator Station:
- .1 Accept data from LAN as needed without scanning entire network for updated point data.
  - .2 Interrogate LAN for updated point data when requested.
  - .3 Allow operator command of devices.
  - .4 Allow operator to place specific control units in or out of service.
  - .5 Allow parameter editing of control units.
  - .6 Store duplicate data base for every control unit and allow down loading while system is on line.
  - .7 Control or modify specific programs.
  - .8 Develop, store and modify dynamic colour graphics.
  - .9 Provide data archiving of assigned points and support overlay graphing of this data utilizing up to four (4) variables.
- .6 Alarm Processing:
- .1 Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state/value and determine which alarms cause automatic dial-out.
  - .2 Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
  - .3 Print on line changeable message, up to 60 characters minimum in length, for each alarm point specified.
  - .4 Display alarm reports on video. Display multiple alarms in order of occurrence.
  - .5 Define time delay for equipment start-up or shutdown.
  - .6 Allow unique routing of specific alarms.
  - .7 Operator specifies if alarm requires acknowledgement.
  - .8 Continue to indicate unacknowledged alarms after return to normal.
  - .9 Alarm notification:
    - .1 Automatic print.

- 
- .2 Display indicating alarm condition.
  - .3 Selectable audible alarm indication.
  - .7 Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change-of-state, specified state, or alarm occurrence or return to normal.
  - .8 Automatic Restart: Automatically restart field equipment on restoration of power. Provide time delay between individual equipment restart and time of day start/stop. Sequence restart to avoid damage to equipment and systems. Sequence restart to minimize electrical demand.
  - .9 Messages:
    - .1 Automatically display or print user-defined message subsequent to occurrence of selected events.
    - .2 Compose, change, or delete any message.
    - .3 Display or log any message at any time.
    - .4 Assign any message to any event.
  - .10 Reports:
    - .1 Manually requested with time and date.
    - .2 Long term data archiving to hard disk.
    - .3 Automatic directives to download to transportable media such as floppy diskettes for storage.
    - .4 Data selection methods to include data base search and manipulation.
    - .5 Data extraction with mathematical manipulation.
    - .6 Allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
    - .7 Generating reports either normally at operator direction, or automatically under work station direction.
    - .8 Reports may either manually displayed or printed, or may be printed automatically on daily, weekly, monthly, yearly or scheduled basis.
    - .9 Include capability for statistical data manipulation and extraction.
    - .10 Provide capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.
  - .11 Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
  - .12 Data Collection:
    - .1 Automatically collect and store in disk files.
    - .2 Daily electrical energy consumption, peak demand, and time of peak demand for up to 30 electrical meters over 2 year period.
    - .3 Daily consumption for up to 30 meters over a 2 year period.
    - .4 Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.
    - .5 Provide archiving of stored data for use with system supplied custom reports.
  - .13 Graphic Display: Support graphic development on work station with software features:
    - .1 Page linking.
    - .2 Generate, store, and retrieve library symbols.

- .3 Single or double height characters.
- .4 Sixty (60) dynamic points of data per graphic page.
- .5 Pixel level resolution.
- .6 Animated graphics for discrete points.
- .7 Analog bar graphs.
- .8 Display real time value of each input or output line diagram fashion.
- .14 Maintenance Management:
  - .1 Run time monitoring, per point.
  - .2 Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
  - .3 Equipment safety targets.
  - .4 Display of maintenance material and estimated labour.
  - .5 Target point reset, per point.
- .15 Advisories:
  - .1 Summary which contains status of points in locked out condition.
  - .2 Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
  - .3 Report of power failure detection, time and date.
  - .4 Report of communication failure with operator device, field interface unit, point, programmable control unit.

## **2.6 HVAC CONTROL PROGRAMS**

- .1 General:
  - .1 Support Inch-pounds and S.I. metric units of measurement.
  - .2 Identify each HVAC Control system.
- .2 Optimal Run Time:
  - .1 Control start-up and shutdown times of HVAC equipment for both heating and cooling.
  - .2 Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
  - .3 Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
  - .4 Use outside air temperature to determine early shut down with ventilation override.
  - .5 Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
  - .6 Operator commands:
    - .1 Define term schedule
    - .2 Add/delete fan status point.
    - .3 Add/delete outside air temperature point.
    - .4 Add/delete mass temperature point.
    - .5 Define heating/cooling parameters.
    - .6 Define mass sensor heating/cooling parameters.
    - .7 Lock/unlock program.

- .8 Request optimal run time control summary.
- .9 Request optimal run time mass temperature summary.
- .10 Request HVAC point summary.
- .11 Request HVAC saving profile summary.
- .7 Control Summary:
  - .1 HVAC Control system begin/end status.
  - .2 Optimal run time lock/unlock control status.
  - .3 Heating/cooling mode status.
  - .4 Optimal run time schedule.
  - .5 Start/Stop times.
  - .6 Selected mass temperature point ID.
  - .7 Optimal run time system normal start times.
  - .8 Occupancy and vacancy times.
  - .9 Optimal run time system heating/cooling mode parameters.
- .8 Mass temperature summary:
  - .1 Mass temperature point type and ID.
  - .2 Desired and current mass temperature values.
  - .3 Calculated warm-up/cool-down time for each mass temperature.
  - .4 Heating/cooling season limits.
  - .5 Break point temperature for cooling mode analysis.
- .9 HVAC point summary:
  - .1 Control system identifier and status.
  - .2 Point ID and status.
  - .3 Outside air temperature point ID and status.
  - .4 Mass temperature point ID and status.
  - .5 Calculated optimal start and stop times.
  - .6 Period start.
- .3 Supply Air Reset:
  - .1 Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
  - .2 Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
    - .1 Raising cooling temperatures to highest possible value.
    - .2 Reducing heating temperatures to lowest possible level.
  - .3 Operator commands:
    - .1 Add/delete fan status point.
    - .2 Lock/unlock program.
    - .3 Request HVAC point summary.
    - .4 Add/Delete discharge controller point.
    - .5 Define discharge controller parameters.
    - .6 Add/delete air flow rate.
    - .7 Define space load and load parameters.
    - .8 Request space load summary.
- .4 Control summary:

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- .1 HVAC control system status (begin/end).
  - .2 Supply air reset system status.
  - .3 Optimal run time system status.
  - .4 Heating and cooling loop.
  - .5 High/low limits.
  - .6 Deadband.
  - .7 Response timer.
  - .8 Reset times.
  - .5 Space load summary:
    - .1 HVAC system status.
    - .2 Optimal run time status.
    - .3 Heating/cooling loop status.
    - .4 Space load point ID.
    - .5 Current space load point value.
    - .6 Control heat/cool limited.
    - .7 Gain factor.
    - .8 Calculated reset values.
    - .9 Fan status point ID and status.
    - .10 Control discharge temperature point ID and status.
    - .11 Space load point ID and status.
    - .12 Air flow rate point ID and status.
  - .4 Enthalpy Switch over:
    - .1 Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
    - .2 Operator commands:
      - .1 Add/delete fan status point.
      - .2 Add/delete outside air temperature point.
      - .3 Add/delete discharge controller point.
      - .4 Define discharge controller parameters.
      - .5 Add/delete return air temperature point.
      - .6 Add/delete outside air dewpoint/humidity point.
      - .7 Add/delete return air dewpoint/humidity point.
      - .8 Add/delete damper switch.
      - .9 Add/delete minimum outside air.
      - .10 Add/delete atmospheric pressure.
      - .11 Add/delete heating override switch.
      - .12 Add/delete evaporative cooling switch.
      - .13 Add/delete air flow rate.
      - .14 Define enthalpy deadband.
      - .15 Lock/unlock program.
      - .16 Request control summary.
      - .17 Request HVAC point summary.
    - .3 Control summary:
      - .1 HVAC control system begin/end status.



- .2 Enthalpy switch over optimal system status.
  - .3 Optimal return time system status.
  - .4 Current outside air enthalpy.
  - .5 Calculated mixed air enthalpy.
  - .6 Calculated cooling coil enthalpy using outside air.
  - .7 Calculated cooling coil enthalpy using mixed air.
  - .8 Calculated enthalpy difference.
  - .9 Enthalpy switch over deadband.
  - .10 Status of damper mode switch.
- .5 Energy Monitoring (Electrical, Air and Hydronic)
- .1 Airside energy measurements are calculated in the DDC system using air temperature and flow rate measurements.
  - .2 Waterside energy is to be calculated in the DDC system using fluid entering and leaving temperature and known constant flow rate measurements.
    - .1 An energy measuring devices (BTU meters) will be used when the flow is variable, using a microprocessor-based computer with flow and temperature inputs, and analog output to the DDC system representing totalized energy consumption in BTU or ton-hours, or energy flow in BTU per hour, tons, or similar units. (refer to Section 25 30 00)
  - .3 Electrical energy measurements can be calculated in the DDC system or with Power Monitoring Devices.

## **2.7 CHILLER CONTROL PROGRAMS**

- .1 Control function of condenser water reset, chilled water reset, and chiller sequencing. Support inch-pounds and S.I. metric units of measurement.
- .2 Condenser Water Reset: Automatically reset controlled condenser water temperature using measured outside wet bulb temperature and load being handled.
- .3 Chilled Water Reset: Automatically reset controlled chilled water temperature satisfying cooling coil requiring greatest cooling.
- .4 Chiller Sequencing: Determine which combination of chillers will most efficiently satisfy chilled water load, by cycling chillers, based on comparing load to switch over limits defined for each chiller.

## **2.8 PROGRAMMING APPLICATION FEATURES**

- .1 Trend Point:
  - .1 Sample points, real or computed, with each point capable of collecting samples at intervals specified in minutes, hours, days, or month.
  - .2 Output trend logs as line graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique pattern and colour, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.
- .2 Alarm Messages:
  - .1 Allow definition messages.
  - .2 Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
  - .3 Output assigned alarm with "message requiring acknowledgement".

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- .4 Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.
  - .3 Weekly Scheduling:
    - .1 Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
    - .2 Provide program times for each day of week, per point, with one minute resolution.
    - .3 Automatically generate alarm output for points not responding to command.
    - .4 Provide for holidays.
    - .5 Operator commands:
      - .1 System logs and summaries.
      - .2 Start of stop point.
      - .3 Lock or unlock control or alarm input.
      - .4 Add, delete, or modify analog limits and differentials.
      - .5 Adjust point operation position.
      - .6 Change point operational mode.
      - .7 Open or close point.
      - .8 Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
      - .9 Begin or end point totalization.
      - .10 Modify totalization values and limits.
      - .11 Access or secure point.
      - .12 Begin or end HVAC or load control system.
      - .13 Modify load parameter.
      - .14 Modify demand limiting and duty cycle targets.
    - .6 Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.
  - .4 Interlocking:
    - .1 Permit events to occur, based on changing condition of one or more associated master points.
    - .2 Binary contact, high/low limit of analog point or computed point are capable of being utilized as master. Same master may monitor or command multiple slaves.
    - .3 Operator commands:
      - .1 Define single master/multiple master interlock process.
      - .2 Define logic interlock process.
      - .3 Lock/unlock program.
      - .4 Enable/disable interlock process.
      - .5 Execute terminate interlock process.
      - .6 Request interlock type summary.

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**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Section 21 05 00: Verification of existing conditions before starting work.
- .2 Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

**3.2 INSTALLATION**

- .1 Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- .2 Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.
- .3 Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.
- .4 Provide conduit and electrical wiring to Section 26 05 80. Electrical material and installation to appropriate requirements of Division 26.

**3.3 MANUFACTURER'S FIELD SERVICES**

- .1 Section 21 05 00: Prepare and start systems.
- .2 Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- .3 Provide service engineer to instruct The City's representative in operation of systems plant and equipment. Provide sign off sheets; refer to section 21 05 00.
- .4 Provide basic operator training for the operators on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include the required number of hours of dedicated instructor time to ensure the user is satisfied and sufficiently trained. Provide training on site.

**3.4 DEMONSTRATION AND INSTRUCTIONS**

- .1 Section 21 05 00: Demonstrating installed work.
- .2 Demonstrate complete and operating system to The City.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1    Sequence of operation:
  - .1    Central refrigeration and heat rejection system.
  - .2    Central fan systems.
  - .3    Combustion air unit heaters.
  - .4    Excess pressure controls.
  - .5    Fan coil units.
  - .6    Heating Coils.
  - .7    Heating water zone control.
  - .8    Radiant panels.
  - .9    Radiation.
  - .10   Terminal air units.
  - .11   Unit heaters.

**1.2            RELATED SECTIONS**

- .1    Section 25 30 00 - Instruments And Control Elements.
- .2    Section 25 50 01 - Analog Control Equipment.
- .3    Section 25 50 02 - Digital Control Equipment.
- .4    Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3            SYSTEM DESCRIPTION**

- .1    This section defines the manner in which controls function.
- .2    Requirements for each type of control system operation are specified.
- .3    Equipment, devices, and system components required for control systems are specified in other Sections.

**1.4            SUBMITTALS FOR REVIEW**

- .1    Section 21 05 00: Procedures for submittals.
- .2    Shop Drawings: Indicate mechanical system controlled and control system components.
  - .1    Label with settings, adjustable range of control and limits. Include written description of control sequence.
  - .2    Include flow diagrams for each control system, graphically depicting control logic.
  - .3    Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

**1.5            SUBMITTALS AT PROJECT CLOSEOUT**

- .1    Section 21 05 00: Submittals for project closeout.
- .2    Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

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**Part 2            Products**

**2.1                Not Used**

.1                Not Used

**Part 3            Execution**

**3.1                CONNECTION TO CENTRAL SERVER**

.1                Building Controls shall connect to and utilize existing connection to central controls server at The City's Controls Headquarters. Coordinate with The City to establish control communication via appropriate communication protocol.

**3.2                CENTRAL REFRIGERATION SYSTEMS**

- .1                Time Schedule: Start and stop condensing water pump.
- .2                Condensing Water Pumps P-9 and P-10: Allow start on proof of water in fluid cooler sump and on outdoor temperature above 10C (50F). Start on demand from ventilation system.
- .3                Energize chilled water pumps, P-7 and P-8 to start and allow fluid cooler fans and spray pump to start when condensing water pump started.
- .4                When chilled water pump starts, open chiller control valve. Modulate chiller control valve to maintain constant flow through chiller.
- .5                When chilled water flow and condensing water flow are proven by flow switches, allow refrigeration machine to start.
- .6                Maintain minimum condenser water temperature of 13 degrees C (55 degrees F) by modulating tower bypass valve and cycling fluid cooler fans.
- .7                Maintain temperature in fluid cooler sump of 4.5 degrees C (40 degrees F) by cycling electric sump heaters. Outdoor thermostat set at 2 degrees C (35 degrees F) to activate electric heat tracing.
- .8                Thermostat in fluid cooler sump, set at 2 degrees C (35 degrees F), open drain valve, close make-up valve and deactivate sump heaters and piping electric heat tapes.
- .9                Three-way water side economizer valves shall modulate to maintain 40F in chilled water loop.
- .10              Display:
  - .1                System graphic.
  - .2                Condensing water pump on/off indication.
  - .3                Chilled water pump on/off switch.
  - .4                Chiller on/off indication.
  - .5                Chiller condensing water supply and return temperatures.
  - .6                Chiller chilled water supply and return temperatures.
  - .7                Chiller condensing water control point adjustment.
  - .8                Common chilled water control point adjustment.
  - .9                Low level fluid cooler sump alarm.
  - .10              Expansion tank low level alarm.
  - .11              Fluid cooler fans on/off indication.
  - .12              Fluid cooler spray pump on/off indication.

- .13 Fluid cooler sump heater on/off indication.
- .14 Fluid cooler dump indication.
- .15 Chilled water control point adjustment.
- .16 Condensing water pump on/off [auto] switch.
- .17 Chilled water pump on/off/auto switch.
- .18 Chiller on/off [auto] switch.
- .19 Provide alarms if any status does not match command
- .20 Provide alarm if any temperature is out of normal range

### 3.3 CENTRAL FAN SYSTEMS (Typical for AHU-1, AHU-2, AHU-3)

- .1 Time Schedule: Start and stop supply and return fans. Determine fan status by current sensing devices. If fan fails to start as commanded, signal alarm.
- .2 Safety Devices:
  - .1 Freeze Protection: Stop fans and close outside air dampers if temperature downstream of heating coil and in preheat coil return line is below 3 degrees C (37 degrees F); signal alarm.
  - .2 High Temperature Protection: Stop fans and close outside dampers if temperature in return air is above 150 degrees C (300 degrees F); signal alarm.
  - .3 Smoke Detector: Stop fans, close outside dampers, and close smoke dampers if smoke is detected; signal alarm.
- .3 Heating Coil:
  - .1 When fan is not running, and outside air temperature is below 5 degrees C (40 degrees F), fully open heating coil valve to heating.
  - .2 When fan is running in heating mode, maintain constant space temperature of 20 degrees C (71 degrees F) by modulating heating coil valve.
- .4 Cooling Coil:
  - .1 When fan is running in cooling mode, maintain constant space temperature of 22 degrees C (74 degrees F) by modulating Cooling coil valve.
- .5 Outside Air Damper: When supply fan is running, open outside air damper to minimum position.
- .6 Outside, Return, and Relief Dampers:
  - .1 When supply fan is not running, outside and relief dampers are closed and return damper is open.
  - .2 When supply fan is running, dampers are controlled and operate with outside and relief dampers opening, and return damper closing.
  - .3 For cooling and outside air temperatures below 12 degrees C (55 degrees F), modulate dampers to maintain mixed air temperature of 12 degrees C (55 degrees F).
  - .4 For cooling and outside air temperatures above 12 degrees C (55 degrees F) outside and relief dampers are open and return damper is closed.
  - .5 For cooling and outside air temperatures above 12 degrees C (55 degrees F) compare return and outside air enthalpies. If return air enthalpy is lower, drive outside damper to minimum, close relief damper, and open return damper.
  - .6 For outside air temperatures above 26 degrees C (79 degrees F), drive outside damper to minimum, close relief damper, and open return damper.
  - .7 For heating, drive outside damper to minimum, close relief damper, and open return damper.

- .7 Modulate mixed air dampers heating coil valve and cooling coil valve in sequence to maintain constant space air temperature.
- .8 Air systems are constant flow, maintain constant static pressure by modulating relief air damper based on space mounted static pressure sensor.
- .9 Display:
  - .1 System graphic.
  - .2 System on/off indication.
  - .3 System day/night mode.
  - .4 System fan on/off indication.
  - .5 Return fan on/off indication.
  - .6 Heating coil pump on/off indication.
  - .7 Heating coil valve commanded position.
  - .8 Cooling Coil valve commanded position.
  - .9 Outside air temperature indication.
  - .10 Outside air humidity indication.
  - .11 Mixed air temperature indication.
  - .12 Mixed air humidity indication.
  - .13 Fan discharge air temperature indication.
  - .14 Space air temperature indication.
  - .15 Return humidity indication.
  - .16 Fan discharge temperature control point adjustment.
  - .17 Supply static pressure indication.
  - .18 Building static pressure indication.
  - .19 Building static pressure control point adjustment.
  - .20 System on/off auto switch.
  - .21 System day/night/auto switch.
  - .22 Supply fan on/off switch.
  - .23 Return fan on/off/auto switch.
  - .24 Heating coil pump on/off switch.
  - .25 Provide alarms if any status does not match command
  - .26 Provide alarm if any temperature is out of normal range
  - .27 Provide alarm if any pressure is out of normal range
  - .28 Provide alarm if any humidity level is out of normal range

### 3.4 PACKAGED ROOF TOP UNIT (RTU-1)

- .1 Time Schedule: Start and stop supply and exhaust fans. Determine fan status by current sensing devices. If fan fails to start as commanded, signal alarm.
- .2 Safety Devices:
  - .1 Freeze Protection: Stop fans and close outside air dampers if temperature downstream of heating coil and in preheat coil return line is below 3 degrees C (37 degrees F); signal alarm.
  - .2 High Temperature Protection: Stop fans and close outside dampers if temperature in return air is above 150 degrees C (300 degrees F); signal alarm.
- .3 Heating:

- 
- .1 When fan is running in heating mode, maintain constant space temperature of 20 degrees C (71 degrees F) by operating gas heating section.
  - .4 Cooling Coil:
    - .1 When fan is running in cooling mode, maintain constant space temperature of 20 degrees C (71 degrees F) by operating d/x cooling section.
  - .5 Outside Air Damper: When supply fan is running, open outside air damper to minimum position.
  - .6 Outside, Return, and Relief Dampers:
    - .1 When supply fan is not running, outside and relief dampers are closed and return damper is open.
    - .2 When supply fan is running, dampers are controlled and operate with outside and relief dampers opening, and return damper closing.
    - .3 For cooling and outside air temperatures below 12 degrees C (55 degrees F), modulate dampers to maintain mixed air temperature of 12 degrees C (55 degrees F).
    - .4 For cooling and outside air temperatures above 12 degrees C (55 degrees F) outside and relief dampers are open and return damper is closed.
    - .5 For cooling and outside air temperatures above 12 degrees C (55 degrees F) compare return and outside air enthalpies. If return air enthalpy is lower, drive outside damper to minimum, close relief damper, and open return damper.
    - .6 For outside air temperatures above 26 degrees C (79 degrees F), drive outside damper to minimum, close relief damper, and open return damper.
    - .7 For heating, drive outside damper to minimum, close relief damper, and open return damper.
  - .7 Modulate mixed air dampers, heating section and cooling section in sequence to maintain constant space air temperature.
  - .8 Display:
    - .1 System graphic.
    - .2 System on/off indication.
    - .3 System day/night mode.
    - .4 System fan on/off indication.
    - .5 Return fan on/off indication.
    - .6 Outside air temperature indication.
    - .7 Outside air humidity indication.
    - .8 Mixed air temperature indication.
    - .9 Mixed air humidity indication.
    - .10 Fan discharge air temperature indication.
    - .11 Space air temperature indication.
    - .12 Return humidity indication.
    - .13 Fan discharge temperature control point adjustment.
    - .14 System on/off auto switch.
    - .15 System day/night/auto switch.
    - .16 Supply fan on/off switch.
    - .17 Return fan on/off/auto switch.
    - .18 Heating coil pump on/off switch.
    - .19 Provide alarms if any status does not match command



- .20 Provide alarm if any temperature is out of normal range
- .21 Provide alarm if any pressure is out of normal range
- .22 Provide alarm if any humidity level is out of normal range

### **3.5 COMBUSTION AIR UNIT HEATERS**

- .1 Single temperature room thermostat set at 20 degrees C (68 degrees F) maintains constant room temperature by modulating unit heater fan.
- .2 Single temperature thermostat on return heating water line de-energizes unit fan on temperature below 35 degrees C (95 degrees F).

### **3.6 EXCESS PRESSURE CONTROLS**

- .1 Maintain constant pressure differential between supply and return lines by modulating bypass valve (chilled water system) and varying pump speed through variable speed drive control (radiation and glycol loops). End of line constant pressure bypass valve shall modulate to maintain minimum flows in glycol and radiation loop.

### **3.7 FAN COIL UNITS**

- .1 Dual temperature unit mounted thermostat set at 21 degrees C (70 degrees F) maintains constant space temperature during the day and 3 degrees C (6 degrees F) cooler at night by modulating two-way control heating valve and two-way cooling control valve in sequence.

### **3.8 HEATING WATER ZONE CONTROL**

- .1 Flow switch in heating pump discharge provides on/off indication, typical for all heating water and glycol pumps.
- .2 Primary loop heating pumps, P-1 and P-2 shall operate while building is in heating mode and shut off while in cooling mode.
- .3 Secondary Arena cascade loop pumps, P-16 and P-17, shall operate while building is in heating mode and be disabled while building is in cooling mode.
- .4 Control heating water supply temperature set to outdoor reset schedule by modulating boiler controls signal via controls interface.
- .5 Control heating water at maximum 82 degrees C (180 degrees F) at outdoor temperature of -35 degrees C (-30 degrees F), and minimum 54 degrees C (130 degrees F) at outdoor temperature of 18 degrees C (64 degrees F), with straight line relationship between.
- .6 Boiler packaged controls to stage boilers automatically based on input signal from control interface.
- .7 Flow switch in heating water circuit on no flow conditions indicates alarm.
- .8 On outside temperatures above 19 degrees C (66 degrees F), de-energize boilers and heating pumps and suppress alarm.
- .9 Mixing Valve MV-1 shall modulate to maintain glycol loop supply setpoint.
- .10 Glycol pumps, P-5 and P-6, shall modulate to maintain appropriate pressure within glycol loop. End-of- line pressure independent valve shall modulate to maintain minimum flow in loop.
- .11 Display:
  - .1 System graphic.
  - .2 System supply and return temperatures for heating loop and glycol loop.

- .3 System supply control point adjustment for heating loop and glycol loop.
- .4 Outdoor reset setpoint.
- .5 System return temperature.
- .6 Pump on/off indication
- .7 Pump on/off switch.
- .8 Boiler firing rate for each boiler.
- .9 Provide alarms if any status does not match command
- .10 Provide alarm if any temperature is out of normal range

### **3.9 RADIANT PANELS**

- .1 Single temperature set at 21 degrees C (70 degrees F) during the day and 3 degrees C (6 degrees F) cooler at night by modulating two-way control heating valve. Operate in sequence with space fan coil where applicable.

### **3.10 RADIATION**

- .1 Single temperature thermostat set at 21 degrees C (70 degrees F) maintains constant space temperature during the day and 3 degrees C (6 degrees F) cooler at night by modulating two-way control heating valve.
- .2 Radiation pumps, P-3 and P-4, shall modulate to maintain appropriate pressure within radiation loop. End-of-line pressure independent valve shall modulate to maintain minimum flow in loop.

### **3.11 UNIT HEATERS**

- .1 Single temperature electric room thermostat maintains constant space temperature of 20 degrees C (68 degrees F) by cycling unit fan motor.

### **3.12 POOL DEHUMIDIFICATION UNIT – DHU-1**

- .1 Connect factory controls interface to Building BAS network.
- .2 Pool dehumidification unit shall run based on pool operation schedule.
- .3 DHU-1 shall operate via internal controls to maintain constant pool space static pressure negative relative to neighboring spaces, pool area space temperature, and humidity.
- .4 Display
  - .1 Pool area space temperature and humidity
  - .2 Pool area space static pressure
  - .3 Space static pressure of neighboring pool area
  - .4 Heat recovery loop pump status
  - .5 Heating valve commanded position.
  - .6 Air conditioning commanded control
  - .7 Freezestat status (alarmed)
  - .8 Provide high and low humidity level alerts
  - .9 Provide high and low temperature alerts
  - .10 Provide alarm if unit status does not match unit start/stop command.
  - .11 Provide alarm upon failure of supply or exhaust fan.

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**3.13 DOMESTIC HOT WATER BOILER SYSTEM**

- .1 Domestic Boiler to be enabled for continuous operation and shall maintain supply water temperature of 150F.
- .2 Domestic hot water tank heating pump (P-21) shall operate continuously.
- .3 Domestic hot water heat exchanger pump (P-20) shall operate continuously.
- .4 Mixing valve MV-3 shall modulate to maintain domestic hot water supply temperature of 140F.
- .5 Pool heat exchanger heating pump shall operate continuously.
- .6 Mixing valve MV-4 shall modulate to maintain desired pool heating water temperature.
- .7 Arena domestic hot water recirculation pump (P-18) shall run continuously.
- .8 Display:
  - .1 System graphic.
  - .2 Boiler supply and return temperatures.
  - .3 Boiler supply control point adjustment.
  - .4 Domestic hot water supply temperature
  - .5 Pool heating water temperature.
  - .6 Pump on/off indication: P-18, P-19, P-20, P-21.
  - .7 Pump on/off switch: P-18, P-19, P-20, P-21.
  - .8 Boiler firing rate.
  - .9 Provide alarms if any status does not match command
  - .10 Provide alarm if any temperature is out of normal range

**3.14 ERV CONTROL**

- .1 Under normal operating conditions, ERV shall operate continuously at minimum exhaust flow requirements.
- .2 ERV supply and exhaust fans shall operate to maintain minimum exhaust flow and equal flow through supply side of ERV. Supply and exhaust fans shall modulate to maintain CO<sub>2</sub> setpoint as second stage for all spaces.
- .3 Under free-cooling conditions, ERV shall operate at minimum exhaust flow in free cooling mode.
- .4 Supplemental exhaust air motorized dampers shall modulate to maintain duct static pressure in exhaust upstream of ERV.
- .5 Motorized dampers at each AHU-1 and AHU-2 shall modulate to maintain the higher of their respective minimum air volume or CO<sub>2</sub> setpoint as first stage.
- .6 Volume control damper on AHU-3 shall modulate to maintain constant 400cfm fresh air.
- .7 Display:
  - .1 System graphic.
  - .2 Free cooling status
  - .3 Exhaust fan status
  - .4 Supply fan status
  - .5 Exhaust to outdoors temperature and humidity.
  - .6 Building exhaust temperature and humidity.
  - .7 Outdoor air temperature and humidity.

- .8 Supply air temperature and humidity.
- .9 Provide alarms if any status does not match command
- .10 Provide alarm if any temperature or humidity are out of normal range

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Electrical demolition.

**Part 2            Products**

**2.1                MATERIALS AND EQUIPMENT**

- .1            Materials and equipment for patching and extending work: As specified in individual Sections.

**Part 3            Execution**

**3.1                EXAMINATION**

- .1            Refer to 26 05 00 Common Work Results for Electrical.
- .2            Verify field measurements and circuiting arrangements are as shown on Drawings.
- .3            Verify that abandoned wiring and equipment serve only abandoned facilities.
- .4            Electrical drawings are based on existing record documents and/or casual field observations. Coordinate full extent of demolition work with all disciplines. Coordinate on site with all trades prior to commencement of demolition.
- .5            Report discrepancies to the Contract Administrator, and The City before disturbing the existing installation.
- .6            Beginning of demolition means installer accepts existing conditions.

**3.2                PREPARATION**

- .1            Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- .2            Reroute/extend/re-feed existing electrical as required to maintain existing systems not indicated to be removed.
- .3            Coordinate utility service outages with Utility Company.
- .4            Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- .5            Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switch overs and connections. Obtain permission from the The City at least forty eight (48) hours before partially or completely disabling system. Disable system at a time suitable to the The City only. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area as required.
- .6            Where existing luminaires, equipment or devices are to be temporarily relocated, and are to remain in service, provide an apparatus suitable to support the equipment.

**3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- .1 Demolish and extend existing electrical work to this Section and as indicated.
- .2 The construction documents indicate major items of equipment, fixtures and devices, that exist and may not indicate every item or supporting wiring and conduit to be removed and/or relocated.
- .3 Carefully examine the site and construction documents to verify the extent of work defined in the construction documents. Be responsible for determining which existing equipment and/or devices are to be removed and/or relocated.
- .4 Remove, relocate, and extend existing installations to accommodate new construction including all existing equipment and/or devices indicated within the construction documents.
- .5 Where existing equipment and/or devices are to be temporarily relocated, coordinate the required structure to support the equipment.
- .6 Remove abandoned wiring to source of supply.
- .7 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- .8 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- .9 Disconnect and remove abandoned panelboards and distribution equipment.
- .10 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- .11 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- .12 Repair adjacent construction and finishes damaged during demolition and extension work.
- .13 Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- .14 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

**3.4 PANELBOARDS**

- .1 Existing panelboards shall be retrofitted to accommodate new sprinklers. Provide mechanically fastened manufacturer approved drip hoods for all surface mounted panelboards. Seal existing conduit and wiring penetrations for all surface mounted panelboards with weatherproof connectors. All work shall be conducted in accordance to approved methods by the authority having jurisdiction.

**3.5 CLEANING AND REPAIR**

- .1 Clean and repair existing materials and equipment which remain or are to be reused.
- .2 Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, broken electrical parts and lenses.

**3.6 FINISHES**

- .1 Clean, prime and paint exposed wiring, conduit, junction and pull boxes, hangers, racking, and fasteners to prevent rusting and to match existing finishes where applicable.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1    Division 0 – Bidding & Contract Requirements
- .2    General Requirements
- .3    All Electrical Drawings and Division 25, 26, 27, 28 Series Specification Sections.

**1.2                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2    CAN3-C235-83 (R2015) - Preferred Voltage Levels for AC Systems, 0 to 50 000 V.
- .3    CSA (Canadian Standards Association).
- .4    ULC (Underwriters' Laboratories of Canada).
- .5    ASTM E-814, - Fire Tests of Penetration Fire Stops.
- .6    ANSI/ UL1479 - Fire Tests of Through Penetration Firestops

**1.3                REGULATORY REQUIREMENTS**

- .1    Conform to CSA-C22.1-18.
- .2    Comply with all CSA Electrical Bulletins in force at time of Bid Submission.
- .3    Comply with all provincial by-laws, ordinances, codes, rulings, and other requirements.
- .4    Comply with requirements of the electrical supply authority and the local inspection authority.
- .5    Products: Listed and classified by CSA, or ULC and as suitable for the purpose specified and indicated. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the appropriate Inspection Departments.

**1.4                DEFINITIONS**

- .1    The following are definitions of terms and expressions used in the specification:
  - .1    **Contract Administrator:** Electrical Engineering Consultant: Epp Siepman Engineering Inc.
  - .2    **Inspection Authority:** agent of any authority having jurisdiction over construction standards associated with any part of electrical work on site.
  - .3    **Supply Authority:** electrical power utility company responsible for delivery of electrical power to project.
  - .4    **Electrical Code:** Canadian Electrical Code or Local Code in effect at project location.
  - .5    **Indicated:** as shown on Contract drawings or noted in Contract Documents.
  - .6    **Install:** To remove from site storage, move or transport to intended location, install in position, connect to utilities, repair site caused damage, and make ready for use.



- .7 **Supply:** To acquire or purchase, ship or transport to the site, unload, remove packaging to permit inspection for damage, re-package, replace damaged items, and safely store on-site.
- .8 **Provide:** Wherever the term "provide" is used in relationship to equipment, conduit and other materials specified for the work, it means "supply, install, connect and leave in working order all materials and necessary wiring, supports, access panels, etc., as necessary for equipment indicated." Wherever the terms "provide" is used in connection with services such as testing, load balancing, start-up, preparation of drawings for any part of the work, it means procure, prepare, supervise, take responsibility for, and pay for these services.
- .9 **Typical:** A representative characteristic that is standard for all installations whether individually noted or not throughout the documents. "Typical" applies to each individual or combined installation except where specifically noted or otherwise indicated that the application is non-typical.
- .10 **Exposed:** Any work not concealed in wall, shaft, or ceiling cavities or spaces. Work behind doors, in closets or cupboards or under counters is considered exposed.
- .11 **New:** Produced from new materials.
- .12 **Renewed:** Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.
- .13 **Defective:** A condition determined exclusively by the Contract Administrator.

## 1.5 PERMITS & FEES

- .1 Submit all quantities of drawings and specifications necessary for examination and approval to Electrical Permit Department and Electrical Supply Authority prior to commencement of work.
- .2 Obtain and pay for all permits necessary for the electrical installation.

## 1.6 INSPECTION

- .1 Furnish a Certificate of Acceptance from the Inspection Authorities on completion of work. Copies of Certificate shall be included in Maintenance Manuals.
- .2 Certificate of Inspection and Approval shall be submitted before final payment may be considered to be due.
- .3 During the course of the project construction, the Contract Administrator will carry out periodic site reviews and prepare a deficiency list for remedial action by the Electrical Subcontractor. When requested, the Electrical Subcontractor shall respond in writing to the Contract Administrator, stating corrective action and completion date for each item listed as deficient. This response shall be in the hands of the Contract Administrator within three working days of receipt of the Site Review Report.

## 1.7 PRODUCT CHANGES & SUBSTITUTIONS

- .1 Change in Product/Products: Submit request for substitution or alternative in accordance with this Section, the Instructions to Bidders, and Division 01 Product Exchange Procedures Division 01 Substitutions Sections. In case of a discrepancy between this section and Division 00 and Divisions 01, the more stringent requirements shall apply.
- .2 The Instructions to Bidders specify time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section.

- .3 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- .4 Any substituted item submitted for consideration must not exceed the available space limitations, and all additional costs for mechanical, electrical, structural and architectural revisions required to incorporate the substituted material shall be the responsibility of the Electrical Division. Review maximum dimensions and weights when provided in the specification and schedules, and where not specified review the drawings for space limitations.
- .5 A request constitutes a representation that the Bidder:
  - .1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
  - .2 Will provide the same warranty for the Substitution as for the specified Product.
  - .3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to The City.
  - .4 Waives claims for additional costs or time extension which may subsequently become apparent.
  - .5 Will reimburse The City and Contract Administrator for review or redesign services associated with re-approval by authorities.
- .6 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

## **1.8 SUBMITTALS FOR REVIEW**

- .1 Refer to Division 01.
- .2 Progress Payment Application Template
  - .1 Prior to the first application for payment, submit for review a draft progress application template.
  - .2 Progress Application shall contain separate line items for the following systems:
    - .1 Site Services
    - .2 Distribution Equipment including Panels, Distribution Panels, Transformers, etc.
    - .3 Lighting
    - .4 Lighting Controls
    - .5 Branch Wiring, Conduit, Raceway, Boxes
    - .6 Exit & Emergency Lighting
    - .7 Voice/Data
    - .8 Paging
    - .9 Audio/Visual Systems
    - .10 Intercom
    - .11 Fire Alarm
    - .12 CCTV
    - .13 Intrusion
    - .14 Access Control
  - .3 Progress for each system shall break out labor and materials separately.

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- .3 Shop Drawings Administrative Requirements
    - .1 **Shop drawings shall be submitted electronically in PDF format documents to [shopdrawings@eppsiepman.com](mailto:shopdrawings@eppsiepman.com).**
    - .2 Shop drawing documents **shall be grouped by specification section**. Clearly list the specification section on the front page or cover sheet of the submittal. Shop drawings related to **multiple sections may not be grouped together** into a single document. Documents that are groups incorrectly will be returned without being examined and shall be considered rejected.
      - .1 Each drawing shall include the name of project as found on the drawings or specifications, the equipment supplier and the specification section that the equipment is specified under.
    - .3 Submit to Contract Administrator submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
    - .4 Work affected by submittal shall not proceed until review is complete.
    - .5 Present Shop Drawings, product data, samples and mock-ups in SI Metric and/or Imperial inch-pound units, to match the units used in the schedules.
  - .4 Shop Drawings and Product Data
    - .1 Submit shop drawings and product data for review by the Contract Administrator. All drawings shall be in English and metric dimensions or in imperial where indicated. Manufacture of equipment shall not commence until shop drawings have been reviewed.
    - .2 Material submitted for review shall be marked up bear the Contractor's and where applicable the Utility's reviewed stamp.
    - .3 Shop drawings shall be reviewed by the Electrical Subcontractor, General Contractor, and where applicable the Utility prior to submittal to Contract Administrator, confirming that they meet all the design requirements. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.
    - .4 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.
    - .5 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
    - .6 Where applicable, include wiring, single line and schematic diagrams.
    - .7 Include wiring drawings or diagrams showing inter-connection with work of other sections.
  - .5 Provide scaled drawings showing layout of all electrical equipment and coordination of same with mechanical equipment in all electrical, electrical/mechanical and voice data rooms.
  - .6 Submit samples in accordance with General Conditions. Samples shall be forwarded to the Contract Administrator's office and returned. Approved samples will be retained until after Bid closing, then all samples will be returned except for the sample submitted by the Manufacturer who has been listed by the successful Contractor in the Bid documents.

This sample will be used for comparison with the actual production run of successful manufacturer.

- .7 Submit shop drawings of service entrance equipment to utilities.

## 1.9 CLOSEOUT SUBMITTALS

- .1 Refer to Division 01.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 Four (4) weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, one (1) draft copy of operating and maintenance manuals in Canadian English.
- .4 Copy will be returned with Contract Administrator's comments.
- .5 Revise content of documents as required prior to final submittal.
- .6 Two (2) weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, three (3) final copies of operating and maintenance manuals in Canadian English.
- .7 Maintenance Data:
  - .1 Provide operation and maintenance data for incorporation into Maintenance Manuals.
  - .2 Include 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.
  - .3 Include technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
  - .4 Include all warranty information.
  - .5 Submit Maintenance Manuals to the Contract Administrator for review. Manuals that are incomplete shall be returned to the Electrical Sub-Contractor for completion. Completed manuals shall be submitted, to the satisfaction of the Contract Administrator, before final payment may be considered to be due.
  - .6 Format
    - .1 Refer also to Section 01 78 10 for formats for manuals. Where there is a discrepancy with this section, follow the requirements of 01 78 10.
    - .2 Organize data in the form of an instructional manual.
    - .3 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 8.5 x 11 inch (219 x 279 mm) with spine and face pockets.
    - .4 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
    - .5 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
    - .6 Arrange content by systems under Section numbers and sequence of Table of Contents.
    - .7 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
    - .8 Text: Manufacturer's printed data, or typewritten data.

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- .9 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
  - .7 Contents
    - .1 Refer also to Section 01 78 10 for formats for contents. Where there is a discrepancy with this section, follow the requirements of 01 78 10.
    - .2 Table of Contents: Provide:
      - .1 Title of project.
      - .2 Date of submission.
      - .3 Names, addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties.
      - .4 Schedule of products and systems, indexed to content of volume.
    - .3 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
    - .4 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.
    - .5 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control, wiring, and schematic diagrams and performance curves.
    - .6 Include Systems Certifications where applicable.
    - .7 Include manufacturer specific warranties where applicable.
    - .8 Include a list of maintenance materials provided in each related section.
    - .9 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including code compliance certificate, life safety systems performance certificate.
    - .10 Training: Record of The City's representative training as specified.
  - .8 Maintenance Materials:
    - .1 Provide maintenance materials as specified. Include a list of the maintenance materials in each related section of the operation and maintenance data.
    - .2 Turn materials over to The City in an orderly fashion upon completion of installation.
  - .9 Record Documentation:
    - .1 Prior to Substantial Performance of the Work, electronically transfer the marked-up information from the as-built documents, as follows:
      - .1 Drawings: Scan the full-sized field-verified as-built drawing set and save to PDF format. Scans shall be in colour and with good resolution to ensure drawings and markups are legible.
    - .2 Mark revised documents as "RECORD DOCUMENTS". Include all revisions.
    - .3 Submit completed record documents to Contract Administrator on a CD, DVD, or by electronic transfer.
    - .4 Project record documents shall comprise a complete and accurate record of the actual electrical installation. Record drawings that are inaccurate or incomplete shall be returned to the contractor for correction and completion.

- .5 Record drawings shall contain a stamp bearing the words "Record Drawing" or "As-Built Drawing", the Electrical Subcontractor's company name, date, and the contractor's signature.
- .6 The Contract Administrators will recommend a suitable deficiency holdback until accurate and complete record drawings have been submitted in acceptable form.
- .7 Indicate on record drawings, location of all buried services. This information is to be certified correct by Contract Administrator before backfilling commences.
- .8 Record actual size and location of all cables including depth of cables where buried.
- .9 Contractor to take all schedules/details from specification and put onto additional drawing sheets for Record Drawings.

#### **1.10 EXAMINATION**

- .1 Prior to submitting a Bid, examine the site and local conditions which will affect the work. Refer to the Architectural, Mechanical and Structural drawings, schedules and specifications for construction details to be certain that the electrical work can be satisfactorily carried out as specified. Claims for extra payments resulting from conditions which could reasonably be foreseen during an examination of the documents and/or site, will not be recognized.
- .2 Ensure that all equipment designated as "Existing to Remain" or "Existing to be Relocated" is suitable for its intended re-use, including panelboards and circuits. Report any discrepancies to the Contract Administrator before Bid close.
- .3 Refer to General Conditions for instructions regarding a prearranged site visit during the Bid period.
- .4 Notify Contract Administrator of any discrepancies, omissions, etc., prior to the awarding of the Contract, otherwise the Electrical Subcontractor shall perform the work as directed at no additional cost to the The City.

#### **1.11 SHORT CIRCUIT/COORDINATION/ARC FLASH STUDY**

- .1 Provide a Short Circuit Study based on the IEEE calculation methods found in IEEE 551. The study shall include a summarized table which lists all equipment included in the short circuit study and their respective short circuit interrupt ratings. The study shall list equipment which marginally passes or fails the short circuit test calculations. The study shall also provide recommendations for mitigating equipment which marginally pass or fail their associated short circuit ratings.
- .2 Provide a Protection and Coordination Study based on IEEE 242 and IEEE 1015. The study shall include all circuit breakers, relays, fuses, transformers, and other protective equipment which are fed from all energy sources in the associated distribution. The study shall include time-current curves as necessary to determine all circuit breaker settings. The study shall include an analysis of all time-current curves, an analysis of the coordinated circuit breaker settings, and recommendations for mitigating any potential protection and coordination issues. The study shall include all phase and ground fault curves with recommended settings for full selective coordination on all life safety devices including but not limited to generators, fire pumps, elevators and lifts. The study shall include a table of all circuit breaker settings for every circuit breaker considered in the study. The study shall be coordinated with the Arc Flash study to mitigate serious potential arc flash incident energies when applicable.
- .3 Provide an Arc Flash study based on IEEE 1584 and CSA Z462. The arc flash study shall include all areas in the distribution where an arc-flash hazard is present which includes,

but is not limited to, equipment analyzed in the short circuit study. The arc flash study shall be coordinated with the protection and coordination study. The Arc Flash Study shall include, for all considered equipment, worst case arc flash results including the local incident energies, working distances, and arc flash boundaries.

- .4 Provide Arc Flash labels based on the results of the Arc Flash Study. Labels shall conform to the requirements set out in CSA Z462.
- .5 Submit a preliminary copy of the studies complete with short circuit information and preliminary breaker coordination to the Contract Administrator with distribution and fire pump shop drawings. Feeder lengths for the preliminary study shall be based on worst case estimates based on the intended installation by the Electrical Subcontractor.
- .6 Submit a final copy of the Short Circuit/Coordination/Arc Flash Study to the Contract Administrator upon completed installation of all feeders and distribution. Final copy of Short Circuit/Coordination/Arc Flash Study shall be signed and sealed by a Professional Engineer. Feeder lengths shall be based as-installed on site measurements. Arc Flash Study shall be based on real fault data, provided by the utility. All data sources and their respective origins shall be listed and included in the report or appendices.
- .7 Include the final copy of the Short Circuit/Coordination/Arc Flash Study in each Maintenance Manual.
- .8 Ensure circuit protective devices such as over current trips, relays, fuses, are installed and adjusted to values and settings as recommended in the Studies.
- .9 Ensure arc flash labels are affixed to the appropriate equipment and placed on the equipment as per the guidelines set out in CSA Z462.
- .10 Arc flash labels shall be placed on the exterior of the electrical equipment; free of moving doors, hinges, and moving parts; and be visible on approach to the electrical equipment. Panelboards in public spaces may have their arc flash labels installed inside of a hinged door provided the equipment is constructed such that with the door open there are no exposed current-carrying parts.
- .11 The Short Circuit study shall include all new and existing infrastructure from the secondary side of the utility distribution transformer.

#### **1.12 MANITOBA HYDRO POWER SMART**

- .1 Electrical Subcontractor shall make application on behalf of the The City for the Manitoba Hydro Power Smart Incentive for all available rebates under the Commercial Lighting Program.
- .2 Application shall be made and acceptance provided by MB Hydro prior to commencement of demolition.
- .3 Electrical Subcontractor shall gather all information as required to complete the application.
- .4 Electrical Subcontractor shall provide updates to the The City regarding status of the application and expected rebates.

### **Part 2 Products**

#### **2.1 MATERIALS AND EQUIPMENT**

- .1 Provide labour, materials, transportation, equipment and facilities, etc., required for the complete electrical installation as indicated or implied on the drawings and specifications.

- .2 Electrical equipment shall be new and of type and quality specified.
- .3 Request for approval of material, as equal, shall conform to the specification.
- .4 Equivalent materials and equipment
  - .1 Bidders shall submit a Bid based on the specified materials and equipment only.
  - .2 Bidders may submit a Bid based on equivalent materials and equipment only if such items have been approved as equals by the Contract Administrator.
  - .3 Bidders may submit, with their Bid, an alternate price based on alternate materials and equipment only if such items have been approved as alternates by the Contract Administrator.
  - .4 Submissions for equals or alternates shall be received by the Contract Administrator, ten (10) working days prior to Bid closing. Submissions shall include sufficient manufacturer's data to clearly show equivalency, as well as an itemized list of equal or alternate items, the items for which they were submitted and a space for the Contract Administrator to indicate "approved equal", "approved alternate", or "not approved". Submittal list will be returned or may be picked up at the Contract Administrator's office. Where submissions are not returned by the Contract Administrator before Bid closing or are not received by the Contract Administrator ten (10) working days before close of Bid, they are considered not approved.
  - .5 All submissions shall include the following phrase "We have reviewed all Contract documents, Contract drawings and specifications relating to the equipment presented herein" and shall bear the name and signature of the manufacturer or their agent.

## **2.2 VOLTAGE RATINGS**

- .1 Operating voltages: to CAN3-C235-83(R2015).
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment shall operate in extreme operating conditions established in above standard without damage to equipment.

## **2.3 FINISHES**

- .1 Finish outdoor electrical equipment such as parking lot panels, to match light standards.
- .2 Paint indoor switchgear light grey to EEMAC-2Y-1.
- .3 Paint indoor distribution enclosure trims light grey to EEMAC-2Y-1. Distribution tub shall be galvanized.
- .4 Paint outdoor electrical equipment enclosures with two (2) coats of U.V. resistant Urethane Enamel to minimum 1.5 mil dry coat thickness. Colour shall be "equipment green" to EEMAC 2Y-1.
- .5 Clean and touch up surfaces of shop-painted equipment, scratched or marred during shipment or installation, to match original paint.
- .6 Clean, prime and paint exposed wiring, conduit, junction and pull boxes, hangers, racking, and fasteners to prevent rusting and to match surrounding finishes where applicable.



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## **2.4 LABELS AND WARNING SIGNS**

- .1 Manufacturer's nameplates and CSA labels shall be visible and legible after equipment is installed.
- .2 Provide warning signs on equipment, as required, to meet the requirements of the Inspection Authorities, including indication of multiple power sources.
- .3 Provide quantity as required of buried cable signs reading "Buried Cable" and "Buried High Voltage Cable". Signs shall be installed at building structure/equipment, at locations as directed on site and as per Canadian Electrical Code.

## **2.5 PROTECTION**

- .1 Guards
  - .1 Provide guards for all electrical equipment and devices in areas subject to damage.
- .2 Sprinkler Proof Equipment
  - .1 All surface mounted electrical equipment located in sprinklered areas shall be sprinkler proof and shall be provided with suitable hoods and shields.
  - .2 Entrance of conduits into the top of surface mount electrical panels/cabinets/distributions and motor control centers shall utilize O-rings and watertight connectors.
  - .3 All recessed mounted branch circuit panels and distribution panels shall be provided with a Type 2 enclosure.
- .3 Construction
  - .1 Protect exposed live equipment during construction for personnel safety.
  - .2 Shield and mark live part "LIVE ( ) VOLTS", with appropriate voltage.
  - .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision.

## **2.6 SPARE PARTS AND MAINTENANCE MATERIALS**

- .1 Assemble spare parts as specified.
- .2 Include the following:
  - .1 Part number.
  - .2 Identification of equipment or system for which parts are applicable.
  - .3 Installation instructions as applicable.
- .3 Provide a written list complete with The City's signature assuring that spare parts have been received by the The City.

## **2.7 ACCESS DOORS**

- .1 Access doors shall be minimum #12 gauge prime coat painted bonderized steel. Each shall be complete with a heavy flush frame and anchor, concealed hinges, positive locking screwdriver lock, and mounting and finishing provisions to suit the finish material for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc. shall be ULC. listed and labeled and of a rating to maintain the fire separation integrity.

- .2 Where access doors are located in surfaces where special finishes are required, they shall be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout.
- .3 Supply access doors in inaccessible construction shall give access to all concealed junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair.
- .4 Before commencing installation of electrical work, submit to the Architectural Contract Administrator for approval, a list of required access doors showing the exact sizes and locations of such access doors. Locate access doors in walls and partitions to the Architectural Contract Administrator's approval, and arrange electrical work to suit. Access doors shall be, wherever possible, of a standard size for all applications. Confirm exact dimensions with the Architectural Contract Administrator, prior to ordering.
- .5 Access doors will be installed by the Division responsible for the particular type of construction in which access doors are required. Supply the access doors to the Division installing same at the proper time to avoid construction delays.

### **Part 3 Execution**

#### **3.1 COORDINATION WITH OTHER TRADES**

- .1 Refer to Mechanical, Structural, Architectural and Interior Design drawings and specifications for additional electrical work in connection with other Divisions. Where such work is included in other sections of the specifications, provide equipment, conduit, wiring, etc. (in accordance with the approved manufacturer's shop drawings), as required, for operation of the specified equipment.
- .2 Schedule execution of electrical work with associated work specified in other Divisions.
- .3 Coordinate electrical work with work of other trades to avoid conflicts with pipes, air ducts or other equipment. Provide additional supports, wiring, etc., to relocate electrical equipment, as required, where structural members, air ducts, piping or other equipment interferes with the electrical installation.
- .4 Prior to installation provide scaled drawings of all mechanical/electrical rooms and communication rooms showing layout of all equipment (mechanical and electrical) for Contract Administrator review.

#### **3.2 QUALITY ASSURANCE**

- .1 Do complete installations in accordance with CSA C22.1-18.
- .2 While not identified and specified by number in this Division, comply with CSA Electrical bulletins in force at time of Bid Submission. Comply with the requirements of all Provincial and local laws, rules, ordinances and codes.
- .3 Electrical installations shall comply with all requirements of the electrical supply authority and the inspection authority.
- .4 Electrical installation shall be in accordance with the applicable versions of the Canadian Electrical Code, Provincial and other codes, rules and regulations. Supply material and labour required to meet the requirements of these codes, rules and regulations even though the work is not shown on the drawings or mentioned in the specifications. Where the electrical installation calls for better quality materials or construction than the minimum requirements of these codes, rules and regulations, the electrical installation shall be as shown on the drawings and as specified.

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**3.3 WORKMANSHIP**

- .1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Contract Administrator. Install conduit and cable runs parallel and perpendicular to building lines in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.
- .2 Install equipment/junction boxes and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearances and accessibility for same.
- .3 Provide for all requirements shown on shop drawings or manufacturer's installation instructions.
- .4 Work deemed by the Contract Administrator to be unsatisfactory shall be replaced at no additional cost.

**3.4 DELIVERY STORAGE AND HANDLING**

- .1 Deliver all materials to site in an orderly fashion.
- .2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials shall be left in shipping containers until required for use.
- .3 Provide additional protection such as tarps, padding, wood skids, etc., as required to ensure protection of equipment and as directed by the Architectural Contract Administrator.

**3.5 EXCAVATION AND BACKFILLING**

- .1 Excavate and backfill as required for underground electrical services as indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise work. Backfilling shall restore the excavated area to the original condition and shall include sodding where required.
- .2 Work shall be in accordance with the current CSA Bulletin.
- .3 Include all costs for excavation and backfilling, for any underground electrical installation, unless otherwise indicated.
- .4 Work shall be arranged in such a manner that will not interfere with regular pedestrian or vehicular traffic patterns.
- .5 Provide trenching, cable installations and backfill promptly. Open trenches shall be barricaded in an appropriate manner.
- .6 Cables required to cross under roadways, paved areas, sidewalks, etc. shall be installed in PVC conduits pushed under such areas.
- .7 Six (6") of sand shall be provided surrounding installed cables and 2" x 4" treated plank installed 6" above the cables. Install cable marker tape in all trenches, minimum 12" above cables. The remainder of the trench shall be backfilled with granular base course. All backfill material shall be thoroughly tamped and compacted to at least 90% of maximum density at optimum moisture. The ground shall be left free from ruts and rough spots. In any asphalt areas, backfill shall be granular material only.
- .8 All sodded areas disturbed or damaged during trenching and backfilling shall be repaired with manured soil mix and resodded. Make all repairs to damaged asphalt and/or concrete surfaces to match existing.

- .9 Care shall be taken when excavating near existing services. Existing trees and shrubbery in work area shall be protected from damage.
- .10 Install buried cable signs as per CEC and Manitoba Electrical addendums.

### **3.6 CONDUIT SLEEVES AND HOLES**

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete shall be sized for free passage of conduit.
- .2 Holes through exterior walls and roof shall be flashed and made weatherproof.
- .3 Make necessary arrangements for cutting of chases, drilling of holes and other structural work required to install electrical conduits, cables, pullboxes and outlet boxes.
- .4 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .5 Provide a minimum of two (2) separate conduit sleeves embedded in each concrete lighting fixture base. At least one (1) unused conduit shall be for possible future extension of wiring.
- .6 All conduits and cables shall be entered into the building above grade unless otherwise noted.
- .7 All coring in buildings with electrical in the slab shall be scanned at contractor's expense to prevent damage.

### **3.7 CUTTING AND PATCHING**

- .1 Pay the costs of all cutting and patching required for the installation of electrical work. Payment for cutting and patching shall be made through the General Contractor.
- .2 Cutting and patching required for the installation of electrical work shall be done by the particular trade whose work is involved. No cutting or patching shall be carried out by the tradesman employed on the electrical work.
- .3 Obtain the approval of the Architectural Contract Administrator before arranging for any cutting. Patching shall restore the affected area to the original condition; materials and methods used for patching shall be in accordance with the requirements of the corresponding Divisions of the specification.

### **3.8 DEVICE INSTALLATION**

- .1 Device Location
  - .1 Locate devices as indicated.
  - .2 Do not install devices back-to-back in wall.
  - .3 Drawings are schematic only and do not indicate all architectural or structural elements.
  - .4 Change location of devices at no extra cost or credit, providing distance does not exceed 10'-0" (3 m) and information is provided before installation.
  - .5 Locate light switches on latch side of doors.
  - .6 Vertically align devices of different systems when shown in close proximity to each other and occurring at different mounting heights.
  - .7 Coordinate mounting heights and location of all equipment with Architectural, Mechanical and Structural Drawings prior to installation of rough-in boxes.
- .2 Mounting Heights

- .1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated, verify with Architectural Contract Administrator before proceeding with installation.
- .3 Install electrical equipment at the following heights unless indicated or directed otherwise:

Device / Equipment	Mounting Height	
Devices above counters	150mm	6"****
Receptacles:		
- General	400mm	16"
- General (Accessible Height)	450mm	18"
- Mechanical/Shop Areas	1000mm	40"
- Clock	2150mm	84"
- Above top of continuous baseboard heater	200mm	8"
- Exterior	1000mm	40"
Switches, Dimmers, push buttons, Luxo bracket		
- General	1200mm	47"
- Accessible Suites	900mm	36"
Clocks	2150mm	84"
Exit Signs	25mm*****	1"*****
Emergency Lighting Battery Banks/Remote Headers	2350mm* or 150mm**	92"* or 6"*
Automatic Door Operator Pushbuttons	900mm	36"
Occupancy Sensors – Switch based with manual override controls.	1200mm	47"
Occupancy Sensors – General	Per manufacturers recommendations	
Fire Alarm Visual, Audible, & Combination Devices	2350mm* or 150mm**	92"* or 6"*
Fire Alarm Manual Pullstations	1200mm	47"
Fire Fighter Handsets	1500mm	59"
Thermostats	1200mm	47"
Intercom Stations	1200mm	47"
Proximity/Card Readers	900mm	36"
Communication Outlets	400mm	16"
Communication Outlets (Accessible Height)	450mm	18"
Hand Dryers	1200mm	47"
Branch Circuit Panelboards, Control Panels, Annunciators. Install panels taller than 1800mm (72") with bottom no more than 100mm (4") above floor.	2000mm*	78"*
Enclosed circuit breakers	1600mm***	60"***

- \*Measured to top of device/equipment
- \*\*Measured from Ceiling to top edge of device where mounting height would be lower than required specification.
- \*\*\*Measured to operating handle of device.
- \*\*\*\*Coordinate counter backsplash heights with architectural drawings prior to rough-in. Maintain minimum 1" clearance above backsplash height.
- \*\*\*\*\*Measured above door trim to underside of device.

- .1 Coordinate all mounting heights with Architectural elevations.
- .2 Where installed in block or brick, mounting heights shall be as above or at bottom of nearest course.
- .4 Circuiting is representational within a panel only. Circuit all electrical equipment and devices to their individually respective, intended panels.
- .5 Panelboards and other equipment which are to be surface mounted shall be installed on minimum 19mm (3/4") good one side, fir plywood mounting backboards. Treat backboards with wood preservative prior to installation and paint with primer and two (2) coats gray enamel before any equipment is mounted. Provide plywood mounted boards unless specified otherwise in other sections.
- .6 Panelboards mounted on exterior concrete/block walls shall have minimum 3/4" air gap behind enclosure (to minimize condensation).
- .7 All transformers, motor control centers and floor-mounted distribution panels shall be mounted on 100mm (4") concrete housekeeping pads. The Electrical Subcontractor's shall be responsible for provision of these pads.

### 3.9 FIREPROOFING

- .1 Where cables or conduits pass through block or concrete walls and floors and any fire-rated assembly, seal openings with firestopping systems that have been tested for specific fire-resistance-rated construction conditions conforming to the construction assembly type, penetrating item type, annular space requirements, and fire-rating involved in each instance.
- .2 Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
- .3 Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products.
- .4 Fire proofing of electrical cables, conduits, trays, etc, passing through fire barriers shall conform to local codes and inspection authorities.
- .5 Fire stop materials shall be asbestos free and have been tested in accordance with ASTM E-814, and ULC 1479.
- .6 Fire stop and smoke seals shall be done in accordance with Section 07 84 13.
- .7 Approved manufacturers:
  - .1 Nelson Firestop Products
  - .2 Specified Technologies
  - .3 Hilti Firestop

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**3.10 LOAD BALANCE**

- .1 Measure phase current to panelboards with normal loads operating at time of measurement. 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 Submit, at completion of work, a report listing phase and neutral currents on panelboards, transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.
- .4 Include load balance test results in maintenance manuals.

**3.11 TESTING**

- .1 Conduct and pay for tests including, but not limited to, the following systems:
  - .1 High voltage distribution equipment in accordance with relevant sections of specification.
  - .2 Power generation and distribution system.
  - .3 Circuits originating from branch distribution panels.
  - .4 Lighting and its control.
  - .5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .6 Heating cables and mats.
  - .7 Systems:
    - .1 Fire Alarm
    - .2 Public Address
    - .3 Communication cabling systems.
    - .4 Intrusion Detection
    - .5 Access Control
    - .6 CCTV
  - .8 Grounding systems.
- .2 Insulation Resistance Testing
  - .1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
  - .2 Megger 350-600V circuits, feeders and equipment with a 1000V instrument.
  - .3 Check resistance to ground before energizing.
- .3 Furnish Manufacturer's Certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions. Submit letter in accordance with this section.
- .4 Carry out tests in presence of Contract Administrator where directed.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results in Maintenance Manuals.

**3.12 CARE, OPERATION AND START-UP**

- .1 Instruct the The City's operating personnel in the operation, care and maintenance of equipment. Arrangement of such instructional sessions shall be done at a time convenient to the The City.
- .2 Arrange and pay for services of Manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such a period, and for as many visits as necessary to put equipment into operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

**3.13 CLEANING**

- .1 Final cleaning shall be done in accordance with the specification.
- .2 Final cleaning shall include, but not be limited to, all lighting reflectors, lenses, and other lighting surfaces that have been exposed to dust and dirt throughout the course of construction.

**END OF SECTION**



**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Building wire and cable.
- .2 Direct burial cable.
- .3 Armoured cable.
- .4 Metal clad cable.
- .5 Variable frequency (speed) drive cable.
- .6 Fire rated cable.
- .7 Wiring connectors and connections.

**1.2 RELATED SECTIONS**

- .1 Section 26 05 53 - Electrical Identification.
- .2 Section 31 23 18 - Trenching: Trenching and backfilling for direct burial cable installation.

**1.3 REFERENCES**

- .1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2 C22.2 No. 0.3-09 (R2014) - Test Methods for Electrical Wires and Cables.
- .3 CSA C22.2 No. 51-14 - Armoured Cables.
- .4 CSA C22.2 No. 52-15 - Underground Secondary and Service Entrance Cables.
- .5 CAN/CSA-C22.2 No. 65-18 - Wire Connectors.
- .6 CSA C22.2 No. 75-17 - Thermoplastic-Insulated Wires and Cables.
- .7 CSA C22.2 No. 123-16 - Metal Sheathed Cables.
- .8 CAN C22.2 No.131-17 - Type TECK 90 Cable.
- .9 NECA (National Electrical Contractors Association) - National Electrical Installation Standards (NEIS).
- .10 NETA (InterNational Electrical Testing Association) - ANSI/NETA ATS-2017 - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- .11 CSA (Canadian Standards Association).
- .12 ULC (Underwriters' Laboratories of Canada).

**1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Coordination:
  - .1 Coordinate with other work having a direct bearing on work of this section.
  - .2 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

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**1.5 SUBMITTALS FOR INFORMATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Record Documentation:
  - .1 Record actual locations of components and circuits.
  - .2 Record routing of all equipment and panelboard feeders.

**1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

**1.8 REGULATORY REQUIREMENTS**

- .1 Conform to CSA-C22.1.
- .2 Provide products listed and classified by CSA or ULC and as suitable for the purpose specified and indicated.

**1.9 PROJECT CONDITIONS**

- .1 Conductor sizes are based on copper unless indicated as aluminum or "AL".

**Part 2 Products**

**2.1 BUILDING WIRE AND CABLE**

- .1 Description: Single conductor insulated wire.
- .2 Conductor: Copper unless otherwise noted.
- .3 Insulation Voltage Rating: 600 volts.
- .4 Insulation: Thermoplastic material rated 90 degrees C.

**2.2 DIRECT BURIAL CABLE**

- .1 Description: Type NMWU.
- .2 Conductor: Copper unless otherwise noted.
- .3 Insulation Voltage Rating: 600 volts.
- .4 Insulation Temperature Rating: 90 degrees C.
- .5 Underground Warning Tape: 100 mm(4 inch) wide plastic tape, detectable type, coloured yellow with suitable warning legend describing buried electrical lines.

**2.3 ARMoured CABLE**

- .1 Description: Type ACWU90 and AC90.

- .2 Conductor: Copper for sizes smaller than 4 AWG; aluminum and copper for sizes 4 AWG and larger.
- .3 Insulation Voltage Rating: 600 volts.
- .4 Insulation Temperature Rating: 90 degrees C.
- .5 Insulation Material: Thermoplastic.

#### **2.4 METAL CLAD CABLE**

- .1 Description: Type TECK90.
- .2 Conductor: Copper for sizes smaller than 4 AWG; aluminum and copper for sizes 4 AWG and larger.
- .3 Insulation Voltage Rating: 600 volts.
- .4 Insulation Temperature Rating: 90 degrees C.
- .5 Conductor Insulation Material: Cross-Linked Polyethylene (XPLE), type RW90.
- .6 Armour Material: Aluminum.
- .7 Armour Design: Interlocked metal tape.
- .8 Outer jacket: PVC.
- .9 Rating: Hazardous Location, CSA FT4

#### **2.5 VARIABLE FREQUENCY (SPEED) DRIVE CABLE:**

- .1 Provide variable frequency drive cables meeting the requirements of CSA C22.2 No. 123 from all VFD's to each designated motor load.
- .2 Insulation Voltage Rating: 1000 volts.
- .3 Insulation Temperature Rating: 90 degrees C.
- .4 Conductor Insulation Material: Cross-Linked Polyethylene (XPLE), type RW90.
- .5 Shield Material: Copper or Aluminum.
- .6 Shield Design: spiral tape or braided shield.
- .7 Outer jacket: PVC.
- .8 Rating: Hazardous Location, CSA FT4

#### **2.6 CONNECTORS**

- .1 Pressure type connectors, fixture type splicing connectors, cable clamps and lugs, as required.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that field measurements are as indicated.
- .3 Verify that interior of building has been protected from weather.
- .4 Verify that mechanical work likely to damage wire and cable has been completed.

- .5 Verify that raceway installation is complete and supported.

**3.2 PREPARATION**

- .1 Completely and thoroughly swab raceway before installing wire.

**3.3 WIRING METHODS**

- .1 Concealed Dry Interior Locations: Use only armoured cable and building wire in raceway.
- .2 Exposed Dry Interior Locations: Use only building wire in raceway.
- .3 Above Accessible Ceilings: Use only armoured cable, metal clad cable, and building wire in raceway.
- .4 Wet or Damp Interior Locations: Use only metal clad cable, armoured cable with jacket, and building wire in raceway.
- .5 Exterior Locations: Use only building wire Type RWU90 insulation in raceway, metal clad cable, and armoured cable with jacket.
- .6 Underground Installations: Use only direct burial cable, armoured cable with jacket, and metal clad cable.
- .7 Use wiring methods indicated.

**3.4 INSTALLATION**

- .1 Route wire and cable as required to meet project conditions.
- .2 Install cable to the CSA-C22.1.
- .3 Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- .4 Use stranded conductors for control circuits.
- .5 Use conductor not smaller than 12 AWG for power and lighting circuits.
- .6 Use conductor not smaller than 16 AWG for control circuits.

Maximum Conductor Length for 120V  
Branch Circuits

Breaker Size[A]	Conductor	
	Size [AWG]	Max Length [m]
15A	#12	20
	#10	35
	#8	55
	#6	90
20A	#12	15
	#10	25
	#8	40
	#6	65
	#4	110

30A	#10	15
	#8	25
	#6	45
	#4	70

- .7 Pull all conductors into raceway at same time.
- .8 Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- .9 Protect exposed cable from damage.
- .10 All cable routed below grade shall enter/exit the building below grade unless noted otherwise.
- .11 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- .12 Single conductor cables shall be installed one cable diameter apart on suspended cable tray or channel supports and shall be clamped with aluminum cable clamps. Cables shall be terminated using non-magnetic connectors and shall be watertight for top entry. Cable armour shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate, at the load end of the cable. A #3/0 AWG insulated (unless otherwise noted) copper ground wire shall be installed with each set of feeder cables. Cable bending radius shall be at least twelve times the overall cable diameter and bend shall not damage or distort the outer sheath.
- .13 Armoured cable shall be used for connections from conduit systems to recessed luminaires in accessible ceilings. Cable shall be of sufficient length to allow the lighting fixture to be relocated to any location within an 1800mm (6') radius. Cable shall be clamped before entering the lighting fixture and shall be clipped before entering the conduit system junction box. (Minimum requirements).
- .14 Provide VFD cable between the VFD and associated motor for all for all VFD driven motors. Coordinate VFD locations with mechanical. VFD cable lengths shall be kept as small as practically possible to reduce electromagnetic interference. Maintain as much separation as possible between noise-susceptible cables and VFD cables: a minimum of 1 ft. for shielded instrumentation cables and 3 ft. for unshielded instrumentation cables. If the VFD cables and noise-susceptible cables must lie close to each other, parallel runs shall not exceed 3 m (10 ft.). If VFD cable must cross other cable type, cables shall cross perpendicularly, at a single point.
- .15 Use suitable cable fittings and connectors.
- .16 Neatly train and lace wiring inside boxes, equipment, and panelboards.
- .17 Clean conductor surfaces before installing lugs and connectors.
- .18 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- .19 Terminate aluminum conductors with tin-plated aluminum- bodied compression connectors only. Fill with anti- oxidant compound before installing conductor.
- .20 Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.

- 
- .21 Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
  - .22 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
  - .23 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
  - .24 Trench and backfill for direct burial cable installation as specified in Section 32 23 18 and Section 32 23 23. Install warning tape along entire length of direct burial cable, within 75 mm (3 inches) of grade.
  - .25 Identify wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Grounding electrodes and conductors.
- .2    Equipment grounding conductors.
- .3    Bonding.

**1.2                RELATED SECTIONS**

- .1    Section 26 00 00 – Basic Electrical Materials and Methods.

**1.3                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2    IEEE 81-2012 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

**1.4                SYSTEM DESCRIPTION**

- .1    System shall conform to requirements of CSA-C22.1-18. System includes but not necessarily limited to:
  - .1    Rod electrodes.
  - .2    Secondary neutrals of transformers.
  - .3    Building bonding system.
  - .4    Communications system ground.
  - .5    Equipment bonding
  - .6    Metal water piping system.
  - .7    Metal frame of the building.
  - .8    Metal gas piping system.

**1.5                PERFORMANCE REQUIREMENTS**

- .1    Maximum Grounding System Resistance: 5 ohms.

**1.6                SUBMITTALS FOR REVIEW**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Product Data: Provide for grounding electrodes and connections.

**1.7                CLOSEOUT SUBMITTALS**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Record Drawings: Record actual locations of components and grounding electrodes.
- .3    Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.
- .4    Test results: Include ground continuity and resistance test results in Operation and Maintenance Manual.

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**1.8 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years' experience.

**1.9 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by ULC and/or CSA as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 ROD ELECTRODES**

- .1 Material: Copper-clad steel.
- .2 Diameter: 15.8 mm (5/8 inch) minimum.
- .3 Length and Quantity: As required to meet performance requirements.

**2.2 MECHANICAL CONNECTORS**

- .1 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.

**2.3 WIRE**

- .1 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated.

**2.4 GROUNDING WELL COMPONENTS**

- .1 Well Pipe: 200mm (8") by 600 mm(24") long concrete.
- .2 Well Cover: Cast iron with legend "GROUND" embossed on cover.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that final backfill and compaction has been completed before driving rod electrodes.

**3.2 INSTALLATION**

- .1 Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- .2 Provide bonding to meet Regulatory Requirements.



- .3 Exposed conductors shall be protected from mechanical injury.
- .4 Mechanical connections shall be used for bonding connections to equipment. Soldered joints shall not be permitted.
- .5 Buried connections of grounding and bonding conductors shall be made using exothermic welding process.
- .6 Provide bonding wire connected to both ends of flexible conduit. Neatly attach to exterior of flexible conduit.
- .7 Provide separate ground conductors for all exterior pole mounted luminaires.
- .8 Interface with site grounding system.
- .9 Interface with lightning protection system.
- .10 Bonding connections shall be made using a star configuration. Loop connections shall be avoided.
- .11 Single conductor cables with metallic armour shall be bonded at the supply end only. Provide non-metallic entry plates for load end terminations. Provide a separate bonding conductor.
- .12 Provide separate bonding conductor in all non-metallic raceways.
- .13 Provide additional separate bonding conductor within branch circuit raceways where indicated on the drawings. Terminate each end on suitable lug, bus, or bushing.

### **3.3 SYSTEM GROUNDING**

- .1 Install system and circuit grounding connection from neutral points of 600V and 208V systems. 600V and 208V systems shall be permitted to be grounded by the system bonding jumpers that are connected to the bonding conductors included in the primary supply.
- .2 Where separate grounding conductors are required, they shall be routed in or adjacent to primary conduits or cables.
- .3 Provide grounding connection to utility pad mounted transformer in accordance with the requirements of the supply authority.

### **3.4 EQUIPMENT BONDING**

- .1 Install bonding connections to typical equipment included in, but not necessarily limited to:
  - .1 Service equipment
  - .2 Distribution Panels
  - .3 Transformers
  - .4 Motor Frames
  - .5 Motor Control Centres
  - .6 Starters
  - .7 Control Panels
  - .8 Building Steel Work
  - .9 Outdoor lighting

**3.5 COMMUNICATION SYSTEMS**

- .1 Install communications grounding system for bonding of all telephone, data, fire alarm, paging as follows:
  - .1 Provide minimum #6 AWG ground (or larger as indicated on drawings) from all voice/data, server, and IT communications rooms to main building ground.
  - .2 Provide grounding for utility telephone and data demarcation locations in accordance with utility requirements.
  - .3 Sound, fire alarm, and other communication systems as indicated.

**3.6 FIELD QUALITY CONTROL**

- .1 Perform tests before energizing electrical system.
- .2 Disconnect ground fault indicator, if provided, during tests.
- .3 A ground electrode with an unsatisfactory resistance test result shall be altered as necessary until the required resistance reading is achieved.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Conduit and equipment supports.
- .2    Anchors and fasteners.

**1.2                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2    CECA - Canadian Electrical Contractors Association.
- .3    CSA (Canadian Standards Association).
- .4    ULC (Underwriters' Laboratories of Canada).

**1.3                SUBMITTALS FOR REVIEW**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Product Data: Provide manufacturer's catalogue data for fastening systems.

**1.4                REGULATORY REQUIREMENTS**

- .1    Provide products listed and classified by CSA and as suitable for purpose specified and shown.

**Part 2            Products**

**2.1                PRODUCT REQUIREMENTS**

- .1    Materials and Finishes: Provide adequate corrosion resistance.
- .2    Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- .3    Anchors and Fasteners:
  - .1    Concrete Structural Elements: Use expansion anchors.
  - .2    Steel Structural Elements: Use beam clamps and spring steel clips.
  - .3    Concrete Surfaces: Use expansion anchors.
  - .4    Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
  - .5    Solid Masonry Walls: Use expansion anchors.
  - .6    Sheet Metal: Use sheet metal screws.
  - .7    Wood Elements: Use wood screws.

**2.2                STEEL CHANNEL**

- .1    U-shape, galvanized steel, size 1.6" x 1.6" (41 x 41 mm), 0.1" (2.5 mm) thick, surface-mounted, suspended or set in poured concrete walls and ceilings as required.

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**2.3           INSTALLATION**

- .1       Install products to manufacturer's written instructions.
- .2       Provide anchors, fasteners, and supports to CSA-C22.1.
- .3       Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- .4       Do not use powder-actuated anchors.
- .5       Obtain permission from Contract Administrator before using powder-actuated anchors.
- .6       Do not drill or cut structural members.
- .7       Obtain permission from Contract Administrator before drilling or cutting structural members.
- .8       Do not use plastic cable ties.
- .9       Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- .10      Install surface-mounted cabinets and panelboards with minimum of four anchors.
- .11      In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 inch) off wall.
- .12      Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Metal conduit.
- .2 Flexible metal conduit.
- .3 Liquid tight flexible metal conduit.
- .4 Electrical metallic tubing.

**1.2 RELATED SECTIONS**

- .1 Section 07 84 00 - Firestopping.
- .2 Section 26 05 34 - Boxes.
- .3 Section 26 05 37 - Duct Bank.
- .4 Section 26 05 26 - Grounding And Bonding.
- .5 Section 26 05 29 - Electrical Supporting Devices.
- .6 Section 26 05 53 - Electrical Identification.

**1.3 REFERENCES**

- .1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2 CSA C22.2 No. 18.1-13 (R2018) - Metallic Outlet Boxes.
- .3 CSA C22.2 No. 45.1-07 (R2017) - Electrical Rigid Metal Conduit - Steel.
- .4 CSA C22.2 No. 56-17 - Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .5 CSA-C22.2 No. 83.1-07 (R2017) - Electrical Metallic Tubing - Steel.
- .6 CSA C22.2 No. 211.1-06 (R2016) - Rigid Types EB1 and DB2/ES2 PVC Conduit.
- .7 CSA C22.2 No. 2420-09 (R2014) - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- .8 CSA C22.2 No. 227.2.1-14 - Liquid-Tight Flexible Nonmetallic Conduit.
- .9 CSA (Canadian Standards Association).
- .10 ULC (Underwriters' Laboratories of Canada).

**1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Coordination:
  - .1 Coordinate with other work having a direct bearing on work of this section.
  - .2 Coordinate location with roofing installation as specified by Division 07.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.

- .2 Record Documentation:
  - .1 Accurately record actual routing of conduits equal to or larger than 35mm (1-1/4").
  - .2 Accurately record actual routing of backbone conduit runs.

## **1.6 REGULATORY REQUIREMENTS**

- .1 Design conduit size to CSA-C22.1.
- .2 Provide products listed and classified by CSA or ULC as suitable for purpose specified and shown.

## **1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Accept conduit on site. Inspect for damage.
- .3 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- .4 Protect PVC conduit from sunlight.

## **Part 2 Products**

### **2.1 CONDUIT REQUIREMENTS**

- .1 Minimum Size: 21 mm (3/4 inch) unless otherwise specified.
- .2 Underground Installations:
  - .1 More than 1525 mm(5 ft) from Foundation Wall: Use thick wall non-metallic conduit.
  - .2 Within 1525 mm(5 ft) from Foundation Wall: Use rigid steel conduit.
  - .3 In or Under Slab on Grade: Use thick wall non-metallic conduit.
  - .4 Minimum Size: 27 mm(1 inch).
  - .5 Provide a separate ground wire in all below-grade conduits.
  - .6 Provide an exterior trace wire for all conduits containing non-current carrying cabling.
  - .7 Use waterproof fittings.
- .3 Outdoor Locations, Above Grade: Use rigid steel conduit.
- .4 Wet and Damp Locations: Use non-metallic conduit.
- .5 Dry Locations:
  - .1 Concealed: Use electrical metallic tubing.
  - .2 Exposed: Use electrical metallic tubing.

### **2.2 METAL CONDUIT**

- .1 Rigid Steel Conduit: C22.2 No. 45.1.
- .2 Fittings and Conduit Bodies: All steel fittings.

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**2.3 FLEXIBLE METAL CONDUIT**

- .1 Description: Interlocked steel construction.
- .2 Fittings: CSA C22.2 No. 56.
- .3 Provide a separate ground wire in all flexible metal conduit.

**2.4 LIQUID TIGHT FLEXIBLE METAL CONDUIT**

- .1 Description: Interlocked steel construction with PVC jacket.
- .2 Fittings: CSA C22.2 No. 56.
- .3 Provide a separate ground wire in all liquid tight flexible metal conduit.

**2.5 ELECTRICAL METALLIC TUBING (EMT)**

- .1 Description: CSA C22.2 No. 83.1; galvanized tubing.
- .2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel, set screw type.
- .3 Refer to Section 26 05 53 for colour requirements.

**2.6 FITTINGS**

- .1 Fittings shall be manufactured for use with conduit specified.
- .2 Insulated throat liners on connectors.
- .3 Steel raintight connector fittings complete with O-rings, for use on weatherproof or sprinklerproof enclosures. Steel raintight couplings shall be used for surface conduit installation exposed to moisture or sprinkler heads. Steel raintight connectors shall be used for all top entries to panels, contactors and motor control centres.
- .4 Expansion fittings
  - .1 Outdoor locations - Weatherproof expansion fittings with internal bonding assembly, suitable for 100 mm (4") or 200 mm (8") linear expansion.
  - .2 Wet and Damp Locations - Watertight expansion fittings with integral bonding jumper suitable for linear expansion, and 21 mm (3/4") deflection in all directions, as required.
  - .3 Panel Entry - Weatherproof expansion fittings for linear expansion as required.
  - .4 PVC Conduit - O-ring type expansion fittings.
  - .5 Flexible watertight conduit between junction boxes with integral bonding jumper suitable for linear and lateral movement greater than 19 mm (3/4").

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that field measurements are as shown on Drawings.
- .3 Verify routing and termination locations of conduit prior to rough-in.
- .4 Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

- .5 Drawings do not contain all conduits. Provide all conduit as required for a complete system.
- .6 All conduit sizes indicated on drawings are minimum sizes unless otherwise noted. Where larger conduit sizes are required to meet Canadian Electrical Code requirements, Electrical Subcontractor shall provide larger size at no additional cost. Increase conduit size at no extra costs where required to accommodate length of run and voltage drop requirements in accordance with Canadian Electrical Code requirements.

### 3.2 **INSTALLATION**

- .1 Install conduit to CSA C22.1.
- .2 Arrange supports to prevent misalignment during wiring installation.
- .3 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- .4 Group related conduits; support using conduit rack.
- .5 Construct rack using steel channel. Provide space on each for 25% additional conduits.
- .6 Fasten conduit supports to building structure and surfaces to Section 26 05 29.
- .7 Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- .8 Do not attach conduit to ceiling support wires.
- .9 Arrange conduit to maintain headroom and present neat appearance.
- .10 Provide flexible metal conduit for all connections to motors, recessed lighting, suspended lighting, transformers, and equipment subject to movement or vibration.
- .11 Conduit Routing:
  - .1 All conduit shall be concealed except in mechanical and electrical rooms or as otherwise noted.
  - .2 Where surface conduit is installed:
    - .1 Locate more than 2000 mm (78 inches) from infrared or gas-fired heaters.
    - .2 Group conduits on suspended or surface rack support.
  - .3 Route conduit parallel and perpendicular to walls.
  - .4 Route conduit installed above accessible ceilings parallel and perpendicular to walls.
  - .5 Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
  - .6 Route conduit in and under slab from point-to-point.
  - .7 Do not route conduits through structural members unless otherwise indicated.
  - .8 Do not route conduit through terrazzo or concrete toppings unless otherwise indicated.
  - .9 Do not route conduit horizontally in masonry walls unless otherwise indicated.
- .12 Conduits in Poured Concrete:
  - .1 Submit marked up drawings of proposed conduit routing complete with conduit sizes to Structural and Electrical consultants for approval prior to installation.
  - .2 Coordinate installation of conduit to suit reinforcing steel.



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- .3 Locate in centre third of slab.
  - .4 Provide minimum separation of 150 mm (6") between parallel conduit runs.
  - .5 Do not install conduit in drop panels, beams, or columns unless approved by the Structural Consultant.
  - .6 Where conduits are grouped, or do not follow perpendicular to parallel to building lines, provide photos in electronic format (minimum resolution 1920x1080) of conduit installation prior to concrete pour.
  - .7 Record drawings shall indicate location of all conduit embedded in concrete, or run below slab complete with dimensions to building lines.
  - .8 For slab-on-grade, conduit larger than 27 mm (1") shall be routed below slab and encased in minimum 75 mm (3") of concrete.
  - .13 All conduit below grade shall be sloped to provide drainage away from the building.
  - .14 Maintain adequate clearance between conduit and piping.
  - .15 Maintain 300 mm (12 inch) clearance between conduit and surfaces with temperatures exceeding 40 degrees C (104 degrees F).
  - .16 Cut conduit square using saw or pipe cutter; de-burr cut ends.
  - .17 Bring conduit to shoulder of fittings; fasten securely.
  - .18 Where threaded connections are used, threads shall be of sufficient length to ensure a tight connection.
  - .19 Where conduit becomes blocked, remove and replaced blocked sections.
  - .20 Join non-metallic conduit using cement as recommended by manufacturer.
    - .1 Wipe non-metallic conduit dry and clean before joining.
    - .2 Apply full even coat of cement to entire area inserted in fitting.
    - .3 Allow joint to cure for 20 minutes, minimum.
  - .21 Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
  - .22 Install no more than equivalent of two 90-degree bends between boxes.
    - .1 Use conduit bodies to make sharp changes in direction, as around beams.
    - .2 Use hydraulic one-shot bender to fabricate and factory elbows for bends in metal conduit larger than 53 mm (2 inch) size.
    - .3 All metallic conduit shall be bent cold. Replace sections where conduit is kinked or flattened by more than 10% of its original diameter.
  - .23 Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
  - .24 Ensure conduit systems are dry prior to installation of wiring.
  - .25 Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic and control expansion joints, and where conduit transitions from below to above grade.
  - .26 Provide polypropylene pull string in each empty conduit except sleeves and nipples.
  - .27 Use suitable caps to protect installed conduit against entrance of dirt and moisture.
  - .28 Ground and bond conduit to Section 26 05 26.
  - .29 Identify conduit to Section 26 05 53.

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**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Wall and ceiling outlet boxes.
- .2 Parking lot outlet boxes.
- .3 Floor boxes.
- .4 Pull and junction boxes.

**1.2 RELATED SECTIONS**

- .1 Section 07 84 00 - Firestopping.
- .2 Section 08 31 13 - Access Doors And Frames.
- .3 Section 26 27 26 - Wiring Devices.

**1.3 REFERENCES**

- .1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2 CSA C22.2 No. 18.1-13 (R2018) - Metallic Outlet Boxes.
- .3 CSA C22.2 No. 40-17 - Junction and Pull Boxes.
- .4 CSA C22.2 No. 85-14 - Rigid PVC Boxes and Fittings.
- .5 CSA (Canadian Standards Association).
- .6 ULC (Underwriters' Laboratories of Canada).

**1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Coordination:
  - .1 Coordinate with other work having a direct bearing on work of this section.
  - .2 Coordinate installation of outlet box for equipment connected under Section 26 05 80.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Record Documentation: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

**1.6 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by CSA or ULC, and as suitable for the purpose specified and indicated.

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**Part 2            Products**

**2.1                OUTLET BOXES**

- .1 Sheet Metal Outlet Boxes: CSA-C22.2 No. 18, galvanized steel.
  - .1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm (1/2 inch) male fixture studs where required.
  - .2 Concrete Ceiling Boxes: Concrete type.
- .2 Non-metallic Outlet Boxes: CSA-C22.2 No. 18.
- .3 Cast Boxes: CSA-C22.2 No. 18, Type FS or FD as indicated or as required, cast ferric alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- .4 In-wall Boxes: 18 gauge white powder coated steel complete with trim ring, will accept standard single gang outlet boxes, wiring devices and cover plates, complete with screw-on steel cover with cable exit.
- .5 Wall Plates for Finished Areas: As specified in Section 26 27 26.

**2.2                PULL AND JUNCTION BOXES**

- .1 Sheet Metal Boxes: CSA-C22.2 No. 18, galvanized steel.
- .2 Hinged Enclosures: As specified in Section 26 27 16.
- .3 Surface Mounted Cast Metal Box: CSA-C22.2 No. 18, Type 4; flat-flanged, surface mounted junction box:
  - .1 Material: Galvanized cast iron.
  - .2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.
- .4 In-Ground Cast Metal Box: CSA-C22.2 No. 18, Type 6, flanged, recessed cover box for flush mounting:
  - .1 Material: Galvanized cast iron.
  - .2 Cover: Non-skid cover with neoprene gasket and stainless steel cover screws.
  - .3 Cover Legend: "ELECTRIC".
- .5 Fibreglass Hand Holes: Die moulded glass fibre hand holes:
  - .1 Cable Entrance: Pre-cut 150 x 150 mm (6 x 6 inch) or as indicated, cable entrance at centre bottom of each side.
  - .2 Cover: Glass fibre weatherproof cover with non-skid finish.

**Part 3            Execution**

**3.1                EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify locations of floor boxes and outlets throughout prior to rough-in.

**3.2                INSTALLATION**

- .1 Install boxes to CSA-C22.1.

- .2 Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- .3 Set wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device and as indicated. Coordinate locations with architectural drawings.
- .4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 ft) if required to accommodate intended purpose.
- .5 Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- .6 Maintain headroom and present neat mechanical appearance.
- .7 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- .8 Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 150 mm (6 inches) from ceiling access panel or from removable recessed luminaire.
- .9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- .10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- .11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- .12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- .13 Use flush mounting outlet box in finished areas.
- .14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- .15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm (6 inches) separation. Provide minimum 600 mm (24 inches) separation in acoustic rated walls.
- .16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- .17 Use stamped steel bridges to fasten flush mounting outlet box between studs.
- .18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- .19 Use in-wall boxes for wall mounted television and smart board power and communications applications.
- .20 Do not install in-wall box back-to-back in walls; provide minimum 150 mm (6 inches) separation. Provide minimum 600 mm (24 inches) separation in acoustic rated walls.
- .21 Secure in-wall box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- .22 Use stamped steel bridges to fasten in-wall outlet box between studs.
- .23 Install in-wall mounting box without damaging wall insulation or reducing its effectiveness.
- .24 Use adjustable steel channel fasteners for hung ceiling outlet box.
- .25 Do not fasten boxes to ceiling support wires.
- .26 Support boxes independently of conduit.
- .27 Use gang box where more than one device is mounted together.

- .28 The use of sectional boxes is not permitted.
- .29 Use gang box with plaster ring for single device outlets.
- .30 Use cast outlet box in exterior locations where exposed to the weather and wet locations.
- .31 Set floor boxes level.
- .32 Large Pull Boxes: Where pull boxes have a long dimension of 305 mm (12 inches) or more, use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

**3.3 ADJUSTING**

- .1 Adjust floor box flush with finish flooring material.
- .2 Adjust flush-mounting outlets to make front flush with finished wall material.
- .3 Install knockout closures in unused box openings.

**3.4 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Clean interior of boxes to remove dust, debris, and other material.
- .3 Clean exposed surfaces and restore finish.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Nameplates and labels.
- .2      Wire markers.
- .3      Conduit markers.
- .4      Underground warning tape.

**1.2                REFERENCES**

- .1      CSA (Canadian Standards Association).
- .2      ULC (Underwriters' Laboratories of Canada).

**1.3                SUBMITTALS FOR REVIEW**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Product Data: Provide catalogue data for nameplates, labels, and markers.
- .3      Installation Data: Provide list of all equipment requiring nameplates complete with associated nameplate configuration for review.

**1.4                REGULATORY REQUIREMENTS**

- .1      Provide products listed and classified by CSA or ULC and as suitable for purpose specified and shown.

**1.5                LANGUAGE**

- .1      All identification shall be in English.

**Part 2            Products**

**2.1                NAMEPLATES AND LABELS**

- .1      Nameplates:
  - .1      Exterior –Stainless steel, etched and color filled with stamped product specific labelling.
  - .2      Interior - Engraved three-layer laminated plastic, white letters on blue background for normal power and systems, white letters on red background for life safety power and systems, and white letters on orange background for standby power and systems.
  - .3      Locations:
    - .1      Electrical distribution, motor control centres, disconnect switches, panelboards and control equipment enclosures.
      - .1      Nameplate shall include:
        - .1      Distribution Name
        - .2      Distribution Voltage, Phase, Wires, Amperage
        - .3      Room Location

- 
- .4 Fed From:
    - .1 Panel Name
    - .2 Supplying Breaker Size/Poles
    - .3 Room Location
  - .2 Electrical distribution and motor control centres..
    - .1 Nameplates at individual breakers shall include:
      - .1 Load Name
      - .2 Room Location of Load
      - .3 Breaker Size/Poles
  - .3 Electrical distribution and panelboards where breakers are applied in series ratings shall also include:
    - .1 "BREAKERS ARE INSTALLED IN A SERIES RATED COMBINATION AND SHALL ONLY BE REPLACED WITH COMPONENTS OF THE SAME TYPE AND RATING."
  - .4 Circuit breakers and fused switches which directly feed a single conductor cable shall include the maximum continuous load allowed:
    - .1 "MAXIMUM CONTINUOUS LOAD: X AMPS"
  - .5 Adjustable circuit breakers shall include the maximum continuous load allowed:
    - .1 "MAXIMUM CONTINUOUS LOAD: X AMPS"
  - .6 Mechanical equipment disconnect switches:
    - .1 Nameplate shall include:
      - .1 Mechanical Equipment Mark
      - .2 Panel Name & Circuit number
  - .7 Communication/Systems Racks & Cabinets
    - .1 Nameplate shall include:
      - .1 System Name
      - .2 Room Number
      - .3 Rack/Cabinet Number (if applicable)
      - .4 Fed From:
        - .1 Room Number.
        - .2 Rack/Cabinet Number (if applicable)
        - .3 Patch Panel and/or Rack Position (if applicable)
  - .8 Fire Alarm System Equipment
    - .1 Nameplate shall include:
      - .1 Room Number
      - .2 Equipment Name
      - .3 Fed From:
        - .1 Room Number.
        - .2 Panel Name and Circuit Number
  - .9 Fire Alarm Equipment Branch Circuit Breakers
    - .1 Nameplate shall indicate "FIRE ALARM PANEL" or approved wording.
  - .10 Pole mounted luminaires.



- .1 Nameplate shall include:
  - .1 Manufacturer & Model # of Pole
  - .2 Manufacturer & Model # of Luminaire
  - .3 Voltage
  - .4 Ballast Model #
  - .5 Lamp Wattage & Model #
  - .6 Fed From Panel & Circuit Number
- .11 Emergency Lighting Units.
  - .1 Nameplate shall include:
    - .1 Unit #
    - .2 Manufacturer & Model # of unit equipment
    - .3 AC circuit supplying unit
    - .4 AC lighting circuits monitored (voltage relay)
    - .5 Date installed
  - .12 Parking receptacles.
    - .1 Nameplate shall include:
      - .1 Circuit number
- .4 Letter Size:
  - .1 Use 6 mm(1/4 inch) letters for identifying equipment mark designations and system types.
  - .2 Use 3 mm(1/8 inch) letters for identifying supporting information.
  - .3 Use 6 mm(1/4 inch) letters for identifying grouped equipment and loads.
- .5 Nameplates on exterior equipment shall be UV & weather resistant.
- .6 Wording on nameplates shall be approved prior to manufacture. Submit schedule of nameplates and wording.
- .2 Labels: Plastic self-adhesive non-smear labels with 5 mm(3/16 inch) black letters on white background.
  - .1 Locations:
    - .1 Wiring devices, including lighting control devices and receptacles.
      - .1 Label shall include:
        - .1 Indicate associated panel and circuit number.
        - .2 E.g. "A-32" (A is for Panel-A, and 32 is the circuit number)
        - .3 Lighting controls to include brief description of lighting being controlled.
        - .4 E.g. "Pendants"
    - .2 Voice/Data Outlets
      - .1 Label shall include:
        - .1 Indicate associated rack or cabinet name
        - .2 Indicate associated patch panel and drop number
        - .3 E.g. "IDC-A-13" (IDC is for rack name, patch panel A, drop number 13)
    - .3 Voice/Data Patch Panels
      - .1 Label shall include:

- .1 Indicate associated rack or cabinet name
- .2 Indicate patch panel name.
- .3 E.g. "IDC-A" (IDC is for rack name, patch panel A)

## 2.2 WIRE MARKERS

- .1 Wire Markers: Permanent tape type wire markers not susceptible to thermal or mechanical influence.
- .2 Locations:
  - .1 Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.
    - .1 Legend:
      - .1 Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
      - .2 Control Circuits: Control wire number indicated on Shop Drawings.
    - .2 Voice/Data drops including both ends of cable.
      - .1 Label shall include:
        - .1 Indicate associated rack or cabinet name
        - .2 Indicate associated patch panel and drop number
        - .3 E.g. "IDC-A-13" (IDC is for rack name, patch panel A, drop number 13)

## 2.3 CONDUIT MARKERS

- .1 Manufacturers:
  - .1 Brady; Product: BMP71 Indoor/Outdoor Vinyl Labels.
  - .2 Substitutions: Refer to Section 26 05 00.
- .2 Description: Vinyl label.
- .3 Location: Provide markers for each conduit longer than 4.7 m(10 ft).
- .4 Spacing: 6 m(20 ft) on centre.
- .5 Colour:
  - .1 Normal Power System: Blue
  - .2 Life-Safety Power System: Red
  - .3 Standby Power System: Orange
  - .4 Fire Alarm System: Red.
  - .5 Communication System: Yellow
  - .6 Security Systems: Black
  - .7 Controls System: White
- .6 Legend:
  - .1 600 Volt System: 600V.
  - .2 120/208 Volt System: 120/208V.
  - .3 Fire Alarm System: FIRE ALARM.
  - .4 Communication System:

- .1 VOICE
- .2 DATA
- .3 VOICE/DATA
- .5 Public Address System: PA
- .6 CCTV System: CCTV
- .7 Access Control System: ACCESS CONTROL
- .8 Intrusion System: INTRUSION
- .9 Controls System: CONTROLS

**2.4 UNDERGROUND WARNING TAPE**

- .1 Manufacturers: Brady
  - .1 Product: Detectable Identoline.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Degrease and clean surfaces to receive nameplates and labels.

**3.2 APPLICATION**

- .1 Install nameplate and label parallel to equipment lines.
- .2 Secure nameplate to equipment front using rivets or screws.
- .3 Conduit shall be integrally colour coded through a colouring process applied by the conduit manufacturer.
- .4 Colour:
  - .1 600 Volt System: Orange
  - .2 208 Volt System: Blue
  - .3 Fire Alarm System: Red.
  - .4 Communication System: Yellow
  - .5 Security Systems: Black
  - .6 Controls System: White
- .5 Identify underground conduits using underground warning tape. Install one tape per trench at 75 mm(3 inches) below finished grade.
- .6 Provide identification on all junction box covers indicating associated system, panel and circuit numbering using permanent marker.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1            Electrical connections to equipment specified under other sections.

**1.2            RELATED SECTIONS**

- .1            Section 26 05 00 - Common Work Results for Electrical.
- .2            Section 22 47 00 - Plumbing Equipment.
- .3            Section 23 81 13 - Unitary Air Conditioners.
- .4            Section 26 05 33 - Conduit.
- .5            Section 26 05 19 - Building Wire And Cable.
- .6            Section 26 05 34 - Boxes.

**1.3            REFERENCES**

- .1            CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2            CSA C22.2 No. 127-18 - Equipment and Lead Wires.
- .3            ANSI/NEMA WD 6-2016 Wiring Devices—Dimensional Specifications.
- .4            NEMA WD 1-1999 (R2015) - General Colour Requirements for Wiring Devices.
- .5            CSA (Canadian Standards Association).
- .6            ULC (Underwriters' Laboratories of Canada).

**1.4            ADMINISTRATIVE REQUIREMENTS**

- .1            Refer to 26 05 00 Common Work Results for Electrical.
- .2            Coordination:
  - .1            Coordinate with other work having a direct bearing on work of this section.
  - .2            Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.
  - .3            Determine connection locations and requirements.
- .3            Sequencing:
  - .1            Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
  - .2            Sequence electrical connections to coordinate with start-up schedule for equipment.

**1.5            SUBMITTALS FOR REVIEW**

- .1            Refer to 26 05 00 Common Work Results for Electrical.
- .2            Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.

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**1.6 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by CSA or ULC, and as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 MECHANICAL CONNECTIONS**

- .1 Include motor starters, disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.
- .2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical equipment, except for temperature/humidity control systems.
- .3 Unless otherwise noted in Mechanical Equipment Schedule, motors and control devices shall be supplied by Division 21, 22, and 23. Motor horsepower ratings shall be as shown in the Division 21, 22, and 23 specifications.
- .4 Provide the Mechanical Subcontractor with a copy of the Mechanical Equipment Schedule and ensure conformance with voltage shown. Verify data, provided in Mechanical Equipment Schedule with Mechanical Subcontractor. Inform Contract Administrator of any inconsistencies.
- .5 All equipment, mounted on the exterior of the building, shall be weatherproof.

**2.2 AUTOMATIC DOOR OPERATORS**

- .1 Power: Wire and connect motorized door operators as indicated.
- .2 Controls: Wire and connect all associated controls including but not limited to entry pushbuttons, vertical kick bars, motion sensors, electric strikes, electric locks, key switches etc. Confirm controls requirements with automatic door shop drawings and automatic door subcontractor.
- .3 Interface with Other Systems: Interface with access control system and intrusion alarm system as indicated. Coordinate sequencing of door operators with other systems to The City's requirements.
- .4 Execution: Coordinate complete installation with automatic door shop drawings and automatic door subcontractor.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that equipment is ready for electrical connection, wiring, and energization.

**3.2 ELECTRICAL CONNECTIONS**

- .1 Make electrical connections to equipment manufacturer's written instructions.
- .2 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.

- 
- .3 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
  - .4 Provide receptacle outlet where connection with attachment plug is indicated or as required. Provide cord and cap where field-supplied attachment plug is indicated or as required.
  - .5 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
  - .6 Install disconnect switches, controllers, control stations, and control devices as indicated or as required by the manufacturer of the associated equipment.
  - .7 Modify equipment control wiring with terminal block jumpers as indicated or as required.
  - .8 Provide interconnecting conduit and wiring between devices and equipment where indicated or as required.
  - .9 Provide ground fault circuit interrupter type circuit breakers for circuits supplying hot tubs, whirlpool tubs, tub lifts etc. Wire and connect associated controls as required by the equipment shop drawings.
  - .10 Mechanical Equipment:
    - .1 Refer to Mechanical Equipment Schedule for specific furnishing, installation and wiring requirements of mechanical equipment and associated disconnects, starters, and control devices.
    - .2 Disconnects shall be mounted independently from the equipment that it's serving.
    - .3 Flexible connections to motors shall not exceed 6 feet (1.83 m), unless approved by Contract Administrator.
    - .4 Install branch circuit wiring for mechanical system control panels, time clocks, and control transformers.
  - .11 Electrical Equipment:
    - .1 Refer to Electrical Equipment Schedule for specific furnishing, installation and wiring requirements of electrical equipment and associated disconnects, starters, and control devices.

**END OF SECTION**

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- Part 1            General**
- 1.1            SECTION INCLUDES**
- .1            Two-winding transformers.
- 1.2            RELATED SECTIONS**
- .1            Section 26 05 26 - Grounding And Bonding.  
.2            Section 26 05 33 - Conduit.
- 1.3            REFERENCES**
- .1            CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.  
.2            CSA-C9-17 - Dry-Type Transformers.  
.3            CSA C22.2 NO. 47-13 (R2018) - Air-Cooled Transformers (Dry Type).  
.4            CSA (Canadian Standards Association).  
.5            ULC (Underwriters' Laboratories of Canada).
- 1.4            SUBMITTALS FOR REVIEW**
- .1            Refer to 26 05 00 Common Work Results for Electrical.  
.2            Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, power, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- 1.5            CLOSEOUT SUBMITTALS**
- .1            Refer to 26 05 00 Common Work Results for Electrical.  
.2            Record Drawings: Record actual locations of transformers in project record documents.  
.3            Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.
- 1.6            QUALITY ASSURANCE**
- .1            Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.
- 1.7            REGULATORY REQUIREMENTS**
- .1            Products: Listed and classified by CSA and as suitable for the purpose specified and indicated.
- 1.8            DELIVERY, STORAGE, AND PROTECTION**
- .1            Refer to 26 05 00 Common Work Results for Electrical.  
.2            Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

- .3 Handle to manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

**Part 2 Products**

**2.1 TWO-WINDING TRANSFORMERS**

- .1 Manufacturers:
  - .1 Delta
  - .2 Hammond
  - .3 Bmag
  - .4 Substitutions: Refer to Section 26 05 00.
- .2 Description: factory-assembled, air cooled dry type transformers, ratings as indicated.
- .3 Primary Voltage: 600 volts, 3 phase.
- .4 Secondary Voltage: 208Y/120 volts, 3 phase.
- .5 Frequency: 60 Hertz.
- .6 Insulation system and average winding temperature rise for rated kVA as follows:
  - .1 1-15 kVA: Class 185 with 115 degrees C (200 degrees F) rise.
  - .2 16-500 kVA: Class 220 with 150 degrees C (277 degrees F) rise.
- .7 Case temperature: Do not exceed 35 degrees C (60 degrees F) rise above ambient at warmest point at full load.
- .8 Winding Taps: Standard.
- .9 Sound Levels: Maximum sound levels:
  - .1 1-25 kVA: 45 dB.
  - .2 26-150 kVA: 50 dB.
  - .3 151-300 kVA: 55 dB.
  - .4 301-500 kVA: 60 dB.
- .10 Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
- .11 Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- .12 Mounting:
  - .1 1-15 kVA: Suitable for wall mounting.
  - .2 16-75 kVA: Suitable for floor and wall mounting.
  - .3 Larger than 75 kVA: Suitable for floor mounting.
- .13 Coil Conductors: Continuous windings with terminations brazed or welded.
- .14 Enclosure: CSA Type 3R ventilated. Provide lifting eyes or brackets.
- .15 Isolate core and coil from enclosure using vibration-absorbing mounts.
- .16 Nameplate: Include transformer connection data.



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**2.2 SOURCE QUALITY CONTROL**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Production test each unit according to CSA C9.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install transformers to manufacturer's instructions.
- .2 Set transformer plumb and level.
- .3 Use flexible conduit, under the provisions of Section 26 05 33, 600 mm (24 inches) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- .4 Mount wall-mounted transformers using integral flanges or accessory brackets provided by the manufacturer.
- .5 Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- .6 Mount floor-mounted transformers on 100 mm (4") housekeeping pad.
- .7 Provide grounding and bonding to Section 26 05 26.
- .8 Provide minimum 150 mm (6") of clearance from walls and 100 mm (4") of clearance from adjacent equipment for ventilation.
- .9 Maintain shipping supports after transformer is installed and remove just before putting transformer into service.
- .10 Loosen isolation pad retaining bolts until no compression is visible.

**3.2 ADJUSTING**

- .1 Measure primary and secondary voltages and make appropriate tap adjustments.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Weatherproof Pad Mounted CSTE
- .2 Metering transformer cabinets.
- .3 Meter bases.
- .4 Prefabricated pad for utility transformer.

**1.2 RELATED SECTIONS**

- .1 Section 26 24 13 - Distribution Switchboards: Metering transformer compartment.
- .2 Section 26 09 01 - Electrical Sensing and Measurement: Electric meters.

**1.3 REFERENCES**

- .1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2 CSA-C22.2 No. 52-09 - Underground secondary and service-entrance cables.
- .3 CSA (Canadian Standards Association).
- .4 ULC (Underwriters' Laboratories of Canada).

**1.4 SYSTEM DESCRIPTION**

- .1 System Characteristics: As indicated

**1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Pre-manufacture and Pre-installation Meetings:
  - .1 Review service entrance requirements and details with utility company's representatives.

**1.6 SUBMITTALS FOR REVIEW**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Product Data: Provide ratings and dimensions of transformer cabinets and meter bases.

**1.7 SUBMITTALS FOR INFORMATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Manufacturer's Drawings: Submit utility company's prepared drawings.

**1.8 QUALITY ASSURANCE**

- .1 Utility Company: Manitoba Hydro
- .2 Perform Work to utility company's written requirements.

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**1.9 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by CSA, ULC and as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 WEATHERPROOF PAD MOUNTED CSTE**

- .1 Manufacturers:
  - .1 Eaton
  - .2 JRS Mfg. Ltd.
  - .3 Substitutions: Refer to Section 26 05 00.
- .2 Description: Weatherproof Type 3R 12 gauge sheet metal enclosure complete with tin plated aluminum bus per CSA C22.2 No. 76. Ratings as indicated.

**2.2 METERING TRANSFORMER CABINETS**

- .1 Manufacturers:
  - .1 Eaton
  - .2 Schneider
  - .3 Siemens
  - .4 Substitutions: Refer to Section 26 05 00.
- .2 Description: Sheet metal cabinet with hinged door, conforming to utility company requirements, with provisions for locking and sealing.
- .3 Size: As required by utility.

**2.3 PREFABRICATED PAD FOR CSTE**

- .1 Description: Fibreglass reinforced plastic with cable pit sized as required for pad mounted CSTE.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that field measurements are as indicated on utility company's drawings.

**3.2 PREPARATION**

- .1 Arrange with utility company to obtain permanent electric service to the project.

**3.3 INSTALLATION**

- .1 Install transformer pad service rack and metering transformer cabinets as required by utility company.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Switchboards.
- .2 Meter transfer switches.
- .3 Power meters.
- .4 Metering transformers.
- .5 Accessories.

**1.2 RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-place Concrete: Concrete for supporting foundations and pads.
- .2 Section 26 05 26 - Grounding and Bonding.
- .3 Section 26 24 01 - Utility Service Entrance.
- .4 Section 26 25 00 - Feeder and Plug-In Busway.
- .5 Section 26 18 16 - Fuses.

**1.3 REFERENCES**

- .1 ANSI C39.1-1981(R1992) - Requirements for Electrical Analog Indicating Instruments.
- .2 NEMA C12.1-2008 - Code for Electricity Metering.
- .3 IEEE C57.13-2008 - IEEE Standard Requirements for Instrument Transformers.
- .4 CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .5 CSA-C22.2 No. 5-09 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
- .6 NEMA KS 1-2001 (R2006) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- .7 NEMA PB 2-2006 - Deadfront Distribution Switchboards.
- .8 NEMA PB 2.1-2007 - General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 V or Less.
- .9 NEMA 260-1996 (R2004) - Safety Labels for Pad Mounted Switchgear and Transformers Sited in Public Areas.
- .10 NETA ATS 2007 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- .11 CSA (Canadian Standards Association).
- .12 ULC (Underwriters' Laboratories of Canada).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Refer to 26 05 00 Common Work Results for Electrical.

- .2 Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.
- .3 Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral and ground; and switchboard instrument details.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Test Reports: Indicate results of factory production tests.
- .3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- .3 Record Documentation: Record actual locations of switchboard in project record documents.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Extra Stock Materials: Provide two (2) of each key.

**1.8 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

**1.9 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by ULC, CSA and as suitable for the purpose specified and indicated.

**1.10 DELIVERY, STORAGE, AND PROTECTION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- .3 Handle to NEMA PB 2.1 and manufacturer's written instructions. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

**Part 2**

**Products**

**2.1**

**MANUFACTURERS**

- .1 Eaton
- .2 Schneider
- .3 Siemens
- .4 GE
- .5 Substitutions: Refer to Section 26 05 00.

**2.2**

**SWITCHBOARDS**

- .1 Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.
- .2 Ratings:
  - .1 Voltage: As indicated
  - .2 Main Bus: Ampere rating as indicated
  - .3 Integrated Equipment Rating: As indicated
- .3 Main Section Devices: Individually mounted and compartmented.
- .4 Distribution Section Devices: Individually mounted and compartmented.
- .5 Auxiliary Section Devices: Individually mounted and compartmented.
- .6 Bus Material: Copper.
- .7 Bus Connections: Bolted and, accessible from front and for maintenance.
- .8 Fully insulate bus bars in accessible compartments. Do not reduce spacing of insulated bus.
- .9 Ground Bus: Extend length of switchboard.
- .10 Moulded Case Circuit Breakers: CAN/CSA-C22.2 No. 5, integral thermal and instantaneous magnetic trip in each pole.
- .11 Circuit breakers, ULC and CSA listed.
- .12 Include shunt trip and where indicated.
- .13 Moulded Case Circuit Breakers with Current Limiters: CAN/CSA-C22.2 No. 5, moulded case circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole. Include shunt trip and where indicated.
- .14 Current Limiting Moulded Case Circuit Breakers: CAN/CSA-C22.2 No. 5, moulded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 rms amperes symmetrical let-through current and energy level less than permitted for same size Class RK-5 fuse. Include shunt trip and where indicated.
- .15 Solid-State Moulded Case Circuit Breakers: CAN/CSA-C22.2 No. 5, with electronic sensing, timing and tripping circuits for adjustable current settings.
- .16 Ground fault trip ground fault sensing integral with circuit breaker and.
  - .1 Instantaneous trip.

- .2 Adjustable short time trip.
- .3 [Stationary mounting] [Drawout construction] and.
- .4 Include shunt trip and where indicated.
- .17 Line and Load Terminations: Accessible from the front and the rear of the switchboard, suitable for the conductor materials and sizes indicated.
- .18 Ground Fault Sensor: Ground return and type.
- .19 Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.
- .20 Metering Transformer Compartment: For Utility Company's use; compartment size, bus spacing and drilling, door, and locking and sealing requirements.
- .21 Pull Section: Size as indicated or width, depth and height to match switchboard. Arrange as indicated.
- .22 Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.
- .23 Pull Box: Removable top and sides, same construction as switchboard.
- .24 Enclosure: Type 1 provided with a sprinkler drip hood.
  - .1 Align sections at front and rear.
  - .2 Switchboard Height: excluding floor sills, lifting members and pull boxes.
  - .3 Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
- .25 Mimic Bus: Show bussing, connections and devices in single line form on the front panels of the switchboard using black colour, plastic strips and, fastened flat against the panel face with screws or rivets.

### **2.3 DIGITAL MULTI-FUNCTION METERS**

- .1 The power meter to applied in 600V three-phase, four-wire systems in WYE mode.
- .2 The power meter shall be capable of being applied without modification at nominal frequencies of 60Hz.
- .3 The power meter unit and display shall be mounted in the pre-made cut-out without tools.
- .4 The power meter display shall be backlit dot-matrix LCD for easy viewing, display shall also be anti-glare and scratch resistant with a minimum of 128x128 pixels.
- .5 All setup parameters required by the power meter shall be stored in nonvolatile memory and retained in the event of a control power interruption. Cumulative quantities for real, reactive and apparent energies shall be stored in non-volatile memory. The power meter shall provide the user the ability to reset the cumulative energy quantities from the display of the unit or via communications.
- .6 The power meter shall have a real time clock with battery back-up with at least 1 year ride through time without external power.
- .7 The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 31<sup>st</sup> harmonic (fundamental of 60 Hz). The power meter

- shall provide continuous sampling at a minimum of up to 64 samples/cycle, simultaneously on all voltage and current channels in the meter.
- .8 0-10 amps with 5 amps nominal input from CT secondary.
  - .9 Residual current shall be calculated by vectorial summation of the phase currents.
  - .10 A fourth CT input shall be available to measure neutral or ground current.
  - .11 Operating temperature range: meter: -25 to 70 °C, display -20 to 70 °C.
  - .12 The power meter device shall comply with ANSI C12.20 Class 0.5 and IEC 61557-12 Class 0.5 for revenue meters. Accuracy for Active energy of the power meter shall be class 0.5S as per IEC 62053-22. Accuracy for reactive energy of the power meter shall be class 2 as per IEC 62053-23 (reactive energy). No annual calibration shall be required to maintain this accuracy.
  - .13 The power meter shall provide for onboard data logging. Each power meter shall be able to log data, alarms and events, and waveforms (if applicable). Logged information to be stored in each Power Meter include the following: Data logs, Min/Max log files of selected parameter values, Alarm logs for each user defined alarm or event and Waveform log. The meters shall offer the following on-board nonvolatile memory. The power meter shall have onboard memory sufficient to log 14 values every 15 minutes for 90 days.
  - .14 Real-time readings
    - .1 Current (Per-phase, 3-Phase Avg, % Unbalanced)
    - .2 Neutral and Ground (4CTs)
    - .3 Voltage (L-L Per-phase, L-L 3-Phase Avg, L-N Per-Phase, 3-Phase Avg, % Unbalanced)
    - .4 Real Power (Per-phase, 3-Phase Total)
    - .5 Reactive Power (Per-phase, 3-Phase Total)
    - .6 Apparent Power (Per-phase, 3-Phase Total)
    - .7 Power Factor (True/Displacement)(Per-phase, 3-Phase Total)
    - .8 Frequency
    - .9 THD, thd, TDD (Current and Voltage), Neutral & ground current THD
    - .10 Individual harmonics up to the order of 15th
    - .11 Temperature (Internal Ambient)
    - .12 K-Factor (Per-Phase)
    - .13 Crest Factor (Per-Phase)
  - .15 Energy Readings
    - .1 Accumulated Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)
  - .16 Demand Readings
    - .1 Demand Current Calculations (Per-Phase, 3-Phase Avg, Neutral)- Present and Peak
  - .17 Demand Calculations (3-Phase Total):
    - .1 Real Power
    - .2 Reactive Power
    - .3 Apparent Power



- .18 All power demand calculations shall use any one of the following calculation methods, selectable by the user:
  - .1 Thermal demand using a sliding window technique.
  - .2 Block interval, with optional sub-intervals. Block methods available are Sliding, Fixed and Rolling.
  - .3 Demand can be calculated using a Synchronization signal:
  - .4 Demand can be synchronized to an input pulse from an external source.
  - .5 Demand can be synchronized to a communication signal.
  - .6 Demand can be synchronized to the clock in the power meter
- .19 Power Analysis Values
  - .1 THD, thd – Voltage, Current (3-Phase, Per-phase, Neutral & Ground current)
  - .2 Power Factor (Per-phase, 3-Phase)
  - .3 Displacement Power Factor (Per-phase, 3-Phase)
  - .4 Fundamental Voltage, Magnitude and Angle (Per-phase)
  - .5 Fundamental Currents, Magnitude and Angle (Per-phase)
  - .6 Fundamental Real Power (Per-phase, 3-Phase)
  - .7 Fundamental Reactive Power (Per-phase)
  - .8 Harmonic Power (Per-phase, 3-Phase)
  - .9 Phase Rotation
  - .10 Unbalance (Current and Voltage)
  - .11 Harmonic Magnitudes & Angles (Per-phase)
  - .12 Total Demand distortion factor (TDD)

## 2.4 METER TRANSFER SWITCHES

- .1 Manufacturers:
  - .1 Substitutions: Refer to Section 26 05 00 and.
- .2 Ammeter Transfer Switch: Rotary multistage snap-action type with 600 volt AC-DC silver plated contacts, engraved escutcheon plate, oval type and handle, and four positions including OFF.
- .3 Voltmeter Transfer Switch: Rotary multistage snap-action type with 600 volt AC-DC silver plated contacts, engraved escutcheon plate, oval type and handle, and four (4) positions including OFF.

## 2.5 POWER METERS

- .1 Manufacturers:
  - .1 Substitutions: Refer to Section 26 05 00.
- .2 Watt-hour Meters and Watt Meters: NEMA C12.1 three phase induction type with two (2) stators, each with current and potential coil, rated 5 amperes and 120 volts at 60 Hertz. Meter suitable for connection to 3- and 4-wire circuits. Include potential indicating lamps; adjustments for light and full load, phase balance, and power factor; [digital] [four dial clock] and register; [integral demand indicator] [contact devices to operate remote impulse-totalizing demand meter] and; ratchets to prevent reverse rotation; removable meter with draw-out test plug; semi-flush mounted case with matching cover.

- .3 Impulse-Totalizing Demand Meter: NEMA C12.1, suitable for use with switchboard watt-hour meter, including two circuit totalizing relay; cyclometer; four dial digital totalizing kilowatt hour register; positive chart drive mechanism; capillary pen holding minimum one-month ink supply; and a roll chart with minimum 31 day capacity. Indicate and record thirty minute and integrated demand of the totalized system.
- .4 Provide meters with appropriate multiplier tags.

## **2.6 METERING TRANSFORMERS**

- .1 Coordinate CT & PT requirements with Supply Utility.

## **2.7 ACCESSORIES**

- .1 Circuit Breaker Lifting Device: Carriage and track on top of each switchboard with lifting device to serve draw-out circuit breakers in switchboard Portable, floor supported, elevating carriage with a roller base, for movement of circuit breakers in and out of switchboard structure and.

## **2.8 SOURCE QUALITY CONTROL**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Shop inspect and test switchboard according to NEMA PB 2.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that field measurements are as indicated on Shop Drawings and as instructed by the manufacturer.

### **3.2 PREPARATION**

- .1 Provide concrete housekeeping pad to Section 03 30 00.

### **3.3 INSTALLATION**

- .1 Install switchboard in locations shown on Drawings, according to CSA-C22.1.
- .2 Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- .3 Install fuses in each switch.

### **3.4 ADJUSTING**

- .1 Adjust all operating mechanisms for free mechanical movement.
- .2 Tighten bolted bus connections to manufacturer's written instructions.
- .3 Adjust circuit breaker trip and time delay settings to values as indicated.

### **3.5 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Touch up scratched or marred surfaces to match original finish.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Distribution panelboards.
- .2    Branch circuit panelboards.
- .3    Load centres.

**1.2                RELATED SECTIONS**

- .1    Section 26 05 26 - Grounding and Bonding.
- .2    Section 26 05 53 - Electrical Identification.
- .3    Section 26 18 16 - Fuses.

**1.3                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2    CSA-C22.2 No. 29-15 - Panelboards and Enclosed Panelboards.
- .3    CSA C22.2 No. 94.1-15 Enclosures for Electrical Equipment, Non-Environmental Considerations
- .4    CSA C22.2 No. 94.2-15 Enclosures for Electrical Equipment, Environmental Considerations
- .5    NEMA ICS 2-2000 (R2005) - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
- .6    NEMA KS 1-2001 (R2006) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- .7    NETA ATS 2017 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- .8    CSA (Canadian Standards Association).
- .9    ULC (Underwriters' Laboratories of Canada).

**1.4                SUBMITTALS FOR REVIEW**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

**1.5                SUBMITTALS FOR INFORMATION**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

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**1.6 CLOSEOUT SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Maintenance Data: Include spare parts listing; and recommended maintenance procedures and intervals.
- .3 Record Documentation: Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Extra Stock Materials: Provide two (2) of each panelboard key.

**1.8 QUALITY ASSURANCE**

- .1 Products of This Section: Manufactured to ISO 14000 and certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

**1.9 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by CSA and as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 DISTRIBUTION PANELBOARDS**

- .1 Manufacturers:
  - .1 Eaton
  - .2 Schneider
  - .3 Siemens
  - .4 Substitutions: Refer to Section 26 05 00.
- .2 Description: CSA-C22.2 No.29, circuit breaker type.
- .3 Panelboard Bus: Copper and ratings as indicated. Provide copper ground bus in each panelboard.
- .4 Minimum integrated short circuit rating: 22,000 amperes rms symmetrical for 250 volt panelboards; 50,000 amperes rms symmetrical for 600 volt panelboards or as indicated.
- .5 Moulded Case Circuit Breakers: CSA-C22.2 No. 5, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers ULC listed as Type HACR for air conditioning equipment branch circuits.
- .6 Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- .7 Enclosure: CSA C22.2 No. 94.1:
  - .1 Surface mounted: Type 2.
- .8 Cabinet Front: Surface type, continuous hinged trim complete with hinged door (door-in-door) with flush lock, metal directory frame and finished in manufacturer's standard gray enamel.

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## **2.2 BRANCH CIRCUIT PANELBOARDS**

- .1 Manufacturers:
  - .1 Eaton
  - .2 Schneider
  - .3 Siemens
  - .4 Substitutions: Refer to Section 26 05 00.
- .2 Description: CSA-C22.2 No.29, circuit breaker type, lighting and appliance branch circuit panelboard.
- .3 Panelboard Bus: Copper and ratings as indicated. Provide copper ground bus in each panelboard. Provide insulated ground bus as indicated.
- .4 Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 250 volt panelboards; 18,000 amperes rms symmetrical for 600 volt panelboards or as indicated.
- .5 Moulded Case Circuit Breakers: bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers unless indicated.
- .6 Enclosure: CSA C22.2 No. 94.1:
  - .1 Surface mounted: Type 2.
  - .2 Recessed mounted: Type 2.
  - .3 Exterior use: Type 4 or as indicated.
- .7 Cabinet Box: 153 mm(6 inches) deep, 508 mm(20 inches) wide.
- .8 Cabinet Front: Surface type, continuous hinged trim complete with hinged door (door-in-door) with flush lock, metal directory frame and finished in manufacturer's standard gray enamel.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install panelboards to CSA-C22.1 and to manufacturer's written instructions.
- .2 Install panelboards plumb. Install recessed panelboards flush with wall finishes.
- .3 Height: Refer to section 26 05 00.
- .4 Provide filler plates for unused spaces in panelboards.
- .5 Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- .6 Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- .7 Provide spare conduits out of each recessed panelboard to an accessible location below floor and above ceiling where applicable. Minimum spare conduits: three (3) empty 35mm (1-1/4") up and two (2) 35mm (1-1/4") down. Identify each as spare.
- .8 Ground and bond panelboard enclosures according to Section 26 05 26.

**3.2 FIELD QUALITY CONTROL**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Perform inspections and tests listed in NETA ATS Section 7.4 for switches, Section 7.5 for circuit breakers.

**3.3 ADJUSTING**

- .1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20% of each other.
- .2 Maintain proper phasing for multi-wire branch circuits.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Hinged cover enclosures.
- .2 Cabinets.
- .3 Terminal blocks.
- .4 Accessories.

**1.2 RELATED SECTIONS**

- .1 Section 26 05 29 - Electrical Supporting Devices.

**1.3 REFERENCES**

- .1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2 CAN/CSA-C22.2 No. 94-M91 (R2006) - Special Purpose Enclosures.
- .3 CSA-C22.2 No. 158-10 - Terminal Blocks.
- .4 CSA (Canadian Standards Association).
- .5 ULC (Underwriters' Laboratories of Canada).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Product Data: Provide manufacturer's standard data for enclosures and cabinets.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Extra Stock Materials: Provide two (2) of each key.

**1.7 REGULATORY REQUIREMENTS**

- .1 Conform to requirements of CSA-C22.1.
- .2 Products: Listed and classified by CSA and as suitable for the purpose specified and indicated.



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**Part 2 Products**

**2.1 HINGED COVER ENCLOSURES**

- .1 Construction: CAN/CSA-C22.2 No. 94.
  - .1 Surface Mounted Indoor: Type 2 16 gauge steel enclosure complete with sprinkler drip hood.
  - .2 Recessed Mounted Indoor: Type 2 16 gauge steel enclosure.
  - .3 Exterior Use: Type 4 14 gauge steel enclosure or as indicated.
- .2 Covers: Surface or Flush cabinet front with continuous hinge,
  - .1 Indoor: Held closed by flush latch operable by key.
  - .2 Outdoor: Held closed by hasp and staple for padlock.
- .3 Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- .4 Enclosure Finish: Manufacturer's standard grey enamel.

**2.2 TERMINAL BLOCKS**

- .1 Terminal Blocks: CSA-C22.2 No. 158.
- .2 Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- .3 Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- .4 Provide ground bus terminal block, with each connector bonded to enclosure.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install components to CSA-C22.1 and to manufacturer's written instructions.
- .2 Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner to Section 26 05 29.
- .3 Install cabinet fronts plumb.

**3.2 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Clean electrical parts to remove conductive and harmful materials.
- .3 Remove dirt and debris from enclosure.
- .4 Clean finishes and touch up damage.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Wall switches.
- .2 Wall dimmers.
- .3 Receptacles.
- .4 Device plates and decorative box covers.
- .5 Poke-through service fittings.

**1.2 RELATED SECTIONS**

- .1 Section 26 05 34 - Boxes.

**1.3 REFERENCES**

- .1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2 CSA C22.2 No. 42-10 (R2015) - General Use Receptacles, Attachment Plugs, and Similar Wiring Devices
- .3 CSA C22.2 No. 42.1-13 (R2017) - Cover Plates for Flush-Mounted Wiring Devices.
- .4 CSA C22.2 No. 55-15 - Special use switches.
- .5 CAN/CSA C22.2 No. 111-18 - General-Use Snap Switches.
- .6 CSA C22.2 No. 184-15 - Solid-State Lighting Controls.
- .7 CSA (Canadian Standards Association).
- .8 ULC (Underwriters' Laboratories of Canada).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Installation Data: Submit manufacturer's installation instructions.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Extra Stock Materials:
  - .1 Provide two (2) of each style, size, and finish wall plate.

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**1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

**1.8 REGULATORY REQUIREMENTS**

- .1 Provide products listed and classified by CSA and as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 WALL SWITCHES**

- .1 Manufacturers:
  - .1 Leviton
  - .2 Hubbell
  - .3 Cooper
  - .4 Legrand
  - .5 Substitutions: Refer to Section 26 05 00.
- .2 General-use snap switch:
  - .1 Grade: Heavy Duty Industrial Grade CSA-C22.2 No. 111
  - .2 Style: Standard toggle
  - .3 Device Body: White nylon toggle.
  - .4 Ratings: Match branch circuit and load characteristics. Amperage rating shall be marked on body of switch.
- .3 Body and Handle: White with nylon toggle.
- .4 Indicator Light: Separate pilot strap red colour with load on.
- .5 Locator Pilot Light: Separate pilot strap red colour.

**2.2 WALL DIMMERS**

- .1 Manufacturers:
  - .1 Lutron
  - .2 Substitutions: Refer to Section 26 05 00
- .2 Description: Wall dimmer complete with slide to off control and surge protection.
- .3 Body and Handle: White ivory with linear slide control.
- .4 Voltage: 120 volts.
- .5 Power Rating: Match load as required for circuits controlled.
- .6 Products:
  - .1 Electronic Low Voltage: NTELV series

**2.3 RECEPTACLES**

- .1 Manufacturers:
  - .1 Leviton

- .2 Hubbell
- .3 Cooper
- .4 Legrand
- .5 Substitutions: Refer to Section 01 62 00.
- .2 General-duty duplex convenience receptacle:
  - .1 Grade: Heavy Duty Specification Grade, Nema WD-6 Compliant, CSA-C22.2 No.42.
  - .2 Style: Standard
  - .3 Device Body: Smooth white nylon face and base.
  - .4 CSA Configuration: Type as specified and indicated.
  - .5 Tamper resistant as indicated or as per Electrical Code.
- .3 GFCI Receptacle: Duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements complete with steady-on "Green-Power-On" and steady-on "Red-Power-Tripped Off" LED indicator lights.
- .4 Exterior Use Receptacle: Extra Heavy Duty Industrial grade duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements complete with steady-on "Green-Power-On" and steady-on "Red-Power-Tripped Off" LED indicator lights complete with UV and corrosion resistant device body complete with CSA 5-20R configuration only.
- .5 USB Charger Receptacle: General-duty decorator style duplex receptacle with USB chargers and Green LED indicator light for USB power. USB chargers shall be 3 Amps, 5 Volts DC and shall be compatible with USB 1.1/2.0/3.0 devices.
- .6 Controlled Receptacle: General-duty dual-controlled duplex receptacle with integral relay, wireless RF communication, and manual override button. Control system shall be complete with wireless RF signal packs to control all receptacles in individual rooms as indicated on drawings. RF signal packs shall be integrated with room lighting control occupancy sensor to turn off controlled receptacle within 20 minutes of unoccupied state.
- .7 Receptacle on Emergency Circuit: Heavy Duty Specification grade duplex receptacle with smooth red nylon face. CSA configuration as indicated. Type as indicated.
- .8 Suitable for No. 10 AWG for back and side wiring.
- .9 Break-off links for use as split receptacles.
- .10 Double wipe contacts and riveted grounding contacts.
- .11 Receptacles shall be of one manufacturer throughout the project.

## **2.4 WALL PLATES**

- .1 Nylon Cover Plate: Impact resistant unbreakable nylon with reinforcing ribs. Style and color shall match wiring device. Combination or multi-gang covers as required or indicated. Jumbo or standard size as indicated or specified.
- .1 Heavy Duty Stainless Steel Cover Plate – To be installed in rink and in pool areas: 302/304 type stainless steel cover plate complete with protective plastic film. Combination or multi-gang covers as required or indicated.
- .2 Standard Stainless Steel Cover Plate: 430 type stainless steel cover plate complete with protective plastic film. Combination or multi-gang covers as required or indicated. Jumbo or standard size as indicated or specified.

- .3 Metallic While-in-Use covers: Nema 3R rated, die-cast aluminum construction with powder coated "chip resistant" paint corrosion protection and plug/cord management, suitable for horizontal mounting on device box only, and padlock provision.
- .4 Weatherproof Cover Plate: Gasketed cast metal with gasketed double hinged device covers suitable for horizontal mounting on device box only. Provide single hinged device cover for GFI type receptacle only.

## **2.5 POKE-THROUGH FITTINGS**

- .1 Manufacturers:
  - .1 Thomas & Betts – Steel City – Furniture Feed FFPT4 Series
  - .2 Thomas & Betts – Steel City – Flush Service FPT4 Series
  - .3 Legrand – Furniture Feed Style Poke Thru Device – 4FF Series
  - .4 Legrand – Flush Poke Thru Device – RC4 Series
  - .5 Substitutions: Refer to Section 26 05 00.
- .2 Description: Assembly comprising service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination.
- .3 Fire Rating: 2 hours.
- .4 Service Fitting:
  - .1 Type: Flush
  - .2 Housing: Satin aluminum.
  - .3 Device Plate: Plastic and.
  - .4 Configuration: One (1) duplex and one (1) communications outlet]

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that outlet boxes are installed at proper height.
- .3 Verify that wall openings are neatly cut and will be completely covered by wall plates.
- .4 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

### **3.2 PREPARATION**

- .1 Provide extension rings to bring outlet boxes flush with finished surface.
- .2 Clean debris from outlet boxes.

### **3.3 INSTALLATION**

- .1 Install to CSA-C22.1 and to manufacturer's written instructions.
- .2 Install devices plumb and level.
- .3 Install switches with OFF position down.
- .4 Provide neutral conductor in box for all line voltage lighting control devices.

- .5 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
- .6 Do not share neutral conductor on load side of dimmers.
- .7 Install receptacles with grounding pole on bottom.
- .8 Use exterior use receptacles for exterior applications unless noted otherwise.
- .9 Connect wiring device grounding terminal to branch circuit equipment grounding conductor and outlet box.
- .10 Install locator pilot light for lighting controls located in crawlspace.
- .11 Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- .12 Connect wiring devices by wrapping conductor around screw terminal.
- .13 Use jumbo size plates for outlets installed in masonry walls.
- .14 Stainless steel protective coverings shall be maintained until project completion and turn-over to The City.
- .15 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- .16 Install metallic While-In-Use covers on exterior receptacles.
- .17 Use weatherproof covers for parking receptacles, and dust-tight applications only, or as indicated.
- .18 Install protective rings on active flush cover service fittings.

**3.4 INTERFACE WITH OTHER PRODUCTS**

- .1 Coordinate locations of outlet boxes provided under Section 26 05 34 to obtain mounting heights specified and as indicated on drawings.

**3.5 FIELD QUALITY CONTROL**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Inspect each wiring device for defects.
- .3 Operate each wall switch with circuit energized and verify proper operation.
- .4 Verify that each receptacle device is energized.
- .5 Test each receptacle device for proper polarity.
- .6 Test each GFCI receptacle device for proper operation.

**3.6 ADJUSTING**

- .1 Adjust devices and wall plates to be flush and level.

**3.7 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Clean exposed surfaces to remove splatters and restore finish.

**END OF SECTION**

**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Luminaires.
- .2 Emergency lighting units.
- .3 Emergency remote fixtures
- .4 Exit signs.
- .5 LED luminaires and drivers.
- .6 Lamps.
- .7 Luminaire accessories.

**1.2 REFERENCES**

- .1 ANSI/NEMA C78.379-2006 - American National Standard for Electric Lamps - Classification of the Beam Patterns of Reflector Lamps.
- .2 CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .3 CSA-C22.2 No. 9.0-96 (R2006) - General Requirements for Luminaires.
- .4 CSA-C22.2 No. 250.0-08 - Luminaires.
- .5 CSA-C22.2 No. 141-15 - Emergency lighting equipment.
- .6 CAN/CSA-E920-98 (R2007) - Ballasts for Tubular Fluorescent Lamps - General and Safety Requirements.
- .7 CAN/CSA-E928-98 (R2007) - Auxiliaries for Lamps - A.C. Supplied Electronic Ballasts for Tubular Fluorescent Lamps - General and Safety Requirements.
- .8 CAN/CSA-E61347-2-3-03 (R2008) - Lamp Control gear - Part 2-3: Particular Requirements for A.C. Supplied Electronic Ballasts for Fluorescent Lamps.
- .9 NEMA WD 6-2002 (R2008) - Wiring Devices - Dimensional Requirements.
- .10 CSA (Canadian Standards Association).
- .11 ULC (Underwriters' Laboratories of Canada).

**1.3 SUBMITTALS FOR REVIEW**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- .3 Product Data: Provide dimensions, ratings, and performance data.

**1.4 SUBMITTALS FOR INFORMATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Installation Data: Submit data indicating application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include

instructions for storage, handling, protection, examination, preparation, and installation of product.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Operation and Maintenance Data: Submit manufacturer's operation and maintenance instructions for each product.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Extra Stock Materials:
  - .1 Provide two (2) of each plastic lens type.
  - .2 Provide ten (2) replacement lamps for each lamp type.

**1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.
- .2 Conform to requirements of CSA C22.1, and to the Manitoba Hydro Power Smart Commercial Lighting Program.
- .3 Products: Listed and classified by CSA, and as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 LUMINAIRES**

- .1 Manufacturers:
  - .1 Refer to Luminaire Schedule on drawings.
  - .2 Substitutions: Refer to Section 26 05 00 Common Work Results for Electrical.
    - .1 All requests for substitutions shall be complete with photometric layouts indicating proposed luminaire performance in a 1' by 1' grid.

**2.2 EMERGENCY LIGHTING UNITS**

- .1 Description: Self-contained LED emergency lighting unit.
- .2 Battery: 12 volt, lead acid type, with minimum 1/2 hour capacity.
- .3 Battery Charger: Solid state pulse type charger, current limited, temperature compensated, short circuit proof, and reverse polarity protected.
- .4 Lamps: LED, 5W minimum, 340 lumens minimum.
- .5 Housing: Factory white, corrosion resistant steel cabinet.
- .6 Indicators: Lamps to indicate AC ON and RECHARGING.
- .7 TEST Switch: Transfers unit from external power supply to integral battery supply.
- .8 Electrical Connection: 1800 mm cord with plug cap, NEMA WD 6, Type 5-15 configuration.



- .9 Input Voltage: Universal 120-347V.
- .10 Accessories:
  - .1 4 voltage sensing relays integral to battery bank unit.
  - .2 AC/DC terminal blocks
  - .3 Auto test function
  - .4 Mounting shelf (200W and over)
  - .5 Voltage sensing relay panel as indicated
- .11 Manufacturers:
  - .1 Refer to Emergency Lighting Schedule on drawings.
  - .2 Substitutions: Refer to Section 26 05 00

### **2.3 EMERGENCY REMOTE FIXTURES**

- .1 General:
  - .1 Voltage: To match emergency battery bank.
  - .2 Spring capture for all lamps.
- .2 Compact Mini Remote Heads
  - .1 Lamps: LED, 5W minimum, 340 lumens minimum or as indicated. Quantity of 2 or as indicated.
  - .2 Housing: injection molded, impact resistant, thermoplastic, .
  - .3 Tool less adjusting.
- .3 Nema 4X Enclosed Wet Location Remote Heads
  - .1 Lamps: LED, 5W minimum, 340 lumens minimum or as indicated. Quantity of 2 or as indicated.
  - .2 Housing: NSF certified, gasketed, polycarbonate lens and back plate, tamper proof screws.
- .4 Manufacturers:
  - .1 Refer to Emergency Lighting Schedule on drawings.
  - .2 Substitutions: Refer to Section 26 05 00.

### **2.4 EXIT SIGNS**

- .1 Housing: Extruded aluminum
- .2 Face: Green Pictogram face with white chevrons.
- .3 Directional Arrows: Universal type for field adjustment
- .4 Mounting: Universal, for field selection and as indicated
- .5 Lamps: LED
- .6 Input Voltage: Universal 120-347VAC, 6-24VDC.
- .7 Manufacturers:
  - .1 Refer to Emergency Lighting Schedule on drawings.
  - .2 Substitutions: Refer to Section 26 05 00

## 2.5 LED LUMINAIRES AND DRIVERS

- .1 All Luminaires
  - .1 Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.
  - .2 Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.
  - .3 LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
  - .4 LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
  - .5 LED luminaires shall deliver a minimum of 60 lumens per watt.
    - .1 LED's shall be "Bin No. 1" quality.
  - .6 Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.
  - .7 The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
  - .8 LED color temperatures: CRI 85, 2700K as noted +/- 145K.
  - .9 LED color temperatures: CRI 85, 4000K as noted +/- 275K.
  - .10 LED color temperatures: CRI 85, 5000K as noted +/-283K.
  - .11 Luminaires shall have internal thermal protection.
  - .12 Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
  - .13 Color spatial uniformity shall be within .004 of CIE 1976 diagram.
  - .14 Color maintenance over rated life shall be within .007 of CIE 1976.
  - .15 Indoor luminaires shall have a minimum CRI of 85.
  - .16 Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management
  - .17 LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.
  - .18 Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.
- .2 Power Supplies and Drivers
  - .1 MB Hydro Powersmart approved.
  - .2 Power Factor: 0.90 or higher
  - .3 Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.
  - .4 Output operating frequency: 60Hz.
  - .5 Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
  - .6 Total Harmonic Distortion Rating: 20% Maximum.
  - .7 Meet electrical and thermal conditions as described in LM-80 Section 5.0.
  - .8 Primary Current: Confirm primary current with Drawings.
  - .9 Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.

- .10 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.
- .11 Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.
- .3 Controller and Control System
  - .1 System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required.
  - .2 The Electrical Subcontractor shall ensure that external control equipment is compatible with LED control requirements
  - .3 Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.
  - .4 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers

## 2.6 ACCESSORIES

- .1 Description: Standard down light reflector shall be semi-specular unless noted otherwise.
- .2 Joiner Fittings: As specified for linear lighting systems, or as required for end to end continuous row mounting as indicated on drawings. Fittings to match style and finish of luminaire specified.
- .3 End Caps: As specified for linear lighting systems, or as required for end of row or stand-alone luminaire installations as indicated on drawings. End caps to match style and finish of luminaire specified.
- .4 Power Cord: As required for suspended lighting systems where wiring is exposed between fixture canopy and fixture lamp assembly. Power cord shall match finish of lighting fixture. Provide 0-10V combination cable as required for dimming purposes. Length of cable shall be suitable for minimum suspension length of 4'-0" from ceiling finish. Confirm final lengths with installation requirements.
- .5 Wireguard: As specified for luminaire, or as indicated on the drawings.
  - .1 Gauge: Minimum 8 gauge unless noted otherwise.
  - .2 Color: Custom color to be confirmed by architect at time of shop drawing review.

## 2.7 SOURCE QUALITY CONTROL

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Certify fluorescent ballast design and construction by Certified Ballast Manufacturers, Inc.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Support luminaires larger than 600 x 1200 mm(24 x 48 inch) size independent of ceiling framing.
- .2 Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

- .3 Install surface mounted luminaires, emergency lighting, and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- .4 Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling grid members using bolts, screws, or suitable clips.
- .5 Install recessed luminaires to permit removal from below.
- .6 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- .7 Install clips to secure recessed grid-supported luminaires in place.
- .8 Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated.
- .9 Install linear lighting with appropriate end caps where practicable.
- .10 Lighting installed in corridors shall be oriented to maximize light distribution along the corridor rather than across it.
- .11 Install accessories provided with each luminaire.
- .12 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .13 Bond products and metal accessories to branch circuit equipment grounding conductor.
- .14 Wire remote heads to separate lamp load evenly to the output circuits of the associated battery bank.

### **3.2 FIELD QUALITY CONTROL**

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.

### **3.3 ADJUSTING**

- .1 Aim and adjust luminaires as directed.
- .2 Position exit sign directional arrows as indicated.

### **3.4 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.

### **3.5 CLOSEOUT ACTIVITIES**

- .1 Demonstration: Demonstrate luminaire operation for minimum of one (1) hours.

### **3.6 PROTECTION OF FINISHED WORK**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Re-lamp luminaires that have failed lamps at Substantial Completion.

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**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 26 05 00 - Common Work Results for Electrical.

**1.2                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 communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3                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 indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2            Store and protect communication raceway systems from nicks, scratches, and blemishes.
  - .3            Replace defective or damaged materials with new.

**Part 2            Products**

**2.1                SYSTEM DESCRIPTION**

- .1            Empty telecommunications raceways system consists of outlet boxes, cover plates, terminal and distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.

**2.2                MATERIAL**

- .1            Conduits: EMT type, in accordance with Section 26 05 33 - Conduits.
- .2            Junction boxes, cabinets in accordance with Section 26 05 34 - Boxes.
- .3            Outlet boxes, conduit boxes, and fittings: in accordance with Section 26 05 34 Boxes
- .4            Fish wire: polypropylene type.

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**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 communication raceway systems installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

**3.2 INSTALLATION**

- .1 Install empty raceway system, including [underfloor] [overhead] distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.
- .2 Maintain the following clearances from all electrical equipment as follows:
  - .1 Transformers above 5kVA – 1000mm
  - .2 347/600V power – 1000mm
  - .3 120V power – 50mm
  - .4 208/240V power – 300mm
  - .5 Motors – 1000mm
  - .6 120V fluorescent lighting – 300mm
  - .7 347V fluorescent lighting – 1000mm

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 00 50 - General Instructions.
  - .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 00 50 - General Instructions.
- .3 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 00 50 - General Instructions .
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).
- .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA/EIA-568-C.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
  - .2 TIA/EIA-568-C.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
  - .3 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.

**1.2 SYSTEM DESCRIPTION**

- .1 Structured telecommunications wiring system consist of unshielded-twisted-pair, terminations, connectors, cross-connection hardware.
- .2 Installed in physical star configuration with separate horizontal sub-systems.
  - .1 Horizontal cables link work areas to the telecommunications room located in the basement.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 00 50 - General Instructions.
- .2 As-built Records and Drawings:
  - .1 Provide Microsoft Access database reflecting cable installation and cross-connections.
  - .2 Provide electronic drawings in AutoCAD 2010 format depicting all construction.
  - .3 Provide two (2) bound complete hard-copy sets of as-built records to The City.
    - .1 Provide and place one hard copy of as-built records for each telecommunications room in plan holder in each telecommunications room.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal: separate waste materials for reuse or recycling in accordance with Section 01 00 50 - General Instructions.



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**Part 2 Products**

**2.1 FOUR-PAIR 100  $\Omega$  BALANCED TWISTED PAIR CABLE**

- .1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 or CMP to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA-568-C.

**2.2 WORK AREA UTP 4-PAIR MODULAR JACK**

- .1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA/EIA-568- C:
  - .1 In self-contained surface-mount box, 4 jacks per box.
  - .2 Mounted in compatible double gang faceplate, flush entry, 4 jack positions per faceplate.

**2.3 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP**

- .1 Patch panel, 2 rack units high, 48 ports:
  - .1 Each port equipped with factory installed "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568-C.
  - .2 Horizontal cable-management unit for every 48 ports.

**2.4 UTP PATCH CORDS**

- .1 1, 2, and 3 metres long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568-C.

**2.5 UTP WORK AREA CORDS**

- .1 1, 2, and 3 metres long, each end equipped with "RJ-45" plug Category 6 to: TIA/EIA-568-C.

**2.6 DATA CABINETS**

- .1 Floor mountable equipment cabinet to be 44/45U high and the frame to be constructed of rugged 12 GA steel welded and rigid, 30" deep and 22" wide.
- .2 Front and rear lockable perforated doors.
- .3 Standard with 19" EIA 10-32 tapped mounting holes with permanently marked U spacing identification.
- .4 Cabinet is standard with one copper 10-32 x 0.5 L ground stud.
- .5 All racks to be black in colour and tapped front and back with 10-32 holes.
- .6 Built-in vertical wire management.

**Part 3 Execution**

**3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE**

- .1 Install termination and cross-connect hardware in cabinet as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

### **3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES**

- .1 Install horizontal cables as indicated in conduits, and "J" hooks from telecommunication room to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A.
- .2 Support horizontal cables at intervals not exceeding 2 metres.
  - .1 Where raceways are used to distribute cables to each zone, provide supplementary "J" hooks to support cables at intervals not exceeding 2 metres.
- .3 Install horizontal cables from consolidation point to individual work-area jacks.
  - .1 Provide supplementary "J" hooks to support cables at intervals not exceeding 2 metres.
  - .2 Identify and label as indicated to: TIA/EIA-606-A.
- .4 Terminate horizontal cables in telecommunications room and at individual work-area jacks.
  - .1 Identify and label as indicated to: TIA/EIA-606-A.
- .5 Coil spare cables and store in ceiling space in zone.
- .6 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

### **3.3 FIELD QUALITY CONTROL**

- .1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy, electronic record on CD.
  - .1 Perform tests for Permanent Link on installed cables, including spares:
    - .1 Category 6 using certified level III tester to: TIA/EIA-568-C.
    - .2 Perform the following tests: wire map, length, insertion loss, NEXT loss, ELFEXT, PSELFEXT, ACR, PSACR, propagation delay, delay skew, return loss.
  - .2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.
    - .1 Category 6 using certified level III tester to: TIA/EIA-568-C.
    - .2 Perform the following tests: wire map, length, insertion loss, NEXT loss, ELFEXT, PSELFEXT, ACR, PSACR, propagation delay, delay skew, return loss.

### **3.4 CONTRACTOR CERTIFICATION**

- .1 The cabling system shall be installed by a contractor or sub-contractor certified by the cable manufacturer.

### **3.5 WARRANTY**

- .1 The installation Subcontractor shall support the installed system for a period of two years from the date of acceptance by The City.
- .2 Subcontractor shall be responsible for obtaining all documentation necessary to achieve manufacturer's warranty

- .3 The manufacturer shall provide a minimum 20 year warranty for the complete cabling system.
- .4 The manufacturer's warranty shall be provided directly to The City and shall be independent of the installation Subcontractor.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1            Paging equipment and accessories.

**1.2            RELATED SECTIONS**

- .1            Section 26 05 19 - Building Wire and Cable.
- .2            Section 26 05 34 - Boxes.
- .3            Section 26 05 26 - Grounding and Bonding.

**1.3            SYSTEM DESCRIPTION - CLASSROOM INTERCOM SYSTEM**

- .1            Description: Existing classroom intercom system being expanded.
- .2            Communications:
  - .1            Public Address System

**1.4            SUMMARY**

- .1            Work Included. The scope of work of this Section consists of the designing, installation, and programming of all materials to be furnished under this SECTION, and without limiting the generality thereof, consists of providing all labor, materials, equipment, plant, transportation, appurtenances and services necessary and/or incidental to properly complete all work as shown on the drawings, as described in the specifications, or as reasonable inferred from either or, in the opinion of the Architect and The City, as being required and in general, is as follows:

- .1            Public Address System, including but not limited to:
  - .1            Public address system amplifiers, zone controls, back boxes, and all equipment, cabling and support required to interface the Public Address System to the The City's Telephone System (Not included in this Contract).
  - .2            Public Address System Speakers, ceiling mounted, and wall mounted.
  - .3            Cabling to support the Public Address System (NOTE: any category 5/6 cable must conform with The City guidelines. Coordinate with The City prior to submission for approval)
  - .4            PA override signal to local sound systems. Coordinate with 27 40 00 Contractor.

- .2            Actual control room and rack layouts will be based upon the specific designs submitted by the Contractors. Needs for equipment, specific speakers, etc. will be dependent on actual product manufacturers. Contractors shall coordinate room layout, actual speaker and equipment placement and programming options with The City prior to installation.

**1.5            SUBMITTALS FOR REVIEW**

- .1            Section 01 33 00: Submission procedures.

- .2 Product Data: Submit product data for each item of equipment.
- .3 Shop Drawings: Indicate cable routing and connections. Include layout of equipment within racks and cabinets complete with component interconnections with wiring diagrams.

## **1.6 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special installation requirements.

## **1.7 CLOSEOUT SUBMITTALS**

- .1 Section 01 78 10: Submission procedures.
- .2 Maintenance Contracts: Provide service and maintenance of classroom intercom system for one (1) year from Date of Substantial Completion.
- .3 Operation Data: Include instructions for routine operation of system components.
- .4 Maintenance Data: Include instructions for minor troubleshooting, preventive maintenance, and cleaning.
- .5 Record Documentation: Accurately record actual locations of devices and wiring.

## **1.8 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.
- .2 Supplier Qualifications: Authorized distributor of specified manufacturer with minimum five (5) years documented experience.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 TOA Electronics
- .2 Or Approved Equal in Accordance with B7.
- .3 All Public Address main equipment including card cages and all cards, power amplifiers, program sources, etc., shall be rack mounted in the Electrical Room 4-post cabinet in the basement, provide all required racking hardware. The system shall be a 70-Volt paging system providing paging zones as indicated and determined by the The City. The system shall be of modular design utilizing plug-in circuit cards to enable quick on-site replacement or addition of components for system expansion and modification. Provide shelves, doors, blank panels, AC power distribution, etc. as required to support all equipment and fill empty rack space.
- .4 Public address loudspeaker system to incorporate:
  - .1 Voice paging.
  - .2 Recorded music from digital audio - MP3.
  - .3 Broadcast programs from AM/FM tuner.
  - .4 Additional features as specified.
- .5 Operations:

- .1 Paging:
  - .1 Voice paging from microphone overrides broadcast or recorded music reproductions.
  - .2 Selective area page to areas as indicated.
  - .3 Emergency page to all areas.
- .2 Music:
  - .1 Music from external source.

**2.2 PRE-AMPLIFIER MIXER**

- .1 TOA Electronics M-9000M2 CU complete with A-9000 & 900 Series Modules
- .2 Or Approved Equal in Accordance with B7.
- .3 Quantity: 1
- .4 Dual channel modular mixer/matrix, max 8x8:
  - .1 Power Source: 120 V AC, 60 Hz
  - .2 Power Consumption: 40 W
  - .3 Audio Input: Max. 8 channels, modular construction
  - .4 Audio Output: Preamplifier output 1, 2: 0 dB(\*1), 600  $\Omega$ , balanced, removable terminal block (3 pins)
  - .5 Digital Audio Signal Reference Level: -20 dBFS
  - .6 Frequency Response: 20 Hz - 20 kHz, +1, -3 dB
  - .7 S/N Ratio:
    - .1 At Input short, 20 Hz - 20 kHz, set to ALL FLAT or OFF setting
    - .2 Output volume min.: 90 dB
    - .3 Output volume max.: 61 dB (Input 1 volume: 0 dB, Other Inputs: OFF)

**2.3 DUAL MIC/LINE INPUT MODULE WITH DSP**

- .1 TOA Electronics D-001T
- .2 Or Approved Equal in Accordance with B7.
- .3 Quantity: 3

**2.4 DUAL MIC/LINE OUTPUT MODULE WITH DSP**

- .1 TOA Electronics T-001T
- .2 Or Approved Equal in Accordance with B7.
- .3 Quantity: 2

**2.5 DIGITAL MULTI-CHANNEL AMPLIFIER**

- .1 TOA Electronics DA-250FH CU
- .2 Or Approved Equal in Accordance with B7.
- .3 Quantity: 1
- .4 Digital multi-channel amplifier 250W x 4 channel, 70V:
  - .1 Power Source: 120 V AC, 50/60 Hz

- .2 Amplification System: Class D
- .3 Power Consumption:
  - .1 200 W (based on UL/CSA standards)
  - .2 1200 W (rated output 70 V line,  $19.6 \Omega \times 4$ )
- .4 Input:
  - .1 4 circuits, +4 dB\* (1.23 V) (input level control in maximum position), 10 k $\Omega$ , electronically-balanced, removable terminal block (3 pins)  
CH 1 mode ON/OFF switch (ON: CH 1 to All ch, OFF: Each ch)
- .5 Rated Output:
  - .1 4 channels: 250 W  $\times$  4 (70 V line, 19.6  $\Omega$ )  
2 channels (BRIDGE): 500 W  $\times$  2 (140 V line, 39.2  $\Omega$ )  
M4 screw terminal, distance between barriers: 8.8 mm
- .6 Frequency Response: 20 - 20,000 Hz ( $\pm 1$  dB): HPF OFF/50 - 20,000 Hz (-3 dB, +1 dB): HPF ON (selectable with the inner jumper)
- .7 Total Harmonic Distortion:
  - .1 0.1% (1 kHz), 0.3% (20 - 20,000Hz): HPF OFF
  - .2 0.1% (1 kHz), 0.3% (100 - 20,000 Hz): HPF ON

## 2.6 DIGITAL POWER AMPLIFIER

- .1 TOA Electronics DA-250F
- .2 Or Approved Equal in Accordance with B7.
- .3 Quantity: 1
- .4 4-Channel Digital Power Amplifier 250W x 4 channels (4 Ohm output):
  - .1 Power Source: 120 V AC, 50/60 Hz
  - .2 Amplification System: Class D
  - .3 Power Consumption:
    - .1 200 W (based on UL/CSA standards)
    - .2 1200 W (rated output 70 V line,  $19.6 \Omega \times 4$ )
  - .4 Input:
    - .1 4 circuits, +4 dB\* (1.23 V) (input level control in maximum position), 10 k $\Omega$ , electronically-balanced, removable terminal block (3 pins)  
CH 1 mode ON/OFF switch (ON: CH 1 to All ch, OFF: Each ch)
  - .5 Rated Output:
    - .1 4 channels: 250 W  $\times$  4 (70 V line, 19.6  $\Omega$ )  
2 channels (BRIDGE): 500 W  $\times$  2 (140 V line, 39.2  $\Omega$ )  
M4 screw terminal, distance between barriers: 8.8 mm
  - .6 Frequency Response: 20 - 20,000 Hz ( $\pm 1$  dB): HPF OFF/50 - 20,000 Hz (-3 dB, +1 dB): HPF ON (selectable with the inner jumper)
  - .7 Total Harmonic Distortion:
    - .1 0.1% (1 kHz), 0.3% (20 - 20,000Hz): HPF OFF
    - .2 0.1% (1 kHz), 0.3% (100 - 20,000 Hz): HPF ON

## 2.7 MICROPHONE

- .1 TOA Electronics Q-RM9012 complete with power supply AD-246.

- 
- .2 Or Approved Equal in Accordance with B7.
  - .3 Quantity: 1
  - .4 Microphone: uni-directional, dynamic type, complete with cradle :
    - .1 Frequency response: 100-20,000 Hz.
    - .2 S/N Ratio: 60dB or more
    - .3 Audio Output: 0dB = 1V, 600 Ohm, transformer balanced
    - .4 Housing, metal, flexible goose neck, desk mounting
    - .5 Push-to-talk switch.
    - .6 Number of Paging Zones: 12
  
  - 2.8 WALL MOUNT SPEAKER BASEMENT (TYPE A)**
    - .1 Product: TOA Electronics SC-615T Or Approved Equal in Accordance with B7.
    - .2 Tap Settings: 7.5W (70V Line)
  
  - 2.9 WALL MOUNT SPEAKER FITNESS ROOM (TYPE B)**
    - .1 Product: TOA Electronics HS-1200BT Or Approved Equal in Accordance with B7.
  
  - 2.10 WALL MOUNT SPEAKER POOL AND AUDITORIUM (TYPE C)**
    - .1 Product: TOA Electronics F-2000BT for Auditorium Or Approved Equal in Accordance with B7.
    - .2 Product: TOA Electronics F-2000BTWP for Pool Or Approved Equal in Accordance with B7.
    - .3 Tap Settings: 15W (70V Line)
  
  - 2.11 WALL MOUNT SPEAKER CLASSROOM (TYPE D)**
    - .1 Product: TOA Electronics F-1000BT Or Approved Equal in Accordance with B7.
    - .2 Tap Settings: 2.5W (70V Line)
  
  - 2.12 CEILING MOUNT SPEAKER (TYPE E)**
    - .1 Product: TOA Electronics PC-580RU Or Approved Equal in Accordance with B7.
    - .2 Tap Settings: 1W (70V Line)
  
  - 2.13 WALL MOUNT SPEAKER ARENA (TYPE F)**
    - .1 Product: TOA Electronics SC-630TU Or Approved Equal in Accordance with B7.
    - .2 Tap Settings: 15W (70V Line)
  
  - 2.14 AM/FM TUNER**
    - .1 Product: TOA Electronics DT930UL Or Approved Equal in Accordance with B7.
  
  - Part 3 Execution**
  
  - 3.1 EXAMINATION**
    - .1 Section 01 70 00: Verify existing conditions before starting work.
    - .2 Verify that surfaces are ready to receive work.



- .3 Verify field measurements are as instructed by manufacturer.
- .4 Verify that required utilities are available, in proper location, and ready for use.
- .5 Beginning of installation means installer accepts conditions.

### **3.2 INSTALLATION**

- .1 Install components to manufacturer's written instructions.
- .2 Wiring Methods:
  - .1 Install wiring in raceway except within consoles, desks, and counters, and except in accessible ceiling spaces, and in gypsum board partitions, where cable wiring method may be used. Use ULC listed plenum cable in environmental air spaces including plenum ceilings.
- .3 Wiring Within Enclosures:
  - .1 Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
  - .2 Provide physical isolation from each other for speaker-microphone, line-level, speaker-level, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12 inch minimum separation between conductors to speaker-microphones and adjacent parallel power and telephone wiring. Provide physical separation as recommended by equipment manufacturer for other Integrated Electronic Communications Network system conductors.
- .4 Splices, Taps, and Terminations:
  - .1 Make splices, taps and terminations on numbered terminal punch blocks in junction, pull, and outlet boxes, terminal cabinets and equipment enclosures.
- .5 Identification of Conductors and Cables:
  - .1 Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.
- .6 Weatherproofing:
  - .1 Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.
- .7 Repairs:
  - .1 Wherever walls, ceilings, floors, or other building finishes are cut for installation , repair, restore, and refinish to original appearance.
- .8 Ground and bond equipment and circuits to Section 26 05 26.

### **3.3 FIELD QUALITY CONTROL**

- .1 Section 01 45 00: Field inspection and testing.
- .2 Manufacturer's Field Services:
  - .1 Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
- .3 Inspection:

- .1 Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
- .4 Testing:
  - .1 Perform operational test on completed installation to verify proper operation.
- .5 Replace equipment, components, and wiring to eliminate audible noise, clicks, pops, or hum when system is in standby or operation.

### **3.4 CLOSEOUT ACTIVITIES**

- .1 Demonstration:
  - .1 Allow minimum of two (2) hour training session to facilitate the training of staff.
  - .2 Provide detailed operation and maintenance instruction and training.
  - .3 Use submitted operation and maintenance manual as reference during demonstration.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1    Access Control Panel Door Controller
- .2    Proximity Readers
- .3    Proximity Key Fobs
- .4    Door Contacts

**1.2            CODES AND STANDARDS**

- .1    Work shall be performed in accordance with the applicable National, Provincial and local codes or standards current at the commencement of installation. The following list summarizes applicable standards:
  - .1    UL 294, UL 1076, ULC
  - .2    CE
  - .3    FCC-Part 15, Part 68
  - .4    NFPA70, NEC
  - .5    IEEE, RS170 variable standard
  - .6    IEEE, NTSC (colour camera broadcast)
- .2    Where more than one code or regulation is applicable, the more stringent shall apply.
- .3    Cable installation, identification and termination shall be performed in accordance with the manufacturer's technical installation guidance, in addition to the applicable codes above.
- .4    In the absence of the manufacturer's recommendations on conductor application, the Electrical Subcontractor shall ensure that the cable selected meets all technical requirements of the equipment to be installed.

**1.3            RELATED SECTIONS**

- .1    Section 08 71 00 - Door Hardware - General.
- .2    Section 26 05 19 - Building Wire and Cable.

**1.4            SYSTEM DESCRIPTION**

- .1    The access control system (ACS) shall be an integrated system that utilizes a Sybase embedded SQL database for the storage and manipulation of related data. The ACS shall include an operator and administrator workstation with appropriate software, hard copy printers and fixed magnetic storage media. The security field devices (readers, door position switches, etc) shall communicate with the field panels via a dedicated cable network. The field panels shall communicate to the server via a Fast Ethernet 10/100, TCP/IP network, RS 232/RS 485 connection, or dial up modem.
- .2    The ACS shall be modular in nature, allowing system capacities to be easily expanded without requiring major changes to system operation. All defined system data as well as historical information shall be maintained. Customizable user interfaces shall allow management of system information and activity for administrators and operators. The response time between the moment when a card is presented at the reader and when the

door is unlocked shall not exceed one second. The ACS shall include a badging solution with a GUI for badge design. No extra licensing shall be required for the badging solution.

- .3 The ACS shall be able to connect to authenticated non-SSL or non-authenticated email server for all email features described. The ACS shall be able to connect to SMTP or POP3 authenticated email server.
- .4 The ACS shall support up to:
  - .1 1 computer workstation
  - .2 64 Door controllers
  - .3 128 Card readers and/or keypads and/or elevator cabs
  - .4 Unlimited Access cards
  - .5 Unlimited Card families or site codes
  - .6 16,834 Monitored points
  - .7 16,834 Control relays
  - .8 2 Simultaneous operator languages

#### **1.5 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide electrical characteristics and connection requirements.
- .3 Shop Drawings: Indicate system wiring diagram showing each device and wiring connection required.

#### **1.6 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.
- .2 Test Reports: Indicate satisfactory completion of required tests and inspections.
- .3 Installation Data: Manufacturer's special installation requirements.
  - .1 Indicate application conditions and limitations of use stipulated by Product testing agency.
  - .2 Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

#### **1.7 CLOSEOUT SUBMITTALS**

- .1 Section 01 78 10: Submission procedures.
- .2 Maintenance Contracts: Provide service and maintenance of intrusion detection system for one (1) year from Date of Substantial Completion.
- .3 Operation Data: Operating instructions.
- .4 Maintenance Data: Maintenance and repair procedures.
- .5 Record Documentation: Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

#### **1.8 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years experience and with service facilities within 160 km(100 miles) of Project.

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**1.9 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by ULC as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Kantech KT-300 Series complete with Entrapass Special Addition single workstation software management system (ACS)
- .2 Or Approved Equal in Accordance with B7.

**2.2 SYSTEM CAPABILITIES**

- .1 The following functional capabilities are considered essential for the system described in this specification. The capabilities are to be considered standard, without the need for add-on software or hardware:
  - .1 Control access to various doors equipped with a card reader.
  - .2 Ensure more secure control with the anti-passback control function.
  - .3 Monitor all defined alarm points as well as all doors controlled by card readers based on programmed schedules.
  - .4 Send transactions for which printing is required to a printer, based on a set schedule.
  - .5 Access the system using the main and secondary menus (to which access is limited by a password) to make additions and required changes to various data files so that they can be updated by the user without the manufacturer's assistance.
  - .6 Enable the entry of access code data for every card or group of cards.
  - .7 Automatically display all alarms on screen in text with optional graphic or picture and trigger a sound requiring an acknowledgement on the keyboard to stop the alarm.
  - .8 The system should have the ability to print on a log printer. For security reasons, each event shall be incremented with a print number. Numbering shall start from 0 every day.
  - .9 Generate reports and view them on the screen, output them to a printer, or send them to an email address.
  - .10 Save the database manually or automatically backup following a schedule.
  - .11 Uninterrupted backups. The operator shall be able to perform any task during a ACS backup.
  - .12 The ACS shall offer the option to create 4 digit, 5 digit or 6 digit PIN for the card holders.
  - .13 The PIN length shall be defined ACS wide.
  - .14 The ACS shall remind ACS operators via email and messages (pop-ups) of the ACS KAP status. The ACS shall have pre-defined reminders set to:
    - .1 60 days before KAP expiration.
    - .2 30 days before KAP expiration.
    - .3 Day of KAP expiration.
    - .4 30 days after KAP expiration.

- .15 The ACS KAP reminder shall include but not be limited to ACS serial number tokens needed and ACS Edition.
- .16 Each card holder shall have the option of having the multi-swipe function active.
- .17 A specific event shall be generated for any valid or invalid, double or triple swipes.
- .18 It shall be possible to bypass the door contact for Door Forced Events and Door open too long events. It shall be possible to have the Door open too long be optional bypass on a door basis.
- .19 Operators shall be able at any time to bypass the door contact manually from the ACS workstation.
- .20 Save events on a hard drive according to required criteria.
- .21 Perform the following operations from all workstations:
  - .1 Lock or unlock, one time unlock, return to schedule one door or a group of doors.
  - .2 View the last access event on the door.
  - .3 Bypass the door contact and keep door locked.
  - .4 Disable and enable readers.
  - .5 View custom programmed comments in the component's Operation section.
  - .6 Activate or deactivate a relay or a group of relays.
  - .7 Activate or deactivate a point or a group of points.
  - .8 Program or modify one card or a group of cards.
  - .9 Validate or invalidate one card or a group of cards.
  - .10 Change time and date.
  - .11 Demand the system state in text or graphic mode.
  - .12 Query, create and/or modify data on: Access levels, Schedules and holidays, Access card, Instructions, Reports and log, Doors, Supervision points and relays, Operator levels, and Graphics.
- .22 Mandatory comments can be added by the operator when acknowledging the alarm pop-up.

### **2.3 ACCESS CONTROL PANEL DOOR CONTROLLER**

- .1 Manufacturer: Kantech KT-300 series
- .2 Scalable two-reader controller complete with network link complete with status and diagnostic LED's complete with adequate power supply to serve control panel and ancillary equipment.
- .3 Include battery-operated emergency power supply with capacity for operating system in standby mode for twenty-four (24) hours.
- .4 The controller shall have the ability to interface with an intrusion alarm system for intrusion system arming and disarming functionality.

### **2.4 PROXIMITY READER**

- .1 Manufacturer: Kantech ioProx series
  - .1 Mullion Mount Reader: P225 series (or approved equal in accordance with B7)

- 
- .2 Single Gang Mount Reader: P325 series (or approved equal in accordance with B7)
  - .2 The proximity reader shall be compatible with dual encoded proximity cards – 26-bit Wiegand and Kantech Extended Secure Format (XSF) complete with red/green LED indicator light complete with integrated piezoelectric buzzer complete with black finish. Read range up to 165mm.
- 2.5 PROXIMITY KEY FOB**
- .1 Manufacturer: Kantech ioProx P40Key series (or approved equal in accordance with B7)
  - .2 Ultrasonically welded, ABS shell and epoxy potted complete with grey finish.
  - .3 Provide two hundred (200) compatible proximity key fobs.
- 2.6 DOOR CONTACT**
- .1 Manufacturer: GE Interlogix 1076D-G series. (or approved equal in accordance with B7)
  - .2 Steel magnetic door contact complete with grey finish (4-pole).
- 2.7 PROXIMITY CARD PROGRAMMER**
- .1 Quantity (1) proximity card programmer to be provided.
- Part 3 Execution**
- 3.1 INSTALLATION**
- .1 Install to manufacturer's written instructions.
  - .2 Integrate with barrier free door operators as required where controlled doors are complete with operators. Coordinate requirements with the Contractor to ensure proper sequencing is applied.
  - .3 Make conduit and wiring connections to door hardware devices provided under Section 08 71 00.
- 3.2 SYSTEM PROGRAMMING**
- .1 Database: The Electrical Subcontractor shall assist The City in setting up the system database requirements and formats. Forms to be utilized in collecting and entering all data shall be included. Examples of the sequence of completion for all related forms shall be provided. The City shall be responsible for the actual data collection and entry to ensure a complete understanding of the system and its contents.
  - .2 Programming: The Electrical Subcontractor shall initially configure the system in accordance with the design shown in the drawings. The City shall perform any additional programming with the assistance of the Electrical Subcontractor.
- 3.3 SYSTEM TESTING**
- .1 System Testing: The Electrical Subcontractor shall demonstrate the functionality of the system upon completion of installation, and shall document the result of all tests and provide these results to The City.

**3.4 MANUFACTURER'S FIELD SERVICES**

- .1 Section 01 78 10: Prepare and start components.
- .2 Include services of technician to supervise installation, adjustments, final connections, system testing, and operator training.

**3.5 DEMONSTRATION**

- .1 Section 01 79 00: Systems demonstrations.
- .2 Demonstrate normal and abnormal modes of operation, and required responses to each.
- .3 Training: Provide two (2) sessions at minimum of two (2) hours of training to The City personnel. Provide sign-off sheet from The City personnel to confirm acceptance of training.

**END OF SECTION**



**Part 1**

**General**

**1.1 SECTION INCLUDES**

- .1 Alarm control panel.
- .2 Zone expansion panels.
- .3 Initiating Devices.
- .4 Signaling devices.

**1.2 RELATED SECTIONS**

- .1 Section 08 71 00 - Door Hardware - General.
- .2 Section 26 05 19 - Building Wire and Cable.

**1.3 REFERENCES**

- .1 CAN/ULC-S303-M91(R1999) - Local Burglar Alarm Units and Systems.
- .2 CAN/ULC-S304-06 - Signal Receiving Centre and Premise Burglar Alarm Control Units.
- .3 ULC-306-03 - Intrusion Detection Units.
- .4 ULC-S318-96 - Power Supplies for Burglar Alarm Systems.
- .5 NFPA 730 - Guide for Premises Security, 2011 Edition.
- .6 NFPA 731 - Installation of Electronic Premises Security Systems, 2011 Edition.

**1.4 SYSTEM DESCRIPTION**

- .1 Intrusion Detection System: Protect building and selected areas from intrusion during SECURE hours and provide redundant monitoring of specific building mechanical systems as follows:
  - .1 Exterior Doors:
    - .1 Detect status of doors using magnetic contacts.
  - .2 Interior Secured Spaces
    - .1 Detect motion using passive infrared (PIR) technology.

**1.5 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide electrical characteristics and connection requirements.
- .3 Shop Drawings: Indicate system wiring diagram showing each device and wiring connection required.

**1.6 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.
- .2 Test Reports: Indicate satisfactory completion of required tests and inspections.
- .3 Installation Data: Manufacturer's special installation requirements.

- .1 Indicate application conditions and limitations of use stipulated by Product testing agency.
- .2 Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

### **1.7 CLOSEOUT SUBMITTALS**

- .1 Section 01 78 10: Submission procedures.
- .2 Maintenance Contracts: Provide service and maintenance of intrusion detection system for one (1) year from Date of Substantial Completion.
- .3 Operation Data: Operating instructions.
- .4 Maintenance Data: Maintenance and repair procedures.
- .5 Record Documentation: Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

### **1.8 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (1) years of experience and with service facilities within 160 km(100 miles) of Project.

### **1.9 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by ULC as suitable for the purpose specified and indicated.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Digital Security Controls (DSC)
- .2 Or Approved Equal in Accordance to B7.

### **2.2 ALARM CONTROL PANEL**

- .1 Control Panel: Modular construction with surface wall-mounted enclosure with adequate power supply to serve control panel modules, alarm signaling devices remote annunciator keypads, remote devices, and relays.
- .2 Include battery-operated emergency power supply with capacity for operating system in standby mode for twenty-four (24) hours.
- .3 System Supervision: Provide electrically-supervised system, with supervised alarm initiating and alarm signaling circuits. Component or power supply failure places system in alarm mode.
- .4 Initiating Circuits: Supervised zone module with alarm and trouble indication.
- .5 Signal Circuits: Supervised zone coded signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode and does not disable that circuit from transmitting alarm.
- .6 Remote Station Signal Transmitter: Electrically supervised, capable of transmitting alarm and trouble signals over telephone lines to central station receiver.

- .7 Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.
- .8 Alarm Sequence of Operation: Actuation of intrusion detecting device places system in alarm mode, which causes the following operations:
  - .1 Sound and display local alarm signaling devices with non-coded signal.
  - .2 Transmit zone-coded signal to central station.
  - .3 Indicate location of actuated device on [control panel] remote annunciator keypad.
  - .4 Alarm Reset: Key-accessible reset function resets alarm system out of alarm if alarm initiating circuits have cleared.
  - .5 Lamp Test: Manual lamp test function causes alarm indication at each zone at remote annunciator keypad.

### **2.3 INITIATING DEVICES**

- .1 Standard Range Motion Detector: Dual passive infrared (PIR) motion sensor complete with temperature compensation complete with RFI protection suitable for wall and ceiling mounting and up to 15m x 12m (50'-0" x 40'-0") area of coverage.
  - .1 Product: Bravo 6, manufactured by Digital Security Controls Ltd. (DSC).
  - .2 Or Approved Equal in Accordance to B7.
- .2 Long Range Motion Detector: Passive infrared (PIR) motion sensor complete with temperature compensation complete with RFI protection suitable for wall and ceiling mounting and 21m x 21m (70'-0" x 70'-0") or 45m x 2.5m (150'-0" x 8'-0") area of coverage.
  - .1 Product: CX-702, manufactured by Optex Co. Ltd.
  - .2 Or Approved Equal in Accordance to B7.
- .3 Steel Door Contact: 2-wire magnetic door contact.
  - .1 Product: 1078/1076 Series, manufactured by GE.
  - .2 Or Approved Equal in Accordance to B7.

### **2.4 SIGNAL DEVICES**

- .1 Alarm Horn: Electric warbling tone, 125 mm(5 inch) siren. Sound Rating: 115 dB 3 m(10 ft).
- .2 Remote Annunciator Keypad: Provide a supervised remote annunciator keypad complete with backlit alpha-numeric keypad and LCD display including audible and visual indication of intrusion by zone, and audible and visual indication of system trouble. Install in a surface wall-mounted enclosure complete with keyed access.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Use minimum 4/C 22 AWG minimum size conductors for detection and signal circuit conductors. Install wiring in conduit.

- 
- .3 Use minimum 10/C 18 AWG minimum size conductors for interconnection between main control panel and expansion panels. Install wiring in conduit.
  - .4 Confirm wiring with manufacturer.
  - .5 Make conduit and wiring connections to door hardware devices provided under Section 08 71 00.

**3.2 MANUFACTURER'S FIELD SERVICES**

- .1 Section 01 78 10: Prepare and start components.
- .2 Include services of technician to supervise installation, adjustments, final connections, system testing, and operator training.

**3.3 DEMONSTRATION**

- .1 Section 01 79 00: Systems demonstrations.
- .2 Demonstrate normal and abnormal modes of operation, and required responses to each.
- .3 Training: Provide two(2)hours of training to The City personnel. Provide sign-off sheet from The City personnel to confirm acceptance of training.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Network Video recorder.
- .2    Cameras.
- .3    UPS
- .4    Software.

**1.2                REFERENCES**

- .1    Underwriters Laboratories of Canada (ULC)
  - .1    ULC-S317-[1996], Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

**1.3                RELATED SECTIONS**

- .1    Section 28 13 28 - Security Access Components.
- .2    Section 28 16 00 - Intrusion Detection.

**1.4                SYSTEM DESCRIPTION**

- .1    Description: Provide network video recorder (NVR) system, video cameras, and video communications between points of surveillance as scheduled and indicated on Drawings.

**1.5                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 video surveillance equipment and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2    Submit:
    - .1    Functional description of equipment.
    - .2    Technical data sheets of all devices.
    - .3    Device location plans and cable lists.
    - .4    Video camera surveillance chart.
    - .5    Video interconnection detail drawings.
    - .6    Camera mounting details specific to location.
- .3    Shop Drawings:
  - .1    Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
  - .2    Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme.
  - .3    Submit zone layout drawings indicating number and location of zones and areas covered.

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- .4 Samples:
    - .1 Submit for review and acceptance of each unit.
    - .2 Samples will be returned for inclusion into work.
    - .3 Submit [1] sample of each camera selected complete with housing, brackets and mounting hardware.
    - .4 Camera will be returned for incorporation into work as appropriate.
  - .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .1 Submit UL Product safety Certificates.
    - .2 Submit verification Certificate that service company is "UL List alarm service company".
    - .3 Submit verification Certificate that monitoring facility is "UL Listed central station".
    - .4 Submit verification Certificate that video surveillance system is "Certified alarm system".
  - .6 Test and Evaluation Reports:
    - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .7 Manufacturer's Instructions: submit manufacturer's installation instructions.
  - .8 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

#### **1.6 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. Include following:
  - .1 System configuration and equipment physical layout.
  - .2 Functional description of equipment.
  - .3 Manufacturer's Instructions for operation, adjustment and cleaning.
  - .4 Illustrations and diagrams to supplement procedures.

#### **1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years experience.
- .2 Supplier: Authorized distributor of manufacturer with minimum five (5) years' experience.
- .3 Installer Qualifications: Electrical Subcontractor shall have been in business for a minimum of five (5) years and have successfully completed one or more projects of scope 50% of the magnitude specified by these documents. Authorized installer of specified manufacturer with service facilities within 160 km(100 miles) of the project.

#### **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 video surveillance materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 DESIGN CRITERIA**

- .1 Provide operator with ability to control all camera functions.
- .2 Alarm point monitoring: system capable, upon alarm recognition, of switching CCTV cameras associated with alarm point.
- .3 Switching:
  - .1 Provision to switch any camera in system to any monitor in system manually or automatically.
  - .2 Provision to switch system video recorders to selective monitor outputs in system.
- .4 Control: provision for any camera equipped with pan, tilt, and/or motorized zoom lens:
  - .1 Manually control pan, tilt and lens functions.
  - .2 Set pan and tilt home position.
  - .3 Set and clear movement limits of pan and tilt mechanism.
  - .4 Adjust motorized zoom lens.
- .5 Enter and edit CCTV programs and save them for future use.
- .6 Provide ability to display stored 'video image' of cardholder, and switch real-time camera to card reader location for specific card usage.
- .7 Overall control of CCTV provided through software control, which provides complete integration of security components.
- .8 Environment: design video components and systems to operate with specified requirements under following ambient temperatures:
  - .1 Indoor installations:
    - .1 Temperature: 0 degrees C to 30 degrees C.
    - .2 Humidity: 10 to 90%.
  - .2 Outdoor installations:
    - .1 Temperature: -30 degrees C to 60 degrees C.
    - .2 Humidity: 10 to 100%.
- .9 Manufacturers:
  - .1 Hanwha Techwin
  - .2 Or Approved Equal in Accordance with B7.

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## 2.2 NETWORK VIDEO RECORDER

- .1 Digital Video Recorder: 16 channel network video recorder c/w PoE, rack mounted.
  - .1 Hanwha Techwin QRN-1610S-8TB
  - .2 Or Approved Equal in Accordance with B7.
- .2 Performance Ratings:
  - .1 Inputs: Max 16ch
  - .2 Resolution: CIF~8MP
  - .3 Operating System:
    - .1 Recording Bandwidth: Max 128Mbps
    - .2 Resolution: CIF~8MP
  - .4 Storage: 8TB
- .3 Electrical:
  - .1 Input voltage 120V.
  - .2 Integrated PoE ports with sufficient power to support 16 PoE cameras.
- .4 Environmental:
  - .1 Operating temperature 0°C ~ 40°C.
  - .2 Operating Humidity: 20%~85% Relative.
- .5 Features:
  - .1 Scheduled backup to NAS
  - .2 Display: Web 3 users minimum
  - .3 Compression: H.264/H.265
  - .4 Bandwidth: 180Mbps
  - .5 Event Trigger: Alarm, Video loss, Camera event (Sensor, Video analytics), Tampering, Enter/Exit, Passing, Face detection, Audio Detection, Defocus.
  - .6 Event Action: E-mail, PTZ preset, Alarm out, Buzzer, Monitor out
  - .7 Digital storage for 30 days of continuous recording in 2 MP.
    - .1 Hard drives shall be designed and rated for continuous read-write application.
  - .8 Remote connection through LAN unity Remote PC Client Application.

## 2.3 CAMERAS

- .1 C1 - General purpose wide angle interior video camera with smoked dome housing:
  - .1 Hanwha Techwin LND-6022R
  - .2 Or Approved Equal in Accordance with B7.
  - .3 Performance Rating:
    - .1 Full HD network IR video camera.
    - .2 Resolution: 2 mega pixels.
    - .3 Pixels: 1920 x 1080 minimum
    - .4 Maximum 30fps@all resolutions (H.264)
    - .5 H.264, MJPEG codec supported, Multiple streaming
    - .6 Day & Night (ICR), WDR (120dB)



- 
- .7 Tampering, Motion detection
  - .8 microSD/SDHC/SDXC memory slot (Maximum 32GB), PoE
  - .9 Hallway view, WiseStreamII support
  - .10 IR viewable length 30m
  - .11 IP66, IK10 rated
- .2 C2 - General purpose interior video camera with smoked dome housing:
- .1 Hanwha Techwin LND-6032R
  - .2 Or Approved Equal in Accordance with B7.
  - .3 Performance Rating
    - .1 Full HD network IR video camera.
    - .2 Resolution: 2 mega pixels.
    - .3 Pixels: 1920 x 1080 minimum
    - .4 Maximum 30fps@all resolutions (H.264)
    - .5 H.264, MJPEG codec supported, Multiple streaming
    - .6 Day & Night (ICR), WDR (120dB)
    - .7 Tampering, Motion detection
    - .8 microSD/SDHC/SDXC memory slot (Maximum 32GB), PoE
    - .9 Hallway view, WiseStreamII support
    - .10 IR viewable length 30m
    - .11 IP66, IK10 rated
- .3 C3 - General purpose wide angle exterior video camera with smoked dome housing:
- .1 Hanwha Techwin LNV-6022R
  - .2 Or Approved Equal in Accordance with B7.
  - .3 Performance Rating
    - .1 Full HD network IR video camera.
    - .2 Resolution: 2 mega pixels.
    - .3 Pixels: 1920 x 1080 minimum
    - .4 Maximum 30fps@all resolutions (H.264)
    - .5 H.264, MJPEG codec supported, Multiple streaming
    - .6 Day & Night (ICR), WDR (120dB)
    - .7 Tampering, Motion detection
    - .8 microSD/SDHC/SDXC memory slot (Maximum 32GB), PoE
    - .9 Hallway view, WiseStreamII support
    - .10 IR viewable length 30m
    - .11 IP66, IK10 rated
- .4 C4 - General purpose exterior video camera with smoked dome housing:
- .1 Hanwha Techwin LNV-6032R
  - .2 Or Approved Equal in Accordance with B7.
  - .3 Performance Rating
    - .1 Full HD network IR video camera.
    - .2 Resolution: 2 mega pixels.
    - .3 Pixels: 1920 x 1080 minimum

- .4 Maximum 30fps@all resolutions (H.264)
  - .5 H.264, MJPEG codec supported, Multiple streaming
  - .6 Day & Night (ICR), WDR (120dB)
  - .7 Tampering, Motion detection
  - .8 microSD/SDHC/SDXC memory slot (Maximum 32GB), PoE
  - .9 Hallway view, WiseStreamII support
  - .10 IR viewable length 30m
  - .11 IP66, IK10 rated
- .5 Camera Mounts (As required Electrical Subcontractor to Coordinate)
- .1 Indoor Camera wall mount
    - .1 Hanwha Techwin SBP-120WMW
    - .2 Or Approved Equal in Accordance with B7.
  - .2 Outdoor Camera wall mount
    - .1 Hanwha Techwin SBV-120WCW
    - .2 Or Approved Equal in Accordance with B7.

**2.4 UPS:**

- .1 Pure sine wave line interactive UPS with 60 minute runtime and total load of 160 watts.
  - .1 Xtreme Power Conversion P80-1500 (P/N90000902)
  - .2 Or Approved Equal in Accordance with B7.
- .2 Performance Ratings:
  - .1 Inputs: 120VAC
  - .2 Output: 120VAC
  - .3 Battery Quantity: (4) 12V 7AH
  - .4 Charging Current: 1.5A max
  - .5 Typical recharge: 4 hours to 90%
  - .6 Include Adjustable 4-Post Rail kit

**2.5 SOFTWARE:**

- .1 The web viewer shall provide a monitoring screen which displays live camera video and simultaneously provides same-screen access to the following functions:
  - .1 Live view window size
  - .2 Resolution setting
  - .3 Image (snapshot) capture
  - .4 Manual recording to SD or NAS
  - .5 Audio/microphone control
  - .6 Access Playback and Setup menus
- .2 The web viewer shall provide a playback screen which provides access to the following functions:
  - .1 Search date and time range
  - .2 Search event type

- .3 Play an event video
- .4 Set resolution
- .5 Play audio if present
- .6 Generate a backup copy of saved video data
- .3 The web viewer shall provide a setup screen which provides access to the following configuration settings and functions in the camera:
  - .1 Digital video profile to include compression type, maximum or target bit rate, frame rate, multicast parameters, crop encoding area
  - .2 User profile to include password, access level, authentication
  - .3 Date and time
  - .4 Network settings and IP version
    - .1 DDNS
    - .2 SSL, including certificate management
    - .3 802.1x authentication
    - .4 Quality of Service settings
    - .5 SNMP to include version selection and settings
    - .6 Auto configuration
  - .5 Video setup to include flip and mirror mode, hallway view mode, video type, privacy zone
  - .6 Audio setup to include source, audio codec type, gain, and bit rate
  - .7 Camera settings to include image preset, sensor frame capture, dynamic range, white balance, back light, exposure, day/night operation, on-screen display, IR illumination, sharpness, contrast, color level, lens distortion correction.
  - .8 Event detection setup to include notification parameters, recording rules, time schedule, tamper protection, motion detection, event triggers
  - .9 System function to include reboot, upgrade, check system and event logs, application (SDK) management
  - .10 View profile information
- .4 Minimum client hardware requirement:
  - .1 Processor: Intel Core i3, AMD Ryzen 3
  - .2 Ram: 4GB
  - .3 OS: Windows 7, 8, 10, Mac OS X 10.8
  - .4 Display: 1920 x 1080 (32bit)
  - .5 Web browsers: Internet Explorer, Edge, Firefox, Chrome, Safari
- .5 Licensing requirement: included with hardware package.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for video surveillance installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of The City.

- .2 Inform The City 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 City.

### **3.2 INSTALLATION**

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheet.
- .2 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.
- .3 Install components secure, properly aligned and in locations shown on reviewed shop drawings.
- .4 Connect cameras to cabling in accordance with installation instructions.
- .5 Install ULC labels where required.

### **3.3 NETWORK SETTING**

- .1 Coordinate network plan with The City.
- .2 Where IP (Network) type cameras are installed, coordinate network addresses and camera settings with The City. Electrical Subcontractor is responsible for configuring camera.
- .3 Provide documentation horizontal cabling identifying on which Patch Panel port each camera cable is terminated (e.g. Camera X = port Y).

### **3.4 INTERFACE WITH OTHER PRODUCTS**

- .1 Interface installation of closed circuit television system with security access and intrusion detection systems.

### **3.5 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
  - .2 Submit 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 at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of Work, after cleaning is carried out.

### **3.6 SYSTEM STARTUP**

- .1 Perform verification inspections and test in the presence of The City.
  - .1 Provide all necessary tools, ladders and equipment.
  - .2 Ensure appropriate subcontractors, and manufacturer's representatives and security specialists are present for verification.

- .2 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
  - .1 Sturdiness of equipment fastening.
  - .2 Non-existence of installation related damages.
  - .3 Compliance of device locations with reviewed shop drawings.
  - .4 Compatibility of equipment installation with physical environment.
  - .5 Inclusion of all accessories.
  - .6 Device and cabling identification.
  - .7 Application and location of ULC approval decals.
- .3 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
  - .1 Measurements of tension and power.
  - .2 Connecting joints and equipment fastening.
  - .3 Measurements of signals (dB, lux, baud rate, etc).
  - .4 Compliance with manufacturer's specification, product literature and installation instructions.
- .4 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
  - .1 Operation of each device individually and within its environment.
  - .2 Operation of each device in relation with programmable schedule and or/specific functions.
  - .3 Operation control of camera lens, pan, tilt and zoom.
  - .4 Switching of camera to any monitor.
  - .5 Switching of system video recorder to selective monitor.
  - .6 Set dwell times.
  - .7 Demonstrate:
    - .1 Sequence viewing of cameras on each monitor.
    - .2 Bypass capability.
    - .3 Display of stored image to cardholder.

### **3.7 ADJUSTING**

- .1 Adjust manual lens irises to meet lighting conditions.
- .2 Adjust lens angle and zoom to meet The City's requirements. Review all camera views with The City and acquire written signoff.

### **3.8 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.
  - .1 Clean camera housing, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

**3.9 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by video surveillance installation.

**3.10 CLOSEOUT ACTIVITIES**

- .1 Demonstration:
  - .1 Demonstrate system operation and provide two (2) hours of instruction with manufacturer's training personnel.
  - .2 Conduct walking tour of Project and briefly describe function, operation, and maintenance of each component.
  - .3 Provide written signoff from The City to confirm accepted camera views.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Fire alarm control panels.
- .2    Fire alarm initiating and signaling devices.
- .3    Auxiliary fire alarm equipment and wiring.

**1.2                RELATED SECTIONS**

- .1    Section 08 71 00 - Door Hardware - General: Door closers, electric locks, electric releases.
- .2    Section 21 12 00 - Standpipe and Fire Hose.
- .3    Section 21 13 00 - Sprinklers.
- .4    Section 26 05 00 - Common Work Results for Electrical
- .5    Section 26 05 19 - Building Wire and Cable.

**1.3                REFERENCES**

- .1    The latest version of the following including all amendments:
  - .1    CAN/ULC S524 - Standard for the Installation of Fire Alarm Systems.
  - .2    CAN/ULC S525 - Audible Signal Devices for Fire Alarm Systems, Including Accessories.
  - .3    CAN/ULC S526 - Visible Signal Devices for Fire Alarm Systems.
  - .4    CAN/ULC S527 - Control Units for Fire Alarm Systems
  - .5    CAN/ULC S528 - Manual Pull Stations for Fire Alarm Systems.
  - .6    CAN/ULC S529 - Smoke Detectors for Fire Alarm Systems.
  - .7    CAN/ULC S530 - Heat Actuated Fire Detectors for Fire Alarm Systems.
  - .8    CAN/ULC S536 - Inspection and Testing of Fire Alarm Systems.
  - .9    CAN/ULC-S537 - Standard for Verification of Fire Alarm Systems.
  - .10    CAN/ULC S541 - Speakers for Fire Alarm Systems, Including Accessories.
  - .11    ULC ORD-C386-1990 - Flame Detectors.

**1.4                SYSTEM DESCRIPTION**

- .1    Existing fire alarm system is based on is a fully supervised, manual and automatic, single stage addressable fire alarm control panel (FACP) Simplex 4100.
- .2    All existing conventional initiating devices shall be demolished throughout and replaced with new addressable initiating devices, compatible with existing FACP.
- .3    All existing audible notification bells shall be demolished throughout and replaced with new audible and audiovisual notification appliances.
- .4    All new fire alarm devices shall wired back to existing fire alarm control panel. Electrical Subcontractor shall modify existing control panel as required to accommodate.
- .5    The fire alarm system shall carry out fire alarm and protection functions consisting of receiving alarm signals, initiating alarm and trouble sequences, continuous supervision of

fire alarm components and wiring, actuation of annunciators and auxiliary functions and signals to remote monitoring agency.

- .6 Fire alarm system shall be modular in design complete with 15% spare capacity to allow for future system expansion
- .7 The fire alarm system shall include, but not be limited to the following:
  - .1 Existing Control panel
  - .2 Trouble signal devices
  - .3 Power supplies and booster facilities
  - .4 Manual alarm stations
  - .5 Automatic alarm initiating devices
  - .6 Audible and visual signal devices
  - .7 End-of-line devices
  - .8 Annunciators
  - .9 Ancillary devices
  - .10 Input and output modules
  - .11 Isolator modules

#### **1.5 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide electrical characteristics and connection requirements.
- .3 Shop Drawings:
  - .1 Provide control panel and annunciator layout
  - .2 Provide system wiring diagram showing each device and wiring connection required.
    - .1 Wiring diagram shall be specific to the project and shall meet manufacturers recommendations and required building codes and standards.

#### **1.6 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00: Submission procedures.
- .2 Test Reports: Indicate satisfactory completion of required tests and inspections.
- .3 Installation Data: Manufacturer's special installation requirements.
  - .1 Indicate application conditions and limitations of use stipulated by Product testing agency.
  - .2 Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

#### **1.7 CLOSEOUT SUBMITTALS**

- .1 Section 01 78 10: Submission procedures.
- .2 Maintenance Contracts: Provide service and maintenance of fire alarm system for one (1) year from Date of Substantial Completion.
- .3 Operation Data: Operating instructions.
- .4 Maintenance Data: Maintenance and repair procedures.



- .5 Record Documentation: Record actual locations of initiating devices, signaling appliances, and end-of-line devices. Include zone number and device number for each device installed. Include circuit number for signalling appliances.

## **1.8 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Section 01 78 40: Maintenance and extra material requirements.
- .2 Extra Stock Materials:
  - .1 Provide six (6) keys of each type.
  - .2 Provide three (3) of the following devices:
    - .1 Addressable manual station
    - .2 Addressable heat detector
    - .3 Ceiling mounted smoke detector
    - .4 Ceiling mounted combination smoke detector and fixed temperature heat detector
    - .5 Wall mounted combination horn/strobe, standard cd rating
  - .3 Provide two (2) addressable multi-criteria fire/CO detector

## **1.9 QUALITY ASSURANCE**

- .1 Design and install fire alarm system to CAN/ULC S524.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum fifteen (15) years documented experience and with service facilities within 160 km (100 miles) of Project.

## **1.10 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by ULC and as suitable for the purpose specified and indicated.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 The fire alarm devices as described here-in are based on the Notifier NFS Series fire alarm system performance only. Simplex Grinnell, as well as Honeywell Firelite and Siemens compatible with existing fire alarm panel, are approved equals.
- .2 Substitutions: Refer to Section 01 62 00.

### **2.2 MANUAL INITIATING DEVICES**

- .1 Single Stage Manual Station: Non-coded type, double action manual station with key-operated reset lock constructed of red-colored polycarbonate. The station shall be designed that after emergency operation they cannot be restored to normal without key.
  - .1 Addressable manual station shall be complete with loop polling LED (Green), and shall be equal to Notifier NBG-12LX.
  - .2 Non-Addressable manual station shall be equal to Notifier NBG-12. Non-Addressable stations shall be used in crawlspaces only, or as indicated. Connect to addressable zone module as indicated.

- .3 Provide manufacturer's standard backbox for surface applications. Backbox finish to match station finish.

## **2.3 AUTOMATIC INITIATING DEVICES**

- .1 Heat Detector: Combination rate-of-rise and fixed temperature, rated 57 degrees C (135 degrees F) and temperature rate of rise of 8.3 degrees C (15 degrees F).
  - .1 Addressable heat detector shall be complete with inter-changeable plug-in base and loop polling LED (Green), and shall be equal to Notifier FST-851A.
  - .2 Non-Addressable moisture-proof heat detector shall be equal to Mircom CR-135-MP. Non-Addressable, moisture-proof heat detectors shall be used in crawlspaces only, or as indicated. Connect to addressable zone module as indicated.
- .2 Ceiling Mounted Smoke Detector: Addressable photoelectric type with adjustable sensitivity with inter-changeable plug-in base and loop polling LED (Green). LED shall provide (Red) visual indication of detector actuation. Provide auxiliary relay contact as indicated. Provide sounder bases as indicated. Smoke detector shall be equal to Notifier FSP-851A.
- .3 Ceiling Mounted Combination Smoke Detector and Fixed Temperature Heat Detector: Addressable photoelectric type smoke detector with adjustable sensitivity with inter-changeable plug-in base and loop polling LED (Green). LED shall provide (Red) visual indication of detector actuation. Fixed temperature shall be rated 57 degrees C (135 degrees F). Provide auxiliary relay contact as indicated. Provide sounder bases as indicated. Smoke detector shall be equal to Notifier FSP-851TA.
- .4 Duct Mounted Photoelectric Smoke Detector: Addressable photoelectric type with key-operated NORMAL-RESET-TEST switch, duct sampling tubes extending width of duct, and visual indication of detector actuation, in duct-mounted housing. Provide auxiliary relay contact as indicated. Housing shall be complete with tamper signal and shall be suitable to mount on square or rectangular duct. Provide addressable relay. Duct smoke detector shall be equal to Notifier DNR series.
- .5 Multi-Criteria Fire/CO Detector: Addressable combination detector combines smoke, CO, light/flame, and heat sensing technology in one device with adjustable sensitivity settings, and loop polling LED (Green). LED shall provide (Red) visual indication of detector actuation. Unit shall be complete with separate CO detection signal, and built-in CO cell end-of-life warning and fault. Provide dual sounder bases as indicated with separate audible signals for fire or CO alarm. Multi-Criteria Fire/CO Detector shall be equal to Notifier FCO-851(A).
- .6 Stand-Alone CO Detector: Non-Addressable complete with an audible and visual alarm, test/silence switch, built-in CO cell end-of-life warning and alarm/trouble relay outputs connected to an addressable zone monitor module and supervised power supply. The detector shall be suitable for wall or ceiling mounting. CO detector shall be equal to System Sensor CO1224A.
- .7 Stand-Alone CO Detector: Non-Addressable complete with an audible and visual alarm, test/silence switch, built-in CO cell end-of-life warning and alarm/trouble relay outputs connected to a new zone module and supervised power supply. The detector shall be suitable for wall or ceiling mounting. CO detector shall be equal to System Sensor CO1224A.

## **2.4 INPUT MODULES**

- .1 Fully addressable modules to facilitate the monitoring of the following:

- .1 Sprinkler flow and tamper inputs
- .2 Generator common trouble input
- .3 Fire pump running, loss of phase, phase reversal and controller connected to alternate source and common trouble.
- .4 Dry contact devices

## **2.5 OUTPUT MODULES**

- .1 Fully addressable output modules with provision to accept a 24 VDC input from the control panel or local power supply (transponder) to facilitate the following:
  - .1 Audible signals
  - .2 Visual signals
- .2 Output modules shall provide dry normally open contact with output up to 2A at 24V.

## **2.6 SIGNAL LINE ISOLATORS**

- .1 Provide signal isolators on addressable loops to suit CAN/ULC S524 and CAN/ULC S537.

## **2.7 SIGNALING APPLIANCES**

- .1 Alarm Horns and Strobes: The signalling device shall be 2-wire, and shall operate at 24VDC. Horn sound rating shall be rated at a sound level of at least 95dB at 3m (10ft). Horn tones and volume shall be field adjustable by way of integral switch. Strobe candela (cd) rating shall be field adjustable by way of integral switch. Standard strobe cd shall be field adjustable from 15 – 115cd. High cd strobes shall be field adjustable from 135 – 185cd. Provide ceiling or wall mounted, standard or high cd, indoor or outdoor units as indicated. All devices shall be red in color. Alarm horns and strobes shall be equal to Notifier SpectrAlert Advance series.

## **2.8 AUXILIARY DEVICES**

- .1 Door Release: Magnetic door holder with integral diodes to reduce buzzing. Coil voltage 24 VDC.
- .2 Door Release: Door closer as specified in Section 08 71 00.

## **2.9 END-OF-LINE DEVICES**

- .1 End-of-line devices shall control supervisory current where required, and sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, initiating an alarm or trouble condition.

## **2.10 FIRE ALARM WIRE AND CABLE**

- .1 Fire Alarm Power Branch Circuits: Building wire as specified in Section 26 05 19.
- .2 Initiating Device and Indicating Appliance Circuits:
  - .1 Description: Type FAS solid conductor, complete with red tinted interlocking armour as required
  - .2 Conductor: Copper unless otherwise noted.
  - .3 Insulation Voltage Rating: 300 volts.

- .4 Insulation: Coded PVC insulation and with overall red PVC jacket in accordance with the Canadian Electrical Code, rated 105 degrees C. Use shielded cable as per manufacturer's recommendations only.
- .3 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To audible signal circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .5 To visual signal circuits: 12 AWG minimum, and in accordance with manufacturer's requirements.
- .6 Wiring shall be as per manufacturer's recommendations. All wiring shall be in red coloured conduit unless noted otherwise.

## **2.11 ACCESSORIES**

- .1 Manual Station Vandal Guard: Clear vandal resistant, UV Stabilized polycarbonate shield and frame complete with integral 95db piezo horn and battery. Flush mounted or surface as indicated. Outdoor rated as required. Vandal guard shall be equal to STI Stopper II series.
- .2 Wire Guard: ULC listed 9 gauge steel wire complete with corrosion resistant polyester coating and tamper resistant hardware where indicated. Wire guard to be suitably sized to accommodate device and/or equipment being protected.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install products to manufacturer's written instructions and CAN/ULC S524, local and national codes, as indicated, and as recommended by the manufacturer.
- .2 All initiating and signalling devices, control panels and remote annunciators shall be flush mounted unless indicated otherwise.
- .3 Install devices at heights indicated in Section 26 05 00.
- .4 Locate detectors minimum 0.45m (18") from air discharge or return grille as measured from the edge of the detector, and not closer than 300 mm (12") to lighting fixtures.
- .5 Locate ceiling mounted detectors minimum 100mm (4") from edge of ceiling where it meets the wall as measured from the edge of the detector.
- .6 Detectors shall be located such that a clear space of 450mm is maintained between the detector and any obstructions except where ceiling mounted obstructions protrude less than 100 mm (4") from the ceiling.
- .7 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.
- .8 Mount end-of-line devices in separate box adjacent to last device in circuit.
- .9 Mount outlet box for electric door holder to withstand 36 kg (80 lbs) pulling force.
- .10 Make conduit and wiring connections to duct smoke detectors, sprinkler valve tamper and flow switches, fire suppression system control panels, door release devices, smoke control fans and equipment.
- .11 Circuiting for fire alarm devices shall be as follows:

- .1 Provide Class "A" addressable initiating/alarm circuits throughout unless indicated otherwise.
- .2 Provide Class "B" audible/visual signal circuits for signal circuits throughout unless indicated otherwise.
- .3 Provide Class "A" audible/visual signal circuits for residential dwelling unit signal circuits only.
- .4 Circuits shall have a minimum 15% spare capacity for future system expansion.
- .5 All SLC, signal and power riser wiring shall be supervised, including internal wiring between modules.
- .12 Where wiring is required to be surface mounted within finished areas, wiring shall be installed in a single piece metal raceway unless noted otherwise. Color of raceway shall be white unless noted otherwise.
- .13 Where devices are surface mounted in finished areas, provide a surface mounted metal raceway device box. Color of box shall match the device.
- .14 Where initiating devices are located within an attic space, and crawlspace, non-addressable type devices shall be used, connected to an addressable zone module located outside the attic space and/or crawlspace in an accessible location. Associated EOL's and Modules shall be clearly labelled.
- .15 Where attic spaces and crawlspaces are compartmentalized, each compartment shall be wired in such a manner that each compartment is on a separate fire alarm zone. Provide additional zone modules as required.

### **3.2 WIRING METHODS**

- .1 Concealed Dry Interior Locations: Use FAS wire in raceway for all main runs. Armoured Securex for individual device drops only.
- .2 Exposed Dry Interior Locations: Use only FAS wire in raceway.
- .3 Above Accessible Ceilings: Use FAS wire in raceway for all main runs. Armoured Securex for individual device drops only.
- .4 Wet or Damp Interior Locations: Use only FAS wire in raceway.
- .5 Exterior Locations: Use only FAS wire in raceway.
- .6 Underground Installations: Use only FAS wire in raceway.

### **3.3 INTERCONNECTIONS**

- .1 Interconnect with all systems and devices as identified on the drawings.
- .2 Interconnect with all electromagnetic locks to release on fire alarm signal. Provide a manual release/reset keyswitch adjacent the fire alarm panel.

### **3.4 FIELD QUALITY CONTROL**

- .1 Section 01 45 00: Field inspection and testing.
- .2 Test to CAN/ULC S536 and CAN/ULC-S537 and local inspection authority requirements.
- .3 Include services to re-test system one (1) month prior to completion of warranty.

### **3.5 MANUFACTURER'S FIELD SERVICES**

- .1 Section 01 78 10: Prepare and start components.

- .2 Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

**3.6 CLOSEOUT ACTIVITIES**

- .1 Demonstration: Demonstrate normal and abnormal modes of operation, and required responses to each.

**END OF SECTION**

## Part 1 General

### 1.1 QUALITY ASSURANCE

- .1 Manufacturer: Wallace and Wallace / Wallace and Wallace Perimeter Security or approved equal in accordance with B7.
- .2 Fencing as per drawings/specifications and in accordance with City of Winnipeg Standards.

### 1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit Shop Drawings and product data to requirements of Section 01 30 00.
- .2 Indicate on Shop Drawings, plan layout, grid, spacing of components, accessories, fittings, hardware, anchorages, and schedule of components.

## Part 2 Products

### 2.1 MATERIALS

- .1 Framework: CAN2-138.2M or latest, Schedule 40 steel pipe, standard weight, one piece without joints, hot-dipped galvanized.
- .2 Welded Wire Panels: hot-dipped galvanized steel, welded wire panel – Rampart 358, or equivalent.
- .3 All components to be hot dipped galvanized to ASTM Standard A123.

### 2.2 COMPONENTS – MECHANICAL EQUIPMENT ENCLOSURE (FLUID CHILLER)

- .1 Line Posts: 4 ½" diameter steel pipe.
- .2 Corner and Terminal Posts: 4 ½" diameter steel pipe.
- .3 Gate Posts: 4 ½" diameter steel pipe
- .4 Top and Brace Rail: 43mm (1 ¾") diameter, plain end, sleeve coupled steel pipe.
- .5 Gate Frame: CAN2-138.4M or latest, 45mm (1 ¾") diameter steel pipe. Sizes and locations as per Drawings.
- .6 Gate Hardware:
  - .1 10" wheels, one per gate
  - .2 Centre-drop rod assembly c/w concrete pad to anchor into
  - .3 4 ½" OD latch catch for padlock securing
- .7 Caps: Cast steel of malleable iron, galvanized, sized to post dimension, set screw retained. Provide for all posts.
- .8 Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings: Galvanized steel.
- .9 Welded Wire Security Panel: Rampart 358 – security panel (non-climbable), hot-dipped galvanized, 8'-0" high, 3"x5" mesh opening, 8 gauge wire, c/w all required clips/brackets/angles for attachment to fence posts.
- .10 Tension Wire: 1/4" mm thick steel, single strand.
- .11 Fence Slats: Bottom-locking style PVC fence slats – confirm extent with Contract Administrator.

### 2.3 COMPONENTS – ROOF ACCESS LADDER ENCLOSURE W/ PEDESTRIAN GATE

- .1 Corner and Terminal Posts: 2-5/8" diameter steel pipe c/w ½" thick base plates for mounting to concrete pad.
- .2 Top and Brace Rail: 43mm (1 ¾") diameter, plain end, sleeve coupled steel pipe.
- .3 Pre-Hung Pedestrian Gate:
  - .1 Model # PMG-03-01-1110 (Foldsmart XT)

- .2 Features: key lock control w/ stainless steel pull handle in the entry direction; mechanical push bar exit control; gate to include mesh infill and hydraulic closing mechanic
- .3 Constuction: fully welded 2" square vertical and horizontal structural steel tubing, hot-dipped galvanized.
- .4 Gate Frame: fully welded 2" square vertical and horizontal structural steel tubing, hot-dipped galvanized c/w welded ½" thick base plates for mounting to concrete pad.
- .5 Infill Panels: Rampart 358 welded wire panel, welded to gate frame
- .6 Hydraulic Closure: outdoor rated, strength to close the weight of the gate size
- .7 Operation: gate shall have the ability to provide free egress in exit direction, and controlled access in opposite direction.
- .8 Keyed cylinder shall be SFIC interchangeable type, to suit Best Access Systems keyway. Final keyed cylinders to be provided by Others for installation by the City once keying is complete.
- .4 Caps: Cast steel of malleable iron, galvanized, sized to post dimension, set screw retained. Provide for all posts.
- .5 Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings: Galvanized steel.

### Part 3 Execution

#### 3.1 INSTALLATION

- .1 Install framework, accessories and gates in accordance with manufacturer's instructions.
- .2 Provide fence of height indicated – 8'-0" minimum.
- .3 Provide top rail through line post tops and splice with 6 7/8" long rail sleeves.
- .4 Brace each gate and corner post back to adjacent line post with horizontal center brace rail . Install brace rail, one bay from end and gate posts.
- .5 Install center and bottom brace rail on corner gate leaves.
- .6 Install security fence panels in accordance with manufacturer's instructions.

**END OF SECTION**