

ARCHITECT (A)		MECHANICAL ENGINEER (M)	
STRUCTURAL ENGINEER (S)		ELECTRICAL ENGINEER (E)	
CIVIL ENGINEER (C)			

END OF SECTION

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END OF SECTION

1 ARCHITECTURAL

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M-102	Ground Floor – Plumbing – Sanitary Drainage
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M-501	Details – Plumbing
M-502	Details - HVAC
M-601	Schedules – Plumbing
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4 ELECTRICAL

Drawing Number	Drawing Title
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E-101	Site Plan
E-102	Floor Plan – Ground Level
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E-602	Details

5 CIVIL

Drawing Number	Drawing Title
C-001	General Notes
C-002	Grading Plan
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END OF SECTION

1 GENERAL

1.1 SUMMARY

- 1.1.1 This Section describes requirements for submission of bids for construction of the Ganaraska Forest Centre Auxiliary Building.
- 1.1.2 Work includes construction of a new single-storey, wood-framed building with associated architectural, structural, mechanical, electrical, and site works as indicated in the Contract Documents.
- 1.1.3 The building is approximately 381 m² and includes offices, washrooms, multipurpose spaces, and support areas as indicated on drawings.

1.2 BID DOCUMENTS

- 1.2.1 Bid Documents include:
 - .1 Instructions to Bidders
 - .2 Drawings and Specifications
 - .3 Addenda issued prior to bid closing
- 1.2.2 Bidders shall review all Contract Documents in their entirety.
- 1.2.3 Failure to examine documents will not relieve Bidder of obligations.

1.3 INTERPRETATION OF DOCUMENTS

- 1.3.1 Drawings and specifications are complementary.
- 1.3.2 Where discrepancies occur, bidders shall request clarification prior to bid closing.
- 1.3.3 Do not rely on assumptions regarding incomplete or unclear scope.
- 1.3.4 Report conflicts, omissions, or ambiguities to Consultant.

1.4 SITE EXAMINATION

- 1.4.1 Bidders shall visit the site prior to submitting bid.
 - .1 Bidders Walk on Site: **August 11th, 2026 10:00 AM**
 - .2 Site access and logistics
 - .3 Existing conditions including adjacent buildings and services
 - .4 Location of existing propane tanks and site servicing constraints visible on-site plan
- 1.4.2 No claim for extras will be considered due to failure to examine site conditions.

1.5 EXISTING CONDITIONS AND RISKS

- 1.5.1 Site includes rural servicing conditions including:
- .1 Well water supply systems
 - .2 On-site servicing infrastructure
 - .3 Existing site features and constraints
- 1.5.2 Geotechnical conditions are subject to confirmation: Geotechnical Investigation Report – New Ganaraska Forest Centre, Kirby, Ganaraska Region, Ontario, Project No. 06-G-184 (G020398-A1), prepared by Geo-Logic Inc., dated January 2007.
- .1 Bearing capacity to be verified prior to construction
 - .2 Allow for variability in subsurface conditions
- 1.5.3 Include all costs associated with coordination, protection, and adjustments required for existing conditions.

1.6 BIDDER QUALIFICATIONS

- 1.6.1 Bidders shall:
- .1 Have been selected by the Owner in the Pre-qualification List

1.7 BID SUBMISSION

- 1.7.1 Submit bids on Form of Tender provided.
- 1.7.2 Include:
- .1 Lump sum price
 - .2 Allowances as specified in Section 01 00 00
 - .3 Unit prices where required
- 1.7.3 Submit bids prior to closing time. Late submissions will not be accepted.
- .1 Bid Closing Time: **August 19th, 2026 4:00 PM**
 - .2 **Construction Start Date: September 4th**

1.8 BID VALIDITY

- 1.8.1 Bids shall remain valid for a period of 60 days following bid closing.

1.9 BID SECURITY

- 1.9.1 Provide bid security as specified in Form of Tender.
- 1.9.2 Failure to provide required security may result in rejection of bid.

1.10 ADDENDA

- 1.10.1 Addenda form part of Contract Documents.
- 1.10.2 Acknowledge all addenda in bid submission.
- 1.10.3 Failure to acknowledge addenda may result in disqualification.

1.11 SUBSTITUTIONS

- 1.11.1 Substitutions shall be submitted prior to tender closing. Cost Effective Substitutions will be considered while meeting the below:
- 1.11.2 Provide:
 - .1 Complete technical data
 - .2 Performance equivalency
 - .3 Impact on adjacent systems
- 1.11.3 Substitutions after closing will not be considered unless requested.

1.12 ALLOWANCES

- 1.12.1 Include all cash allowances as specified in Section 01 00 00.
- 1.12.2 Allowances include cost of materials only unless otherwise indicated.
- 1.12.3 Include all labour, overhead, and profit in base bid.

1.13 UNIT PRICES

- 1.13.1 Provide unit prices for items identified in tender form.
- 1.13.2 Unit prices shall include all labour, materials, equipment, overhead, and profit.
- 1.13.3 Include Separate line item for Alternatives

1.14 EXCLUSIONS

- 1.14.1 Clearly identify any exclusions in bid submission.
- 1.14.2 Unstated exclusions will not be considered.

1.15 TAXES

- 1.15.1 Include all applicable taxes except HST unless otherwise indicated.

1.16 BID IRREGULARITIES

- 1.16.1 Owner reserves right to:

- .1 Reject any or all bids
- .2 Accept any bid deemed in best interest
- .3 Waive informalities

2 BIDDER RESPONSIBILITIES

2.1 REVIEW OF DOCUMENTS

- 2.1.1 Review all drawings and specifications including all disciplines.
- 2.1.2 Coordinate:
 - .1 Architectural
 - .2 Structural
 - .3 Mechanical
 - .4 Electrical
 - .5 Civil
- 2.1.3 Drawings indicate that:
 - .1 Not all details are explicitly shown
 - .2 Contractor is responsible for reviewing full document set for scope completeness

2.2 COORDINATION REQUIREMENTS

- 2.2.1 Coordinate all trades and systems.
- 2.2.2 Coordinate:
 - .1 Service penetrations through rated assemblies
 - .2 Structural openings and restrictions
 - .3 Mechanical and electrical layouts
- 2.2.3 Maintain continuity of fire separations and ratings:
 - .1 Fire stopping required at all penetrations on a fire rated wall
 - .2 Fire-rated assemblies must comply with ULC listings

2.3 FIELD VERIFICATION

- 2.3.1 Verify all dimensions and conditions on site.
- 2.3.2 Do not rely solely on drawings.

2.3.3 Report discrepancies prior to construction.

2.4 CONSTRUCTABILITY

2.4.1 Include all costs required for complete installation.

2.4.2 Provide complete systems even where minor components are not explicitly indicated.

2.5 TEMPORARY WORK

2.5.1 Include:

- .1 Temporary heating
- .2 Protection of materials
- .3 Environmental control

2.5.2 Prevent damage to:

- .1 Wood framing
- .2 Insulation
- .3 Air/vapour barriers

2.6 TESTING AND COMMISSIONING

2.6.1 Include all testing required by:

- .1 Codes
- .2 Specifications
- .3 Authorities Having Jurisdiction

2.6.2 Include:

- .1 Mechanical system testing and balancing
- .2 Electrical system verification
- .3 Water quality testing

2.6.3 Provide commissioning and system demonstration.

2.7 SUBMITTALS

2.7.1 Include cost for all required submittals:

- .1 Shop drawings
- .2 Product data
- .3 Samples

2.7.2 Submittals must be:

- .1 Coordinated
- .2 Reviewed by Contractor prior to submission

2.8 CLOSEOUT REQUIREMENTS

2.8.1 Include:

- .1 As-built drawings
- .2 Operation and Maintenance manuals
- .3 Training

2.8.2 Payment may be withheld until closeout documentation is complete.

3 BID EVALUATION

3.1 BASIS OF AWARD

3.1.1 Contract will be awarded to the lowest compliant bidder meeting requirements.

3.1.2 Owner reserves right to evaluate based on:

- .1 Price
- .2 Qualifications
- .3 Completeness of bid

3.2 COMPLETENESS OF BID

3.2.1 Bids will be evaluated for:

- .1 Inclusion of all required scope
- .2 Proper acknowledgement of allowances
- .3 Coordination with Contract Documents

3.3 POST-BID CLARIFICATIONS

3.3.1 Owner may request clarification of submitted bids.

3.3.2 Failure to provide clarification may result in disqualification.

4 CONTRACT AWARD

4.1 NOTIFICATION

4.1.1 Successful bidder will be notified in writing: **August 26th, 2026**

4.2 EXECUTION OF CONTRACT

4.2.1 Successful bidder shall:

- .1 Execute Contract
- .2 Provide required bonds and insurance
- .3 Submit construction schedule

4.3 FAILURE TO EXECUTE

4.3.1 Failure to execute Contract may result in forfeiture of bid security.

END OF SECTION

1 GENERAL

1.1 SUMMARY

- 1.1.1 Work under this Section includes all administrative, procedural, and coordination requirements applicable to the Work.
- 1.1.2 Provide all labour, materials, equipment, and services necessary for complete execution of the Work in accordance with Contract Documents.
- 1.1.3 The Work includes construction of a new auxiliary building consisting of:
 - .1 Wood-framed structure with slab-on-grade foundation
 - .2 Prefabricated wood roof trusses and metal roofing systems
 - .3 Interior program including offices, washrooms, multipurpose spaces, and support rooms
 - .4 Associated mechanical, electrical, and site works
- 1.1.4 Provide complete and functional systems, including all incidental components required for performance, whether or not explicitly indicated.

1.2 RELATED REQUIREMENTS

- 1.2.1 Division 00 – Procurement and Contracting Requirements
- 1.2.2 All Sections of Divisions 02 through 33
- 1.2.3 This Section incorporates requirements typically included in Division 01.

1.3 REFERENCES

- 1.3.1 Ontario Building Code (OBC), latest edition
- 1.3.2 National Building Code of Canada (NBC)
- 1.3.3 Occupational Health and Safety Act (OHSA)
- 1.3.4 Applicable CSA, ASTM, ULC standards
- 1.3.5 Applicable municipal by-laws and Authority Having Jurisdiction (AHJ) requirements

1.4 CONTRACT DOCUMENTS

- 1.4.1 Drawings and Specifications are complementary.
- 1.4.2 Provide all Work indicated in either Drawings or Specifications.
- 1.4.3 In the event of a discrepancy or conflict in the Contract Documents, notify the Contract Administrator and obtain clarification before proceeding. Where the discrepancy results

in differing requirements, the more stringent requirement shall apply unless otherwise directed by the Contract Administrator.

- 1.4.4 Do not scale drawings; verify all dimensions on site prior to construction.

1.5 CONTRACTOR RESPONSIBILITIES

- 1.5.1 Coordinate all trades and subcontractors.
- 1.5.2 Verify site conditions, dimensions, and elevations prior to commencing Work.
- 1.5.3 Report discrepancies to Consultant prior to proceeding.
- 1.5.4 Coordinate Work with all disciplines to ensure complete and compatible systems.
- 1.5.5 Do not cut or alter structural elements without written approval.
- 1.5.6 Coordinate all service penetrations to maintain fire separations and structural integrity.

1.6 SITE EXAMINATION

- 1.6.1 Visit site prior to submission of bid.
- 1.6.2 Confirm:
- .1 Existing conditions
 - .2 Access limitations
 - .3 Site services and constraints
- 1.6.3 No extras will be permitted due to failure to verify site conditions.

1.7 SUBMITTALS

- 1.7.1 Submit in electronic PDF format unless otherwise specified.
- 1.7.2 Submit sufficiently in advance of procurement and installation.
- 1.7.3 Allow minimum 10 working days for Consultant review.
- .1 Action Submittals:
 - .1 Shop drawings (fully coordinated)
 - .2 Product data
 - .3 Samples
 - .2 Informational Submittals:
 - .1 Certificates
 - .2 Test reports
 - .3 Inspection reports
 - .3 Closeout Submittals:

- .1 Operation and Maintenance (O&M) manuals
- .2 As-built drawings
- .3 Warranty documentation

1.7.4 Review submittals before submission to the Consultant. This review represents that necessary requirements have been determined and verified, and that each submittal has been checked and coordinated with requirements of the Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

1.8 QUALITY ASSURANCE

- 1.8.1 Perform Work using qualified tradespersons.
- 1.8.2 Comply with applicable codes and referenced standards.
- 1.8.3 Coordinate Work to maintain system integrity.
- 1.8.4 Provide testing and inspection as required.
- 1.8.5 Correct deficiencies in a timely manner and at no additional cost to the Owner.

1.9 REGULATORY REQUIREMENTS

- 1.9.1 Comply with all applicable codes and regulations.
- 1.9.2 Obtain and pay for permits and inspections unless otherwise specified.
- 1.9.3 Coordinate inspections with authorities having jurisdiction.

1.10 HEALTH AND SAFETY

- 1.10.1 Act as "Constructor" under OHSA.
- 1.10.2 Provide and enforce site-specific safety program.
- 1.10.3 Maintain Safety Data Sheets on site.
- 1.10.4 Ensure protection of workers and public.

1.11 PROJECT CONDITIONS

- 1.11.1 Maintain existing services unless authorized otherwise.
- 1.11.2 Protect adjacent properties and structures.
- 1.11.3 Maintain site access at all times.
- 1.11.4 Protect installed materials from weather and damage.
- 1.11.5 Provide temporary heating and environmental control to maintain construction conditions suitable for materials and finishes.

1.12 CONSTRUCTION SCHEDULING

- 1.12.1 Submit construction schedule within 10 days of contract award.
- 1.12.2 Update schedule bi-weekly.
- 1.12.3 Coordinate sequencing of trades to avoid conflicts and delays.

1.13 TEMPORARY FACILITIES AND CONTROLS

1.13.1 Provide:

- .1 Temporary utilities
- .2 Site fencing and security
- .3 Signage and safety controls

1.13.2 Maintain:

- .1 Safe access routes
- .2 Fire protection systems

- 1.13.3 Protect air/vapour barriers, insulation, and moisture-sensitive materials during construction.

1.14 PRODUCT SUBSTITUTIONS

- 1.14.1 Submit substitution requests prior to tender closing unless otherwise permitted.

1.14.2 Provide:

- .1 Product data
- .2 Performance comparison
- .3 Impact on adjacent systems

- 1.14.3 Acceptance of substitutions is at Consultant's discretion.

1.15 PROJECT MEETINGS

- 1.15.1 Attend pre-construction meeting.
- 1.15.2 Chair and minute bi-weekly progress meetings.
- 1.15.3 Provide coordination updates and scheduling input.
- 1.15.4 Record and distribute meeting minutes within 3 business days of meetings

1.16 DOCUMENT CONTROL

1.16.1 Maintain on site:

- .1 Contract drawings (with redline as-builts)
- .2 Specifications
- .3 Approved shop drawings
- .4 Inspection and test reports

1.17 FIELD QUALITY CONTROL

1.17.1 Arrange and pay for required testing unless specified otherwise.

1.17.2 Testing includes, but is not limited to:

- .1 Concrete testing
- .2 Mechanical system testing and balancing
- .3 Electrical verification
- .4 Water quality testing

1.17.3 Provide reports to Consultant.

1.17.4 Re-test failed work at Contractor's expense.

1.18 COMMISSIONING

1.18.1 Perform start-up, testing, and commissioning of all systems.

1.18.2 Coordinate with trades and suppliers.

1.18.3 Provide:

- .1 Functional testing
- .2 System verification
- .3 Performance documentation

1.18.4 Demonstrate operation to Owner.

1.19 CUTTING AND PATCHING

1.19.1 Perform cutting and patching required for Work.

1.19.2 Match existing or adjacent construction.

1.19.3 Do not impair structural integrity.

1.20 PROTECTION OF WORK

- 1.20.1 Protect Work from damage.
- 1.20.2 Repair damage to match original condition.
- 1.20.3 Protect completed Work until Substantial Performance.

1.21 CLEANING AND WASTE MANAGEMENT

- 1.21.1 Perform daily cleaning.
- 1.21.2 Remove debris regularly.
- 1.21.3 Dispose of waste in accordance with regulations.
- 1.21.4 Recycle materials where feasible.

1.22 ENVIRONMENTAL REQUIREMENTS

- 1.22.1 Prevent contamination of soil and water.
- 1.22.2 Control dust and noise.
- 1.22.3 Comply with environmental legislation.

1.23 CLOSEOUT PROCEDURES

- 1.23.1 Submit:
 - .1 As-built drawings
 - .2 O&M manuals
 - .3 Warranties
- 1.23.2 Complete deficiencies prior to final acceptance.
- 1.23.3 Provide training to Owner.

1.24 WARRANTY

- 1.24.1 Provide minimum one-year warranty unless otherwise specified.
- 1.24.2 Correct defects promptly during warranty period.

1.25 CASH ALLOWANCES

- 1.25.1 Include in Contract Price all cash allowances as specified herein.
- 1.25.2 Cash allowances shall include cost of products and materials only, unless otherwise indicated.

1.25.3 Labour, overhead, profit, supervision, and installation costs shall be included in the Contract Price and not in the allowance amount.

1.25.4 Adjustment of allowances:

- .1 Difference between allowance and actual cost will be adjusted by Change Order
- .2 Include Contractor's mark-up 5% and in accordance with procedures provided in CCDC 2, GC 6.1 - Changes CCDC 2, 6.2 Change Order and CCDC 2, 6.3 Change Directive.

1.25.5 Unused portions of allowances shall be credited to the Owner.

1.26 SCHEDULE OF ALLOWANCES

1.26.1 Cash Allowances:

Item No.	Description	Amount	Basis	Notes
CA-1	Interior Partition and Associated track, support and Structure	\$125,000	Supply and install	Final selection of Finish to Be Selected by Owner/Architect
CA-2	Washroom Accessories	\$8,000	Supply only	Includes dispensers, grab bars, mirrors, per OBC
CA-3	Door Hardware	\$18,000	Supply only	Includes barrier-free operators and controls

1.26.2 Contingency Allowances:

Item No.	Description	Amount	Type	Notes
CT-1	Subsurface / Geotechnical Variability	\$20,000	Cash Allowance	Bearing confirmation required
CT-2	Minor M/E Coordination Adjustments	\$10,000	Cash Allowance	Equipment locations "to be coordinated on site"
CT-3	Existing Site / Service Adjustments	\$10,000	Cash Allowance	Rural site, well + propane coordination

2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- 2.1.1 Provide new products unless otherwise specified.
- 2.1.2 Products shall be of good quality and suitable for intended use.
- 2.1.3 Match existing materials where required.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Verify site readiness prior to commencing Work.
- 3.1.2 Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION – GENERAL

- 3.2.1 Execute Work in accordance with Contract Documents.
- 3.2.2 Follow manufacturer's instructions.
- 3.2.3 Ensure proper alignment, fit, and finish.

3.3 COORDINATION

- 3.3.1 Coordinate all trades and systems.
- 3.3.2 Ensure compatibility between materials and assemblies.
- 3.3.3 Coordinate penetrations, sleeves, and openings.

3.4 FIELD QUALITY CONTROL

- 3.4.1 Perform inspections and testing.
- 3.4.2 Correct deficiencies immediately.

3.5 ADJUSTING

- 3.5.1 Adjust systems for proper operation.

3.6 CLEANING

- 3.6.1 Perform final cleaning prior to turnover.

3.7 PROTECTION

- 3.7.1 Protect completed Work until Substantial Performance.

3.8 PROJECT CLOSEOUT

- 3.8.1 Submit all required documentation.
- 3.8.2 Obtain final acceptance from Consultant and Owner.

END OF SECTION

1 General

1.1 Related Requirements

- 1.1.1 Section 03 15 00 – Concrete Accessories.
- 1.1.2 Section 03 20 00 – Concrete Reinforcing.
- 1.1.3 Section 03 30 00 – Cast-in-Place Concrete.
- 1.1.4 Section 03 35 00 – Concrete Finishing.
- 1.1.5 Section 03 39 00 – Concrete Curing.
- 1.1.6 The Contractor shall obtain a copy of all sections even if they do not pertain directly to his speciality. When bidding, the Contractor agrees implicitly with articles and requirements of all sections in these specifications, including those they might not have read. The Contractor should consult the table of contents of the specifications to be aware of the complete list of sections.

1.2 References

- 1.2.1 American Concrete Institute (ACI).
 - .1 ACI 303R-12, Guide to Cast-in-Place Architectural Concrete Practice.
 - .2 ACI 347R-14(21), Guide to Formwork for Concrete.
 - .3 ACI 347.2R-17, Guide for Shoring/Reshoring of Concrete Multistory Building.
 - .4 ACI 347.3R-13(21), Guide to Formed Concrete Surfaces.
- 1.2.2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A 36/A 36M-19, Standard Specification for Carbon Structural Steel.
 - .2 ASTM B 633-23, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - .3 ASTM C 177-19e1, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - .4 ASTM C 518-21, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .5 ASTM C 578-22, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - .6 ASTM D 1621-16(2023), Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - .7 ASTM D 6817/D 6817M-17(2021), Standard Specification for Rigid Cellular Polystyrene Geofoam.

- 1.2.3 Canadian Standard Association (CSA)/CSA International.
 - .1 CSA A23.1/A23.2-24, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - .2 CSA O86-24, Engineering Design in Wood.
 - .3 CSA O121-17, Douglas Fir Plywood.
 - .4 CSA O151-17, Canadian Softwood Plywood.
 - .5 CSA O153-19, Poplar Plywood.
 - .6 CSA O325-21, Construction Sheathing.
 - .7 CSA O437 Series-93(R2006), Standards on OSB and Waferboard.
 - .8 CSA S269.1-16(R2021), Falsework and Formwork.
 - .9 CAN/CSA S269.2-16, Access Scaffolding for Construction Purposes.
 - .10 CSA Z809-16(R2021), Sustainable Forest Management.
- 1.2.4 Forest Stewardship Council.
 - .1 FSC-STD-01-001 (V5-2), FSC Principles and Criteria For Forest Stewardship.
- 1.2.5 International Concrete Repair Institute (ICRI).
 - .1 Guideline No. 320.1R-2019, Guide for Selecting Application Methods for the Repair of Concrete Surfaces.
 - .2 Guideline No. 320.2R-2018, Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces.
- 1.2.6 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC S701.1-2022, Standard for Thermal Insulation, Polystyrene Boards.
- 1.2.7 Sustainable Forestry Initiative.
 - .1 SFI 2022 Standards and Rules.
- 1.2.8 Notwithstanding the version of the standard mentioned above, it remains the responsibility of the Contractor to consult the most recent version.
- 1.3 Contractor's Liabilities**
 - 1.3.1 The Contractor scope of work includes concrete forming, falseworks, their design and installation. No examination or comments from the Owner's Representative or anyone else shall relieve the Contractor of assuming solely all risks and liability regarding these parts of work.

- .1 Calculations, layout, and construction of formworks are the sole responsibility of the Contractor.
- 1.3.2 The Contractor shall provide insulation to be placed in foundation walls. The insulation shall be placed by the Contractor, in collaboration with the Contractor specialized in reinforcement.
- 1.3.3 The schedule of work of the Contractor shall take into account the constraints associated with the execution of other work, including any constraints linked to sequencing such as the necessity of constructing the ground floor slabs prior to beginning of backfilling.
- 1.4 Formworks and Falsework Design**
 - 1.4.1 Formwork and falsework design shall be performed by a Professional Engineer licensed in the Province of Ontario.
 - 1.4.2 Formwork and falsework design shall be done in accordance with laws and regulations in place, including but not limited to O.Reg. 213/91: Construction Projects.
 - 1.4.3 Special precautions shall be taken during design to limit loads applied on existing structures to values inferior to the maximum allowable loads on these structures. Where applicable, the structural capacity of existing or partially built element serving as support shall be checked by the contractor's engineer. The preservation of the structural integrity of the existing element is entirely the responsibility of the contractor's engineer, who shall, if necessary, determine by his own calculations and investigations the capacity of the existing structure.
 - 1.4.4 Describe the construction sequence incorporated into the design of structures. Show or describe the position of construction joints provided and, if applicable, the principle of formworks and falseworks reuse. Provide construction joint in accordance with article 3.5 of this section. Submit to the Owner's Representative the location of construction joints for approval.
 - 1.4.5 Calculations shall be made in accordance with recommendations and loads indicated in ACI 347R or ACI 347.2R guides and CSA S269.1. Wind loads shall conform to the requirements of the Ontario Building Code.
 - 1.4.6 When work schedules require that reshores on lower levels be removed when upper-level slabs are not completed, provide detailed shoring / reshoring procedure in accordance with ACI 347.2R guide. The procedure shall account for variation in concrete strength due to curing time and condition, impact on long-term slab deflection and work to be done by others.
 - .1 Pay particular attention to concrete mixes whose specified strength may be achieved after a period of more than 28 days. For these mixtures, the shoring/re-shoring procedure shall account for strength gain curves specific to each concrete mix.
 - 1.4.7 The design and supervision of temporary work including formwork is the sole responsibility of the design engineer of such structures and the contractor engaging them. The Owner's Representative shall not be responsible in any way for the design and/or supervision of temporary structures.

1.5 Actions and Informational Submittals

- 1.5.1 Submittals in accordance with Section 01 00 00 - General Requirements.
- 1.5.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets.
- 1.5.3 Co-ordinate submittal requirements and provide submittals required by section 01 00 00 - General Requirements.
- 1.5.4 Submit descriptions of all formwork materials in direct contact with wet concrete.
- 1.5.5 Submit for approval a drawing including location of all sleeves and openings embedded in concrete.
- 1.5.6 Submit formworks and falseworks shop drawings.
 - .1 The drawings shall bear the seal and signature of a professional engineer, licensed in the Province of Ontario.
- 1.5.7 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings and formwork drawings. Refer to CSA A23.1 article 6.5.2.2 for requirements concerning architectural formwork.
- 1.5.8 Indicate formwork design data in accordance with article 6.5.2.1 of CSA A23.1, including, but not limited to, permissible rate of concrete placement, and temperature of concrete, in forms.
- 1.5.9 When falseworks or structural element are connected or lean on an existing structure used as support, shop drawings shall indicate maximum forces transmitted in each direction.
- 1.5.10 Before concreting, submit a letter signed by a professional engineer licensed in the Province of Ontario, stating that the construction of falseworks and formworks was done in accordance with the plans submitted. The engineer attesting the conformity of falseworks and formworks shall visit the site of work prior to the production of the letter and attach the report of his visit to the letter. If the Contractor does not use falsework or temporary shoring, the Owner's Representative may request to be provided with a letter signed by a professional engineer licensed by the PEO stating that temporary shoring is not required.
- 1.5.11 Indicate sequence of erection and removal of formwork/falsework as directed by the Owner's representative.
- 1.5.12 When slip forming and/or flying forms are used, submit details of equipment and procedures for review by the Owner's representative.

1.6 Quality Control

- 1.6.1 Realize the following activities and submit required documents:

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.4.6	Shoring / Reshoring Procedure	At least fourteen (14) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription to the technical specification registry	Contractor
1.5.6	Formworks and falseworks shop drawings	At least fourteen (14) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription to the technical specification registry	Contractor Review by the Owner's Representative
1.5.6 1.5.4	Location of construction joints	At least fourteen (14) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Breakpoint. Transmission letter Inscription to the technical specification registry	Contractor Review by the Owner's Representative
1.5.10	Certificate of compliance of falseworks and formworks	Prior to applying loads on falseworks,	Certificate of compliance signed by an engineer and visit report	Contractor Engineer employed by the Contractor
1.5.4	Descriptions of formwork materials in contact with wet concrete	At least seven (7) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription to the technical specification registry	Contractor Review by the Owner's Representative
1.5.5	Drawing including location of all sleeves embedded in concrete	At least seven (7) days prior to concreting	Location drawing Inscription to the technical specification registry	Contractor Review by the Owner's Representative
2.2.4	Technical documentation of sacrificial formwork system	Prior to acquisition of sacrificial formwork system	Technical documentation Inscription to the technical specification registry	Contractor Review by the Owner's Representative

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
3.2.2.3	Certificate of compliance for anchors	At least seven (7) days prior to steel erection	Breakpoint Certificate of compliance signed by an engineer	Contractor Engineer employed by the Contractor
3.7.1	Surveys of top of formworks	Prior to concreting	Breakpoint Surveys	Contractor Surveyor employed by the Contractor
3.7.3	Inspection of formworks and falseworks	Prior to concreting	Breakpoint Inspection report	Contractor Inspection by the Owner's Representative
3.7.4	Survey of top of slabs	Prior to removal of formwork and shoring	Breakpoint Surveys	Contractor Surveyor employed by the Contractor
3.3.3	Notice to Owner's Representative	At least twenty-four (24) hours prior to formwork removal and reshores removal	Written notice Formwork and reshore removal registry	Contractor

- 1.6.2 For all the activities to be carried out in the previous table, keep a register indicating at least the activity carried out, the date of submission by the Specialized contractor and the date of review. The register shall be updated and sent to the Owner's Representative at regular intervals, corresponding at most to the intervals between site meetings.

1.7 Delivery, Storage and Handling

- 1.7.1 Store and manage hazardous materials in accordance with section 01 00 00 - General Requirements.

- 1.7.2 Waste Management and Disposal:

- .1 Separate waste materials for reuse/recycling in accordance with section 01 00 00 - General Requirements.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Recover and sort packaging for recycling purposes, in accordance with the waste management plan.

- .4 Divert wood materials from landfill to a recycling, reuse or composting facility as approved by the Owner's Representative.
- .5 Divert plastic materials from landfill to a recycling, reuse or composting facility as approved by the Owner's Representative.
- .6 Divert unused form release material from landfill to an official hazardous material collection site as approved by the Owner's Representative.

2 Products

2.1 Materials

- 2.1.1 Materials and resources in accordance with section 01 00 00 - General Requirements.
- 2.1.2 Do verification requirements in accordance with section 01 00 00 - General Requirements.
- 2.1.3 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials in accordance with CSA O86, CSA O121, CSA O153 and/or CSA O437 Series.
 - .2 Rigid insulation board: in accordance with CAN/ULC S701, type II, thermal rating RSI 0.82 for 25 mm thickness, RSI 1.18 for 38 mm and RSI 1.50 for 50 mm.
 - .3 For watertight walls in works such as reservoir or any tank, use formwork systems without steel or wooden ties.
- 2.1.4 Formwork materials for exposed surface (architectural concrete):
 - .1 The use of "Duraform" type formwork is not allowed for these surfaces.
 - .2 Use brand-new formwork materials. Use brand-new plywood, 19 mm thick, sanded and coated with high quality formwork release agent. For lining only, use three-ply 6 mm thick plywood.
 - .3 For concrete with an exposed surface, use brand-new plywood, high density in accordance with CSA O121.
- 2.1.5 Formwork for a ribbed surface: removable or lost formwork, steel, reinforced plastic or aluminium, as indicated.
- 2.1.6 Prefabricated formwork: for concealed surface only, steel, cardboard or wood formwork shop-fabricated meeting the same standard for rigidity, watertightness and quality as built-in-place wood formwork.
- 2.1.7 Form release agent: use a non-toxic, biodegradable, and low VOC product.
 - .1 Oil: colourless mineral oil, non-toxic, biodegradable, and low VOC, free of kerosene, with viscosity between 15 to 24 mm²/s at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

- .2 Where applicable, the product used shall be compatible with the application of coating, waterproofing, membrane or any other product to be placed in direct contact with the hardened concrete.
 - .3 Approved products: Formshield Pure by Euclid, MasterFinish RL 100 (formerly Cast-Off) by BASF and King Form Release by KING.
- 2.1.8 Falsework materials: to CSA S269.1, table 1. Identify materials through quality indices and present data from tests or any certificate of compliance.
- 2.1.9 Form ties:
- .1 For concrete without special architectural features, use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
 - .2 For concrete with an apparent surface, use snap ties complete with plastic cones and light grey concrete plugs. Cone diameter shall be less than 38 mm. Insure concrete cover of 25 mm or more.
 - .3 Unless otherwise indicated, use watertight snap ties with a neoprene washer in the centre of the tie, able to resist 12 meters high water pressure for foundation walls and retaining walls. In general, use watertight snap ties for all concrete work considered watertight.
 - .4 Sealing mortar for form ties holes:
 - .1 Cementitious, two-component, fast-setting mortar, grey colored and containing a corrosion inhibitor, such as:
 - .1 Sikatop 123 Plus or Sikatop 123 Plus Winter Grade, at low temperature.
 - .2 Verticoat Supreme by EUCLID;
 - .3 Super-top OV by KING;
 - .4 MasterEmaco N 1501HCR Vertical Overhad (former Zero-C Vertical Overhead Mortar) by BASF;
 - .5 Planitop X or XS by MAPEI.
 - .2 For exposed surfaces, refer to article 3.6.3 when selecting the appropriate product.
- 2.1.10 Diamond-plate doweling system for construction joints in slabs on ground:
- .1 Vertical system to ensure slab alignment at construction joints shall consist of molded pockets installed in the formwork and steel plates.
 - .2 Steel plates shall comply with ASTM A 36/A 36M.
 - .3 Steel plates shall be coated with zinc in accordance with ASTM B 633 SC 3 type II, corresponding to a minimum zinc thickness of 12 µm.

- .4 Approved products:
 - .1 PNA Diamond Dowel System.
 - .2 Sika Speed-Plate System.

2.1.11 Expanded polystyrene insulation block for non-structural fill:

- .1 To CAN/ULC-S701.1 type 2 or ASTM D 6817/D 6817M type EPS15 or higher, minimum compressive strength of 100 kPa to ASTM D 1621 (10% deformation), thermal transmission R-4 for 25 mm thickness minimum to ASTM C 177 and/or ASTM C 518.
- .2 Approved products:
 - .1 Fransyl Izosol 20 THR;
 - .2 Legerlite GEO15;
 - .3 Polymos poly-usage 20.

2.1.12 Expanded polystyrene insulation block for structural fill (under slab on grade):

- .1 To CAN/ULC-S701.1 type 4 or ASTM D 6817/D 6817M type XPS29 or higher, minimum compressive strength of 275 kPa to ASTM D 1621 (10% deformation), thermal transmission R-4 for 25 mm thickness minimum to ASTM C 177 and/or ASTM C 518.
- .2 Approved products:
 - .1 Fransyl Izosol 40 EHD);
 - .2 Legerlite GEO40;
 - .3 Polymos poly-usage HD45.

2.1.13 Refer to section 03 15 00 for concrete accessories.

2.2 Sacrificial Formwork System

2.2.1 The selection of a sacrificial formwork system by the specialized contractor shall be based on the following performance criteria:

- .1 The system shall provide a dimensionally stable void space, maintaining an even plane of separation between the base soil and the intended building structure elements.
- .2 The system shall have sufficient structural strength to maintain the intended void space while experiencing the anticipated construction loads. Construction loads include static and dynamic loading occurring due to rebar placing, concreting, vibratory consolidation, and finishing of concrete including manpower and equipment required to execute all of the tasks listed previously.

- .3 The system shall be able to be delivered and stored unprotected in the open jobsite environment for as long as required to execute work, but not less than 90 days, without loss of design strength.
- .4 The system shall be naturally waterproof in terms of its intended use in this section.
- .5 The structural integrity of the system shall be unaffected by high/low ambient temperatures and elevated surface temperatures from direct sunlight extremes, above or sub-freezing, frozen soil and ice buildup.
- .6 The system shall have a recorded history of consistent performance integrity during and after all types of weather event applications, from jobsite delivery to final curing of concrete.

2.2.2 The sacrificial formwork system shall use materials that:

- .1 Maintains structural integrity in 100% relative humidity and is not affected by becoming damp, wet, or when completely submerged in standing water.
- .2 Does not promote the formation or emergence of mold spore, organic or other biological colonization.
- .3 Are fire-resistant and incombustible as well as having negligible buoyancy.

2.2.3 After concrete placement and curing, the sacrificial formwork system shall:

- .1 Remain in place without reuse.
- .2 Prevent the transmission of forces on building components which can result from soil movement. The system shall absorb or redirect the forces of soil movements by: crumpling, crushing, collapsing, deforming, material section degradation, or any other mode of load relief that will not affect the structural components.
- .3 Degrade naturally so as to leave an empty space that will allow the circulation of air instead of the space occupied by the formwork system.
- .4 Shall not emit offensive off-gassing odors during decomposition.

2.2.4 Submit technical documentation associated with sacrificial formwork system for review by Owner's Representative. The use of the system must be approved by the Representative before the specialized contractor acquires it.

3 Execution

3.1 Fabrication And Erection

- 3.1.1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings. Allow for a 100 mm tolerance on the elevation of the bottom of excavation at no supplementary charge.
- 3.1.2 Prior to concreting, clean formwork and treat surfaces with a form stripping agent in accordance with CSA A23.1.

- 3.1.3 Obtain Owner's Representative approval for use of earth forms, or for framing openings not indicated on drawings.
- 3.1.4 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- 3.1.5 Fabricate and erect falsework in accordance with CSA S269.1. Ensure stability and lateral bracing of shores at all times.
- 3.1.6 Do not place shores and mud sills on frozen ground. Bottom of excavation shall be protected against frost at all times. Concrete shall never be poured over a frozen surface.
- 3.1.7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- 3.1.8 Prevent damage to waterproofing membrane under rafts or watertight slabs when installing sills and shores.
- 3.1.9 Fabricate and erect formwork in accordance with CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations, and levels indicated. Insure proper temporary bracing to maintain the shape of formwork from pouring to hardening of concrete.
- 3.1.10 Geometric configuration and localisation shall be within tolerances required by CSA A23.1, article 6.4.
- 3.1.11 Align form joints and make them watertight. Keep form joints to minimum. Adequate reinforcements must be placed at the back of the joints between plywood sheets to ensure obtaining a continuous flat surface able to withstand all stages of concreting without deforming or moving.
- 3.1.12 Unless otherwise indicated, use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints.
- 3.1.13 For all sharp angles of exposed concrete, provide 25 mm chamfers, even where no indications are given on drawings.
- 3.1.14 When formwork's height is significant, windows shall be incorporated into the forms to facilitate concreting. Windows shall be placed to limit free fall of concrete and segregation of ingredients during concrete pouring.
 - .1 Minimally, for vertical elements more than three (3) meters high, access window shall be spaced 2.4 meters apart horizontally and vertically.
 - .2 When pumping concrete, lowering a trunk down into the casing from the top to limit the drop height is likely to create segregation of concrete during the interruption of pumping or when opening the valve before the descent of the trunk. This method cannot be considered as to guarantee proper placing of concrete – the addition of access window in the formwork should be used.
- 3.1.15 Form chases, slots, openings, drips, recesses, expansion, and control joints as indicated. Refer to section 03 15 00 for requirements regarding expansion or dilatation joint.

- 3.1.16 Special care shall be taken in fabrication and erection of formwork for architectural concrete, as indicated on drawings and specifications.

.1 It might not be possible to align joints using panels of standard dimensions or maximum spacing between snap ties.

- 3.1.17 At least twenty-four (24) hours prior to closing forms, advise the Owner's Representative as to allow inspection of reinforcement.

3.2 Anchors, Sleeves and Embedded Elements

- 3.2.1 Provide and install into formwork all embedded elements (anchors, sleeves, ducts, machinery anchor bolts, etc.) in accordance with CSA A23.1 article 6.7. Refer to section 03 15 00 – Concrete Accessories for additional requirements.

- 3.2.2 Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.2 Prior to concreting, ensure, by survey, that all dimensions required in drawings and specifications and tolerances imposed for the implementation are met.

.3 Provide a certificate of compliance signed by an engineer attesting that (1) installation of anchor rods complies to the anchoring plan and (2) concrete foundations reached the strength required to support the erection of steel structure.

- 3.2.3 Tolerances shall be in accordance with standard CSA A23.1 article 6.7.3.

- 3.2.4 Sleeves and openings with a side larger than 100 mm shall be examined by the Owner's Representative if not indicated on drawings.

- 3.2.5 No sleeve, pipe or duct shall be installed, and no openings shall be made into a joist, a beam, a slab, slab capitol or a column unless directed otherwise by the Owner's Representative.

- 3.2.6 When authorized by the Owner's Representative, incorporate openings, place sleeves, ties, hangers, ducts or pipes and any other embedded elements as indicated in drawings.

- 3.2.7 Unless otherwise indicated, the following guidelines shall be met when installing sleeves, ducts or pipes:

.1 Ducts shall be placed between top and bottom rebars.

.2 Ducts shall be spaced apart 300 mm or farther. Maximum dimension of ducts shall be less than a third of the thickness of the concrete element or fifty (50) millimetres, whichever is less. Location of ducts shall be approved by the Owner's Representative.

.3 Centre-to-centre dimension between sleeves or pipes shall be superior to three (3) times the diameter of the larger element.

- .4 The exterior diameter of the embedded element shall not be larger than the third of the thickness of the wall, beam or slab into which it is embedded.
 - .5 Do not remove or move rebars to place embedded elements. If placement of embedded elements is impossible where prescribed, any modification needs to be approved by the Owner's Representative.
 - .6 Nothing shall be embedded into a slab on ground exposed to the effect of bad weather.
- 3.2.8 Notify the Owner's Representative and wait for his instructions if the preceding requirements cannot be met.
- 3.2.9 Coordinate delivery and placement into formworks of embedded elements with subcontractors.
- 3.2.10 Aluminium material embedded into concrete shall be covered with a proper coating to prevent aluminium corrosion.

3.3 Formwork Removal

- 3.3.1 Leave formwork in place for the following minimum periods of time after placing concrete:
- .1 One (1) day for footings, abutment and thrust blocks.
 - .2 Three (3) days for walls less than three (3) meters high and beam sides.
 - .3 Five (5) days for walls three (3) to six (6) meters high.
 - .4 Seven (7) days for column.
 - .5 Twenty-eight (28) days for beams, slabs, decks and any other framing elements, or seven (7) days if formworks are replaced immediately by adequate reshoring. Reshores shall remain set in place for twenty-one (21) days. Falsework drawings in accordance with CSA S269.1 shall indicate the method, materials and locations used for reshores. Each drawing shall bear the seal and signature of an engineer licensed by the PEO.
 - .6 Refer to section 03 39 00 – Concrete Curing for the minimum time prior to formwork removal, notwithstanding the indication of the preceding articles. Coordinate the time required before formwork removal with concrete curing.
- 3.3.2 Formwork removal will be authorized by the Owner's Representative if non-destructive tests demonstrate that the concrete has reached 75% of its computed resistance. The Contractor shall assume all expenses related to those tests and the Owner's Representative shall be the sole individual able to evaluate test results.
- 3.3.3 Notify the Owner's Representative at least twenty-four hours prior to carrying out formworks stripping or removal of reshores. Keep a register indicating the location of the concrete elements, the date of concreting, the date of stripping and the date of removal of reshores for all the concrete elements, such as the following table:

Formwork removal registry			
Location	Concreting	Removal of formworks	Removal of reshores

3.3.4 Notwithstanding preceding articles, formwork removal is authorised only when the Owner's Representative allows it. The authorization shall be given only if proper methods of curing are ensured, including protection against cold- or hot-weather, rain or any other adverse conditions. Moreover, time prior formwork removal may be increased depending on the process used for concreting, curing conditions and weather conditions.

3.3.5 The Contractor remains the sole responsible for any damage to concrete following early formwork removal, even if they have been authorized to proceed.

3.3.6 Reuse formworks and falseworks as indicated in CSA A23.1 standard. Except for exposed surfaces, reuse of formwork is allowed if the surfaces are thoroughly cleaned and are not cracked, nor rough.

3.4 Concrete Forming Where Membrane Will Be Applied

3.4.1 Examine architectural documents to determine where a membrane is applied on concrete and the type of membrane to be used. Any wall backfilled on only one side shall be considered intended for membrane application.

3.4.2 Quality of concrete finish shall allow the application of membrane, whenever required. In general, smooth-form finish complying with article 7.10.2.6 of CSA A23.1 is required where membranes are applied, no matter which type of membrane is used.

3.4.3 The Contractor specialized in formworks shall maintain the concrete structures at a minimum temperature of 10 degrees for a period sufficient to achieve adhesion of the membrane to concrete in accordance with the architectural requirements and any requirements specifics to the type of membrane used. Consider any delay required to obtain a proper evaporation rate. Allow a minimum of 14 days after pouring when installing modified bitumen waterproofing membrane (weldable).

3.4.4 Any wall backfilled on only one side shall be considered intended for membrane application.

3.5 Construction Joints

- 3.5.1 Refer to CSA A23.1 article 7.3 for construction joints.
- 3.5.2 When the elements to be poured are of such volume or complexity that the placement of the concrete cannot be done in a single operation, the Contractor shall, with the authorization of the Owner's Representative, provide construction joints other than those indicated on the plans. The materials as well as the work necessary for the construction of these joints are at the expense of the Contractor.
- 3.5.3 The Contractor shall submit a drawing with location and details for construction joints to the Owner's Representative, who may take up to two (2) weeks for review.
- 3.5.4 When choosing construction joints location, abide by the following requirements:
- .1 Irregular construction joints are prohibited.
 - .2 Construction joints shall be placed in the middle third of the spans.
 - .3 Joints in beams should be avoided wherever possible.
 - .4 Joints shall align from floor to floor.
 - .5 No vertical joints shall be provided in shear walls or foundation of stairwells and/or elevator shafts.
 - .6 The configuration of construction joints shall take into account the presence of underlying or contiguous rigid elements which restrict the potential movements of the slabs.
- 3.5.5 Concrete reinforcement shall be continuous through the construction joints. For each joint in a structural slab, use a shear key and add supplementary 15M@300 o/c 600 mm long rebars at the center of slab.
- 3.5.6 For vertical elements (walls, continuous footings), place construction joints at 20 m center-to-center maximum. For structural slabs, place construction joints to delimit a maximum area of 25 m by 25 m.
- 3.5.7 Construction joints indicated on drawings are mandatory and shall not be moved.
- 3.5.8 Horizontal construction joints between 2 concrete elements shall be roughen to a minimum amplitude of 5 mm on the surface.
- 3.5.9 Before placing new concrete, Contractor shall prepare joint in accordance with the following requirements:
- .1 Tighten formworks at joint.
 - .2 Clean thoroughly hardened concrete to obtain a surface free of foreign matter, laitance, damaged concrete, etc.
 - .3 Saturate surface with water (saturated superficially dry – SSD).

- .4 Cover hardened concrete with a mortar of same composition than mortar used for concrete and add a bonding agent following the manufacturer's recommendations.

3.5.10 When preparing construction joints for deep members, pour concrete in excess and screed one (1) or two (2) hours after discharge.

3.5.11 Where indicated, respect concreting sequence. Allow a minimum of seven (7) days before pouring concrete in neighboring section.

3.6 Patching Of Form Tie Holes

3.6.1 Refer to article 7.10.3 from CSA A23.1 standard for patching of form tie holes.

3.6.2 All conical cavities left after removal of the plastic cones on the ends of snap ties shall be filled with grout. Proceed according to the instructions of the grout manufacturer. Moisten the surface beforehand. Ensure a smooth finish with the grout blending into the surrounding concrete surfaces. Allow to cure.

3.6.3 For exposed surfaces (architectural concrete), products used to fill the holes shall have the same texture and color as the concrete. Provide the technical datasheet of the product for approval by the Owner's Representative.

3.7 Field Quality Control

3.7.1 Surveys shall be conducted prior to concreting to measure the level of the top of the formwork. At minimum, five (5) survey points shall be taken for every span. Provide this survey to the Owner's Representative and wait for his approval before placing concrete.

3.7.2 Survey points shall be used as guide to control slab thickness during concreting.

3.7.3 During inspection of concrete reinforcement, formworks and falseworks shall be inspected as well. Formwork quality and its cleanliness shall be inspected, as well as solidity of falseworks.

3.7.4 Following concreting, before removing formworks or shoring, conduct a new survey of the top of the slab consisting of an equal number of survey points as the formwork's survey within seventy-two (72) hours following concreting.

END OF SECTION

1 General

1.1 Related Requirements

- 1.1.1 Section 03 11 00 – Concrete Forming.
- 1.1.2 Section 03 20 00 – Concrete Reinforcing.
- 1.1.3 Section 03 30 00 – Cast-in-Place Concrete.
- 1.1.4 Section 03 35 00 – Concrete Finishing.
- 1.1.5 Section 03 39 00 – Concrete Curing.
- 1.1.6 The Contractor shall obtain a copy of all sections even if they do not pertain directly to their speciality. When bidding, the Contractor agrees implicitly with articles and requirements of all sections in these specifications, including those they might not have read. The Contractor should consult the table of contents of the specifications to be aware of the complete list of sections.

1.2 References

- 1.2.1 American Concrete Institute (ACI).
 - .1 ACI RAP Bulletin 1, Structural Crack Repair by Epoxy Injection, 2003.
- 1.2.2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM C 39/C 39M-24, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - .2 ASTM C 42/C 42M-20, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - .3 ASTM C 496/C 496M-19, Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - .4 ASTM C 881/C 881M-20a, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - .5 ASTM C 920-18, Standard Specification for Elastomeric Joint Sealants;
 - .6 ASTM C 1107/C 1107M-20, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 - .7 ASTM D 624-00(2020), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .8 ASTM D 638-14, Standard Test Method for Tensile Properties of Plastics.
 - .9 ASTM D 1751-23, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

- .10 ASTM D 1752-18(2023), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .11 ASTM D 2628-91(2016), Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- .12 ASTM E 1643-24, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- .13 ASTM E 1745-17(2023), Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.2.3 Canadian Standard Association (CSA)/CSA International.

- .1 CSA A23.1/A23.2-24, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
- .2 CSA G40.20/G40.21-13(R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.2.4 Canadian General Standards Board (CGSB).

- .1 CAN/CGSB 19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.
- .2 CAN/CGSB 51.34-M86(R1988) and CAN/CGSB 51.34-M86 AMEND, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.2.5 Notwithstanding the version of the standard mentioned above, it remains the responsibility of the Contractor to consult the most recent version.

1.3 Attachments

1.3.1 When attachments or anchors are required for concrete work to support vertically or laterally architectural elements, precast concrete panels, mechanical or electrical equipment, or other, manufacturer of said elements is the sole responsible for the design and calculations of attachments.

1.3.2 Steel plates, angles, steel rods, bolts, studs, anchoring elements, or any hardware parts in direct contact with, embedded or partially embedded into concrete shall be considered attachments.

1.4 Actions And Informational Submittals

1.4.1 Submittals in accordance with section 01 00 00 - General Requirements.

1.4.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets, in accordance with section 01 00 00 - General Requirements.

1.4.3 Submit documents and samples in accordance with section 01 47 15 - Sustainable development - Construction and coordinate the requirements of this section with those set out therein.

1.4.4 Submit shop and location drawings for all steel elements embedded in concrete. When forces are induced into the concrete by embedded steel elements, provide forces and direction of forces applied to concrete works where they are embedded.

.1 The drawings shall bear the seal and signature of a professional engineer, licensed in the Province of Ontario.

1.4.5 Submit location drawings for all embedded fasteners and anchors including force and strains induced into substrate.

1.5 Quality Control

1.5.1 Realize the following activities and submit required documents:

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.4.4	Shop and location drawings for embedded steel element	Fourteen (14) days prior to beginning works, per the requirements for shop drawings presentation in the tender document	Transmission letter Inscription into the shop-drawing registry	Contractor Review by the Owner's Representative
1.4.5	Location drawings for fasteners and anchors	Fourteen (14) days prior to beginning works, per the requirements for shop drawings presentation in the tender document	Transmission letter Inscription into the shop-drawing registry	Contractor Review by the Owner's Representative
1.4.1 2.1	Technical descriptions of concrete accessories	Seven (7) days prior to beginning concrete works, per the requirements for shop drawings presentation in the tender document	Transmission letter Inscription into the technical specification registry	Contractor Review by the Owner's Representative
3.2.3	Certificate of compliance for anchors	At least seven (7) days prior to steel erection	Breakpoint Certificate of compliance signed by an engineer	Contractor Inspection by an engineer employed by the Contractor

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
Error! Reference source not found.	Method of control for sealer	Prior to sealing surface	Transmission letter Inscription into the shop-drawing registry	Contractor Review by the Owner's Representative

1.5.2 For all the activities to be carried out in the previous table, keep a register indicating at least the activity carried out, the date of submission by the Specialized contractor and the date of review. The register shall be updated and sent to the Owner's Representative at regular intervals, corresponding at most to the intervals between site meetings.

1.6 Delivery, Storage and Handling

1.6.1 Store and manage hazardous materials in accordance with section 01 00 00 - General Requirements.

1.6.2 Waste Management and Disposal:

- .1 Separate waste materials for reuse/recycling in accordance with section 01 00 00 - General Requirements.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Recover and sort packaging for recycling purposes, in accordance with the waste management plan.
- .4 Divert wood materials from landfill to a recycling, reuse or composting facility as approved by the Owner's Representative.
- .5 Divert plastic materials from landfill to a recycling, reuse or composting facility as approved by the Owner's Representative.
- .6 Divert unused hazardous material from landfill to an official hazardous material collections site as approved by the Owner's Representative.

2 Products

2.1 Materials

2.1.1 Materials and resources in accordance section 01 00 00 - General Requirements.

2.1.2 Do verification requirements in accordance with section 01 00 00 - General Requirements.

2.1.3 Sealing joints compound.

- .1 Sealing joints compound shall figure on the registered products listing from the qualification and certification program of the CGSB. When a product has been certified with a primer, this primer shall be used in conjunction with the sealing compound.
- .2 Sealing compound for uncoupling, dilation and control joints: polyurethane-based, chemically-cured, self-levelling two- or three-component elastomeric sealant, in accordance with CAN/CGSB 19.24 and ASTM C 920 (type M, grade P or NS, class 25, use T) standards.
 - .1 Approved products: THC 901 by Tremco, Sikaflex 2C SL by Sika and MasterSeal SL 2 by Master Builders.
- .3 Sealing compound for concrete slab joints: one-component, moisture-cured, polyurethane-based, non-sag elastomeric sealant in accordance with CAN/CGSB 19.24 and ASTM C 920, (type S, grade P or NS, class 25, use T) standards.
 - .1 Approved products: Sikaflex 1a by Sika, Vulkem 116 by Tremco, Eucolastic 1SL d'Euclid and MasterSeal SL 1 by Master Builders.
- .4 Sealing compound for vertical joints: two- or three-component, chemically-cured, polyurethane-based, elastomeric sealant in accordance with CAN/CGSB 19.24 and ASTM C 920, (type M, grade NS, class 25 or 50) standards.
 - .1 Approved products: Sikaflex 2C NS EZ MIX by Sika, Dymeric 240FC by Tremco, or MasterSeal NP 2 by Master Builders.

2.1.4 Premoulded joint fillers:

- .1 Bituminous fiber board: to ASTM D 1571, bituminous impregnated fiber board, premoulded and resilient. Dimensions shall be as indicated on drawings.
 - .1 Substitute product: Deck-o-Foam from W.R. Meadows.
- .2 Sponge rubber: to ASTM D 1752, type I, flexible or firm.
- .3 Standard cork: to ASTM D 1752, type II.
- .4 Self-expanding cork: to ASTM D 1752, type III.

2.1.5 Damp proof membrane, under slab on ground: 0.40 mm thick polyethylene film, to ASTM E 1745, type A and CSA A23.1 clause 6.2.5.

2.1.6 Bonding agent: water-based epoxy-cementitious bonding agent, three-component, acting as a corrosion inhibitor, such as:

- .1 SikaTop Armatec 110 EpoCem by Sika.
- .2 DuralPrep A.C. by Euclid.

- .3 MasterEmaco P124 by Master Builders.
- .4 Planibond 3C by MAPEI.
- 2.1.7 Steel for embedded steel elements: to CSA G40.20/G40.21 grade 350W or superior.
- 2.1.8 Chemical adhesive system: structural epoxy resin, two-components. Unless otherwise indicated, use:
 - .1 Hilti RE-500-V3 or Dewalt PURE-110+ adhesive in general.
 - .2 Hilti HIT HY-200 or Dewalt AC200+ adhesive for applications where quick setting is required such as overhead applications, or for use at low temperature, between -10°C and 10°C.
 - .3 Hilti HIT ICE adhesive for use in cold temperatures above -23°C.
- 2.1.9 Shrinkage compensating grout: premixed compound to ASTM C 1107/C 1107M type C, 50 MPa minimum compressive resistance after twenty-eight (28) days such as:
 - .1 SikaGrout 212 by Sika.
 - .2 Dry Pact Grout by Euclid.
 - .3 In-Pakt Construction Grout or In-Pakt Precision Grout CT by KING (Sika) depending on weather conditions.
 - .4 Planigrout 712 by MAPEI.
- 2.1.10 Elastomeric joint seals for new concrete.
 - .1 To ASTM D 2628.
 - .2 Provided in one continuous length without interruption.
- 2.1.11 Crack injection epoxy: two-component structural resin, 100% solid, moisture insensitive, low-viscosity, in accordance with ASTM C 881/C 881M type IV, grade 1, class A or B, such as:
 - .1 Euco 452 LV by Euclid.
 - .2 MasterInject 1380 by Master Builders.
 - .3 Sikadur 52 by Sika.
 - .4 Sikadur 35 Hi-MOD LV by Sika.
- 2.1.12 Epoxy grout for base plates/equipment base: three-component epoxy system, such as:
 - .1 Sikadur 42 Grout pak Multi-Flo by Sika (6:1 ratio).
 - .2 Masterflow 648 by Master Builders.
 - .3 E³-Deep Pour by Euclid.

- .4 Planigrout 350 de MAPEI.
- 2.1.13 Epoxy grout for repairs: one or more component, moisture-insensitive, rapid strength gaining epoxy repair mortar such as:
 - .1 Sikadur 43 Patch Pak by Sika.
 - .2 MasterEmaco T 1061 by Master Builders.
 - .3 Duralflex Fastpatch by Euclid.
 - .4 Planitop 18 by MAPEI.
- 2.1.14 Cement-based mortar for horizontal repair: shrinkage-compensated, cementitious based mortar containing a corrosion inhibitor, such as:
 - .1 Sikatop 122 PLUS.
 - .2 Eucocrete Supreme by Euclid.
 - .3 Planitop 25 ou MAPECEM 202 de MAPEI.
- 2.1.15 Cement-based mortar for vertical or overhead repair: shrinkage-compensated, cementitious based mortar containing a corrosion inhibitor, such as:
 - .1 Verticoat Supreme from Euclid.
 - .2 Sikatop 123 PLUS or Sikatop 123 PLUS Winter Grade by Sika depending on weather conditions.
 - .3 MasterEmaco N 420 CI by Master Builders.
 - .4 Planitop 23 or Planitop XS (low thickness repairs) by MAPEI.
- 2.1.16 Self-consolidating repair concrete: self-levelling, premixed concrete, such as:
 - .1 Sikacrete 08 SCC or Sikacrete 211 Flow PLUS by Sika.
 - .2 Tamms Form and Pour by Euclid.
 - .3 MasterEmaco S 440MC by Master Builders.
 - .4 Planitop 11 SCC or Planitop 15 by MAPEI.
 - .5 MS-S6 or MS-S10 by KING (SIKA) depending on required thickness.
- 2.1.17 Cementitious floor screed: levelling mortar for correcting unevenness or other surface defects of slabs such as :
 - .1 Sikafloor Level 25 by SIKA.
 - .2 MasterTop 111SL by Master Builders.
 - .3 USG Durock Brand NE Floor Patch by USG.

.4 Ultraplan 1 Plus by MAPEI.

2.1.18 Weep hole tubes: galvanized steel/plastic.

3 Execution

3.1 General

3.1.1 In general, the procedure for installing accessories must comply with the manufacturer's requirements and recommendation. If no specification is given in this specification for the installation of accessories, follow the manufacturer's procedure. If the manufacturer's procedure is more restrictive than the specifications, follow the most restrictive procedure.

3.2 Anchor Rods

3.2.1 Set anchor rods to templates in co-ordination with appropriate trade prior to placing concrete.

3.2.2 Install anchor rods in accordance with the tolerances permitted in article 6.7.3 of the CSA A23.1 standard.

3.2.3 Provide a certificate of compliance signed by an engineer attesting that (1) installation of anchor rods complies to the anchoring plan and (2) concrete foundations reached the strength required to support the erection of steel structure in accordance with article 3.24.12 of the Safety Code for the construction industry.

3.2.4 Locate anchor rods used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

3.3 Joint Fillers (Backing Foam/Backer Rod)

3.3.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Owner's Representative.

3.3.2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

3.3.3 Locate and form isolation, construction and expansion joints as indicated.

3.3.4 Use 12 mm thick joint fillers to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

3.4 Joints Sealing

3.4.1 Clean and dry joint surfaces. Cleaning shall be accomplished by mechanical means. All joint surfaces must be clean, sound, dry and frost-free. Joint walls must be free of oils, tar, asphalt, bitumen, grease, paints, coatings, sealers, curing compound residues, and any other foreign matter that might prevent adhesion.

3.4.2 Bond breaker tape, backing foam or backer rod must be used in bottom of joint to prevent bond. Leave free space of sufficient height to place a thickness of sealant in accordance with manufacturer's recommendations.

3.4.3 Before applying sealant, apply primary per manufacturer's recommendation. Clean surrounding areas after application.

3.4.4 Allow a minimum of 120 days of air drying at 20°C before applying the caulking product. This period is extended to 150 days for semi-rigid (as opposed to flexible) products.

3.5 Vapour Barrier

3.5.1 Refer to Section 07 25 00 – Air/Vapour Barriers for under slab-on-grade membrane.

3.6 Embedded Steel

3.6.1 Fabrication of embedded steel elements in accordance with CSA S16.

3.6.2 Install embedded parts in accordance with the tolerances in article 6.7.3 of the CSA A23.1 standard which are considered to be the minimum requirements applicable to all steel elements (anchors, plates, angles, hardware, etc.) unless otherwise indicated.

3.6.3 Ensure galvanic separation (galvanization, neoprene or other) between any steel and aluminium element.

3.7 Crack Injection

3.7.1 Refer to ACI RAP Bulletin 1 Structural Crack Repair by Epoxy Injection.

3.7.2 No crack injection shall take place unless concrete temperature is between 15 and 30 °C. Temperature of epoxy component must remain between 20 and 30 °C prior to injection.

3.7.3 Clean the surface area 13 mm wide on each side of the crack, using « oil-free » compressed air.

3.7.4 Install entry ports at a maximum spacing of 200 mm or the thickness of the concrete element, whichever is less. Use surface-mounted entry ports when adequate, except for blocked cracks where socket-mounted ports shall be used. Seal the surface around entry points and cracks. Install entry ports where crack is clean and of maximum width whenever possible, even if spacing between entry ports vary slightly. Place first and last entry port at a distance corresponding to half the usual spacing.

3.7.5 Use equipment such as electrical or hydraulic piston pumps, with a maximum pressure of 200 psi, for crack injection.

3.7.6 When surface sealant has hardened, inject epoxy into entry ports. Start the injection at the widest section of a horizontal crack or at the bottom of a vertical crack. Continue the injection until refusal. When an adjacent port starts bleeding, cap the port being injected and continue injecting at the furthest bleeding port.

3.7.7 Upon completion of the injection process, when epoxy has hardened, grind concrete surface to eliminate leftover epoxy and sealant. Surfaces shall present a high-quality finish.

- 3.7.8 Quality control: The Owner's Representative may require that concrete cylinders, drilled in concrete after crack injection, shall be submitted to compressive or indirect tensile strength tests, in accordance with ASTM C 42 (sampling), ASTM C 39 (compressive strength) and ASTM C 496 (tensile strength) standards.
- 3.7.9 When crack injection is required to correct deficiencies resulting from work done by the Contractor, all direct and indirect costs related to crack injection shall be assumed by the Contractor.

3.8 Execution – Chemical Adhesive System

- 3.8.1 Anchor installers shall be trained by the supplier of the product used and have proof to this effect.
- 3.8.2 Drill hole normal to the surface, 4 mm larger than anchor rods, or more, as indicated by anchoring system manufacturer.
- 3.8.3 Borehole shall be free of dust, debris, ice, oil, grease, and other contaminants. Use a hammer drill set in rotation-hammer mode for drilling. Use round steel brush and oil-free compressed-air blower for cleaning, per manufacturer's recommendation. The use of a diamond drill is subject to the approval of the Owner's Representative.
- 3.8.4 Prepare and apply epoxy as indicated in the manufacturer's technical datasheet. Consider the indication on temperature and setting time.
- 3.8.5 Partially fill hole with epoxy before placing anchor rod. Inject epoxy to fill out the hole.
- 3.8.6 Unless otherwise indicated, anchor depth shall be the largest value between 150 mm or fifteen (15) times the diameter of the anchor in concrete.

3.9 Execution – Bonding Agent

- 3.9.1 Using dry or wet sand blast, remove all deteriorated concrete, dirt, oil, grease and any other contaminants from surfaces.
- 3.9.2 Moisten concrete surface at least four (4) hours prior to concreting, as to obtain saturated-surface dry (SSD) substratum.
- 3.9.3 Apply per manufacturer instructions a no less than 0.5 mm thick layer of bonding agent using a stiff paint brush or roller.
- 3.9.4 Pour repair concrete or mortar within six (6) hours after bonding agent is applied or less, following manufacturer's recommendations.

END OF SECTION

1 General

1.1 Related Requirements

- 1.1.1 Section 03 11 00 – Concrete Forming.
- 1.1.2 Section 03 15 00 – Concrete Accessories.
- 1.1.3 Section 03 30 00 – Cast-in-Place Concrete.
- 1.1.4 Section 03 35 00 – Concrete Finishing.
- 1.1.5 Section 03 39 00 – Concrete Curing.
- 1.1.6 Section 31 23 00 – Excavation and Fill.
- 1.1.7 The Contractor shall obtain a copy of all sections even if they do not pertain directly to their speciality. When bidding, the Contractor agrees implicitly with articles and requirements of all sections in these specifications, including those they might not have read. The Contractor should consult the table of contents of the specifications to be aware of the complete list of sections.

1.2 References

- 1.2.1 American Concrete Institute (ACI).
 - .1 ACI 315R-18, Guide to Presenting Reinforcing Steel Design Details.
 - .2 ACI 318-19(R2022), Building Code Requirements for Structural Concrete with Commentary.
 - .3 ACI 421.1R-20, Guide to Shear Reinforcement for Slabs.
 - .4 ACI 421.2-21, Seismic Design of Punching Shear Reinforcement in Flat Plates - Guide.
 - .5 ACI MNL-66(20), ACI Detailing Manual 2020.
- 1.2.2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A 143/A 143M-07(2020), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .2 ASTM A 641/A 641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .3 ASTM A 706/A 706M-24, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - .4 ASTM A 722/A 722M-18, Standard Specification for Uncoated High-Strength Steel Bars for Prestressing Concrete.

- .5 ASTM A 767/A 767M-19, Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- .6 ASTM A 780/A 780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- .7 ASTM A 970/A 970M-19, Standard Specification for Headed Steel Bars for Concrete Reinforcement.
- .8 ASTM A 1035/A 1035M-24, Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement.
- .9 ASTM A 1044/A 1044M-22a, Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete.
- .10 ASTM A 1060/A 1060M-22, Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .11 ASTM A 1064/A 1064M-24, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

1.2.3 Canadian Standard Association (CSA)/CSA International.

- .1 CSA A23.1/A23.2-24, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
- .2 CSA A23.3-24, Design of Concrete Structures.
- .3 CSA G30.18-21, Carbon Steel Bars for Concrete Reinforcement.
- .4 CSA G40.20/G40.21-13(R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .5 CSA S413-21, Parking Structures.
- .6 CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.2.4 Reinforcing Steel Institute of Canada (RSIC).

- .1 RSIC-2020, Manual of Standard Practice.

1.2.5 Canadian General Standards Board (CGSB).

- .1 CAN/CGSB 1.181-99, Ready-Mixed, Organic, Zinc-Rich Coating.

1.2.6 Notwithstanding the version of the standard mentioned above, it remains the responsibility of the Contractor to consult the most recent version.

1.3 Actions And Informational Submittals

1.3.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

1.3.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets, in accordance with section 01 00 00 - General Requirements.

- 1.3.3 Submit documents and samples in accordance with section 01 00 00 - General Requirements, and coordinate the requirements of this section with those set out therein.
- 1.3.4 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice, ACI 315R, and ACI MNL-66 standard.
- 1.3.5 Submit shop drawings. Indicate placing of reinforcement and:
 - .1 Bar bending details.
 - .2 Lists of reinforcing elements.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Owner's Representative, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
 - .6 Adapt the shop drawings with the location of the construction joints, whether indicated on plans or according to the location determined by the formwork contractor.
 - .7 Highlight using clouds the modifications made between the different versions of the shop drawings.
- 1.3.6 Submit, in conjunction with shop drawings, lists of steel reinforcing elements corresponding to shop drawings.
- 1.3.7 Verify on field all dimensions and levels not defined on drawings or that may depend on field conditions.
- 1.3.8 The Owner's Representative may take up to ten (10) working days to verify and return shop drawings.
- 1.3.9 Corrections and comments made on shop drawings during the revision process do not limit the Contractor responsibility to respect requirements of drawings and specifications. Review of shop drawings is done only to ensure the general conformity regarding design and contract requirements. Contractor shall confirm and correlate all dimensions and characteristics, choose method of fabrication and construction, and execute work safely.
- 1.3.10 If revision required on shop drawings are too numerous or too important, Owner's Representative will return drawings without annotations, awaiting a new submittal. If drawings are submitted more than two times, the Contractor shall pay, by mean of a permanent deduction, the cost of review.
- 1.3.11 Work shall not begin before shop drawings have been reviewed by the Owner's Representative.
- 1.3.12 The Contractor assumes full responsibility for the exactness of their drawings. They may not claim any extra charge for delays resulting from the discovery, be it on the field or before, of mistakes on their drawings, even if they were examined by the Owner's Representative.

1.4 Rebar Detailing

- 1.4.1 In general, use details in accordance with RSIC *Reinforcing Steel Manual of Standard Practice* and ACI *Detailing Manual*.
- 1.4.2 Unless otherwise indicated, development lengths and cover shall be in accordance with articles 7 and 12 of CSA A23.3 standard.
- 1.4.3 Detail lap lengths and bar development lengths as type B tension lap splices unless otherwise indicated. Refer to *RSIC Reinforcing Steel Manual of Standard Practice*, table 14B, for lap lengths, unless otherwise indicated.
- 1.4.4 Dimensions of ties, spiral reinforcing, hangers and stirrups shall be determined in accordance with minimum concrete cover from article 6.6.6 of CSA A23.1 standard.
- 1.4.5 Unless otherwise indicated, hooks required, including stirrups and ties, shall be standard hooks as defined in article 6.6.6.2 of CSA A23.1 standard.
- 1.4.6 Unless otherwise indicated on drawings, the hooks of the stirrups and ligatures of the elements that are part of the seismic force resistance system (SFRS) shall comply with the definition of seismic hooks in article 3.1 of the CSA A23.3 standard. These hooks shall have an extension of at least 100 mm at an angle of 135 degrees. Any shear wall, elevator shaft or stairwell are considered part of the SFRS.
- 1.4.7 Consider the location of construction joints before submitting rebar detailing.
- 1.4.8 Unless otherwise indicated, development lengths, lap splices and length of projection beyond critical section of composite reinforcing bars shall be determined in accordance with article 9 of CSA S806.

1.5 Quality Control

- 1.5.1 Realize the following activities and submit required documents:

ART.	PRESCRIPTI ONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
2.2.8	Mill test reports for reinforcement	At least fourteen (14) days prior to beginning reinforcing work	Mill test report	Contractor
1.3.5	Concrete reinforcing shop drawings	At least fourteen (14) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription to the technical specification registry	Contractor Review by Owner's Representative

ART.	PRESCRIPTI ONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.3.6	Steel reinforcing schedule	At least fourteen (14) days prior to beginning work, per the requirements for shop drawings presentation in the tender document	Transmission letter Inscription to the technical specification registry	Contractor Review by Owner's Representative
1.3.1 2.1	Technical description of concrete reinforcing products	At least fourteen (7) days prior to beginning work, per the requirements for shop drawings presentation in the tender document	Transmission letter Inscription to the technical specification registry	Contractor Review by Owner's Representative
3.5.2	Certificate of compliance for underslab fill	Prior to placing reinforcing steel for slab on grade	Breakpoint Certificate of compliance for underslab fill	Contractor
3.5.3	Certificate of compliance for formworks	Prior to placing reinforcing steel	Certificate of compliance for formworks	Contractor
3.5.15	Notice to Owner's Representative for concrete reinforcing inspection	At least forty-eight (48) hours prior to concreting	Breakpoint Inspection report	Contractor
Error! Refere nce source not found.	Notice to Owner's Representative for shear stud inspection	At least forty-eight (48) hours prior to installation of reinforcing and embedded steel	Breakpoint Inspection report	Contractor

1.5.2 For all the activities to be carried out in the previous table, keep a register indicating at least the activity carried out, the date of submission by the Specialized contractor and the date of review. The register shall be updated and sent to the Owner's Representative at regular intervals, corresponding at most to the intervals between site meetings.

1.6 Delivery, Storage and Handling

1.6.1 Store and manage hazardous materials in accordance with section 01 00 00 - General Requirements.

1.6.2 Waste Management and Disposal:

- .1 Separate waste materials for reuse/recycling in accordance with section 01 00 00 - General Requirements.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Recover and sort packaging for recycling purposes, in accordance with the waste management plan.
- .4 Divert wood materials from landfill to a recycling, reuse or composting facility as approved by the Owner's Representative.
- .5 Divert plastic materials from landfill to a recycling, reuse or composting facility as approved by the Owner's Representative.
- .6 Divert unused hazardous material from landfill to an official hazardous material collections site.

2 Products

2.1 Materials

- 2.1.1 Materials and resources in accordance with section 01 00 00 - General Requirements.
- 2.1.2 Do verification requirements in accordance with section 01 00 00 - General Requirements.
- 2.1.3 Reinforcing steel: unless otherwise indicated, billet bars, to CSA G30.18 grade 400W, or ASTM A 706/A 706M, grade 60.
- 2.1.4 Low-carbon steel bars: to ASTM A 1035/A 1035M.
- 2.1.5 High strength steel bars: to ASTM A 722/A 722M.
- 2.1.6 Galvanized steel bars: to ASTM A 767/A 767M, class I or II.
- 2.1.7 Steel welded galvanized wire reinforcement: welded wire reinforcement (mesh), to ASTM A 1060/A 1060M.
 - .1 Provide in flat sheets only.
- 2.1.8 Steel welded wire reinforcement: welded wire reinforcement (mesh), to ASTM A 1064/A 1064M.
 - .1 Provide in flat sheets only.
- 2.1.9 Galvanized carbon steel wire: to ASTM A 641/A 641M.
- 2.1.10 Galvanizing of non-prestressed reinforcement: to ASTM A767/A 767M class I or II, minimum zinc coating 610 g/m².
 - .1 Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.

- .2 If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.
- .3 Temperature of solution equals to or greater than 32 degrees and galvanized steels immersed for minimum of twenty (20) seconds.
- .4 If galvanized steels are at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.
 - .1 In this case, no restriction applies to temperature of solution.
- .5 Chromate solution sold for this purpose may replace solution described above, provided it is of equivalent effectiveness.
 - .1 Provide product description as described in 1.4 - Action and Informational Submittals.
- 2.1.11 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
 - .1 For rebars on steel deck, use continuous chairs or bolsters with plates.
- 2.1.12 Mechanical splices: to ACI 318 art. 18.2.7.1 or CSA A23.3 art. 21.2.7.3.1, type I, subject to approval of Owner's Representative, such as:
 - .1 Rebar coupler with lock shear bolts:
 - .1 D-250SCA Bar Lock by Dayton Superior.
 - .2 Zap Screwlok SL Series by Barsplice.
 - .3 Any rebar coupler conforming to ACI 318 type 2, including products identified in article 2.1.13.1.
 - .2 Threaded rebar coupler:
 - .1 D50 DBR Coupler System by Dayton Superior; 1
 - .2 BPI Barsplicer Standard by Barsplice.
 - .3 HRC 400 Series by HRC.
 - .4 Any rebar coupler conforming to type 2, including products identified in article 2.1.13.2.
- 2.1.13 Mechanical splices for seismic applications: to ACI 318 art. 18.2.7.1 or CSA A23.3 art. 21.2.7.3.1, type 2, subject to approval of Owner's Representative, such as:
 - .1 Rebar coupler with lock shear bolts:
 - .1 Lenton Connect S2 Series by Lenton.

- .2 D-250L Bar Lock by Dayton Superior.
 - .3 Zap Screwlok Type 2 Series by Barsplice.
 - .4 Unitec by Dextra.
- .2 Threaded rebar coupler:
 - .1 Lenton Standard Coupler by Lenton.
 - .2 DBDI Splice System ou D310 Taper-Lock by Dayton Superior.
 - .3 BPI Barsplicer XP by Barsplice.
- 2.1.14 Mechanical splices at end of rebars: threaded, welded or pressed coupler to ACI 318 article 25.4.4.1, CSA 23.3 article 7.1.4.1 and ASTM A 970/A 970M class A, with a net area equivalent to at least five (5) times the area of the rebar attached to it.
 - .1 Lenton Terminator D6 by Lenton.
 - .2 D251 Bar-Lock or D351 Taper-Lock by Dayton Superior.
 - .3 BPI ButtonHead 5Ab or BPI Barsplicer Doughnut Term by BarSplice Products.
- 2.1.15 Mechanical splices at end of rebars: threaded, welded or pressed coupler to CSA A23.3 article 7.1.4.2 and ASTM A 970/A 970M class B, with a net area equivalent to at least ten (10) times the area of the rebar attached to it.
 - .1 Lenton Terminator D14 by Lenton.
 - .2 D158 End Anchor (10 Ab) by Dayton Superior.
 - .3 BPI ButtonHead 10Ab or BPI Barsplicer Doughnut DNX by BarSplice Products.
- 2.1.16 Plain round bars: to CSA-G40.20/G40.21.
- 2.1.17 Zinc-rich coating:
 - .1 Use zinc-rich coating to CAN/CGSB 1.181 and ASTM A 780/A 780M containing at least 92% of metallic zinc in dried coat, brush applied.
 - .2 Approved products:
 - .1 Zinc paste 70-40 by Metaflux.
 - .2 ZRC Galvilite by Méta-Plus.
 - .3 Rust-anode by Galvatech (distributor).
 - .4 Zinga by Galvanisation Zinga (distributor).
 - .5 Galvacon by Lanco.

2.2 Fabrication

- 2.2.1 Fabricate reinforcing steel in accordance with CSA A23.1 and RSIC Reinforcing Steel Manual of Standard Practice.
- 2.2.2 Fabrication tolerances shall be in accordance with RSIC manual chapter 6 or the following paragraphs, as determined by the more stringent requirement. Bars fabricated without conforming to those tolerances will be rejected.
 - .1 General tolerance: ± 25 mm.
 - .2 For ties, stirrups and spirals with a diameter less than 750 mm, the tolerance is ± 13 mm.
- 2.2.3 Obtain Owner's Representative's written approval for locations of reinforcement splices other than those shown on shop drawings.
- 2.2.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
- 2.2.5 Ship epoxy coated bars in accordance with ASTM A 775A/A 775M.
- 2.2.6 Galvanized bars shall be bent after galvanizing.
 - .1 After the bar is bent, minor peeling of coating is considered acceptable. A value of surface peeling up to the bar nominal section area is considered acceptable. For surface peeling higher than the nominal section area, bar shall be rejected and need to be replaced.
- 2.2.7 All reinforcing steel shall be bent to be parallel to the edge of concrete works, as indicated on drawings. Bending shall be done in shop, as indicated on shop drawings.
- 2.2.8 Identify bundles of bar reinforcement and wire mesh, in accordance with shop drawings, bar bending details and lists before shipping.
- 2.2.9 All rebars shall be identified during fabrication. Identification shall include diameter, grade, and fabricator. Rebar not properly identified will not be allowed on site.

2.3 Source Quality Control

- 2.3.1 Upon request, provide Owner's Representative with certified copy of mill test report of reinforcing steel, minimum two (2) weeks prior to beginning reinforcing work. Test reports shall indicate physical and chemical properties of steel.
 - .1 The mill test report shall include the information specified in article 18 of CSA standard G30.18.
 - .2 Inform the Owner's Representative of the proposed source of supply for the materials to be supplied.

3 Execution

3.1 Storage And Handling

- 3.1.1 Store materials off ground over wood studs or indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area to prevent rusting.
- 3.1.2 Protect reinforcing steel if stored over a long period.
- 3.1.3 Replace defective or damaged materials with new.

3.2 Preparation

- 3.2.1 Galvanizing to include chromate treatment.
 - .1 Duration of treatment: 1 hour per 25 mm of bar diameter.
- 3.2.2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A 143/A 143M.

3.3 Field Bending

- 3.3.1 Do not field bend or field weld reinforcement except for a written approval by Owner's Representative.
- 3.3.2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- 3.3.3 Replace bars which develop cracks or splits.
- 3.3.4 Unless otherwise indicated, field weld reinforcement is prohibited. When authorized, weld specially identified rebars.

3.4 Connection To Existing Work

- 3.4.1 When connecting to existing work, prior to preparing shop drawings, verify dimensions and condition of existing work, report discrepancies and potential problem areas to Owner's Representative for direction before commencing fabrication. Dimensions of steel elements shall be modified to adapt for the existing conditions and modifications shall be submitted to Owner's Representative for approval.
- 3.4.2 For reinforcement anchored to an existing reinforced concrete or masonry element, use the following procedure, under the sole responsibility of the specialized contractor:
 - .1 Detect existing reinforcement bars prior to drilling to locate anchors.
 - .2 Use manual percussion drilling to drill anchor loads and protect existing reinforcement.
- 3.4.3 For reinforcement anchored to an existing unreinforced masonry element, use rotatory drilling to drill anchors as to protect the existing work. The contractor may use a different mean of drilling only if they are able to demonstrate that no damage will occur to the existing work due to drilling. If the contractor uses an alternative mean of drilling, any damage occurring to the existing work following drilling shall be automatically considered their responsibility.

- 3.4.4 Where new concrete is placed in contact with existing concrete or masonry works, follow the directions below, unless otherwise indicated:
- .1 Drill holes with a minimum depth of 150 mm up to a maximum of two thirds of the depth of the existing work.
 - .2 Place holes at the centre of the existing element, at 300 mm centre-to-centre maximum.
 - .3 Place 20M reinforcing bars used as dowels in holes and pack solidly with adhesive and hold dowels in positions until the adhesive is set.
 - .4 Unless otherwise indicated, use chemical adhesive in accordance with article **Error! Reference source not found.** Refer to article 3.10 of section 03 15 00 – Concrete Accessories for the installation of the adhesive anchor system.

3.5 Placing Reinforcement

- 3.5.1 Clean reinforcing steel before placement. Steel shall be free from mud, oil, or other coatings that adversely affect bond strength. Bar surface shall be in accordance to CSA A23.1 article 6.1.6.
- 3.5.2 Prior to placing concrete reinforcement for slabs on grade, Contractor shall demonstrate to the Owner's Representative the compliance of underslab fill (see section 31 23 00).
- 3.5.3 Prior to placing concrete reinforcement in general, Contractor shall demonstrate to the Owner's Representative the compliance of formworks (see section 03 11 00).
- 3.5.4 Place reinforcing steel as indicated on placing drawings and in accordance with CSA A23.1. Refer to article 6.6.7 of this standard for placement and number of supports.
- 3.5.5 Concrete reinforcement shall be continuous through the construction joints. For each joint in a structural slab, use a shear key and add supplementary 15M@300 o/c 600 mm long rebars at the center of slab.
- 3.5.6 Attach reinforcing steel solidly to supports to prevent any movement during concreting.
- 3.5.7 Support bars are not included on drawings. Use 15M reinforcing bar spaced at 1 000 mm on center to support top reinforcing steel.
- 3.5.8 When concrete will never be exposed to weather conditions, use chairs and hangers with nylon- or plastic-covered extremities.
- 3.5.9 When concrete will be exposed to weather conditions or sandblasted, use chairs and hangers with nylon- -covered extremities.
- 3.5.10 For slab-on-grade and footings, reinforcing steel is placed on chairs, supports and/or cement brick, spaced on center 1 000 mm maximum.
- 3.5.11 Rocks, piece of rocks, woods or pipes shall not be used to support reinforcing steel.
- 3.5.12 Lifting the reinforcing steel with a hook at the time of concreting is prohibited.
- 3.5.13 Overlap wire mesh by 150 mm minimum, unless otherwise indicated.

- 3.5.14 Use plain round bars as slip dowels in concrete, unless otherwise indicated in drawings.
- .1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
 - .2 When paint is dry, apply thick even film of mineral lubricating grease.
- 3.5.15 At least forty-eight (48) hours prior to placing concrete, advise Owner's Representative for inspection of reinforcing material and placement. Provide notice when completion of reinforcing placement is expected within the next twenty-four (24) hours.
- 3.5.16 Ensure cover to reinforcement is maintained during concrete pour.
- 3.5.17 During concreting, a worker shall be assigned to replacing reinforcing steel that may have been displaced during the operation.
- 3.5.18 Drill holes into concrete, place adhesive and anchor steel into existing concrete per manufacturer's recommendations.
- 3.5.19 Protect reinforcement coating during concreting.
- 3.5.20 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

3.6 Concrete Cover

- 3.6.1 Unless otherwise indicated, cover thickness for reinforcement in concrete, shall be:

Exposure condition	Exposure class			
	Not exposed	Exposed to freezing thawing	Exposed to chlorides	Parking structures
Cast against and permanently exposed to earth, including footings	75	75	75	75
Columns and walls (principal reinforcement)	50	50	60	50
Slabs	25	40	60	45 top 30 bottom
Ratio of cover to nominal bar diameter	1.0	1.5	2.0	1.5
Ratio of cover to nominal maximum aggregate size	1.0	1.5	2.0	1.5

"Not exposed" concrete refers only to concrete that will be continually dry within the conditioned space (i.e., members entirely within the vapour barrier of the building envelope).

3.7 Field Touch-Up

- 3.7.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

.1 For galvanized steel, use zinc-rich coating to article 2.1.17.

3.8 Welding

- 3.8.1 Unless written approval, do not weld reinforcement.
- 3.8.2 When welded splice are specified and location has been approved by the Owner's Representative, weld reinforcement in accordance with CSA W186 and article 6.6.10 of CSA A23.1 standard. Weldable (W) grade reinforcement shall be used.
- 3.8.3 Welding shall be done by contractor certified by the Canadian Welding Bureau.

3.9 Anchor Rods

- 3.9.1 The Contractor shall consider that anchor rods will be placed within walls, columns or other concrete works when placing concrete reinforcing.
- 3.9.2 Placement of anchor rods within formworks shall be done by the formwork contractor, in collaboration with the reinforcement contractor. Anchor rods are placed using templates, including a template embedded in concrete.

END OF SECTION

1 General

1.1 Related Requirements

- 1.1.1 Section 03 11 00 – Concrete Forming.
- 1.1.2 Section 03 15 00 – Concrete Accessories.
- 1.1.3 Section 03 20 00 – Concrete Reinforcing.
- 1.1.4 Section 03 35 00 – Concrete Finishing.
- 1.1.5 Section 03 39 00 – Concrete Curing.
- 1.1.6 The Contractor shall obtain a copy of all sections even if they do not pertain directly to their speciality. When bidding, the Contractor agrees implicitly with articles and requirements of all sections in these specifications, including those they might not have read. The Contractor should consult the table of contents of the specifications to be aware of the complete list of sections.

1.2 References

- 1.2.1 American Concrete Institute (ACI).
 - .1 ACI PRC 223R-21, Shrinkage Compensating Concrete Guide.
 - .2 ACI 302.1R-15, Guide for Concrete Floor Slab Construction.
 - .3 ACI 304.6R-09(R2019), Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment.
 - .4 ACI 305R-20, Hot Weather Concreting.
 - .5 ACI 306R-16, Recommended Practice for Cold Weather Concreting.
 - .6 ACI 309R-05, Guide for Consolidation of Concrete.
- 1.2.2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM C 31/C 31M-24b, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - .2 ASTM C 33/C 33M-23, Standard Specification for Concrete Aggregates.
 - .3 ASTM C 39/C 39M-24, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - .4 ASTM C 42/C 42M-20, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - .5 ASTM C 88-24, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

- .6 ASTM C 109/C 109M-23, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
- .7 ASTM C 143/C 143M-20, Standard Test Method for Slump of Hydraulic-Cement Concrete.
- .8 ASTM C 173/C 173M-24a, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- .9 ASTM C 260/C 260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.
- .10 ASTM C 330/C 330M-23, Standard Specification for Lightweight Aggregates for Structural Concrete.
- .11 ASTM C 457/C 457M-23a, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
- .12 ASTM C 494/C 494M-24, Standard Specification for Chemical Admixtures for Concrete.
- .13 ASTM C 535-16, Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- .14 ASTM C 618-23e1, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- .15 ASTM C 685-17/C 685M-17, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
- .16 ASTM C 873/C 873M-23, Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds.
- .17 ASTM C 989/C 989M-24, Standard Specification for Slag Cement for Use in Concrete and Mortars.
- .18 ASTM C 1017/C 1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .19 ASTM C 1157/C 1157M-23, Standard Performance Specification for Hydraulic Cement.
- .20 ASTM C 1202-22, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.
- .21 ASTM C 1218/C 1218M-20, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
- .22 ASTM C 1240-20, Standard Specification for Silica Fume Used in Cementitious Mixtures.
- .23 ASTM C 1582/C 1582M-11(2017)e1, Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.

- .24 ASTM C 1611/C 1611M-21, Standard Test Method for Slump Flow of Self-Consolidating Concrete.

1.2.3 Canadian Standard Association (CSA)/CSA International.

- .1 CSA A23.1/A23.2-24, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA A23.3-24, Design of Concrete Structures.
- .3 CSA A283-19, Qualification Code for Concrete Testing Laboratories.
- .4 CSA A3000-23, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA A3001-23, Cementitious materials for use in concrete.

1.2.4 International Concrete Repair Institute (ICRI).

- .1 Guideline No. 310.1R-2008, Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.
- .2 Guideline No 310.2R-2013 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- .3 Guideline No. 320.1R-2019, Guideline for Selecting Application Methods for the Repair of Concrete Surfaces.
- .4 Guideline No. 320.2R-2018, Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces.

1.2.5 International Organization for Standardization (ISO).

- .1 ISO 14025:2006, Environmental labels and declarations - Type III environmental declarations - Principles.

1.2.6 Volumetric Mixer Manufacturer Bureau (VMMB).

- .1 VMMB 100-01, Volumetric Mixer Standards.

1.2.7 Notwithstanding the version of the standard mentioned above, it remains the responsibility of the Contractor to consult the most recent version.

1.3 Design Criteria

1.3.1 Alternative 1 - Performance: to CSA A23.1, and as described in 2.2 - Mixes.

1.4 Actions And Informational Submittals

1.4.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets, in accordance with section 01 00 00 - General Requirements.

- 1.4.3 Minimum four (4) weeks prior to starting concrete work, submit to Owner's Representative test reports and certificate from testing laboratory certifying that the following materials meet the requirements of this section:
- .1 Portland cement.
 - .2 Blended hydraulic cement.
 - .3 Supplementary cementing material.
 - .4 Admixtures.
 - .5 Aggregates.
 - .6 Water.
- 1.4.4 Provide Owner's Representative, minimum fourteen (14) days prior to starting concrete work, with valid and recognized certificate from plant delivering concrete. Certificate shall indicate that plant, materials, and methods used in fabricating concrete are in accordance with CSA A23.1 standard.
- .1 If plant does not have a valid certificate, submit test data and certificate from independent testing laboratory certifying that concrete mix materials meet the requirements of this section.
- 1.4.5 At minimum fourteen (14) days prior to starting concrete work, provide Owner's Representative and testing Laboratory with concrete mix formulas including admixtures for this project.
- .1 Include analysis results certifying that aggregates used are non-reactive. Provider shall demonstrate that aggregates contain non-significant quantities of pyrrhotite or other harmful minerals.
 - .2 For concrete mix formulas used in mass concrete, provide adiabatic temperature prediction as part of submittal.
 - .3 When the compressive strength specified for a given concrete mix is for a term greater than 28 days, the Contractor shall provide the strength gain curve including compressive resistance values at a time of 1, 3, 5, 7, 14, 28, 42, 56 days and at the specified term. The strength gain curve shall be based on strength data from at least 3 different batches of the same mix. The Owner's Testing Laboratory will produce strength curves on the same basis during the first on-site concreting of the same mix to validate the accuracy of the curves provided.
- 1.4.6 Minimum fourteen (14) days prior to beginning concrete work, provide Owner's Representative with type III Environmental Product Declaration (EDP) compliant with ISO 14025, indicating the global warming potential of all concrete material specified.
- 1.4.7 Minimum fourteen (14) days prior to beginning concrete work, provide Owner's Representative with an undamaged test cylinder made in accordance with CSA A23.2-3C for each concrete mix including white cement.

1.4.8 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet the specified resistance.

1.4.9 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in 3.14 – Field Quality Control.

1.5 Mock-Ups –Exposed Concrete

1.5.1 Walls and columns: for concrete structure exposed to view with superior quality of finish, mock-ups may be required. Refer to article 3.3 of section 03 11 00 – Concrete Forming.

1.5.2 Slabs: provide a mock-up for each different type of concrete slab for approval by the Owner's Representative. Mock-ups shall demonstrate typical joints, surface finish, texture, tolerances, floor treatments and standard of workmanship. When approved, mock-ups shall serve as a standard for workmanship, appearance and material acceptable for entire project. Mock-ups shall comply with requirements of section 03 35 00 in article intitled *Mock- ups – Slabs*.

1.6 Quality Control

1.6.1 Pre-installation Meetings: in accordance with section 01 00 00 - General Requirements. Convene pre-installation meeting one week prior to beginning concrete works.

.1 Ensure key personnel, site supervisor, Owner's Representative, speciality contractor - finishing, forming, concrete producer and testing laboratories attend.

.2 Verify project requirements.

1.6.2 Realize the following activities and submit required documents:

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.4.3 2.1	Technical descriptions of products and components of cast-in place concrete	At least fourteen (14) days prior to beginning concrete works, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription into the technical specification registry	Contractor Review by the Owner's Representative / Testing Laboratory
1.4.5	Concrete mix formulas including strength gain curve when required	At least fourteen (14) days prior to beginning work	Transmission letter Inscription into the technical specification registry	Contractor Review by the Owner's Representative / Testing Laboratory

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.4.4. 1.4.8	Compliance certificate for concrete provider and concrete mixes	Prior to beginning work	Breakpoint Compliance certificate	Contractor
1.4.6	Environmental product declaration (EPD) for concrete mixes	At least fourteen (14) days prior to beginning concrete works	Environmental product declaration (EPD)	Contractor Review by the Owner's Representative
1.4.7	Undamaged test cylinder for white cement mix	At least fourteen (14) days prior to beginning works	Test cylinder	Contractor Review by the Owner's Representative
1.5	Mock-ups	Prior to realizing works corresponding to mock-ups	Inspection report	Contractor Inspection report by the Owner's Representative
Error! Reference source not found. Error! Reference source not found.	Thermal control plan	At least fourteen (14) days prior to beginning work	Thermal control plan	Contractor in charge of concreting
Error! Reference source not found. Error! Reference source not found.	Semi-adiabatic testing	At least fourteen (14) days prior to beginning work	Test report	Contractor providing concrete

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
Error! Reference source not found.3. 5	Procedure for hot-weather concreting	At least fourteen (14) days prior to beginning work	Procedure for hot-weather concreting	Contractor
3.7	Procedure for cold-weather concreting	At least fourteen (14) days prior to beginning work	Procedure for cold-weather concreting	Contractor
3.1.2 section 03 20 00	Notice to Owner's Representative for concrete reinforcing inspection	At least forty-eight (48) hours prior to concreting	Breakpoint Inspection report	Contractor Inspection by the Owner's Representative
3.1.13	Concrete pour registry	Every concrete pour	Concrete pour registry. Delivery slip	Contractor
3.12	Concrete and concrete ingredients tests	As determined per article 3.12	Test reports	Contractor Inspection report by the Laboratory
3.4.1.1	Inspection of concrete reinforcement	Prior to concreting	Inspection report	Contractor Inspection by the Owner's Representative
3.4.1.2	Inspection of anchors, sleeves, and embedded elements	Prior to every concrete pour	Inspection report	Contractor Inspection by the Owner's Representative
3.4.1.3	Inspection of waterproofing for joint	Prior to every concrete pour	Inspection report	Contractor Inspection by the Owner's Representative

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
3.4.1.4	Inspection of joint fillers	Prior to every concrete pour	Inspection report	Contractor Inspection by the Owner's Representative
3.15.4.1	Repair procedure	Prior to repairing concrete	Repair procedure	Contractor Review by the Owner's Representative
3.15.5	Notice to the Owner's Representative	At least twenty-four (24) hours prior to repairing concrete	Breakpoint Inspection report	Contractor Inspection by the Owner's Representative
3.3.13.3.3	Proof of certification of the volumetric concrete mixer	At the first jobsite meeting	Certificate of registration	Contractor
3.3.3 3.3.6	Complete calibration documentation	At least five (5) working days before the first pour and each time a new calibration is required, according to the frequency determined in article	Breakpoint	Contractor

- 1.6.3 For all the activities to be carried out in the previous table, keep a register indicating at least the activity carried out, the date of submission by the Specialized contractor and the date of review. The register shall be updated and sent to the Owner's Representative at regular intervals, corresponding at most to the intervals between site meetings.

1.7 Delivery, Storage and Handling

- 1.7.1 Concrete hauling time: deliver to site of work and discharged within one hundred and twenty (120) minutes maximum after batching.
- .1 Do not modify maximum time limit without receipt of prior written agreement from Owner's Representative and concrete producer as described in CSA A23.1.
 - .2 Deviations to be submitted for review by Owner's Representative.
- 1.7.2 Deliver concrete using means to prevent separation of concrete mix component or any alteration to consistency.
- 1.7.3 Store and manage hazardous materials in accordance with section 01 00 00 - General Requirements.

1.7.4 Waste management and disposal:

- .1 Separate waste materials for reuse/recycling in accordance with section 01 00 00 - General Requirements.
- .2 Divert unused concrete and concrete materials to local quarry after receipt of written approval from Owner's Representative.
- .3 Provide on-site adequate space for the safe washing of concrete trucks.
- .4 Divert unused admixtures from landfill to an official hazardous material collections site.
- .5 Recover and sort packaging for recycling purposes, in accordance with the waste management plan.
- .6 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
- .7 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

2 Products

2.1 Materials

- 2.1.1 Portland Cement: to CSA A3001 or ASTM C 1157, type GU or GUL, unless otherwise indicated.
- 2.1.2 Blended hydraulic cement: to CSA A3001 or ASTM C 1157, type GUb-SF, unless otherwise indicated.
- 2.1.3 Supplementary cementing materials: to CSA A3001.
 - .1 Fly ash (FA) and natural pozzolan (N): to ASTM C 618.
 - .2 Ground granulated blast-furnace slag (S): to ASTM C 989/C 989M.
 - .3 Silica fume (SF): to ASTM C 1240.
- 2.1.4 Water: to CSA A23.1, article 4.2.2.
- 2.1.5 Non-reactive to alkalis aggregates: to CSA A23.1, article 4.2.3 and ASTM C 33/C 33M, normal weight coarse aggregate.
 - .1 The particles must be clean, durable, without dust or deleterious materials, containing less than 25% of flat particles and less than 45% elongated particles, as determined by testing to CSA A23.2-13A.

- .2 Loss by abrasion (to ASTM C 535, CSA A23.2-16A) shall be less than 50%. Loss shall be less than 12% after five (5) cycles of testing soundness by use of sodium sulfate or magnesium sulfate (ASTM C 88, CSA A23.2-9A).
 - .3 The use of potentially reactive aggregates shall be permitted only if compensatory measures as defined in CSA A23.2-27A are used. The use of a mixture containing potentially reactive aggregates is subject to the written approval of the Owner's Representative, under favorable opinion of the laboratory responsible for the quality control of materials.
- 2.1.6 Fine aggregates (sand): to CSA A23.1, article 4.2.3 and ASTM C 33/C 33M, normal weight.
- 2.1.7 Lightweight aggregates: to ASTM C 330/C 330M.
- 2.1.8 Recycled aggregates for non-structural use: to NQ 2560-600.
- 2.1.9 Admixtures:
- .1 Air entraining admixture: to ASTM C 260/C 260M.
 - .2 Chemical admixture: to ASTM C 494/C 494M or ASTM C 1017/C 1017M when added to flowing concrete. Owner's Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
 - .3 Anti-washout admixture: Eucon AWA by Euclid, MasterMatrix UW450 by Master Builders or Sika Stabilizer Aquagel by Sika.
 - .4 Retardating admixtures: to ASTM C 494/C 494M type D such as Sika Plastiment XR by Sika, MasterSet R 100 by Master Builders or Eucon 727 by Euclid.
 - .5 Shrinkage-compensating admixture: to ASTM C 494/C 494M type S, using type K, M or S expansive component as defined in ACI 223R such as Conex by Euclid or Sika Control NS by Sika.
 - .6 Corrosion inhibiting admixtures: to ASTM C 1582/C 1582M, such as Sika CNI, MasterLife CI 222 by Master Builders or Eucon CIA by Euclid.
- 2.1.10 Evaporation retardant: such as MasterKure ER 50 by Master Builders, Eucobar by Euclid or Evapre by W.R. Meadows.

2.2 Mixes

- 2.2.1 Provide concrete to meet content and performance requirements defined by Owner's Representative in accordance with CSA A23.1 on following articles. Refer to table 1 and table 2 of CSA A23.1 for requirements related to class of exposure.
- 2.2.2 Ensure that concrete supplier meet component and performance requirements identified hereafter and control compliance as indicated in 3.14 – Field Quality Control.
- 2.2.3 Refer to the following table for the characteristics of the concrete mixes. If an item can belong to more than one category, consider the most restrictive characteristics, and notify the Owner's Representative.

T Y P E	Use	Primary binder	Maximu m dimensi on coarse aggregat e	Slump or slump flow	Air conten t	Class of exposur e	Ion chloride permeab ility	Min. compress ive strength	Water on cementiti ous material (max)	Max cementit ious content except SF	Notes
			mm	mm	%		coulomb s	MPa			
1	All concrete works unless otherwise indicated, footings, foundation walls and concrete for supports,	GU, GUL	20	80 ± 30	4 to 7	F-2	---	30 at 28d	0.55	---	
2	Interior slabs-on-grade, equipment pads	GU, GUL	20	120 ± 30	0 to 3	N-CF	---	30 at 28d	0.55	20% FA 5% S	
10	Exterior concrete works, without reinforcement (sidewalks, curbs, others)	GUb-SF	20	80 ± 30 30 ± 20 (curbs)	5 to 8	C-2	---	35 at 28d	0.45	20% FA	
11	Exterior concrete works, with reinforcement (curbs, bollards, lamppost foundations, pilasters, etc.)	GUb-SF	20	80 ± 30 30 ± 20 (curbs)	5 to 8	C-1	≤ 1 500	35 at 28d	0.40	20% FA	
12	Ramps, outside porches, reinforced exterior slabs, garage floors, parking structures (all works)	GUb-SF	20	120 ± 30	5 to 8	C-1	≤ 1 500	35 at 28d	0.40	X%	
20	Lean concrete	GU, GUL	20	80 ± 30	5 to 8	N	---	20 at 28d		---	

- 2.2.4 Where the average strength of the concrete consistently exceeds the values specified in this section, the following additional requirements may apply in whole or in part at the discretion of the Owner's Representative.
- .1 The exceedance criterion for which the following requirements may apply is an average strength of more than 15 MPa above the specified strength or 130% of the strength, whichever is greater, repeated over at least three test groups.
 - .2 The requirements of article 8.8 of CSA A23.1 apply to the concrete mix.
 - .3 The curing time is extended for up to seven (7) days after the period specified in section 03 39 00.
- 2.2.5 For concrete mix used for CSC 4 exposed concrete, the requirements of article 8.8 of CSA A23.1 apply.
- 2.2.6 Concrete supplier and Contractor shall ensure that all concrete meet the following requirements:
- .1 Unless otherwise indicated, aggregates shall be of normal weight.
 - .2 Slump or slump flow is measured at the point of discharge.
 - .3 The chloride ion content is inferior to the limits specified on article 4.1.1.2 of CSA A23.1.
 - .4 For all parts of work, concrete mix shall be homogeneous and when cured, have the strength, resistance to deterioration, durability, appearance, and other properties required by this specification.
 - .5 Mix design shall ensure durability, strength, workability, and other properties required for concrete.
 - .6 Mix shall ensure that concrete flows everywhere into formworks, wrap up reinforcing bars completely but without allowing segregation of materials or excessive bleeding.
 - .7 Concrete shall be free from surface blemishes, loss of mortar or color variations.
- 2.2.7 For floors with a trowel finish, Concrete Provider and Contractor shall ensure that concrete mix is appropriate to obtain the level of quality desired for the slab finish.
- .1 Use a concrete mix having a minimum compressive strength of 25 MPa and a maximum water-to-cementitious ratio of 0.55, as specified for class N-CF concrete.
 - .2 For slab poured directly on a vapor retarding membrane, use a maximum water-to-cementitious ratio of 0.45 or less. If using a mix with a ratio higher than 0.45, the Contractor shall allow for a longer drying period for the slab to obtain the relative humidity appropriate to place floor covering.
 - .3 To ensure proper placement and finishing, consider using superplasticizer. Initial concrete slump should be near 60 mm and final slump should reach near 130 mm following addition of superplasticizer.

- 2.2.8 For slabs on ground screeded by machine, 40 mm blended coarse aggregates may be used.
- 2.2.9 When concrete thickness of vertical items is less than 200 mm, the maximum size of coarse aggregate shall be 14 mm.
- 2.2.10 Nominal size of coarse aggregate indicated for mixes should be considered a maximum rather than an absolute. The Contractor may, at their discretion, use smaller aggregates to facilitate concrete placement or for any other consideration, if it results in concrete with equal properties.
- 2.2.11 For vertical elements, the use of a concrete formulation producing an air content higher than the specified content may be acceptable if it does not affect the other properties of the concrete, in particular the strength or the appearance of the concrete, subject to the approval of the Owner's Representative.

2.3 Special Requirements

- 2.3.1 Use of admixtures.
 - .1 Provide samples of admixtures on Owner's Representative's request.
 - .2 Follow manufacturer's recommendations for admixtures use.
 - .3 Ensure compatibility of admixtures, between them and with all components of concrete mix.
 - .4 Use of admixture shall never affect adversely concrete durability including resistance under freeze-thaw cycles.
- 2.3.2 The slump value indicated in the table in article 2.2 for each mix may be modified upwards by the Contractor depending on the required workability of the concrete, the required finish of the concrete surfaces and the conditions of placement, provided that:
 - .1 The modification is accepted by all stakeholders involved in the concreting (formwork contractor, finishing contractor, concrete supplier, etc.).
 - .2 The modification is made by adding admixtures (superplasticizer) and does not affect the other properties of the concrete.
 - .3 The Contractor notifies the Owner's Representative and the Laboratory prior to issuing the concreting notice.
 - .4 The final slump value has a maximum value of 180 ± 30 mm.
- 2.3.3 Internal vibrators shall be used for consolidating concrete.
- 2.3.4 Do not modify concrete mix formulas without Owner's Representative approval. If source of supply for concrete materials is modified, new concrete mix formulas need be approved by Owner's Representative.
- 2.3.5 Unless written authorization is given by Owner's Representative, no water shall be added into concrete mix during transport or after arrival on work site.

2.3.6 Concrete mix selection for exposed concrete:

- .1 Prior to concreting of exposed elements, the Contractor shall ensure that all architectural concrete of a given level (walls and columns) is made of a concrete mix having the same type of cement. If blended cement is used for one or more exposed column or wall of a given level, then blended cement shall be used for all architectural concrete of said level.
- .2 For stairwells with exposed interior walls, the type of cement shall be uniform over the full height of the structure unless the surface is painted. Consult with the Owner's Representative who will provide specific instructions for the management of these particular cases.

2.4 Methods Of Test For Concrete

- 2.4.1 Reference values indicated in this section shall be obtained from tests in accordance with standards indicated in the following table:

TESTS	STANDARD
Air content	ASTM C 173/C 173M, ASTM C 457/C 457M, CSA A23.2-4C, CSA A23.2-7C
Compressive strength of 50 mm cube specimens	ASTM C 109/C 109M
Compressive strength of concrete cylinders	ASTM C 873/C 873M, CSA A23.2-9C
Degradation of coarse aggregates	ASTM C 535, CSA A23.2-16A
Degradation of fine aggregates	ASTM C 88, CSA A23.2-9A
Flat and elongated particles in coarse aggregate	CSA A23.2-13A
Ion chloride content	ASTM C 1218/C 1218M, CSA A23.2-4B
Ion chloride permeability	ASTM C 1202, CSA A23.2-23C
Obtaining and curing concrete test specimens	CSA A23.2-3C
Obtaining and testing drilled cores of concrete (compressive resistance)	ASTM C 42/C 42M, ASTM C 39/C 39M, CSA A23.2-14C
Obtaining concrete test specimens	ASTM C 31/C 31M, CSA A23.2-1C
Slump	ASTM C 143/C 143M, CSA A23.2-5C
Slump-flow (self-consolidating concrete)	ASTM C 1611/C 1611M, CSA A23.2-19C

- 2.4.2 Tests shall be carried out by an independent testing laboratory.

3 Execution

3.1 Preparation

- 3.1.1 Place formworks in accordance with section 03 11 00 – Concrete Forming. Place embedded elements and concrete reinforcing in accordance with sections 03 15 00 – Concrete Accessories and 03 20 00 - Concrete Reinforcing.
- 3.1.2 Obtain Owner's Representative's approval before placing concrete.
 - .1 Provide forty-eight (48) hours minimum notice prior to placing of concrete.
 - .2 The notice shall identify the element cast, the concrete mix, the location and confirm the checks carried out prior to concreting in particular. Use a form prepared for this purpose.
- 3.1.3 During concreting operations:
 - .1 Development of cold joints is not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
 - .3 Placing of concrete shall be done in accordance with article 7.5 of CSA A23.1 standard.
- 3.1.4 Pumping of concrete is permitted only after approval of equipment and mix, conditional to execution in accordance with testing laboratory recommendations.
- 3.1.5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- 3.1.6 Prior to placing concrete, formworks shall be cleaned and free of water.
- 3.1.7 Calcium chloride and other de-icing salts shall not be used as de-icing agents for cleaning purposes in formwork.
- 3.1.8 Prior to placing of concrete, obtain Owner's Representative's approval of proposed method for protection of concrete during placing and curing.
- 3.1.9 Approval is given before concreting, conditional to:
 - .1 Previous approval of formworks and concrete reinforcing after inspection by the Owner's Representative.
 - .2 Favorable climatic conditions, namely an external temperature between 5 and 25°C and the absence of rain or snow, unless the Owner's Representative has approved arrangements (shelter, heating, etc.) previously.
- 3.1.10 Protect previous work from staining.
- 3.1.11 Take special precautions where concrete will be exposed to prevent any damage.
- 3.1.12 Clean and remove stains prior to application for concrete finishes.

- 3.1.13 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken. Submit concrete works registry at the end of each phase of work.
- 3.1.14 Where new concrete is placed in contact with existing concrete or masonry works, follow the directions in section 03 20 00, unless otherwise indicated on drawings.
- 3.1.15 Do not load new concrete until authorized by Owner's Representative.

3.2 Production Of Concrete

- 3.2.1 Provide ready-mixed concrete, fabricated in concrete plant, delivered, and offloaded to site in accordance with article 5.2 of CSA A23.1 standard.
- 3.2.2 Producer of ready-mixed concrete is the sole responsible for formulation of concrete. Producer shall take all steps required to ensure production of high quality, uniform concrete.
- 3.2.3 Request from concrete provider delivery slip for each delivery of concrete and hand over one copy to Owner's Representative. Delivery slip shall include name and address of the batch plant, truck number, name of Contractor, designation of the job (name and location), class or designation of the concrete, amount of concrete delivered and cumulative amount, time of loading, of beginning of unloading and of end of unloading, maximum size of coarse aggregate, slump and air content required, admixtures used, amount and type of cement and water quantity.
- 3.2.4 **Adding water after initial batching at concrete plant is prohibited**, notwithstanding any indications given in article 5.2.5.3.2 of CSA A23.1 standard. Use water-reducing admixture to ASTM C 494, type F or G, to correct concrete's slump.
- 3.2.5 Plan fabrication of concrete and spread deliveries to site to ensure that pouring is continuous.
- 3.2.6 Never again batch concrete or mortar after beginning of hardening.
- 3.2.7 Concrete temperature at discharge shall be within limits of table 14 of CSA A23.1, tested to article 5.2.5.4 of the same standard. Use protective means whenever necessary.
- 3.2.8 Quality control at plant:
 - .1 The concrete supplier shall allow access to its facilities at the request of the Owner's Representative.
 - .2 The testing laboratory designated by the Owner may visit the plant to observe the batching process, the management of the aggregates, the temperature of the raw materials, the method for incorporating fibers in the mix or any other element which could affect the quality of the concrete.

3.3 Job-Site Production of Concrete

- 3.3.1 Volumetric mixers used for field concrete manufacture shall be certified by the Volumetric Mixer Manufacturers Bureau to VMMB 100-01. Provide proof of certification to the Owner's Representative.

- 3.3.2 Concrete production using a volumetric mixer shall comply with the requirements of ASTM C 685/C 685M, ACI 304.6R and VMMB 100.
- 3.3.3 The concrete manufacturer shall perform complete calibration tests for each gauge and volumetric measuring device used and for each constituent of the concrete mixtures, to be produced in accordance with Chapter 6 of ACI 304.6R and Chapter 7 of ASTM C 685/C 685M. Data on these tests as well as the materials proposed for the project shall be provided to the Owner's Representative.
- 3.3.4 Complete calibration of the various gauges and measuring devices for the ingredients shall also be carried out at the Contractor's expense:
- .1 Whenever the source or characteristics of ingredients are changed.
 - .2 For all new equipment.
 - .3 When test data indicate that the concrete does not meet specified performance criteria.
 - .4 When major mechanical repairs are made to the concrete mixer.
 - .5 When a change is made to the proportions of materials or mix for which previous calibration data are not available.
 - .6 When specified by the Owner's Representative.
- 3.3.5 The suggested calibration procedure is presented in ACI 304.6R and VMMB 100. A minimum of three to five tests within tolerances are required to obtain a compliant calibration.
- 3.3.6 Submit all calibration reports and associated documentation prior to concrete production. Review of calibration reports is a prerequisite to obtaining authorization for concreting. Allow a minimum of five (5) working days for review by the Owner's Representative and/or the Laboratory.
- 3.3.7 The flow rate of water supplied to the continuous mixer shall be measured by a calibrated flow meter coordinated with the cement and aggregate feed mechanism and with the mixer. The system shall allow to adjust the flow of water to control the slump at the desired level and to determine that the water-binder ratios are respected.
- 3.3.8 Liquid admixtures shall be added using a calibrated flow meter.
- 3.3.9 Tolerances in the dosage of the various ingredients shall be within the limits listed in section 7.8 of ASTM C 685/C 685M, reproduced here.

Element	Tolerance
Cement, by mass	0 to + 4%
Fine aggregates, by mass	+/- 2%
Coarse aggregates, by mass	+/- 2%

Admixture, by mass or volume	+/- 3%
Water, by mass or volume	+/- 1%

3.3.10 Pay attention to the degree of compaction of the cement, the grading of fine and coarse aggregates, the water content and swelling factor of fine aggregates, and the viscosity of admixtures.

3.3.11 Before commencing calibration and before any concrete manufacturing operation, check the condition of all equipment. It is imperative to ensure that all critical components are in good working order. These include, but are not limited to:

- .1 The cement distributor shall be clean and free of any build-up of materials.
- .2 Valves shall operate smoothly and without leakage.
- .3 Any accumulation of material on a control surface or opening in the system shall be cleaned.
- .4 Mixer augers shall not be worn beyond the manufacturer's recommended limits.
- .5 There shall be no accumulation of concrete on the mixer auger surfaces.
- .6 There shall be no leaks in hydraulic or pneumatic systems.
- .7 There shall be no cuts or damage to the insulation of electrical wires. Electrical wires shall not be cut or damaged and all covers and guards shall be held securely in place.

3.4 Installation / Application

3.4.1 Prior to concreting, the Contractor shall demonstrate to the satisfaction of the Owner's Representative the conformity of the following work. Ensure that the Owner's Representative has released the following breakpoints before starting any subsequent activity.

- .1 Concrete reinforcement work (see section 03 20 00).
- .2 Anchors, sleeves, and embedded elements work (see section 03 11 00 article 3.2).
- .3 Joint waterproofing work (see section 03 15 00 article 3.5).
- .4 Joint fillers work (see section 03 15 00 article 3.3).

3.4.2 Prior to concreting, ensure that the following procedures and / or methods have been submitted and approved by the Owner's Representative:

- .1 Methods for cold-weather concreting (see article 3.7.1).
- .2 Methods for hot-weather concreting (see article 3.5.1).

- .3 Temperature control plan (see articles **Error! Reference source not found.** and **Error! Reference source not found.**).
- 3.4.3 Execute cast-in-place concrete work to CSA A23.1.
- 3.4.4 Saturate (saturated surface dry – SSD) with water hardened concrete surfaces where new concrete will be placed.
- 3.4.5 Bond fresh concrete to rock or hardened concrete to CSA A23.1 article 7.9.5.
- 3.4.6 Concrete shall look good, be free from honeycomb, cold joints, burrs or other defects.
- 3.4.7 Wherever concrete will be exposed, take special precautions in placing concrete and in using good quality brand-new formworks.
- 3.4.8 Ensure no shocks or impacts occur on formworks and on freshly poured concrete.
- 3.4.9 Deposit concrete in horizontal layers, 500 mm thick maximum, as near as possible to its final position.
- 3.4.10 Free-drop of concrete shall not exceed 1.5 m to prevent segregation. Use chutes, slides, windows and/or trunks whenever necessary. When concreting piles or concrete-filled steel column, free-fall may be increased upon approval by Owner's Representative. Notwithstanding those indications, the Contractor is solely liable for choosing the methods of concreting including free-drop height and assuming responsibility for any damage that may occur.
- 3.4.11 When pumping concrete, lowering a trunk down into the casing from the top to limit the drop height is likely to create segregation of concrete during the interruption of pumping or when opening the valve before the descent of the trunk. This method cannot be considered as to guarantee proper placing of concrete – the addition of access window in the formwork should be used.
- 3.4.12 For placing concrete for any concrete element, specifically columns, shear walls and any element with significant reinforcing quantity, use superplasticizer admixture to facilitate placing.
- 3.4.13 Internal vibrators shall be used for consolidating concrete. Vibrators shall be applied at such spacing intervals as to compact all concrete properly. Do not vibrate excessively as to prevent segregation. Do not use vibration to force concrete horizontally in place. Follow requirements of CSA A23.1 article 7.5.4.2 and ACI 309R for consolidating concrete.
- 3.4.14 When using internal vibrators for consolidating concrete is not feasible, self-consolidating concrete shall be used.
- 3.4.15 Do not place concrete in water unless special authorization is given. Follow the Owner's Representative and testing laboratory instructions strictly. If a special authorization is given for placing concrete in water, use an anti-washout admixture.
- 3.4.16 Under adverse weather or if equipment failure occurs, take actions to prevent deterioration of freshly poured concrete. When discontinuing work, prepare construction joints and protect fresh concrete with membranes.

- 3.4.17 The Contractor shall allow a minimum of twenty-four (24) hours between pouring concrete for columns or walls and pouring concrete for structural slabs over these elements.
- 3.4.18 When placing concrete for slabs, follow the requirements of ACI 302.1R standard.
- 3.4.19 Place grout under machinery bases and pedestals, per manufacturer's recommendations, to obtain a bearing surface of 100% of the area covered by grout.

3.5 Hot-Weather Concreting

- 3.5.1 Hot-weather concreting shall comply with CSA A23.1, article 7.2.1 and ACI 305R. Submit, for approval by the Owner's Representative, hot-weather concreting procedure prior to beginning works.
- 3.5.2 The Contractor shall protect in-place concrete against the effects of heat and dry weather. During very hot periods, the Contractor must protect formworks, reinforcement, and concreting equipment against the direct rays of the sun or cool them by spraying water.
- 3.5.3 When outside temperature is 25°C or more, or when the Owner's Representative judges that the temperature may rise to 25°C or more during concreting, use special precautions to maintain concrete temperature as low as practicable, and never higher than 30°C when minimum dimension of concrete element is smaller than 1 m, 25°C when this dimension is between 1 and 2 m and 20°C for elements larger than 2 m.
- 3.5.4 Costs for hot-weather concreting are included in concrete pricing.

3.6 Protection Against Drying

- 3.6.1 During placement of concrete, Contractor shall estimate the rate of superficial moisture evaporation using figure D.1 of CSA A23.1 standard. When the rate is higher than 0.50 kg/(m²*h), the Contractor shall use supplementary means of protection as defined by article 7.2.1 of CSA A23.1, such as:
 - .1 Wet support before placing concrete.
 - .2 Lower concrete temperature.
 - .3 Cover concrete surface prior to and between different steps when finishing concrete.
 - .4 Vaporize water (use fogging) continuously after concrete placement, taking care that ponding does not occur.
 - .5 Start curing immediately after final finishing; or
 - .6 Place and finish concrete by night or early in the morning.
- 3.6.2 In addition to actions defined in article 3.6.3.6.1, the Contractor may use an evaporation retardant to article 2.1.10. The evaporation retardant shall be used immediately after concrete placement, following the manufacturer's recommendations. Depending on climatic conditions, many successive applications may be required.
- 3.6.3 The Owner's Representative or the representative from the testing laboratory may require the use of supplementary means listed above if the Contractor is not able to demonstrate that the rate of superficial moisture evaporation is lower than 0.50 kg/(m²*h).

3.7 Cold-Weather Concreting

- 3.7.1 Cold-weather concreting shall comply with CSA A23.1, article 7.2.2 and ACI 306R. Submit, for approval by the Owner's Representative, cold-weather concreting procedure prior to beginning works.
- 3.7.2 Before placing concrete under cold-weather conditions, all equipment needed to protect concrete shall be available on site of works.
- 3.7.3 Obtain approval from Owner's Representative before pouring concrete when exterior temperature is below 5°C.
- 3.7.4 When outside temperature is 5°C or below, or when the Owner's Representative judges that temperature may fall below 5°C during concreting, ensure that concrete temperature remains above 13°C at placing (at the discharge after pumping if applicable), and never higher than 32°C. Heat water and aggregates if necessary before mixing.
- 3.7.5 When concreting is not done under heated enclosures, Owner's Representative may stop concreting if temperature drops to -10°C or below or if winds or snow affects adversely concreting.
- 3.7.6 Before concreting, inner walls, reinforcing bars and bottom of formworks including steel decking shall be cleaned free of snow or ice. Heat formwork and reinforcing bars if necessary. No concrete shall be poured where surfaces or reinforcing bars temperature is below 5°C.
- 3.7.7 After concreting, maintain surface temperature of concrete at 21°C for a minimum of three (3) days or 10°C for a minimum of seven (7) days or the duration of curing, whichever is longer. Concrete temperature shall remain over freezing point for a minimum of seven (7) days and concrete shall not be exposed under freeze-thaw cycles for a minimum of fourteen (14) days.
- 3.7.8 Use of calcium chloride, other de-icing salts, or chemical products as substitute to proper curing and protection methods is prohibited.
- 3.7.9 After protection, concrete temperature shall be lowered progressively, up to a maximum of 12°C per day, until concrete reaches the outside temperature.
- 3.7.10 If heated enclosures are used, the Contractor shall, if necessary, moisten air to maintain concrete and formwork moist. Stationary heaters can be used as long as concrete surfaces will not be exposed to heating gases resulting from combustion.
- 3.7.11 Costs for cold-weather concreting are included in concrete pricing.

3.8 Construction Joints

- 3.8.1 Refer to CSA A23.1, article 7.3 for construction joints.
- 3.8.2 When concrete works are of a volume or complexity such that placing cannot be done in one operation, the Contractor shall, with approval of Owner's Representative, add construction joints even where there is no indication on drawings. Costs for materials and handiwork required to execute construction joints shall be assumed by the Contractor.

- 3.8.3 The Contractor shall submit a drawing with location and details for construction joints to the Owner's Representative, who may take up to two (2) weeks for review.
- 3.8.4 Respect the following parameters when choosing a pattern for construction joints:
- .1 Irregular construction joints are prohibited.
 - .2 Construction joints shall be placed within the middle third of spans.
 - .3 Avoid joints in beams where possible.
 - .4 Align joints from one floor to another.
 - .5 No vertical joints shall be placed within shear walls or the foundation slab of stairwells and elevators.
 - .6 The configuration of construction joints shall consider the presence of underlying or contiguous rigid elements which restrict potential movements of the slabs.
- 3.8.5 Concrete reinforcement shall be continuous through the construction joints. For each joint in a structural slab, use a shear key and add supplementary 15M@300 o/c 1200 mm long rebars at the center of slab.
- 3.8.6 For vertical elements (walls, continuous footings), place construction joints at 20 m center-to-center maximum. For structural slabs, mat and slab on ground place construction joints to delimit a maximum area of 25 m by 25 m.
- 3.8.7 Construction joints indicated on drawings are mandatory and shall not be moved.
- 3.8.8 Horizontal construction joints between concrete elements shall be roughen to a full amplitude of 5 mm.
- 3.8.9 Before placing new concrete, Contractor shall prepare joint in accordance with the following requirements:
- .1 Tighten formworks at joint.
 - .2 Clean thoroughly hardened concrete to obtain a surface free of foreign matter, laitance, damaged concrete, etc.
 - .3 Saturate surface with water (saturated superficially dry – SSD).
 - .4 Cover hardened concrete with a mortar of same composition than mortar used for concrete and add a bonding agent following the manufacturer's recommendations.
- 3.8.10 When preparing construction joints for deep members, pour concrete in excess and screed one (1) or two (2) hours after discharge.
- 3.8.11 Where indicated, respect concreting sequence. Allow a minimum of seven (7) days before pouring concrete in neighboring section.

3.9 Concreting Over Existing Concrete or Masonry Works

- 3.9.1 Clean thoroughly concrete used as substrate to obtain a surface free of foreign matter, dusts, damaged concrete, etc.
- 3.9.2 When needed, clean existing reinforcing bar by grinding or any other means except sandblasting or waterblasting. When loss of steel exceeds 25% of reinforcing bar section, replace existing reinforcing bars and add dowels if needed.
- 3.9.3 Obtain Owner's Representative approval for exposed surfaces before placing formworks.
- 3.9.4 Prepare surface to CSA A23.1 article 7.9.3.2, method c) or d). All laitance, dirt, dust, debris, grease, or any other foreign matter that may adversely affect bond between existing and new concrete shall be removed. Surface shall be rough and clean before placing new concrete.
- 3.9.5 The roughness of the concrete surface shall correspond to a CSP 6 surface profile or higher unless otherwise indicated on the drawings.
- 3.9.6 Apply bonding agent just before placing new concrete, to CSA A23.1 article 7.9.4.2 and manufacturer's recommendations.
- 3.9.7 Existing concrete surfaces shall be saturated surface dry (SSD) before placing new concrete.
- 3.9.8 Pour concrete shown on drawings to CSA A23.1, article 7.5.

3.10 Concrete Curing and Finishing

- 3.10.1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
- 3.10.2 Using chisel, break concrete projections left by the open joints of the formwork.
- 3.10.3 Finishing to section 03 35 00 – Concrete Finishing.
- 3.10.4 Curing to section 03 39 00 – Concrete Curing.
- 3.10.5 Do not place load upon new concrete before concrete has reached the required strength.

3.11 Construction Tolerances

- 3.11.1 Follow requirements of CSA A23.1, article 6.4, for construction tolerances for cast-in-place concrete.
- 3.11.2 In case of non-compliance, the Owner's Representative may require the demolition of the non-compliant element and the construction of a new one, following tolerances to article 6.4, without any additional cost. Alternatively, a permanent deduction may be applied to the global price of the contract as a compensation for the lower quality of the work. The Owner's Representative will be the sole judge of the appropriate withholding amount, which may amount up to the equivalent cost of the demolition and reconstruction of the element.

3.12 Field Quality Control

- 3.12.1 Conduct tests as follows and in accordance with section 01 45 00 - Quality Control. Submit report as described in 1.5 – Action and Informational Submittals.
- 3.12.2 Inspection and testing of concrete and concrete materials shall be carried out by testing laboratory, certified to CSA A283, designated by Owner's Representative for review to CSA A23.1. In general, inspection and testing is done in accordance with procedures complying with CSA A23.2-25C.
- 3.12.3 The Contractor shall cooperate fully to facilitate testing by allowing access to work site and equipment, providing manpower and materials needed to prepare cylinders, and providing a proper secure space for storing samples.
 - .1 Inform testing laboratory at least twenty-four (24) hours before pouring concrete, no matter the volume of concrete to be poured.
 - .2 Set aside on site a place protected against weather conditions where concrete cylinders will be stored, at a temperature of at least 10°C and at most 25°C before being delivered to laboratory.
- 3.12.4 Except as noted in article 3.12.5, one group of tests shall be carried out to evaluate compressive strength for every 50 m³ of concrete, but not less than one group of tests for each class of concrete poured in a given day.
- 3.12.5 When concrete is produced using a volumetric concrete mixer, one group of tests shall be carried out to evaluate compressive strength for every 20 m³ of concrete maximum, but not less than one group of tests for each class of concrete poured in a given day.
- 3.12.6 Tests shall be carried out in accordance with the indication of article 2.4 of this specification. A group of tests shall include, as a minimum, three (3) cylinders, one slump test and one air content test. Test air content for each concrete truck when concrete will be exposed to freeze-and-thaw cycles or exposed to de-icing salts.
- 3.12.7 Slump tests shall be carried out in sufficient number to ensure uniform consistency of concrete.
- 3.12.8 Testing laboratory shall take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- 3.12.9 The Owner shall pay for the costs of tests indicated above.
- 3.12.10 Non-Destructive Methods for Testing Concrete shall be conducted to CSA A23.2.
- 3.12.11 Inspection and testing by Owner's Representative or testing laboratory cannot replace nor complete the Contractor's quality control. No inspection can liberate the Contractor from their obligations in this respect.

- 3.12.12 If tests demonstrate that concrete resistance is inferior to specification or to requirements of CSA standards, the Owner's Representative may require obtaining drilled cores from the concrete work for testing. If said tests demonstrate that concrete resistance follows requirements, cost of tests shall be assumed by the Owner. If not, costs shall be paid by the Contractor. The Owner's Representative may require that drilled cores be obtained and tested when, based on their opinion, concrete pouring or curing was not done in accordance with the specifications of this section.

3.13 Interpretation Of Compressive Strength Test Results

- 3.13.1 Interpretation of compressive strength test results shall be done in accordance with article 4.4.2.3.1 of CSA A23.1 standard. Concrete meets the requirements of this specification for compressive strength if:

- .1 The average value of a group of three (3) consecutive tests equals or exceeds the specified strength.
- .2 Compressive strength equals at least the specified resistance minus 3.5 MPa for all individual tests.

- 3.13.2 When test results do not meet the above requirements, the Owner's Representative may require, without any additional costs from the Contractor, that:

- .1 Mix proportions are changed for the remainder of work.
- .2 Additional curing is done on the portion of the work represented by test specimens.
- .3 Cores be drilled from the portion of structure in question, in accordance with ASTM C 42/C 42M, ASTM C 39/C 39M and CSA A23.2-14C, interpreted to article 4.4.2.3.2 of CSA A23.1.
- .4 The portion of structure is submitted to load tests, to CSA A23.3, article 20.

- 3.13.3 When the specified resistance applies to a period greater than 28 days, the interpretation of the results is carried out as follows:

- .1 The 28-day resistance obtained by the tests is compared to the reference value of the strength gain curve obtained from the supplier, using the interpretation method described in article 3.13.1 above.
- .2 If the results of the 28-day tests do not meet the resistance of the reference value, the concrete is deemed to have a structural deficiency. The corrective measures required by article 3.13.23.13.2 are then applied, without waiting for results to be obtained at a later date. For example, the Owner's Representative may require at this time that the formula be modified for future concrete work.
- .3 If the strength of the concrete is found to be compliant when the results are obtained at the specified deadline, the deficiency will be lifted, but any expense incurred for the corrective measures done pre-emptively remain the sole responsibility of the contractor.

3.14 Non-Compliant Work

- 3.14.1 Structural defect.

- .1 Work or part of work has a structural defect when concrete strength, as interpreted by article 3.13 of this specification, does not meet the specified resistance.
- .2 Moreover, work or part of work presents a structural defect if one of the following conditions occur:
 - .1 Concrete mix formula was not approved prior to pouring,
 - .2 Owner's Representative and/or testing laboratory was not informed before concreting,
 - .3 Concrete pouring was not done following the requirements of this specification.
 - .4 Concrete was poured without explicit approval of Owner's Representative.
 - .5 Concrete work or part thereof has frozen, even if no damage is apparent.
- .3 Notwithstanding the results of any tests done during concrete pouring, work or part of work presenting a structural defect as interpreted by article 3.14.1.2 is considered as if not meeting the specified strength requirement per article 3.13.1.
- .4 When specific requirements are given for mixes formula, such as chloride ion permeability or spalling due to salt, to ensure or improve durability of concrete, failure to meet these requirements is considered a structural defect.

3.14.2 Esthetic defect.

- .1 Work or part of work has an esthetic defect when concrete is soiled, contaminated by debris, contains honeycombs, surface voids or bug holes, protrusion, smudges, change in colors or any other similar defect. Concrete work that does not meet the finishing criteria defined in article 3.3 of section 03 11 00 – Concrete Forming is also considered to have an aesthetic deficiency.
- .2 Notwithstanding the article above, presence of surface voids, bug holes and/or honeycombs in concrete with a class of exposure C-1 or C-XL is considered presenting a structural defect as in article 3.14.1.
- .3 The following definitions shall be used when determining esthetic deficiencies:
 - .1 Surface voids or bug holes: Small regular or irregular cavities, usually not exceeding 12 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.
 - .2 Honeycombs: Concrete or part of concrete that, due to lack of the proper quantity of fine aggregates or vibrations, contains abundant interconnected large voids or cavities; honeycombs may result from improper consolidation. Any regular or irregular voids exceeding 12 mm in diameter are considered honeycombs.
 - .3 Protrusion: any part of concrete work protruding 5 mm or more from concrete work where rough-form finish is specified. Where smooth-form finish is required, any protrusion from concrete work is considered a defect.

- .4 Smudges: any spillage of concrete from formwork.
- .5 Changes in color: any change in color that affects adversely the overall look of the concrete work.

3.14.3 Cracking in new concrete work:

- .1 Presence of cracks with openings of 0.3 mm or more in new concrete work is considered a defect. Presence of a network of cracks with openings of 0.2 mm or more is considered a defect. One or more cracks of a total length exceeding 1.5 m on an area of 0.25 m² constitute a network of cracks.

3.15 Corrective Work

3.15.1 Structural defect.

- .1 If, after taking actions as defined in section 3.13.2 of this specification, the Owner's Representative still believes that concrete of part of or of all of the works does not meet the strength requirements, they may require strengthening or replacement (demolition and reconstruction) of part of or of the whole work as appropriate. All costs shall be assumed by the Contractor.
- .2 When a structural defect is identified resulting in a lesser durability of the work, but without affecting strength, the Owner's Representative may require that:
 - .1 One or more compensatory measures to obtain a work of a durability equivalent, in the opinion of the Owner's Representative, to that which would have been obtained with the use of a concrete meeting the requirements of this specification, without costs to the Owner.
 - .2 A permanent deduction may be applied to the global price of the contract as a compensation for the lower quality of the work. The Owner's Representative will be the sole judge of the appropriate withholding amount determined on the basis of future expenses (maintenance and repairs) due to the lesser durability, which may amount up to the equivalent of the cost of demolition and reconstruction of the element.

3.15.2 Esthetic defect.

- .1 Make sure the Owner's Representative has inspected defects before beginning surface repairs.
- .2 Any damaged or soiled concrete, or concrete containing debris shall be repaired in accordance with the Owner's Representative directives.
- .3 Honeycombs made visible after removal of formworks shall be scraped to solid concrete, to a minimum depth of 10 mm. Repairs shall be circumscribed by saw cuts of a regular shape without angles of 60 degrees or less. Zone of repairs shall extend at least 150 mm into sound concrete all-around the perimeter of honeycombs.
- .4 When necessary, concrete faces shall be cut to obtain sharp regular edges using saw. Surfaces shall be cleaned, and cavities coated with an epoxy bonding agent then filled with an epoxy modified grout, held in place by formworks if necessary.

- .5 Protrusions, burrs, smudges, etc. due to formworks shall be grinded.
- .6 If concrete faces finish is not satisfactory, if the extent of repair needed is too extensive or if concrete presents significant changes of colors, the Owner's Representative may require the application of a coating product (cement-based paint, epoxy-based grout, or any other product deemed appropriate) on all exposed faces, without any costs to the Owner.
- .7 Corrective work shall conform to article 3.3 of section 03 11 00 – Formwork.

3.15.3 Cracks in new concrete.

- .1 Cracks with openings of 0.3 mm or more shall be injected as described in section 03 15 00 – Concrete Accessories.
- .2 Where a network of cracks is present, the Owner's Representative may require one of the following measures:
 - .1 Application of a coating product (cement-based paint, epoxy-based grout, or any other product deemed appropriate).
 - .2 Partial demolition and reconstruction with an appropriate product.

3.15.4 Procedure for repairing deficiencies.

- .1 The Contractor is responsible to submit methods for repairing deficiencies. They need to obtain the Owner's Representative approval of said method before proceeding with reparations.
- .2 Refer to Guideline No. 310.1R *Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion* by ICRI when preparing methods for repairing deficiencies. Refer to chapters 5 to 7 when determining geometry and extent of surfaces to demolish prior to repairing.
- .3 Refer to Guideline No. 320.2R *Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces* by ICRI when selecting repair materials.
- .4 Refer to Guideline No. 320.1R *Guide for Selecting Application Methods for the Repair of Concrete Surfaces* by ICRI when selecting application method for repair materials.

3.15.5 Inform the Owner's Representative after finishing demolition prior to reparation, at least forty-eight (48) hours before applying repair materials, to allow for inspection.

3.15.6 All costs associated with additional work site supervision due to defect repairs are considered the responsibility of the Contractor and shall be paid by applying a permanent deduction to the contract.

END OF SECTION

1 General

1.1 Related Requirements

- 1.1.1 Section 03 11 00 – Concrete Forming.
- 1.1.2 Section 03 15 00 – Concrete Accessories.
- 1.1.3 Section 03 20 00 – Concrete Reinforcing.
- 1.1.4 Section 03 30 00 – Cast-in-Place Concrete.
- 1.1.5 Section 03 39 00 – Concrete Curing.
- 1.1.6 Section 07 92 00 – Joint Sealants.
- 1.1.7 The Contractor shall obtain a copy of all sections even if they do not pertain directly to his speciality. When bidding, the Contractor agrees implicitly with articles and requirements of all sections in these specifications, including those he might not have read. The Contractor should consult the table of contents of the specifications to be aware of the complete list of sections.

1.2 References

- 1.2.1 American Concrete Institute (ACI).
 - .1 ACI 302.1R-15, Guide for Concrete Floor Slab Construction.
- 1.2.2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM C 920-18, Standard Specification for Elastomeric Joint Sealants.
 - .2 ASTM E 430-23, Standard Test Methods for Measurement of Gloss of High-Gloss Surfaces by Abridged Goniophotometry.
 - .3 ASTM E 965-15(R2024), Standard Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique.
 - .4 ASTM E 1155/E 1155M-23, Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
 - .5 ASTM F 710-22, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - .6 ASTM F 1869-23, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - .7 ASTM F 2659-23, Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter.
- 1.2.3 Canadian Standard Association (CSA)/CSA International.

- .1 CSA A23.1/A23.2-24, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - .2 CSA A283-19, Qualification Code for Concrete Testing Laboratories.
- 1.2.4 Concrete Floor Contractors Association of Canada (CFCA).
 - .1 Specification Bulletin, Polished Concrete – Gloss & Aggregate Exposure, April 12, 2011.
- 1.2.5 International Concrete Repair Institute (ICRI).
 - .1 Guideline No 310.2R-2013 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- 1.2.6 National Floor Safety Institute (NFSI).
 - .1 NFSI B101.1-2020, Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials.
 - .2 NFSI B101.3-2020, Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials.
- 1.2.7 Notwithstanding the version of the standard mentioned above, it remains the responsibility of the Contractor to consult the most recent version.
- 1.3 Performances**
 - 1.3.1 Products and workmanship quality: in accordance with section 01 00 00 - General Requirements.
 - 1.3.2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.
- 1.4 Technical Datasheets**
 - 1.4.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
 - 1.4.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets, in accordance with section 01 00 00 - General Requirements.
 - 1.4.3 Submit documents and samples in accordance with section 01 00 00 - General Requirements and coordinate the requirements of this section with those set out therein.
 - 1.4.4 Submit instructions relating to products application.
- 1.5 Quality Control**
 - 1.5.1 Realize the following activities and submit required documents:

ART.	PRESCRIPTI ONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.3.2	Declaration of compatibility of products	At least seven (7) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription to the technical specification registry	Contractor
1.4	Technical datasheets for concrete finishing products	At least seven (7) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription to the technical specification registry	Contractor Review by the Owner's Representative
3.12.2	Corrective method in case of reinforcement ripple	At least seven (7) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Corrective method	Contractor Review by the Owner's Representative
3.1.5	Evaluation of moisture content of substrate	Before application of products	Breakpoint. Test report	Contractor Testing by Laboratory
3.11.3	Flatness/levelness testing	After concreting	Test report	Contractor Testing by Laboratory
3.11.4	Evaluation of substrate prior to polishing	Prior to polishing	Breakpoint Test report	Contractor Testing by Laboratory
3.12.1	Repair procedure for levelness and flatness of slabs	Prior to beginning repair works	Repair procedure	Contractor Review by the Owner's Representative

1.5.2 For all the activities to be carried out in the previous table, keep a register indicating at least the activity carried out, the date of submission by the Specialized contractor and the date of review. The register shall be updated and sent to the Owner's Representative at regular intervals, corresponding at most to the intervals between site meetings.

1.6 Delivery, Storage and Handling

1.6.1 Store and manage hazardous materials in accordance with section 01 00 00 - General Requirements.

1.6.2 Waste Management and Disposal

.1 Separate waste materials for reuse/recycling in accordance with section 01 00 00 - General Requirements.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Collect and sort packaging for recycling, in accordance with the waste management plan.

.4 Ensure that empty recipients are sealed and stored properly before elimination.

.5 Divert unused hazardous material from landfill to an official hazardous material collections site as approved by the Owner's Representative, in accordance with all applicable legislation.

.6 Dispose of waste generated by work (scarification, stripping of floor, etc.) in an environmentally sound manner.

2 Products

2.1 Chemical Hardeners

2.1.1 Liquid hardener (densifier)

.1 Use a sodium silicate product, translucent, acting as densifier and dustproofing.

.2 Approved products:

.1 MasterKure HD 100WB by Master Builders.

.2 Sikafloor 3S by Sika.

.3 Eucosil by Euclid.

.4 Mapecrete Hard SI by MAPEI.

3 Execution

3.1 Environmental Requirements

3.1.1 Temporary lighting:

.1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 square meters of floor being treated.

3.1.2 Electrical power:

- .1 Provide sufficient electrical power to operate equipment normally used during construction.

3.1.3 Work area:

- .1 Make work area watertight, protected against rain and detrimental weather conditions.

3.1.4 Temperature:

- .1 Maintain ambient temperature of not less than 10 degrees C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

3.1.5 Moisture:

- .1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer. Moisture content shall be controlled by laboratory test and a written report presented prior to product application.

3.2 Finishing Of Formed Surfaces

- 3.2.1 Clean and finish formed surfaces in accordance with article 7.10.2 of CSA A23.1 standard. Use smooth-form finish in accordance with article 7.10.2.6 for exposed surfaces. Finish shall enable installation of membrane whether thermofusible or not. Rough-form finish in accordance with article 7.10.2.5 is deemed acceptable for all other surfaces (surface not exposed to view or in the absence of membranes).

- 3.2.2 For all corners of exposed concrete, chamfer corners to 25 mm, even if no indications are given on drawings.

- 3.2.3 Refer to section 03 11 00 – Concrete Forming for patching of form tie holes.

3.3 Preparation of Slabs

- 3.3.1 Examine slab surfaces and environmental and workmanship conditions to ensure that all manufacturer's requirements are met for the application of finishing products. Verify slab levels and compare to shop drawings and manufacturer's requirements.

3.4 Slab Flatness Tolerances

- 3.4.1 Tolerances for slab and floor finish shall be in accordance to table 21 of CSA A23.1 standard. Method to ASTM E 1155/E 1155M shall be used to determine slab flatness by determining F numbers.

- 3.4.2 Refer to articles 7.7.1.1 and 7.7.1.4 of CSA A23.1 and the following table to determine slab flatness and methods of finishing. When a slab does not belong specifically to a category listed on the following table or no other specifics indications are given elsewhere, use tolerances associated with class B.

Class	Examples	Possible Method	Global F number

			F_F	F_L
A	"Conventional" slab	Hand screeded and single trowel finished	20	15
B	"Flat" slab	Manual or mechanical screeding, pan floating and trowelling.	25	20
C	"Very Flat" slab on ground	Manual or mechanical screeding, bull floating and trowelling using steel trowels.	35	25
D	"Extremely Flat" slab on ground	Concreting in narrow strips, mechanical screeding, bull floating and trowelling using steel trowels	45	30

*Refer to table 21 of CSA A23.1 standard. The above table was developed using the information contained in table 21.

3.4.3 Refer to following table to determine which class applies to different concrete surfaces.

Class	Surfaces
A	Floors to support terracotta or ceramic tiles or terrazzo Roof to support insulating panel, composite roof or waterproofing membrane
B	Ramps for pedestrian or vehicle Floors permanently covered (glued tiles, linoleum, carpets, etc.) Any exposed concrete surface not belonging to a superior category.
C	Warehouse
D	Loading dock

3.5 Slab Finish

3.5.1 Concrete slab finish shall be done in accordance with CSA A23.1 article 7.7 and ACI 308R requirements. Requirements hereby presented shall be read in conjunction with those standards.

3.5.2 Do not sprinkle dry cement or dry cement and sand mix on concrete surfaces.

3.5.3 Control excess bleeding water using methods in accordance with CSA A23.1. Avoid any damage to concrete surfaces.

3.5.4 Initial Finishing.

- .1 After the placing, spreading, and vibrating of concrete, screed surfaces using properly designed screed or straight-edge.

- .2 Using bull float, darby or mechanical equipment as appropriate, work concrete to remove high spots and ridges and to fill voids and hollows. Coarse aggregate shall be slightly embedded into concrete. Surface level shall be as indicated on drawings.
- .3 Complete initial finishing before any bleeding or free water appears on the surface of concrete.

3.5.5 Final Finishing – General.

- .1 Final finishing includes edging, grooving, floating, and trowelling. Commence final finishing as soon as bleed water has disappeared, and concrete has hardened enough to prevent working of excess mortar to the surface.
- .2 Unless otherwise indicated, surfaces shall be monolithic, trowelled using steel trowel to obtain a smooth, non-slip, without streaks, trowel marks or ripples.
- .3 Finishing quality shall meet all quality requirements for the installation of flooring.
- .4 A trowel finish shall not be applied to air-entrained concrete. This does not preclude the use of pan floating on air-entrained concrete.
- .5 Floating aims to embed the aggregates and consolidate the surface paste prior to trowelling or may represent a part of the finishing steps.
- .6 Pan floating is a separate operation from troweling, even if similar tools may be used.

3.5.6 Final Finishing – Stairs and landings.

- .1 Finishing quality shall be sufficient to allow proper installation of nonslip coating. Surfaces shall be monolithic, trowelled using steel trowel to obtain a smooth, abrasive, without streaks, trowel marks or ripples.
- .2 When specified on architectural drawings, embed one carborundum band in per step over the full width of the stair.
- .3 Special care shall be taken to obtain uniform horizontal step nosing.

3.5.7 Finishing – Sidewalks.

- .1 Finish surface at levels and slopes determined on drawings. Unless otherwise indicated, transversal slope shall be 1V:40H toward pavement.
- .2 Level surface using screed bearing on forms.
- .3 Use wood trowels for first trowel pass.
- .4 Before concrete hardening, but after a proper delay, sweep the surface using a rough broom or brush, to create a surface without irregularities, holes or any other defect. Surface shall be nonslip.
- .5 Prepare cross joints with the appropriate tool for this purpose. Round sidewalk and joints edges with an iron rim of 10 mm radius.

3.5.8 Final Finishing – Ramps.

- .1 If needed, surface finish shall allow installation of waterproof membrane. Surface shall be smooth, without streaks, trowel marks or ripples. Finish shall be monolithic, trowelled using wood trowels, and nonslip grooves shall be added to a ramp without membrane.

3.5.9 Ensure that tolerances indicated in section 3.4 are met.

3.5.10 Other works.

- .1 Using carborundum, grind straight edges of concrete to obtain a 3 mm radius.

3.6 Control Joints

3.6.1 Within twenty-four (24) hours of concreting, cut control joints in slabs in accordance with CSA A23.1 standard,

3.6.2 For slabs and toppings, use specialized cutting tools to cut control joints – hand operated concrete saw is not allowed. Vertical joints shall be cut immediately after formwork removal.

3.6.3 When concrete has hardened and surface is dry, follow requirements of section 03 15 00 – Concrete Accessories for joints caulking.

3.6.4 Unless otherwise indicated, refer to drawings for control joint' location. Where there is no indications, use the general requirements as follow:

- .1 Saw cut width shall be 6 mm.
- .2 Saw cut depth shall be 40 mm. Where reinforcing steel is present, depth shall be modified as to prevent any damage to reinforcing steel.
- .3 Maximum spacing between joints on slabs and concrete toppings shall be 4.5 m in each direction, as indicated in article 7.3.2 of CSA A23.1 standard.

3.7 Application of Mineral-Aggregate Hardener

3.7.1 The Contractor shall determine methods for mineral-aggregate hardener application relying on article 10.6.1 of ACI 302.1R guide and written instructions of manufacturer. Unless otherwise indicated, the application rate shall be 9 kg/m².

3.7.2 The Contractor shall adapt the following method to the specific requirements of the project, his particular methodology and any specific site constraints:

- .1 Place concrete and complete initial finishing.
- .2 Evenly distribute two thirds (2/3) of the total quantity of mineral hardener on the surface, before the appearance of bleed water, using a mechanical spreader. If a mechanical spreader cannot be used, place hardener by two successive perpendicular passes and never place hardener from a fix location.

- .3 When sufficient moisture has been absorbed, the surface will darken and incorporation of the dry-shake into the surface may begin. Use a modified highway straightedge to embed the hardener and remove any irregularities in the surface.
- .4 Use a floating machine equipped with float blades or a wooden bullfloat to incorporate the dry shake into the surface. Do not use pan floats nor magnesium floats.
- .5 Apply the remaining hardener and use a floating machine equipped with float blades or a wooden bullfloat to incorporate the dry shake into the surface.
- .6 When more than 5 kg/m² of hardener is used, place the hardener in 3 successive layers (50%-25%-25%).
- .7 If effective, restraighthen the surface using a weighted modified highway straightedge.
- .8 Continue finishing by power trowelling to obtain the desired finish, typically with three passes. Use an appropriate method for final finishing of pigmented or anti slip surface.
- .9 Begin curing immediately following final finishing.

3.8 Application Of Metallic-Aggregate Hardener

- 3.8.1 The Contractor shall determine methods for metallic-aggregate hardener application relying on article 10.6.2 of ACI 302.1R guide and written instructions of manufacturer. Unless otherwise indicated, the application rate shall be 9 kg/m².
- 3.8.2 The Contractor shall adapt the following method to the specific requirements of the project, his particular methodology and any specific site constraints:
 - .1 Place concrete and complete initial finishing.
 - .2 Use a wooden bull float to open the surface and promote movement of bleed water to the top of the slab.
 - .3 Use a power trowel with float blades to break the surface as soon as the concrete can support the weight of the power trowel.
 - .4 Evenly distribute two thirds (2/3) of the total quantity of metallic hardener on the surface, after the disappearance of bleed water, using a mechanical spreader.
 - .5 Use a bull float or modified highway straightedge to embed the hardener and restraighthen the surface and then use the power trowel to break the surface.
 - .6 Apply the remaining hardener at right angle from first application.
 - .7 Embed hardener using the power trowel. Thorough embedment is critical to obtain satisfactory results.
 - .8 When more than 5 kg/m² of hardener is used, place the hardener in 3 successive layers (50%-25%-25%).

- .9 Restraighten the surface using a weighted modified highway straightedge.
- .10 Continue finishing by power trowelling to obtain the desired finish, typically with three passes. Use an appropriate method for final finishing of pigmented or anti slip surface.
- .11 Begin curing immediately following final finishing.

3.9 Slab With Floor Covering

3.9.1 The General Contractor, concrete provider and concrete finisher are severally liable for slab preparation to receive floor covering, including conformity with the following criteria:

- .1 Concrete curing shall be completed.
- .2 Maintain ambient temperature of not less than 10 degrees C from at least 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
- .3 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer. Where no indications are given, the moisture-vapor emission rate must be inferior to 3 lb by 1000 ft² (170 µg par m²) per 24 hours as determined by tests performed in accordance with ASTM F 1869. Alternatively, tests carried out according to ASTM F 2659 method may be used as the basis for evaluating the moisture content, subject to acceptance by the laboratory and the flooring contractor.
- .4 Ensure that concrete substrate is within pH limits prescribed by flooring manufacture. Where no indications are given, the pH value shall be between 7 and 10.
- .5 Moisture content and pH shall be controlled by independent laboratory testing and a written report presented prior to product application. The General Contractor is responsible to ensure proper testing and shall assume all costs related to testing.

3.9.2 Prepare slab to receive resilient flooring in accordance with ASTM F 710.

3.9.3 Verify whether joint sealing compound or cementitious floor screed (or similar product) should be used to fill control joint prior to applying floor covering.

3.9.4 The preceding articles shall apply as well for equipment pads where epoxy covering is used or whenever appropriate.

3.9.5 The contractor shall apply a vapor barrier membrane on the slab at his own expense if he is unable to lower the rate of water vapor emission sufficiently to allow installation of coatings in accordance with the overall project schedule. The product selected shall be compatible with the coatings and is subject to the approval of the Owner's Representative, subject to demonstration of the compatibility of products.

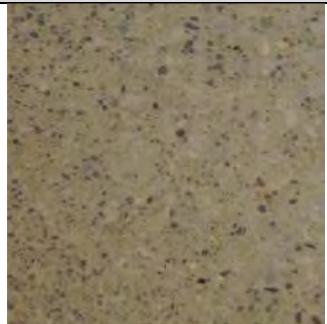
3.10 Polished Concrete

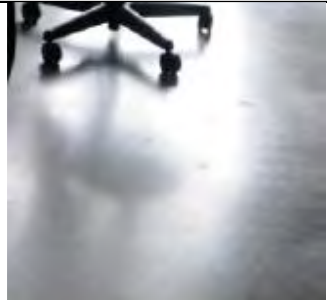
- 3.10.1 Surface preparation: clean concrete surfaces to obtain surface free of laitance, efflorescence, curing compounds, form-release agents, dirt, oil, paint, or any other contaminants.
- 3.10.2 The moisture-vapor emission rate must be inferior to 5 lb by 1000 ft² (2.45 kg by 100 m²) per 24 hours as determined by tests performed in accordance with ASTM F 1869 prior to beginning polishing.
- 3.10.3 For colored finish, pH of slab shall be between 8 and 10 as determined by testing prior to beginning polishing.
- 3.10.4 Polished concrete in accordance with manufacturer recommendation as to obtain the level of finish defined by the Architect and in the following table.

Location	Use	Estimated area	Polished finish	
			Aggregate Exposure	Gloss level
Ground Floor Grids A-F, 1-4	All slabs on grade, U.N.O.	381 m ²	A	1

- 3.10.5 Refer to specification bulletin Polished Concrete - Gloss & Aggregate Exposure of Concrete Floors Contractor Association of Canada to define polished concrete finish and to the following table, based on this publication.

Aggregate Exposure	Description	Approximate Surface Cut Depth	Example
A	Standard (Cream) No intentional effort to produce any aggregate exposure	Very little	

Aggregate Exposure	Description	Approximate Surface Cut Depth	Example
B	Fine Aggregate Exposure (Salt and Pepper) Fine aggregate (sand) exposed, coarse aggregate may be exposed randomly	1.5 mm (1/16 inch)	
C	Coarse Aggregate Exposure - Deep ground polished concrete Large aggregate exposure with little or no fine aggregate exposed	3 to 6 mm (1/8 to 1/4 inch)	

Gloss level	Description	Reflective index	Suggested method	Example
1	Flat - Satin Flat appearance with no to very slight diffused reflection	≥ 40	4 - 5 abrasive passes Grit up to 400	
2	Semi-gloss Objects being reflected are not sharp but identifiable	≥ 55	6 abrasive passes Grit up to 1500	

Gloss level	Description	Reflective index	Suggested method	Example
3	High-gloss Objects being reflected are easily identifiable. Slab appears mirror-like	≥ 70	Minimum of 7 abrasive passes Grit up to 3000	

3.10.6 Measure reflective index in accordance with ASTM E 430 before applying liquid hardener following polishing.

3.10.7 Coefficient of Friction: Achieve following coefficient of friction by field quality control testing in accordance to the following standards:

.1 ANSI B101.1 Static Coefficient of Friction: Achieve a minimum of 0.42 for level floor surfaces.

.2 ANSI B101.3 Dynamic Coefficient of Friction: Achieve a minimum of 0.35 for level floor surfaces.

3.10.8 The process of polishing concrete, for all aggregate exposure and gloss level, shall include application of a type 1 or 2 hardener, in accordance with articles 2.1.1 and **Error! Reference source not found.** of this section.

3.11 Field Quality Control

3.11.1 Site tests: conduct tests as follows and in accordance with section 01 45 00 - Quality Control. Submit report as described in 1.5 – Technical Datasheets.

3.11.2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory, certified to CSA A283, in accordance with CSA A23.1.

3.11.3 The Contractor shall demonstrate conformity with slab flatness tolerances of clause 3.4 by laboratory testing. In the absence of specific tests carried out by a laboratory, the slab is presumed **not** to respect the stated criteria.

3.11.4 Prior to placing floor covering, or prior to polishing, the Contractor shall provide a written report by the Laboratory responsible for field quality control demonstrating that the slab meets criteria for pH and moisture-vapor emission rate.

3.12 Correction Of Deficiencies

- 3.12.1 When a slab does not meet the stated flatness requirements, a correction method shall be submitted. Unless this is not possible, the preferred method of correction is grinding, as described in article 7.7.2 of CSA A23.1. Alternatively, refer to the indications in article 3.13 of this section. The surface shall be tested again, at the expense of the Contractor, following the completion of the corrective work, regardless of the period that has elapsed since the concreting of the structure.
- 3.12.2 Before carrying out work to place concrete slabs, submit a corrective method in case of a slab presenting surface undulations (reinforcement ripple) visible following finishing operations. Favor a method that allows defects to be corrected while the concrete is still in its plastic state.
- .1 During the execution of slab concreting work, look for the appearance of surface undulations (reinforcement ripple) and notify the Owner's Representative. The Contractor is responsible for correcting the defects immediately according to the method previously submitted, without waiting for the opinion of the Owner's Representative or any other third party.
- .2 If surface undulations are visible for the slab after the concrete has set, the slab will be considered as not meeting the flatness requirements and the requirements of article 3.12.1 of this section shall apply.
- 3.12.3 For formed surfaces with defects, refer to the requirements of sections 03 11 00, 03 30 00 and CSA A23.1 in general.

3.13 Slab Levelling

- 3.13.1 Where slab flatness does not meet requirements, apply a cementitious floor screed in accordance with section 03 15 00 – Concrete Accessories to obtain a levelled surface.
- 3.13.2 Prepare surfaces by sandblasting, by manual scarification or manual chipping using a "Needle Gun" to provide a surface profile CSP-4 as specified in guideline 310.2R *Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair* of ICRI.
- 3.13.3 Apply cementitious floor screed per manufacturer's recommendations.

END OF SECTION

1 General

1.1 Related Requirements

- 1.1.1 Section 03 11 00 – Concrete Forming.
- 1.1.2 Section 03 15 00 – Concrete Accessories.
- 1.1.3 Section 03 20 00 – Concrete Reinforcing.
- 1.1.4 Section 03 30 00 – Cast-in-Place Concrete.
- 1.1.5 Section 03 35 00 – Concrete Finishing.
- 1.1.6 The Contractor shall obtain a copy of all sections even if they do not pertain directly to his speciality. When bidding, the Contractor agrees implicitly with articles and requirements of all sections in these specifications, including those he might not have read. The Contractor should consult the table of contents of the specifications to be aware of the complete list of sections.

1.2 References

- 1.2.1 American Association of State Highway and Transportation Officials (AASHTO).
 - .1 AASHTO M 182-05(2021), Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
- 1.2.2 American Concrete Institute (ACI).
 - .1 ACI 308R-16, Guide to Curing Concrete.
- 1.2.3 American Society for Testing and Materials International (ASTM).
 - .1 ASTM C 171-20, Standard Specification for Sheet Materials for Curing Concrete.
 - .2 ASTM C 309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C 1315-19, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
- 1.2.4 Canadian Standard Association (CSA)/CSA International.
 - .1 CSA A23.1/A23.2-24, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- 1.2.5 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB 19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.
- 1.2.6 Notwithstanding the version of the standard mentioned above, it remains the responsibility of the Contractor to consult the most recent version.

1.3 Actions And Informational Submittals

- 1.3.1 Submittals in accordance with section 01 00 00 - General Requirements.
- 1.3.2 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets.
- 1.3.3 At least fourteen (14) days prior to curing concrete, submit to Owner's Representative methods for curing concrete and to control quality of concrete curing.

1.4 Quality Control

- 1.4.1 Realize the following activities and submit required documents:

ART .	PRESCRIPTION S	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.3. 3	Method for curing concrete	At least fourteen (14) days prior to beginning work	Transmission letter Inscription to the technical specification registry	Contractor Review by the Owner's Representative
1.3. 1	Technical datasheets for curing products, including blankets and membrane	At least seven (7) days prior to beginning work, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription to the technical specification registry	Contractor

- 1.4.2 For all the activities to be carried out in the previous table, keep a register indicating at least the activity carried out, the date of submission by the Specialized contractor and the date of review. The register shall be updated and sent to the Owner's Representative at regular intervals, corresponding at most to the intervals between site meetings.

1.5 Delivery, Storage and Handling

- 1.5.1 Store and manage hazardous materials in accordance with section 01 00 00 - General Requirements.
- 1.5.2 Waste Management and Disposal
 - .1 Separate waste materials for reuse/recycling in accordance with section 01 00 00 - General Requirements.
 - .2 Place materials defined as hazardous or toxic in designated containers.

- .3 Collect and sort packaging for recycling, in accordance with the waste management plan.
- .4 Ensure that empty recipients are sealed and stored properly before elimination.
- .5 Divert unused hazardous material from landfill to an official hazardous material collections site as approved by the Owner's Representative, in accordance with all applicable legislation.
- .6 Dispose of waste generated by work in an environmentally sound manner.

2 Products

2.1 Materials

- 2.1.1 Water: to CSA A23.1, article 4.2.2.
- 2.1.2 Membranes, sheet materials: to ASTM C 171.
 - .1 Approved products: UltraCure NCF by Sika, Transguard 4000 by Reef Industries, Reliable Cure by Reliable Concrete Accessories or Konkure by Raven Industries.
- 2.1.3 Curing compound: white or colorless, to CSA A23.1, ASTM C 309 or CAN/CGSB 19.24. Compound to ASTM C 1315 may be used conditional to approval.
- 2.1.4 Jute or burlap cloth: to ASTM C 171 and AASHTO M 182.

3 Execution

3.1 General Requirements

- 3.1.1 Follow requirements of section 03 30 00 – Cast-in Place Concrete for concreting.
- 3.1.2 Concrete curing in accordance with CSA A23.1, article 7.8 and ACI 308R. Refer to those standards when choosing curing methods.
- 3.1.3 Wet curing shall begin as soon as possible, following concrete finishing and as soon as the setting of the concrete allows, regardless of the time of day or night.
- 3.1.4 Use of curing compound is prohibited unless written authorization is given. If the Contractor wishes to use curing compounds, he shall submit in writing curing methods and all relating documents including technical datasheets for compounds. Owner's Representative may or may not approve use of curing compounds.
- 3.1.5 Whenever possible, curing methods shall be chosen such that concrete is moistened by direct contact with water.
 - .1 Use methods reviewed to Owner's Representative satisfaction and as defined in CSA A23.1 standard to eliminate bleeding water. Ensure no damage is done to concrete surfaces.
- 3.1.6 During curing, ensure that concrete remains unloaded and is protected against chocks, vibrations, weather conditions or any other element that might affect quality of works.

- 3.1.7 The curing method shall be compatible with temperature control measures, such as the use of insulating fabrics in cold weather or with measure to control the temperature of mass concrete.

3.2 Wet Curing

- 3.2.1 Water used for curing concrete shall be clean and without matters that may leave marks on concrete.
- 3.2.2 Exposed faces of concrete shall be moistened for at least seven (7) days and protected against weather conditions and other works. Concrete temperature shall remain at or above ten (10) degrees Celsius.
- 3.2.3 When concrete is protected against cold weather, maintain protection at least twelve (12) hours after the end of wet curing.
- 3.2.4 When temperature is twenty-five (25) degrees Celsius or more, use water jet, wet sand, or jute for initial curing of concrete.
- .1 Moisten formworks before concreting and until formworks are removed.
- 3.2.5 If required by ambient conditions, exposed concrete surfaces must be covered with tarpaulins or protected by other means acceptable to the Owner's Representative.
- 3.2.6 Use two layers of constantly wet jute or burlap clothes for curing walls or other vertical elements.
- 3.2.7 Non-formed concrete surfaces shall remain wet for a minimum of seven (7) days.
- 3.2.8 Formed concrete surface (beams, columns, walls, etc.) shall be cured for at least seven (7) days, as follows:
- .1 Before formwork removal: three (3) days, but not less than the duration in section 03 11 00 – Concrete Forming.
- .2 Wet curing following formwork removal: four (4) days.
- 3.2.9 For mass concrete, the preferred method of curing is to maintain a layer of standing water of constant temperature on the concrete surface. Continuous watering of the surface is not permitted for mass concrete. Refer to article E.6 of CSA A23.1.

3.3 Membrane Curing

- 3.3.1 Rather than using a method in accordance with article 3.1.7 of this section, the Contractor may use blankets specially designed for curing concrete. Depending on weather conditions, use sheet materials designed for hot weather. Method for using sheet materials shall be as follow:
- .1 Begin placing immediately after concrete has hardened enough to prevent damages.
- .2 Spray water over a first strip where sheet materials will be installed. Surface shall be covered by 3 to 6 mm of water.

- .3 Unroll sheet materials over wet concrete. Add water when needed.
- .4 Use squeegee to smooth out wrinkles and air bubbles.
- .5 Spray water over next strip and repeat preceding operations. Lap strips over 75 mm minimum. At roll ends, overlap over 300 mm minimum. Cover the entire surface of slab.
- .6 Inspect slab frequently and repair immediately any damage to sheet materials.
- .7 Remove sheet materials after seven (7) days of curing or later. Do not reuse sheet materials.

3.4 Use Of Curing Compounds

- 3.4.1 Only if a written authorization is obtained, curing compounds may be used if compatible with floor finish.
 - .1 Curing compound shall be used following manufacturer's recommendations. Compound shall be selected so that dust will not deposit on concrete surface and so that evaporation of water contained in concrete does not occur. Curing compound should not affect architectural flooring.
 - .2 Use curing compounds compatible with finishing products. Submit a written document certifying that all products applied on concrete surfaces are compatible. The Contractor is the sole responsible to determine and demonstrate compatibility between all products applied on concrete surfaces.

3.5 Cold-Weather Concreting

- 3.5.1 Refer to article 3.7 of section 03 30 00 for cold weather concreting and protective measures. In general, the protective measures in place during cold weather concreting should be maintained for the entire duration of concrete curing.
- 3.5.2 The method of protection required to ensure proper curing of concrete in cold weather shall be determined based on the expected ambient temperature and wind speed (wind chill factor), the dimensions and shape of the concrete structure and the cementitious content of the concrete mix.
- 3.5.3 The Contractor shall at minimum envelope all concrete surfaces with insulating fabrics. Each fabric shall be waterproof, made from closed-cell foam boards, and have a thermal resistance RSI of 0.40. The insulation shall be installed in such a way as to prevent any exposure of the concrete surfaces to the outside air for the entire duration of the protection. The joints of the insulating blankets shall have an overlap of at least 300mm. Suitable elements shall be used to weigh down the insulating fabrics to ensure that they are held in place.

3.6 Water Management

- 3.6.1 Regardless of the curing method used, the contractor shall take appropriate measures to prevent the water used for curing from damaging existing structures.

- 3.6.2 The specialized contractor shall ensure that the disposal of water does not compromise the continuation of the work, whether it is his own work or work carried out by another specialty.

END OF SECTION

1 General

1.1 References

1.1.1 American Society for Testing and Materials International, (ASTM).

- .1 ASTM A 108-18, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- .2 ASTM A 123/A 123M-17, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Product.
- .3 ASTM A 194/A 194M-22a, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
- .4 ASTM A 500/A 500M-21a, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- .5 ASTM A 563/A 563M-21a, Standard Specification for Carbons and Alloy Steel Nuts.
- .6 ASTM A 572/A 572M-21, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- .7 ASTM A 780/A 780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- .8 ASTM A 786/A 786M-15(2021), Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
- .9 ASTM A 913/A 913M-19, Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process.
- .10 ASTM A 992/A 992M-22, Standard Specification for Structural Steel Shapes.
- .11 ASTM A 1008/A 1008M-21a, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- .12 ASTM A 1011/A 1011M-18a, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- .13 ASTM A 1085/A 1085M-22, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
- .14 ASTM C 1107/C 1107M-20, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- .15 ASTM D 6386-22, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

- .16 ASTM F 436/F 436M-19, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
 - .17 ASTM F 959/F 959M-17a, Standard Specification for Compressible–Washer– Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.
 - .18 ASTM F 1136/F 1136M-11(2019), Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners.
 - .19 ASTM F 1554-20, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
 - .20 ASTM F 3125/F 3125M-22, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- 1.1.2 Canadian Standards Association (CSA)/CSA International.
- .1 CSA G30.18-21, Carbon Steel Bars for Concrete Reinforcement;
 - .2 CSA G40.20/G40.21-13(R2018) General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .3 CSA S16-19, Design of Steel Structures.
 - .4 CSA W47.1-19, Certification of companies for fusion welding of steel.
 - .5 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.
 - .6 CSA W55.3-08(R2018), Certification of companies for resistance welding of steel and aluminium.
 - .7 CSA W59-24, Welded steel construction.
 - .8 CSA W178.2-18, Certification of Welding Inspectors.
- 1.1.3 Canadian General Standards Board (CGSB).
- .1 CAN/CGSB 1.40-97, Anticorrosive Steel Alkyd Primer.
 - .2 CAN/CGSB 1.105-M91, Quick-drying Primer.
 - .3 CAN/CGSB 1.181-99, Ready-mix Organic Zinc-Rich Coating.
 - .4 CAN/CGSB 31-GP-108MA, Inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
 - .5 CAN/CGSB 85.10-99, Protective Coatings for Metals.
 - .6 CAN/CGSB 85.100-93, Painting.
- 1.1.4 Canadian Institute of Steel Construction (CISC) / Canadian Paint and Coatings Association (formerly known as Canadian Paint Manufacturers Association – CPMA).

- .1 Handbook of Steel Construction, 11th Edition.
 - .2 Code of Standard Practice, 8th Edition, 2015.
 - .3 Guide for Specifying Architecturally Exposed Structural Steel, 2nd Edition, March 2012.
 - .4 CISC/CPMA 1-73a, A Quick-drying One-coat Paint for Use on Structural Steel.
 - .5 CISC/CPMA 2-75, A Quick-drying Primer for Use on Structural Steel.
- 1.1.5 Master Painters Institute.
- .1 Architectural Painting Specification Manual, June 2019.
 - .1 MPI-INT 5.1, Structural Steel and Metal Fabrications.
 - .2 MPI INT 5.3, Galvanized steel.
 - .3 MPI EXT 5.1, Structural Steel and Metal Fabrications.
 - .4 MPI EXT 5.3, Galvanized steel.
- 1.1.6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International.
- .1 SSPC SP 1-15, Solvent Cleaning.
 - .2 SSPC SP 2-18, Hand Tool Cleaning.
 - .3 SSPC SP 6/NACE No. 3-07, Commercial Blast Cleaning.
 - .4 SSPC SP 6 (WAB)/NACE WAB 3, Commercial Wet Abrasive Blast Cleaning (NACE SP0815-2015).
 - .5 SSPC SP 7/NACE No. 4-07, Brush-Off Blast Cleaning.
 - .6 SSPC SP 7 (WAB)/NACE WAB 4, Brush-Off Wet Abrasive Blast Cleaning (NACE SP1015-2015).
 - .7 SSPC SP 11-20, Bare Metal Power Tool Cleaning.
- 1.1.7 Notwithstanding the version of the standard mentioned above, it remains the responsibility of the Contractor to consult the most recent version.
- 1.2 Design Criteria**
- 1.2.1 Design details and connections in accordance with requirements of CSA S16 to resist forces, moments, shears and allow for movements indicated.
 - 1.2.2 Beam assemblies shall have a depth equal to at least 50% of its depth.

- 1.2.3 Shop assemblies shall be welded. Field assemblies shall be bolted, using at least two (2) high-strength bolts per assembly.
- 1.2.4 Refer to an established manual recognized within the industry for connections design, such as the *Handbook of Steel Construction*.
- 1.2.5 Additional forces into connecting elements:
 - .1 Design connections as to not generate additional forces into connected elements.
 - .2 Connections generating torsion or flexure into connected elements are prohibited and will not be accepted by the Engineer of record.
 - .3 Any modifications to details and connections due to changes requested by the Owner's Representative shall be made free of charge.
- 1.2.6 Prior to designing assemblies, validate the specific requirements associated with the seismic force resistance system (SFRS) of article 27 of the CSA S-16 standard. Report to the Engineer of Record any questions in this regard. Pay particular attention when designing assemblies to ensure ductile mode of failure wherever required
- 1.2.7 For non-standard connections, submit sketches and design calculations stamped and signed by a qualified professional engineer, licensed in the Province of Ontario.

1.3 Shop Drawings

- 1.3.1 Submit shop drawings, including fabrication and erection drawings, as well as list of materials used in accordance with section 01 00 00 - General Requirements.
- 1.3.2 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:
 - .1 the location of the various components of the structure and their erection marks;
 - .2 the main dimensions and their respective levels;
 - .3 the type of bolts used and their diameter;
 - .4 the welds to be done on site;
 - .5 the temporary structural components; and
- 1.3.3 Ensure that drawings submitted for connections, including all members and connection components designed by the fabricator are stamped and signed by a qualified engineer recognized by the PEO. A letter stamped and signed by the engineer listing all drawings with applicable revisions and stating that the connections have been designed and reviewed under the engineer's guidance may be provided rather than stamping and signing each individual shop drawing.
- 1.3.4 Refer to articles 4.2 and 4.3 of CSA S16 standard for information that must be indicated on shop and erection drawings. Include locations and dimensions of the protected zones as well as a complete description of the fabrication operation that are prohibited in those zones.

- 1.3.5 If the Owner's Representative considers that significant or numerous revisions are required on drawings, they shall be returned without annotations to be submitted again. If more than two revisions are required to drawings, the Contractor is liable for the cost associated with any further review.
- 1.3.6 Contractor remains sole responsible for the exactness of drawings. No charge may be added for costs incurred by delays occurring due to mistakes uncovered on the Contractor's drawings on the work site, regardless of whether the drawings have been or have not been examined by the Owner's Representative.
- 1.3.7 Unless special authorization by Owner's Representative, structural steel fabrication shall not begin before approval of shop and erection drawings.

1.4 Quality Control

- 1.4.1 Submit an electronic copy of mill test reports fourteen (14) days prior to fabrication of structural steel. Include following information:
- .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
 - .2 Provide mill test reports certified by metallurgists qualified to practice in Ontario. Reports shall state that tests were made in accordance with CSA G40.20/G40.21.
- 1.4.2 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.
- 1.4.3 Realize the following activities and submit required documents:

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
3.1.3	Welders and welding company certificate of qualification	Fourteen (14) days prior to beginning work	Certificate of qualification	Contractor Laboratory
1.3.1	Shop drawings for structural steel frame elements	Fourteen (14) days prior to fabrication, per the requirements for shop drawings presentation in the tender documents	Transmission letter Inscription into the shop drawing registry	Contractor (steel manufacturer)
1.2.6 Error! Reference source not found.	Calculation notes for connections	Fourteen (14) days prior to fabrication, per the requirements for shop drawings presentation in the tender documents	Inscription into the shop drawing registry	Contractor (steel manufacturer)

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.3.2	Erection drawings for structural steel frame elements	Fourteen (14) days prior to delivery, per the requirements for shop drawings presentation in the tender documents	Inscription into the work procedure registry	Contractor (steel manufacturer)
Error! Reference source not found.	Erection procedure for structural steel frame elements	Fourteen (14) days prior to delivery, per the requirements for shop drawings presentation in the tender documents	Inscription into the work procedure registry	Contractor (steel erector)
1.4.1 1.4.2	Mill test reports and affidavit	Fourteen (14) days prior to fabrication of structural steel	Mill test reports, certificates and affidavit	Contractor (steel manufacturer)
3.5.1 section 03 11 0 0 art. 3.2.2.3.	Certificate of compliance for anchor rods	Before beginning erection	Certificate of compliance	Contractor
3.6.1	Inspection and tests of materials and connections	After erection	Test reports	Laboratory
3.1.4	Welded connection certificate	After erection	Certificate for welded connections to Canadian Welding Bureau requirements	Contractor

1.5 Waste Management and Disposal

- 1.5.1 Separate waste materials for reuse/recycling in accordance with section 01 00 00 - General Requirements.
- 1.5.2 Collect and separate packaging materials for recycling, in accordance with waste management plan.
- 1.5.3 Divert unused metal products to a metal recycling facility approved by the Owner's Representative.
- 1.5.4 Divert unused paints material from landfill to an official hazardous material collections site as approved by the Owner's Representative.

- 1.5.5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

2 Products

2.1 Materials

- 2.1.1 Structural steel: unless otherwise indicated, use:

- .1 W-, WT-, HP-, M- and S-sections: to CSA G40.20/G40.21 350W
- .2 Square and rectangular hollow structural section (HSS): to ASTM A 500/A 500M class C, grade C (50 ksi);
 - .1 HSS to CSA G40.20/G40.21 350W class C or H.
- .3 Round hollow structural section (HSS): to ASTM A 500/A 500M class C, grade B (46 ksi) or ASTM A 1085/A 1085M;
- .4 Angle (L-) and channels (C-): to CSA G40.20/G40.21 350W;
- .5 Plates 65 mm thick or less: to CSA G40.20/G40.21 350W, yield strength of 350 MPa or to ASTM A 572/A 572M grade 50 (345 MPa);

- 2.1.2 Anchor rods: as indicated on drawings and as follows:

- .1 Reinforcing bars: to CSA G30.18, grade 400W or 500W;
- .2 Anchor rods: to ASTM F 1554 grade 55;
- .3 High strength anchor rods: to ASTM F 1554 grade 105.

- 2.1.3 Structural bolts: to ASTM F 3125/F 3125M, unless otherwise indicated. Use type 1 bolts, except for weathering steel for which type 3 bolts shall be used.

- .1 For zinc/aluminium coated bolt, coating shall comply with ASTM F 1136/F 1136M.

- 2.1.4 Nuts: to ASTM A 563/A 563M:

- .1 For bolts, use recommended nuts to table 1 of ASTM F 3125/F 3125M. Nuts to ASTM A 194/A 194M grade 2H may be used as specified in note 'E' of this table.
- .2 For high-strength anchor rods, use nuts of grade D (38 mm diameter or less) or DH (more than 38 mm diameter) to ASTM A 563/A 563M.

- 2.1.5 Washers: to ASTM F 436/F 436M.

- 2.1.6 Compressible washer: to ASTM F 959/ F 959M.

- 2.1.7 Tension control structural bolt, nut and washer: to ASTM F 3125/F 3125M grade F 1852 or F 2280.

- 2.1.8 Welding material: to CSA W48 and CSA W59, certified by the Canadian Welding Bureau (CWB).
- .1 Welding material shall comply with article 27.1.5.3 of CSA S16 when appropriate.
- 2.1.9 Hot-dipped galvanizing: to ASTM A 123/A 123M.
- 2.1.10 Conditioner and rust remover: to CAN/CGSB 31-GP-108MA.
- 2.1.11 Zinc-rich coating:
- .1 Use zinc-rich coating to CAN/CGSB 1.181 and ASTM A 780/A 780M containing at least 92% of metallic zinc in dried coat, brush applied.
- .2 Approved products:
- .1 Zinc-paste 70-40 by Metaflux;
- .2 ZRC Galvilite by Meta-Plus;
- .3 Rust-anode by Galvatech (distributor).
- .4 Zinga by Galvanisation Zinga (distributor).
- .5 Galvacon by Lanco.
- 2.1.12 Shrinkage compensating grout: premixed compound to ASTM C 1107/C 1107M type C, 50 MPa minimum compressive resistance after twenty-eight (28) days such as:
- .1 SikaGrout 212 by Sika;
- .2 In-Pakt Construction Grout or In-Pakt Construction Grout CT by KING depending on weather conditions;
- .3 Planigrout 755 by MAPEI;
- .4 Dry Pact Grout by Euclid.

2.2 Shop Painting

- 2.2.1 Unpainted steel shall be used for structural steel on the interior of building not exposed to view. Take special precautions to minimize outside storage of unpainted elements. Refer to section 2.4 Storage.
- 2.2.2 The following surfaces shall not be painted:
- .1 Surfaces to be encased in concrete.
- .2 Surfaces to receive field installed stud shear connectors and steel decks.
- .3 Surfaces and edges to be field welded.
- .4 Faying surfaces of friction-type connections.

- .5 Below grade surfaces in contact with soil or concrete, including base plates.
- 2.2.3 Shop paint primer:
 - .1 To CISC/CPMA 1 and CAN/CGSB 1.105 for structural steel on the interior of building, exposed to view and without topcoat.
 - .2 To CISC/CPMA 2 and CAN/CGSB 1.40 for any other use of structural steel. Primer shall be compatible with topcoats.
- 2.2.4 Shop-applied finish paint:
 - .1 Refer to section 09 91 00 for shop-applied finish paint.
 - .2 Beam's capacity shall be indicated in black print on both side of beams. Indicate nominal capacity in kg in figures and include the unit kg.
- 2.2.5 Clean, prepare surfaces and shop prime structural steel in accordance with CSA S16, MPI INT 5.1/MPI EXT 5.1 except where members are to be encased in concrete.
- 2.2.6 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface to:
 - .1 SSPC SP 2 for structural steel on the interior of building, exposed to view and without topcoat;
 - .2 SSPC SP 7 or SSPC SP 7 (WAB)/NACE WAB 4 for structural steel on the interior of building, exposed to view where topcoat will be applied;
 - .3 SSPC SP 6/ NACE No 3 or SSPC SP 6 (WAB)/NACE WAB-3 for structural steel on the exterior of building and any steel where a AESS category is specified (see article 3.9).
- 2.2.7 Apply one coat to steel surfaces to achieve dry film thickness of 1.5 to 2.0 mils (37 to 50 µm) for all painted steel surfaces.
- 2.2.8 Apply paint under cover, on dry surfaces, when surface and air temperatures are above 5 degrees C.
- 2.2.9 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- 2.2.10 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.
- 2.2.11 Unless otherwise indicated, do not apply primer on steel elements to be fireproofed. If, upon approval, primers are used, products shall be compatible with fireproofing product.
- 2.2.12 Identify protected zones using a distinct shop-paint or paint color. Apply labels on each face of the members. When members in protected zones are exposed to view, refer to architectural requirements and requirements on drawings.

2.3 Galvanization

- 2.3.1 All steel in contact or that may be in contact with aluminium, even if no indication are given on drawings, shall be galvanized. All steel exposed to outside conditions shall be galvanized as well.
- 2.3.2 Galvanization of structural steel shall be hot-dip galvanizing.
- 2.3.3 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface to SSPC SP 6/NACE No. 3 or SSPC SP 6 (WAB)/NACE WAB 3.
- 2.3.4 When welding is required on members that are going to be galvanized, welds shall be continuous (sealed).
- 2.3.5 Minimum zinc coating thickness shall comply with tables 1 and 2 of ASTM A 123/A 123M. In general, zinc-coating shall be a minimum of 705 g /m².
- 2.3.6 Realize quality control in accordance with ASTM A 123/A 123M.
- 2.3.7 Galvanized bolted elements prior to assembly.
- 2.3.8 When galvanized steel need to be painted after galvanizing, surface preparation shall comply with ASTM D 6386. In general, use the following method:
 - .1 Do not passivate after galvanizing;
 - .2 Use light manual sanding for surface preparation after galvanizing;
 - .3 Clean surface with a metal conditioner and rust remover;
 - .4 Rinse with pressurized clean water;
 - .5 Paint shall be applied immediately following cleaning.
- 2.3.9 When, due to delay that do not result from the actions of the Contractor, it becomes impossible to realize hot-dip galvanizing without affecting work schedule, the Contractor shall, conditional to the approval of the Owner's Representative, apply zinc-rich paint as described in the following articles:
 - .1 Steel shall be cleaned and prepared in accordance with SSPC SP-6 / NACE No. 3-06;
 - .2 Use zinc-rich coating in accordance with section 2.22.1.11 The sole method of application shall be by brush;
 - .3 Apply one coat of zinc-rich paint to steel surfaces to achieve dry film thickness of at least 2.0 mils (50 µm) for all steel surfaces;
 - .4 Allow a minimum of 24 hours for drying;
 - .5 Apply a second coat of zinc-rich paint to steel surfaces to achieve dry film thickness of an additional 2.0 mils (50 µm) for all steel surfaces;
 - .6 Allow a minimum of 24 hours prior to transporting steel;

- .7 During painting and drying, maintain dry condition and 5 degrees Celsius minimum temperature.

2.4 Storage

- 2.4.1 Store materials off ground over wood studs or indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area as to prevent rusting.
- 2.4.2 Protect structural steel if stored over a long period.
- 2.4.3 Replace defective or damaged materials with new ones.

3 Execution

3.1 General

- 3.1.1 Structural steel work: in accordance with CSA S16.
- 3.1.2 Welding: in accordance with CSA W59.
- 3.1.3 Companies to be certified under Division 1 or 2 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components or both as applicable. Part of the work may be sublet to a division 3 fabricator or erector; however, the Division 1 or 2 fabricator or erector shall retain responsibility for the sublet work.
- 3.1.4 Submit certification that welded joints are qualified by Canadian Welding Bureau (CWB).
- 3.1.5 Provide to trade responsible for these works templates and steel elements to be embedded into concrete or masonry.
- 3.1.6 Ensure galvanic separation (galvanization, neoprene or other) between any steel and aluminium element or treated wood.

3.2 Fabrication

- 3.2.1 Fabricate structural steel in accordance with CSA S16 and in accordance with reviewed shop drawings. Structural steel shall be brand-new, free of loose mill scale, rust, oil, dirt and foreign matter.
- 3.2.2 Prior to ordering/buying structural steel, final shop drawings shall be approved by the Owner's Representative.
- 3.2.3 Do not substitute members without written approval from Owner's Representative.
- 3.2.4 Structural bolt holes shall be drilled or punched. Do not use thermally or manually cut holes. Fastener holes shall be made in accordance with article 28.4 of CSA S16.
- 3.2.5 In location subject to plastic hinge, fastener holes shall be either sub-punched and reamed or drilled full size.
- 3.2.6 Steel fabrication shall be done in accordance with CSA S16 article 28 for tolerances, especially article 28.6.

- 3.2.7 Do not splice steel elements unless otherwise indicated on drawings.
- 3.2.8 For all structural steel exposed to weather conditions, or where indicated on drawings, continuously seal members by continuous welds where indicated. Grind smooth.
- 3.2.9 Provide holes in top flanges. Weld threaded studs to top flanges for attachment of wood nailers.

3.3 Connection To Existing Work

- 3.3.1 When connecting to existing work, prior to preparing shop drawings, verify dimensions and condition of existing work, report discrepancies and potential problem areas to Owner's Representative for direction before commencing fabrication. Dimensions of steel elements shall be modified to adapt for the existing conditions and modifications shall be submitted to Owner's Representative for approval.
- 3.3.2 For plates anchored to an existing reinforced concrete or masonry element, use the following procedure, under the sole responsibility of the specialized steel contractor:
 - .1 Detect existing reinforcement bars prior to drilling to locate anchors;
 - .2 Use manual percussion drilling to drill anchor loads and protect existing reinforcement.
 - .3 Measure anchor location on site after drilling prior to fabricating steel plates and adapt dimensions as needed without charges.
- 3.3.3 For plates anchored to an existing unreinforced masonry element, use diamond drilling to drill anchor as to protect the existing work. The contractor may use a different mean of drilling only if he is able to demonstrate that no damage will occur to the existing work due to drilling. If the contractor uses an alternative mean of drilling, any damage occurring to the existing work following drilling shall be automatically considered his responsibility.

3.4 Marking

- 3.4.1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
- 3.4.2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.5 Erection

- 3.5.1 Prior to beginning erection, ensure that the certificate of compliance for anchor rods installation has been provided, in accordance with article 3.2.2.3 of section 03 11 00 of the technical specifications. Confirm the availability of erection procedures on jobsite.
- 3.5.2 Erect structural steel, as indicated and in accordance with CSA S16 and in accordance with reviewed erection drawings.
- 3.5.3 Steel structure erection and dismantling work shall be done in accordance with O. Reg. 213/91: Construction Projects.

- 3.5.4 Erection shall be done in accordance with CSA S16 article 29 for tolerances, especially article 29.3.
- 3.5.5 Field cutting or altering structural members: to approval of Owner's Representative.
- 3.5.6 Protect galvanized steel against any damage, be it from manipulation, storage, contact with lifting equipment or others. Damaged galvanized elements due to welds, impacts, etc. shall be galvanized anew in accordance with article 2.2.10. If approved by Owner's Representative, surfaces may be repaired in accordance with ASTM A 780/A 780M.
- 3.5.7 Any defect shall be submitted to Owner's Representative as quickly as possible. Owner's Representative will determine corrections needed.
- 3.5.8 For bolted assemblies, tighten bolts in accordance with the following requirements:
- .1 Assemblies subject to fatigue or impact, including all assemblies associated with lifting equipment: install bolts snug-tight in accordance with article 23.7.1 of CSA S16, then pretension by rotation of the nut in accordance with article 23.7.2 and table 7;
 - .2 Assemblies of components that are parts of seismic resistance force systems or subject to tensile forces: install bolts snug-tight in accordance with section 23.7.1 of CSA S16, then pretension by rotation of the nut in accordance with article 23.7.2 and table 7. The use of torque wrench is subject to the approval of the Owner's Representative, depending on conditions of use on site;
 - .3 Other assemblies: unless otherwise indicated, install bolts snug-tight as indicated in article 23.7.1 of CSA S16.
- 3.5.9 Twist-off structural bolts to ASTM F 1852 may be used where ASTM F 3125/F 3125M grade A325 structural bolts are specified (or ASTM F 2280 for grade A490 bolts) except for slip-critical assemblies where twist-off structural bolts shall never be used.
- 3.5.10 Clean with mechanical brush and touch up shop primer bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- 3.5.11 Follow the requirements of article 27.1.9 of CSA S16 standard for members of the protected zones. Generally speaking, connecting any element on members within protected zones is prohibited unless specifically indicated on structural drawings.

3.6 Field Quality Control

- 3.6.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Owner's Representative. Inspectors shall be certified by the Canadian Welding Bureau in accordance with CSA W178.2. Depending on the nature of elements inspected, inspection may take place on shop or on jobsite.
- 3.6.2 The following non-exhaustive list presents elements likely to be inspected:
- .1 Origin of structural steel;
 - .2 Certification of welders and erector;
 - .3 Bolted connections: tension, type, diameter and grade;

- .4 Welded connections: workmanship quality, conformity to drawings and shop drawings requirements, welding quality;
 - .5 Plumbness (verticality) of columns;
 - .6 General workmanship.
- 3.6.3 Origin of structural steel:
- .1 The Inspector shall validate the source of structural steel and its conformity to the specifications.
- 3.6.4 Certification of welders and erector:
- .1 The Inspector shall validate certification of erector and welders. Include copies of certification cards in inspection report.
- 3.6.5 Bolted connections:
- .1 Inspection shall validate compliance with the requirements of tables 6 and 7 of CSA S16 standard.
- 3.6.6 Welded connections:
- .1 Testing laboratory shall inspect all welds visually. Non-destructive testing are performed following request by the Owner's Representative.
 - .2 Where required, non-destructive tests shall be carried out by mean of: magnetic particle, radiography or ultrasonic testing. Owner's Representative, in collaboration with inspector will determine the method of testing.
- 3.6.7 General workmanship:
- .1 General workmanship and conformity to drawings and specifications requirements shall be reviewed. Evaluation by visual inspection shall determine any non-conformity, with special attention to connections, presence of slotted holes not specifically required, presence of reinforcing members for holes and quality of coatings (paints, galvanization) including touch up.
- 3.6.8 The Contractor shall cooperate freely to allow testing by providing all the necessary assistance on site required by the testing laboratory. If an item (welding or bolted connection, column, etc.) is deemed defective by the Owner's Representative, another inspection shall be performed on the elements immediately preceding and following the defective item. The Contractor shall assume costs of additional testing. All corrective work required shall be performed, without charges, to the satisfaction of the Owner's Representative.
- 3.6.9 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Owner's Representative.
- 3.6.10 Submit test reports to Owner's Representative within three (3) days of completion of inspection.

3.6.11 Any element identified as non-compliant shall be corrected and inspected again. When additional inspections are required to validate corrections on non-compliant elements, the Contractor shall assume the cost of inspection.

3.6.12 Owner will pay costs of tests as specified in section 01 00 00 - General Requirements.

3.7 Field Painting

3.7.1 Touch up damaged surfaces and surfaces without shop coat with primer identical to shop-applied primer, after preparation to SSPC SP 6/NACE No. 3 or SSPC SP 6 (WAB)/NACE WAB-3. Apply in accordance with CAN/CGSB 85.10 and MPI Architectural Painting Specification Manual.

3.7.2 Galvanized steel: using a compatible finish product, touch up damaged, welded or cut surfaces, to obtain a uniform coating.

- .1 Use zinc-rich coating to CAN/CGSB 1.181 and ASTM A 780/A 780M as indicated in article 2.2.13 of this section.
- .2 Surface to touch up shall be prepared in accordance with SSPC SP 11. Clean surface to expose bare steel.
- .3 Apply coating by brush.
- .4 Dry film thickness shall be at least 130 µm.

END OF SECTION

1 General

1.1 Related Requirements

- 1.1.1 Section 06 17 53 - Shop-Fabricated Wood Trusses.
- 1.1.2 Section 06 20 00 – Finish Carpentry.
- 1.1.3 The Contractor shall obtain a copy of all sections even if they do not pertain directly to his speciality. When bidding, the Contractor agrees implicitly with articles and requirements of all sections in these specifications, including those he might not have read. The Contractor should consult the table of contents of the specifications to be aware of the complete list of sections.

1.2 References

- 1.2.1 American Institute of Timber Construction (AITC):
 - .1 AITC 111-2005, Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection.
 - .2 Tech Note 18, Evaluation of Checks in Structural Glued Laminated Timbers, April 2023.
- 1.2.2 American National Standards Institute (ANSI):
 - .1 ANSI/NPA A208.1-2022, Particleboard.
- 1.2.3 American Society for Testing and Materials International, (ASTM):
 - .1 ASTM A 36/A 36M-19, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A 47/A 47M-99(2022)e1, Standard Specification for Ferritic Malleable Iron Castings.
 - .3 ASTM A 123/A 123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .4 ASTM A 307-21, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .5 ASTM A 563/A 563M-24, Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
 - .6 ASTM A 924/A 924M-22a, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - .7 ASTM C 1396/C 1396M-24, Standard Specification for Gypsum Board.
 - .8 ASTM D 1761–20, Standard Test Methods for Mechanical Fasteners in Wood.
 - .9 ASTM D 3498-19a, Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing.

- .10 ASTM D 5055-24, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .11 ASTM D 5456-24, Standard Specification for Evaluation of Structural Composite Lumber Products.
 - .12 ASTM E 84-23d, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .13 ASTM F 436/F 436M-24, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
 - .14 ASTM F 1667/F 1667M-21a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- 1.2.4 American Society of Mechanical Engineers (ASME):
- .1 ANSI/ASME B18.2.1-2012(R2021) Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
 - .2 ANSI/ASME B18.6.1-1981(R2016), Wood Screws (Inch Series).
- 1.2.5 APA – The Engineered Wood Association (APA) :
- .1 R475F, Technical Note: Evaluation of Check Size in Glued Laminated Timber Beams, July 2021.
- 1.2.6 Canadian Standards Association (CSA) / CSA International:
- .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA B167-16(R2021), Overhead travelling cranes - Design, inspection, testing, maintenance, and safe operation.
 - .3 CSA G40.20/G40.21-13(R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .4 CAN/CSA Series O80-21, Wood Preservation:
 - .1 CAN/CSA O80.0-21, General requirements for wood preservation.
 - .2 CAN/CSA O80.1-21, Specification of treated wood.
 - .3 CAN/CSA O80.2-21, Processing and treatment.
 - .4 CAN/CSA O80.3-21, Preservative formulations.
 - .5 CAN/CSA O80.5-21, Additives.
 - .5 CSA O86-24, Engineering design in wood.
 - .6 CSA O112 Series-M1977 (R2006), CSA Standards for Wood Adhesives.

- .1 CSA O112.6-M1977, Phenol and phenol-resorcinol resin adhesives for wood (High-temperature curing).
- .2 CSA O112.7-M1977, Resorcinol and phenol-resorcinol resin adhesives for wood (Room-and intermediate-temperature curing).
- .7 CSA O112.9-21, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
- .8 CSA O112.10-24, Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).
- .9 CSA O121-17(R2022), Douglas Fir Plywood.
- .10 CSA O122-25, Structural Glued-Laminated Timber.
- .11 CSA O141-23, Softwood Lumber.
- .12 CSA O151-17(R2022), Canadian Softwood Plywood.
- .13 CSA O153-19, Poplar Plywood.
- .14 CSA O177-23, Qualification Code for Manufacturers of Structural Glued-Laminated Timber.
- .15 CSA O325-21, Construction Sheathing.
- .16 CSA Z809-16(R2021), Sustainable forest management.
- 1.2.7 American Wood Council (AWC):
 - .1 Technical Report No.10: Calculating the Fire Resistance of Exposed Wood Members
- 1.2.8 Canadian Wood Council:
 - .1 Wood Design Manual, 2020.
- 1.2.9 National Lumber Grades Authority (NLGA):
 - .1 Standard Grading Rules For Canadian Lumber 2022.
 - .2 SPS 1-2023: Fingerjoined Structural Lumber.
 - .3 SPS 2–2024: Machine Graded Lumber.
 - .4 SPS 3-2023: Fingerjoined “Vertical Stud Use Only” Lumber.
 - .5 SPS 4–2020: Fingerjoined Machine Graded Lumber.
 - .6 SPS 5-2015: Face-Glued Lumber – Vertical Use Only.
 - .7 SPS 6-2015: Structural Face-Glued Lumber.

- 1.2.10 National Research Council of Canada (NRCC) / Institute for Research in Construction (IRC) – Canadian Construction Materials Centre (CCMC).

.1 CCMC, Registry of Product Evaluations.

- 1.2.11 Canadian General Standards Board, (CGSB) :

.1 CAN/CGSB 11.3-M87, Hardboard.

.2 CAN/CGSB 11.5-M87, Hardboard, Precoated, Factory Finished, for Exterior Cladding.

.3 CAN/CGSB 11.6-M87, Installation of Exterior Hardboard Cladding.

.4 CAN/CGSB 71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.

- 1.2.12 Truss Plate Institute of Canada (TPIC):

.1 TPIC 2024, Truss Design Procedures and Specifications For Light Metal Plate Connected Wood Trusses.

1.3 Design Requirements

- 1.3.1 Design of timber structures connections shall be performed by a professional engineer, licensed in the Province of Ontario, employed or hired as a subcontractor of the provider of sawn lumber and glued-laminated structural lumber.

- 1.3.2 Calculate assemblies in accordance with CSA O86, CSA S16, CSA S136 and any other relevant standard considering the forces indicated on the drawings, unless otherwise indicated.

- 1.3.3 Connection details indicated on drawings are only indicative of the principle of connection desired by the design engineer of the building. Refer to the structural engineer when, in the opinion of the connection design engineer, it is not possible to provide assemblies such as those indicated on drawings or to obtain any information necessary for connection design.

- 1.3.4 Prescribe structural connections as indicated in a recognized publication within the industry, such as the *Wood Design Manual*. Respect the rules in the design of assemblies and avoid assemblies which problems are known and documented.

- 1.3.5 Provide timber structure connections with embedded steel elements when a fire resistance is required.

- 1.3.6 Provide connection details as to minimize the risks of water accumulation and allow wood drying.

- 1.3.7 Additional efforts induced in the elements to connect:

.1 All connections shall be designed as not to induce additional efforts in the elements to be connected.

- .2 All details that create a torsional moment, bending moment or others are rejected by the Owner's Representative.
- .3 All modifications attributable to changes requested by the Owner's Representative shall be at the expense of the Contractor.

1.3.8 Unless otherwise indicated, use the following efforts to design connections:

Elements	Loads
Element subjected to bending stresses (beams, columns).	The maximum response to presses of the uniform charge giving the resisting moment of the section or 50% of the shear capacity of the beam.
Element subjected to high concentrated loads.	The lesser of the shear capacity of the beam or 125% of the maximum shear stress.
Columns, trusses, joists and members subject to axial loads	Stresses determined on the basis of the loads on the plans.

- 1.3.9 The Owner's Representative may require that computations be submitted when obtaining shop drawings.
- 1.3.10 For non-standard assemblies and bracing assemblies, submit sketches and design computation notes signed and sealed by a qualified professional engineer, licensed in the Province of Ontario.
- 1.3.11 Coordinate assembly of structural glued-laminated timber with those of the structural steel and prefabricated trusses. Ensure close coordination between the manufacturers as to minimize potential problems when assembling the frame.
- 1.3.12 The price submitted for the wood framing will include, in addition to manufacturing costs, delivery and installation of wooden elements, costs related to the following and any other predictable cost:
- .1 engineering for the design of assemblies.
 - .2 production and submission of shop drawings.
 - .3 production and submission of design computation notes.
- 1.3.13 All work related to bridge cranes, monorails and lifting equipment must comply with bridges manufacturer's requirements and specifications of the CSA B167 standard.

1.4 Action and Informational Submittals

- 1.4.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- 1.4.2 Submit shop drawings of assemblies signed and sealed by a professional engineer, licensed in the Province of Ontario.

- .1 Submit design computation notes for non-standard assemblies or any other required by the Owner's Representative.
- 1.4.3 Refer to section 01 00 00 - General Requirements and submit required documents.
- 1.4.4 Submit technical datasheets for preservative products, flame-retardants and pressure-treated wood.
- 1.4.5 Submit material safety datasheet (MSDS) to the requirement of the Workplace hazardous Material Information System (WHMIS), according to section 01 00 00 - General Requirements.
- 1.5 Quality Control**
 - 1.5.1 Quality Control: to section 01 00 00 - General Requirements.
 - 1.5.2 Timber shall bear the grade stamp of an organization recognized by the Canadian Lumber Standards Accreditation Board (CLSAB).
 - 1.5.3 The plywood, particle board and oriented strand board (OSB) and wood composite panels must be labelled according to the applicable CSA and ANSI standards.
 - 1.5.4 Composite structural wood members shall bear a stamp indicating the grade of wood and the product evaluation report number listed in the Registry of Product Assessments published by the Canadian Construction Materials Centre (CCMC) indicating that these members were manufactured in an accredited factory or the product report published by a certification agency accredited by the Standards Council of Canada.
 - 1.5.5 Delivery inspection: Conduct an inspection of the elements of rough carpentry, wood preservatives and flame retardants when received on site and submit inspection reports in accordance with the requirements of section 01 00 00 - General Requirements.
 - 1.5.6 On-Field Inspection: Conduct inspections of rough carpentry work at every critical step of the erection. After each inspection, submit an inspection report, including, without limitation, the following information:
 - .1 scope of work verified.
 - .2 nominal dimensions of elements.
 - .3 verification of lines, levels and elevations.
 - .4 installation of sub-frames, nailing strips and funds.
 - .5 fasteners.
 - .6 the verification of alignments and eligible gap.
 - .7 types of fasteners and spacing.
 - .8 the use and location of wood treated with preservative and/or fire retardant.
 - 1.5.7 Perform the following activities and submit the required documents:

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILI TY
1.4.4	Technical datasheets of wood preservatives and flame retardants.	At least seven (7) days before delivery, according to the requirements for the submission of shop drawings of the call for tenders.	Transmission letter. Inscription at the technical specification registry.	Contractor
1.3.1 0	Design computation notes for non-standard assemblies.	At least fourteen (14) days prior to assemblies fabrication.	Design computation notes, signed and sealed	Contractor
1.4.2	Shop drawings signed and sealed.	At least fourteen (14) days prior to assemblies fabrication, according to the requirements for the submission of shop drawings of the call for tenders.	Transmission letter. Inscription at the technical specification registry.	Contractor
1.5.5	Materials and preservatives inspection.	Each delivery	Inspection report.	Contractor
1.5.6	Work inspection.	As determined in article 1.5.6	Inspection report.	Contractor
3.8.3	Notice to the Owner's Representative	As soon as cracks or other significant defects are observed	Notice to the Owner's Representative	Contractor
3.9.1	Repair procedure	Prior to beginning repairs	Breakpoint Repair procedure	Contractor Review by the Owner's Representative

1.6 Delivery, Storage and Handling

- 1.6.1 Deliver, store and handle materials in accordance with section 01 00 00 - General Requirements and with manufacturer's written instructions.
- 1.6.2 Deliver, store, handle and protect materials from weather.
- 1.6.3 Delivery and acceptance requirements:

- .1 Wrap materials prior to leaving plant with a moisture resistant wrapping.
- .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Use padded, non-marring slings for handling materials.
- .4 Protect corners with wood blocking.
- .5 Make adequate provision for delivery and handling stresses.

1.6.4 Storage and handling requirements:

- .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Slit underside of membrane covering during storage at site without defacing member.
- .3 Store products on wooden blocks to avoid direct contact with the ground; separate them with wedges to allow free circulation of air on all sides and protect them from bad weather.
- .4 Cover members with opaque moisture resistant polyethylene membrane. Membrane shall cover elements until erection.
- .5 Store and protect wooden products from nicks, scratches, and blemishes. Replace defective or damaged materials with new, unless written approval by the Owner's Representative. Any element where corners have been scratched, or surface is damaged shall be replaced.
- .6 Follow the recommendations of AITC 111 for the storage and handling of glued laminated timber.
- .7 Store the wood in ventilated and heated shelters if the time between delivery and installation exceeds 2 months.

1.6.5 Notwithstanding the preceding articles, the contractor is solely responsible for determining methods of transport, handling and storage in order to:

- .1 Ensure that the structural and aesthetic properties of the materials at the time of installation are the same as after manufacturing.
- .2 Ensure that the moisture content of the dry wood remains at all times below a moisture content of 19%, without sudden variations even if remaining below this limit.
- .3 Ensure that the surface condition of the wood elements is not altered, and that the straightness of the elements remains the same.

1.7 Waste Management and Disposal

- 1.7.1** Separate waste materials for reuse/recycling in accordance with section 01 00 00 - General Requirements.

- 1.7.2 Place substances that meet the definition of toxic or hazardous waste in designated containers.
- 1.7.3 Collect and separate packaging materials for recycling, in accordance with waste management plan.
- 1.7.4 Divert unused wood products to a recycling, reuse/re-use or composting facility authorized by the Owner's Representative.
- 1.7.5 Divert unused plastic to a recycling, reuse/re-use or composting facility authorized by the Owner's Representative.

2 Products

2.1 Framing Timber

- 2.1.1 Unless otherwise indicated in the drawings, for lumber, use: S4S softwood finish (milled on 4 sides) with a moisture content not exceeding 19% (Dry) at the time of installation, and lumber shall:
 - .1 Conform to CSA O141;
 - .2 Be graded in accordance with Standard Grading Rules for Canadian Lumber of NLGA.
- 2.1.2 Abutting elements (finger jointed) and pasted: registered under the standard NLGA must conform to the standard of specialty products.
 - .1 SPS 1 for framing timber.
 - .2 SPS 2 for machine rated lumber (MSR).
 - .3 SPS 3 for studs (vertical use).
 - .4 SPS 4 for the sole of wood I-joists.
 - .5 SPS 5 for glued elements to vertical use only.
 - .6 SPS 6 for glued elements.
- 2.1.3 Fabricated structural glued-laminated timber: to CSA O122 or approved by the Canadian Construction Materials Center (CCMC) and manufactured according to CSA O177.
- 2.1.4 Wooden I joists: to ASTM D 5055 and approved by CCMC. Adhesives shall comply with either CSA O112.6, CSA O112.7, CSA O112.9 or CSA O112.10.
- 2.1.5 Lightweight trusses: in accordance with Section 06 17 53 - Prefabricated wood trusses.
- 2.1.6 Open web joists: comply with the requirements contained in the TPIC 2024 document "Truss Design Procedures and Specifications For Light Metal Plate Connected Wood Trusses".
- 2.1.7 Composite structural wood: to ASTM D 5456 and approved by CCMC.

2.1.8 Framing members and planks: unless otherwise indicated on the drawings, use members that comply with the requirements of the NBC, except for the following:

- .1 Light-frame construction, joists, planks and posts for load-bearing walls: spruce pine fir (S-P-F) species group, grade No. 1 or 2, stamped "dry".
- .2 Framing posts for non-load-bearing walls (architectural partitions): spruce pine fir (S-P-F) species group, grade No. 3/ STUD, stamped "dry".
- .3 Lintels, beams: spruce pine fir (S-P-F) species group, grade No. 1 or 2, stamped "dry".

2.2 Wood Panels

2.2.1 The thickness of the panels is as shown on drawings. Where the thickness is not indicated, use 19 mm thick panels.

2.2.2 Plywood, oriented strand board (OSB) and wood-derived compounds shall conform to CSA O325.

2.2.3 Douglas Fir Plywood (Douglas fir) shall conform to CSA O121.

2.2.4 Canadian softwood plywood shall conform to CSA O151.

2.2.5 Poplar plywood shall conform to CSA O153.

2.2.6 Generally, use the SHG (sheathing) category – standard unless otherwise indicated.

2.2.7 For exposed panels, use Douglas fir plywood category G1S or G2S depending on the number of exposed faces.

2.2.8 The structural panels used on the roof shall be exterior type.

2.2.9 If the climatic conditions, construction deadlines or the sequence of work require it, plan for the use of exposure 1 rating panels wherever necessary to ensure the integrity of the structure.

2.2.10 When the thickness of the panels allows it, use tongue and groove panels unless otherwise indicated.

- .1 Where tongue and groove panels are not available, use plywood clips ("H-clips") suitable for the panel thickness.

2.2.11 Oriented strand board (OSB) structural panels shall conform to CSA O325.

2.2.12 Adhesives: to CSA O112.7.

2.2.13 Drywalls must conform to ASTM C 1396 / C 1396M.

2.2.14 Panels of agglomerated press wood particles for interior finish shall conform to the ANSI A208.1 standard.

2.3 Fastenings

- 2.3.1 Metal connectors: Made of Z275 (G90) galvanized steel conforming to ASTM A 653/A 653M according to the grades set out in clause 17.4.1.2 of CSA O86, and whose resistance calculation parameters are determined according to CSA S347.
- 2.3.2 Split-ring connectors: steel hot-rolled carbon, type SAE 1010, as required by the SAE Handbook.
- 2.3.3 Shear-plate connectors:
 - .1 Pressed steel: hot rolled carbon steel, type SAE 1010, as required by the SAE Handbook;
 - .2 Malleable cast iron: conforms to ASTM A 47/A 47M, of nuance 32510 (22010 metric).
- 2.3.4 Bolts and dowels: to ASTM A 307, unless otherwise stated; hot dipped galvanized for outdoor works, interior works located in areas of high humidity and for treated wood products.
- 2.3.5 Nuts: to ASTM A 563/A 563M.
- 2.3.6 Washers: to ASTM F 436/F 436M.
- 2.3.7 Lag screws: to ANSI/ASME B18.2.1.
- 2.3.8 Side plates: to CSA G40.20/G40.21 or ASTM A 36/A 36M.
- 2.3.9 Drift pins: to ASTM A 307.
- 2.3.10 Joist hangers, connectors and fasteners: to ASTM D 1761, sheet steel at least 1 mm thick, galvanized to a minimum ZF001 coating designation.
- 2.3.11 Timber rivets:
 - .1 Rockwell Hardness C32-39;
 - .2 Ultimate strength of steel: minimum 1 000 MPa.
 - .3 Hot-dipped galvanized;
 - .4 Used in conjunction with steel plates to CSA G40.20/G40.21 or ASTM A 36/A 36M.
- 2.3.12 Nails and spikes: to CSA B111 or ASTM F 1667/F 1667M.
- 2.3.13 Screws: to ANSI/ASME B18.6.1.
- 2.3.14 Hot dip galvanizing: to ASTM A 123/A 123M. The minimum thickness of the coating shall comply with the requirements of Tables 1 and 2 of this standard. Generally, the minimum thickness is 460 g/m² for a steel thickness of 1.6 to 3.2 mm, 600 g/m² for a thickness of 3.2 mm to 6.4 mm or 705 g/m² for thicker material.
- 2.3.15 Construction adhesive for subfloor: conforming to ASTM D 3498.

3 Execution

3.1 Reception and Storage at Construction Site

- 3.1.1 When unloading equipment, do not drag or drop items. Take care not to damage fine surfaces. Use wide nylon slings and pads under chains for handling to avoid damaging sharp edges.
- 3.1.2 The Contractor shall ensure the protection of materials when received on site. The material shall be protected from potential damage caused by water and impacts:
- .1 Protect material from open water, rain, snow, condensation and puddles and any source of moisture, including exposed ground, concrete and masonry.
 - .2 Keep the original packaging but cut it in places on the underside to avoid trapping condensation.
 - .3 Separate the piles to ensure ventilation.
- 3.1.3 The material shall be protected from potential damage caused by drying:
- .1 Protect the material from excessive heat and dry air currents. Avoid exposing it to the sun and direct heat sources.
 - .2 Place the material in a compact pile to minimize the surface area in contact with ambient air.
 - .3 Keep the original packaging on the underside.
- 3.1.4 Treat the timber elements to be stored on site with the same care as is given to storing woodwork. Place 200 mm high shims under the bundles spaced 1 200 mm on centre. Cover the top and sides of the bundles with waterproof packaging.
- 3.1.5 Follow the recommendations of AITC 111 for storage and handling of glued laminated timber until erection.
- 3.1.6 Notwithstanding the preceding indications, the contractor is solely responsible for determining storage methods to:
- .1 Ensure that the structural and aesthetic properties of the materials at the time of installation are the same as upon reception.
 - .2 Ensure that the moisture content of the dry wood remains at all times below a moisture content of 19%, without sudden variations even below this range.
 - .3 Ensure that the surface condition of the wooden elements is not altered and that the straightness of the elements remains the same.

3.2 Installation - General

- 3.2.1 For light framing members (studs, joists, beams, trusses, etc.), the spacings shown on the drawings may be soft metric conversions of the actual dimensions, which are actually measured in imperial units.

Imperial Units	Equivalents	
	Exact Metric Conversion	Soft Metric Conversion
12 in.	305 mm	300 mm
16 in.	406 mm	400 mm
24 in.	610 mm	600 mm

- 3.2.2 Use timber elements of dimensions indicated on the drawings and continuous from the longest pieces possible. Unless otherwise indicated, dimensions on drawings are real dimensions as opposed to nominal dimensions.
- .1 Where dimensions of sawn timber members are given in imperial (inch) units, these dimensions are the nominal dimensions of the members.
- 3.2.3 Install rough carpentry components squared and plumb along the lines, levels and elevations indicated.
- 3.2.4 Structural members that are not visible after the building is finished shall be installed so that the identification stamps are easily legible upon inspection.
- 3.2.5 Unless otherwise indicated on drawings, the spacing of beams and joists is divided equally between walls and columns or between beams whose location is given on the drawing.
- 3.2.6 The spacing of studs, beams, joists or any other repetitive framing element to which a structural panel (plywood or OSB) is to be fixed shall allow for the installation of 1220 mm by 2440 mm panels, so that each end of the panel is supported by a framing element.
- 3.2.7 Carefully select the structural members that will be left exposed. Install lumber and panels to conceal classification markings and signs of deterioration or remove these markings and signs from exposed surfaces by sanding.
- 3.2.8 Assemble, anchor, fasten, tie and brace the members to provide them with the stability and rigidity necessary for the installation of the structure. The Contractor is responsible for ensuring the stability of the frame during assembly, until the permanent bracing system of the building is completely installed.
- 3.2.9 For resilient coverings, use nailing disks in accordance with the material manufacturer's instructions.
- 3.2.10 Immediately remove any water, snow or ice that may accumulate on floors and roofs already installed.
- 3.2.11 When there is a risk of precipitation, install tarps over the entire horizontal surface.

3.3 Installation of Plywood for Roof, Walls, and Floors

- 3.3.1 Plywood for wall, roof or floor shall be placed in a staggered pattern. Place the long edge of the panel perpendicular to the underlying structure. If multiple layers of plywood are laid directly on top of each other, the joints between the sheets shall not be aligned vertically.
- 3.3.2 Unless otherwise specified, fasten plywood to the roof using 2.84 mm diameter by 50 mm long nails spaced 100 mm on centre. at the perimeter of the panels and 300 mm on centre at intermediate supports.
- 3.3.3 Unless otherwise specified, fasten plywood flooring using 3.25 mm diameter by 64 mm long nails spaced 100 mm on centre at the perimeter of the panels and 300 mm on centre at intermediate supports.
- 3.3.4 Unless otherwise specified, fasten the plywood to the stud walls using 3.25 mm diameter by 64 mm long nails, placed at 150 mm on centre at the perimeter of the panels and at 300 mm on centre at the intermediate supports.
- 3.3.5 When load-bearing walls require plywood or OSB panels, these panels must be installed before any loads other than the floor immediately above the wall are applied to the wall. Generally, the Contractor is responsible for ensuring lateral restraint of the wall studs until the panels are installed in accordance with the plans.
- 3.3.6 Unless otherwise indicated on the plans, floor panels shall be glued and nailed. Provide a construction adhesive meeting the requirements of article 2.3.15.
- 3.3.7 Seal the joints between panels immediately after they are installed and until the enclosure is closed.

3.4 Nailing Strips, Backings, And Furs

- 3.4.1 Install furs and shims to ensure flatness and verticality of the works, the permissible deviation being 1: 600.
- 3.4.2 Install around the openings the false frames, nailing strips and trims intended to support the frames and other planned structures.
- 3.4.3 Install the battens and slats, nailing bases for roof edges, nailing rods, members and other required wooden supports and secure them using galvanized steel fasteners.
- 3.4.4 Plane, trim and lightly embed in the roof waterproofing the nailing rods which will be used to receive the roof drains.
- 3.4.5 Install joists as indicated.

3.5 Fasteners And Hardware Parts

- 3.5.1 Unless otherwise indicated, the installation of nails, pins and staples shall comply with the requirements of Section 9.23 of the Ontario Building Code.

3.5.2 Where indicated, fasten the elements using bolts with a minimum diameter of 9 mm. Wherever possible, fasten them using screws. Install the fasteners approximately 300 mm from the ends of the elements and space the others evenly. Unless otherwise indicated, install the bolts at 1 200 mm on centre and the screws at 600 mm on centre.

3.5.3 Mechanical bolts:

- .1 Avoid overtightening the bolts. Do not use electric or air impact wrenches.
- .2 Avoid crushing the wood fibre with the steel plates or washers. Any damage to the wooden members is likely to affect their structural capacity.
- .3 Countersink holes, if necessary, so that bolt heads do not protrude.
- .4 After closing the enclosure and when the humidity level of the wooden elements is stable, proceed with the final tightening of the bolts, even if an initial tightening was carried out during assembly.

3.5.4 Lag screws:

- .1 Drill the wood members before installing the lag screws, in accordance with clause 12.6.2.5 of CSA O86.
- .2 The holes shall consist of a pilot hole for the threaded portion of the lag screw and a clearance hole for the unthreaded portion. Hole diameters depend on the lag screw diameter and are specified in the standard.
- .3 Soap, paraffin, or a non-petroleum-based lubricant may be used to facilitate installation.
- .4 Use a hand wrench, not an impact wrench, to install the lag screws.
- .5 Abide strictly by the manufacturer's instructions.

3.5.5 Wood rivets:

- .1 Drive rivets until their conical heads seat in the steel junction plate, while maintaining a 2 mm projection above the plate. Rivets shall be placed so that their flattened face is parallel to the grain of the wood.
- .2 Rivets should be installed clockwise from the outside of the connection to the inside.
- .3 Ensure the accuracy of the fastener locations before driving the rivets completely. Use either a standard hammer or a pneumatic hammer as appropriate. It is important to wear safety glasses when installing the rivets.

3.6 Protection And Repair

3.6.1 Protect installed elements from damage during construction work.

3.6.2 Repair damage caused to adjacent materials and equipment by the installation of timber framing elements.

3.7 Conditioning

- 3.7.1 It is essential to avoid heating the structure too quickly during construction or following completion of the assembly of the structure. Take special precautions, especially during winter.
- 3.7.2 When heating begins, the relative humidity level shall be increased using humidifiers so as to maintain a humidity level of at least 65% for temperatures between 0 to 30 degrees Celsius. The relative humidity can be gradually reduced over a period of three (3) months following construction.
- 3.7.3 When it is necessary to heat the building, the temperature increase shall be achieved gradually and continuously over a minimum period of 1 month.
- 3.7.4 The relative humidity in the building shall be maintained at normal levels. Measures shall be taken to control relative humidity if necessary.
 - .1 A relative humidity level is considered normal when it is within the ranges expected during the building's operation, as defined in the mechanical documents.
- 3.7.5 At all times, the internal humidity level of wood shall remain under 19%, without sudden change below this value.
- 3.7.6 Do not direct heating or ventilation equipment directly onto vertical faces of wooden elements.
- 3.7.7 Failure to follow these instructions may result in excessive cracking of the structure. If the Contractor has not taken the measures indicated above and any other reasonable measure to prevent cracking of the wood, he will be deemed responsible for the damage, the cause of which will be deemed to be his negligence.

3.8 Deficiencies

- 3.8.1 Cracks, checks, splits, dirt, leaks, surface breaks and any other visual defect affecting the aesthetic character of the work are considered aesthetic deficiencies.
- 3.8.2 Excessive cracking is a structural deficiency in the case where the extent of the crack corresponds to:
 - .1 Columns: Full-height crack penetrating more than 50% of the thickness of the element.
 - .2 Beams:
 - .1 Side faces: Horizontal crack present in the first third of the span from each support, with a depth exceeding 15% of the width of the beam.
 - .2 Lower face: Any crack perpendicular to the grain of the wood.
 - .3 Any through crack.
- 3.8.3 The Contractor is responsible for notifying the Owner's Representative of the presence of such cracks in the structural elements.

- 3.8.4 In addition to the criteria listed in the preceding articles, the contractor may refer to AITC Technical Notes 18 and APA Document R475F to determine whether a crack should be considered a structural or aesthetic deficiency.

3.9 Correction Of Deficiencies

- 3.9.1 Provide a repair method for each type of defect. In the case of a structural defect, the method must be signed and sealed by a professional engineer, licensed in the Province of Ontario.

- 3.9.2 Prepare a representative sample of each repair for approval by the Owner's Representative and the architect.

- 3.9.3 Cracks, checks and splits:

- .1 The designation of the cracks to be repaired is at the sole discretion of the Owner's Representative and the architect.
- .2 Cracks shall be filled using a pore filler or acrylic-based wood filler of the same colour as the element on which it is applied.

- 3.9.4 Dirt, streaks and other visual surface defects:

- .1 Clean with water before undertaking sanding work.
- .2 Sanding and application of the finishing product may be requested on the entire part if cleaning with water is not conclusive.

- 3.9.5 Surface breakage:

- .1 Loose knots shall be replaced with a false knot of the same species and color.
- .2 For breakages requiring in-depth repair, favor repairs using a patching machine.

- 3.9.6 Structural deficiency:

- .1 The repair shall restore the full capacity of the element, regardless of the utilization level of the element in question.
- .2 Once repaired, the element shall have an appearance similar to that of a new element and its durability shall not be reduced.
- .3 Plan for replacement of the element if achieving the previous criteria is not possible otherwise.

END OF SECTION

1 General

1.1 Related Requirements

1.1.1 Section 06 10 00 – Rough Carpentry.

1.1.2 Section 06 20 00 – Finish Carpentry.

1.1.3 The Contractor shall obtain a copy of all sections even if they do not pertain directly to his speciality. When bidding, the Contractor agrees implicitly with articles and requirements of all sections in these specifications, including those he might not have read. The Contractor should consult the table of contents of the specifications to be aware of the complete list of sections.

1.2 References

1.2.1 American Society for Testing and Materials International, (ASTM):

- .1 ASTM A 36/A 36M-19, Standard Specification for Carbon Structural Steel.
- .2 ASTM A 47/A 47M-99(2022)e1, Standard Specification for Ferritic Malleable Iron Castings.
- .3 ASTM A 307-21, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .4 ASTM A 563/A 563M-24, Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
- .5 ASTM A 653/A 653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .6 ASTM A 924/A 924M-22a, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .7 ASTM D 1761–20, Standard Test Methods for Mechanical Fasteners in Wood.
- .8 ASTM F 436/F 436M-24, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
- .9 ASTM F 1667/F 1667M-21a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

1.2.2 American Society of Mechanical Engineers (ASME).

- .1 ANSI/ASME B18.2.1-2012(R2021) Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
- .2 ANSI/ASME B18.6.1-1981(R2016), Wood Screws (Inch Series).

1.2.3 American Wood-Preservers' Association (AWPA)

- .1 AWPA P25-20, Standard for Inorganic Boron (SBX).

- 1.2.4 Canadian Standards Association (CSA) / CSA International:
- .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA G40.20/G40.21-13(R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .3 CAN/CSA Series O80-21, Wood Preservation:
 - .1 CAN/CSA O80.0-21, General requirements for wood preservation.
 - .2 CAN/CSA O80.1-21, Specification of treated wood.
 - .3 CAN/CSA O80.2-21, Processing and treatment.
 - .4 CAN/CSA O80.3-21, Preservative formulations.
 - .5 CAN/CSA O80.5-21, Additives.
 - .4 CSA O86-24, Engineering design in wood.
 - .5 CSA O122-25, Structural Glued-Laminated Timber.
 - .6 CSA O141-23, Softwood Lumber.
 - .7 CSA S347-14(R2023), Method of Test for Evaluation of Truss Plates Used in Lumber Joints.
 - .8 CSA S349-20, Certification requirements for manufacturers of metal-plate-connected wood trusses.
 - .9 CSA W47.1-19(R2024), Certification of Company for Fusion Welding of Steel.
 - .10 CSA Z809-16(R2021), Sustainable forest management.
- 1.2.5 National Lumber Grades Authority (NLGA):
- .1 Standard Grading Rules For Canadian Lumber 2022.
 - .2 SPS 1-2023 : Fingerjoined Structural Lumber.
 - .3 SPS 2–2019 : Machine Graded Lumber.
 - .4 SPS 4–2020 : Fingerjoined Machine Graded Lumber.
- 1.2.6 National Research Council of Canada (NRCC) / Institute for Research in Construction (IRC) – Canadian Construction Materials Centre (CCMC).
- .1 CCMC, Registry of Product Evaluations.
- 1.2.7 SAE International (Society of Automotive Engineers)
- .1 SAE Handbook (2008).

1.2.8 Truss Plate Institute of Canada (TPIC):

- .1 TPIC 2024, Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses.

1.3 Design Requirements

- 1.3.1 Metal connectors with light wood trusses shall be designed according to the methods of the TPIC and computational requirements of CSA O86 (frames and metal connectors) according to the loads indicated on drawings.

- 1.3.2 Calculate trusses, bracing and bracing in accordance with CSA O86 according to the stipulated load, the requirements of Part 4 of the Building Code of Ontario and point loads and uniform minimum stipulated in the comments Code.

- 1.3.3 In addition to the criteria defined in the TPIC for deflection (see Articles 5.1.4.2 and 6.6.3), design trusses according to the following additional criteria:

- .1 The deflection caused by live loads shall not exceed 1/360 of the span for plaster or plasterboard ceilings directly suspended from the trusses.
- .2 Unless otherwise indicated or prescribed, the deflection caused by live loads shall not exceed 1/240 of the span.
- .3 The deflection caused by total loads shall not exceed 1/360 of the span for members supporting a concrete topping.

- 1.3.4 Where it is not possible to provide sufficient heel height or where the center line of the rafter and tie beam does not extend beyond the center line of the support, refer to Appendix F of the TPIC or an equivalent method to design the appropriate reinforcement.

- 1.3.5 Provide camber for trusses as indicated.

1.4 Action and Informational Submittals

- 1.4.1 Submittals in accordance with section 01 00 00 - General Requirements.

- 1.4.2 Technical documentation:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit material safety datasheet (MSDS) to the requirement of the Workplace hazardous Material Information System (WHMIS).

- 1.4.3 Shop drawings:

- .1 Each shop and erection drawing submission to be signed and stamped by a professional engineer, licensed in the Province of Ontario.
- .2 The drawings shall include the information presented in Annex H of the TPIC standard.

- .3 Indicate special structural application and specification as according to local authorities having jurisdiction.
- .4 Shop drawings shall show that requirements from TPIC Truss Design Procedure and CSA O86 shall be met. Specific CCMC Product Registry number of the truss plates shall be indicated on drawings.
- .5 Indicate species, sizes, and stress grades of lumber used as truss members. Show pitch, span, camber, configuration and spacing of trusses. Indicate connector types, thicknesses, sizes, locations, and design value. Show bearing details. Indicate design loads for members.
- .6 Submit stress diagram or print-out of computer design indicating design load for truss members. Indicate allowable load and stress values. Indicate deflections.
- .7 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
- .8 Indicate the location of temporary and permanent bracing and cross-bracing, including details of connections and anchorages of continuous and diagonal ties used for stability during erection and to control the slenderness of compressed members.
- .9 Test Reports: Submit test reports issued by recognized independent laboratories, certifying that the prefabricated trusses meet the requirements as to the physical characteristics and performance criteria.

1.4.4 Submit manufacturer's drawing and installation instructions.

- .1 For trusses longer than 18 m (60 ft), provide written procedures for erection of trusses including their temporary bracing signed by a professional engineer, licensed in the Province of Ontario.

1.5 Quality Control

1.5.1 Quality control: to section 01 45 00 – Quality Control.

1.5.2 Qualifications:

- .1 Fabricator for trusses to show evidence of quality control program such as provided by regional wood truss associations, or equivalent.
 - .1 Submit certificates demonstrating that the company is certified according to the CSA S349 standard.
- .2 Organization accredited by the Standards Council of Canada to certify that the wood is treated with a preservative and is fireproofed in accordance with relevant standards of the CSA O80 series.
- .3 Fabricator for welded steel connections to be certified in accordance with CSA W47.1.

1.5.3 Meeting prior to installation:

- .1 One (1) week before the start of the work covered by this section and installation, convene a meeting in accordance with Section 01 00 00 - General Requirements during which must be examined:

- .1 Specific project requirements.
- .2 Execution conditions.
- .3 Coordination of work with those implemented by other trades.
- .4 Manufacturer's installation instructions and terms of the guarantee offered by the latter.

1.5.4 Health and Safety:

- .1 Respect health and safety construction requirements in accordance with Section 01 00 00 - General Requirements.

1.5.5 Requirements of sustainable development for the construction must comply with section 01 00 00 - General Requirements. Realize the following activities and submit required documents

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.4.2	Datasheets of preservatives, flame retardants and preservative treatment	At least seven (7) days before work, according to the requirements for the submission of shop drawings of the call for tenders.	Transmission letter. Inscription at the technical specification registry	Contractor Review by the Owner's Representative
1.4.3	Shop drawings for prefabricated wood trusses.	At least fourteen (14) days prior to manufacturing, according to the requirements for the submission of shop drawings or performance of the call for tenders.	Transmission letter. Inscription at the technical specification registry	Contractor Review by the Owner's Representative
1.5.2. 1	Quality program for trusses manufacturer.	At least fourteen (14) days prior to work.	Quality Program	Contractor

ART.	PRESCRIPTIONS	PERIOD (FREQUENCY)	REGISTRY BREAKPOINT / MONITORING	RESPONSIBILITY
1.5.2. 2	Certificate of conformity of treatment with a preservative or flame retardant.	Following treatment of preservation or fireproofing.	Certificate of Conformity	Contractor
1.5.2. 3	Certification of steel fabricator	At least fourteen (14) days prior to work.	Certification	Contractor
3.4	Work site inspection.	According to the frequency stated at article 3.4	Inspection report.	Contractor

1.6 Delivery, Storage and Handling

1.6.1 The materials and products must be transported, stored and handled in accordance with section 01 00 00 - General Requirements.

1.6.2 Storage and Protection:

- .1 Store trusses on job site in accordance with manufacturer's instructions. Provide bearing supports and bracings. Prevent bending, warping and overturning of trusses.

1.6.3 Waste Management and Disposal:

- .1 Separate waste materials for reuse/recycling, according to section 01 00 00 - General Requirements.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Put all packing materials in paper, plastic, polystyrene and corrugated cardboard in appropriate bins on site for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse/recycling and place in designated containers steel, metal, and plastic waste.
- .5 Fold up metal and plastic banding, flatten and place in designated area for recycling.

2 Products

2.1 Materials

- 2.1.1 Materials and products in accordance with section 01 00 00 - General Requirements.
- 2.1.2 Lumber: softwood, no. 1 or 2, surfaced on all four sides (S4S), with maximum moisture content of 19% at time of fabrication and to following standards:
 - .1 CSA O141.
 - .2 NLGA (National Lumber Grading Association), Standard Grading Rules for Canadian Lumber.
- 2.1.3 The timber shall be marked with a grade stamp bearing the seal of an organization recognized by the Accreditation Board of the Canadian Standards Commission lumber.

2.2 Fasteners

- 2.2.1 Truss plates: made of Z275 (G90) galvanized steel to ASTM A 653/A 653M according to the grades set out in clause 17.4.1.2 of CSA O86, and whose resistance calculation parameters are determined according to CSA S347.
- 2.2.2 Split Rings: steel hot-rolled carbon, SAE 1010, as required by the SAE Handbook.
- 2.2.3 Shear Discs:
 - .1 Pressed steel: hot rolled carbon steel, SAE 1010, as required by the SAE Handbook;
 - .2 Malleable: conforms to ASTM A 47/A 47M, of nuance 32510 (22010 metric).
- 2.2.4 Bolts and pins: to ASTM A 307, unless otherwise indicated; with hot-dipped galvanized finish for outdoor works, high humidity areas and preservative-treated wood products.
- 2.2.5 Nuts: to ASTM A 563/A 563M.
- 2.2.6 Washers: conform to ASTM F 436/F 436M.
- 2.2.7 Lag screw: to ANSI/ASME B18.2.1
- 2.2.8 Side plates: to CSA G40.20/G40.21 or ASTM A 36/A 36M.
- 2.2.9 Drift pins: according to ASTM A 307 standard.
- 2.2.10 Joist hangers: to ASTM D 1761, with sheet steel at least 1 mm thick and ZF001 galvanized coating.
- 2.2.11 Nails and spikes: to the CSA B111 or ASTM F 1667/F 1667M.
- 2.2.12 Screws: to ANSI/ASME B18.6.1.

- 2.2.13 Seismic and hurricane ties: as indicated on drawings, made of Z275 (G90) galvanized steel to ASTM A 653/A 653M.

.1 In the absence of indications, consider Simpson H2.5A ties at each truss support.

2.3 Wood Preservative

- .1 For shop-fabricated wood trusses, impregnate the wood with a sodium borate product (SBX) compliant with AWWA P25. Use of an Alkaline Copper Quaternary (ACQ) compound is prohibited.

.1 The minimum retention level of the impregnation product shall be 4.5 kg/m³.

3 Execution

3.1 Fabrication

- 3.1.1 Fabricate wood trusses as indicated on reviewed shop drawings.
- 3.1.2 Cut truss elements accurately to length, at the corner and to size, to obtain tight joints during assembly.
- 3.1.3 When positioning firm, let the gables necessary to allow the camber planned and get the slopes calculated for the roof.
- 3.1.4 Trusses may be assembled by means of bolts and nuts, metal gussets, plywood, metal plate, to open rings, or shear plates.

3.2 Reception and Storage at Construction Site

- 3.2.1 When unloading materials, do not drag or drop items. Take care not to damage fine surfaces. Use wide nylon slings and pads under the chains when handling to avoid damaging sharp edges.
- 3.2.2 The Contractor shall ensure the protection of materials upon reception at the site. The materials shall be protected from potential damage caused by water and impacts:
- .1 Protect the materials from open water, rain, snow, condensation, puddles, and any source of moisture, including exposed soil, concrete, and masonry.

3.3 Erection

- 3.3.1 Unless otherwise indicated on the drawings, truss spacings shall be divided equally between walls and columns or between beams whose locations are indicated on the drawings.
- 3.3.2 Reject all trusses where truss plates are not tight.
- 3.3.3 Erect shop-fabricated wood trusses as indicated by the reviewed shop drawings.
- 3.3.4 Perform handling, installation, assembly, bracing and lifting according to manufacturer's instructions. Refer to the BCSI guide – Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses.

- 3.3.5 Take the necessary measures to prevent the trusses from being subjected to stress during handling and assembly.
- 3.3.6 Move trusses carefully to prevent bending in a plane other than the centerline.
- 3.3.7 Install bracing and temporary bracing to maintain the trusses perfectly straight, steadily, until the installation of permanent bracing and sheathing.
- 3.3.8 Restrict the loads so as not to submit the trusses to loads exceeding the design loads.
- 3.3.9 Install the final bracing before trusses are loaded, in accordance with reviewed shop drawings.
- 3.3.10 It is forbidden to cut or remove any part of the truss without the prior consent of the Owner's Representative.
- 3.3.11 Remove any deposits of the chemical or any other substance on the treated wood before applying a topcoat.

3.4 Quality Control

- 3.4.1 Controls provided on site by the manufacturer:
 - .1 Arrange for the manufacturer of the products supplied under this section to review the work related to the handling, installation/application, protection, and cleaning of its products, and submit written reports, in an acceptable format, to verify that the work is being carried out in accordance with the terms of the contract.
 - .2 The manufacturer shall make recommendations regarding the use of the product(s) and conduct periodic visits to verify that the implementation has been carried out in accordance with its recommendations.
 - .3 Schedule site visits at the following stages:
 - .1 After the products have been delivered and stored on site, and the preparatory and other preliminary work has been completed, but before the start of the installation work for the work covered by this section.
 - .2 Twice (2) during the progress of the work, i.e., once it is 25% complete and then 60% complete; and then once the work is completed and cleaning is complete.
 - .4 Obtain the reports within three (3) days following the execution of the inspections and then submit them without delay to the Owner's Representative.

3.5 Cleaning

- 3.5.1 Remove surplus materials, excess materials, rubbish, tools and equipment after installation is completed.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes all finish carpentry and interior woodwork, including:

- .1 Interior wood trim.
- .2 Wood baseboards.
- .3 Interior window trim.
- .4 Interior door trim.
- .5 Wood door frames and related components where wood.
- .6 Shelving, ledges and miscellaneous wood fabrications.
- .7 Blocking and backing required to support finish carpentry items.
- .8 Interface with millwork, doors and hardware.

1.1.2 Related Sections:

- .1 06 10 00 – Rough Carpentry
- .2 06 40 00 – Architectural Woodwork
- .3 08 14 00 – Wood Doors
- .4 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- 1.2.1 Ontario Building Code (OBC)
- 1.2.2 National Building Code of Canada (NBC)
- 1.2.3 CSA O86 – Engineering Design in Wood
- 1.2.4 NLGA – Standard Grading Rules for Canadian Lumber
- 1.2.5 AWMAC – Architectural Woodwork Standards (AWS)

1.3 SUBMITTALS

1.3.1 Submit shop drawings where required for:

- .1 Custom trim profiles.
- .2 Shelving systems.
- .3 Built-up trim details.

- .4 Blocking layouts where coordination with other trades is critical.

1.3.2 Submit:

- .1 Product data.
- .2 Finish samples.
- .3 Trim profile samples if requested by Consultant.

1.4 QUALITY ASSURANCE

- 1.4.1 Conform to AWMAC AWS "Custom Grade" unless noted otherwise.

1.4.2 Install work to maintain:

- .1 Alignment with adjacent finishes
- .2 Tolerances suitable for visible finish applications

1.5 DELIVERY, STORAGE AND HANDLING

- 1.5.1 Deliver materials dry and protected.

1.5.2 Store:

- .1 In conditioned interior spaces
- .2 Off floor and protected from moisture

- 1.5.3 Do not install warped or damaged materials.

1.6 COORDINATION

1.6.1 Coordinate with:

- .1 Door and hardware installation
- .2 Washroom accessory locations
- .3 Mechanical and electrical devices

1.6.2 Provide blocking for:

- .1 Washroom accessories
- .2 Barrier-free devices and controls
- .3 Wall-mounted equipment

- 1.6.3 Confirm accessory mounting locations and heights prior to installation

2 PRODUCTS

2.1 MATERIALS

2.1.1 Lumber:

- .1 SPF, kiln-dried, free of defects

2.1.2 Plywood:

- .1 CSA O121 / O151 compliant
- .2 Minimum 12.5 mm thickness unless noted

2.2 INTERIOR TRIM

2.2.1 General

- .1 Provide factory-primed paint-grade wood trim unless noted otherwise.

2.2.2 Baseboards

- .1 .1 Provide wood baseboards throughout finished interior spaces unless noted otherwise.
- .2 .2 Size and profile as indicated on the Drawings.
- .3 .3 Where no profile is indicated, provide rectangular profile with eased edges.

2.2.3 Door Trim

- .1 Provide wood casing at interior wood door frames where indicated.

2.2.4 Window Trim

- .1 Provide wood trim at interior window openings where indicated.

2.2.5 Profiles

- .1 Match profiles indicated on the Drawings.
- .2 Where profiles are not indicated, provide simple square-edge trim with eased corners.

2.2.6 Joints

- .1 Use scarf joints only where unavoidable.
- .2 Cope inside corners.
- .3 Mitre outside corners.
- .4 Provide tight joints without visible gaps.

2.2.7 Materials

- .1 Finger-jointed paint-grade pine.
or
- .2 MDF suitable for painted finish.
 - .1 As selected by the Consultant.
- .3 Moisture-resistant MDF shall be used in washrooms, janitor rooms and other damp interior areas where MDF trim is permitted.

2.2.8 Finish

- .1 Factory primed.
- .2 Prepared for field painting.
- .3 Coordinate with Section 09 91 23 – Interior Painting.

2.3 SHELVING AND MISCELLANEOUS WOODWORK

2.3.1 Provide:

- .1 Shelving in storage, utility, and support spaces
- .2 Wood backing for wall-mounted elements

2.3.2 Materials:

- .1 Plywood or solid lumber, minimum 19 mm thick

2.4 BLOCKING AND BACKING

2.4.1 Provide concealed wood blocking:

- .1 At all wall-mounted accessories
- .2 At washroom fixtures and grab bars

2.4.2 Design loads:

- .1 Minimum 1.33 kN for accessible fixtures and accessories

2.5 FASTENERS AND ADHESIVES

2.5.1 Fasteners:

- .1 Corrosion-resistant where concealed in walls
- .2 Finish nails for exposed work

2.5.2 Adhesives:

- .1 VOC compliant
- .2 Compatible with substrates

2.6 MOISTURE AND MOVEMENT CONTROL

2.6.1 Provide materials with moisture content:

- .1 Compatible with interior conditions

2.6.2 Allow for:

- .1 Expansion and contraction at joints

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Wall framing is complete and true
- .2 Blocking is installed where required

3.1.2 Do not proceed until deficiencies are corrected.

3.2 PREPARATION

3.2.1 Confirm:

- .1 Locations of all accessories and equipment
- .2 Door and frame installation readiness

3.2.2 Coordinate:

- .1 With gypsum board installation for concealed backing

3.3 INSTALLATION – GENERAL

3.3.1 Install:

- .1 Plumb, level, and aligned
- .2 Tight to adjacent surfaces

3.3.2 Provide:

- .1 Smooth, flush joints
- .2 Secure fastening without visible defects

- 3.3.3 Install baseboards level and tight to adjacent wall and floor finishes.
- 3.3.4 Install door and window trim plumb, level and aligned.
- 3.3.5 Provide consistent reveals around door and window frames.
- 3.3.6 Scribe trim to irregular wall surfaces where required.
- 3.3.7 Fasten trim using concealed finish fasteners.
- 3.3.8 Fill nail holes and prepare surfaces for painting.

3.4 BLOCKING INSTALLATION

- 3.4.1 Install blocking:
 - .1 At all locations requiring support for mounted items
- 3.4.2 Coordinate with:
 - .1 AODA requirements for barrier-free fixtures
- 3.4.3 Ensure blocking locations align with:
 - .1 Grab bars
 - .2 Accessories
 - .3 Wall-mounted equipment

3.5 INSTALLATION – SHELVING

- 3.5.1 Install shelving:
 - .1 Level and securely anchored
- 3.5.2 Provide:
 - .1 Adequate support for anticipated loads

3.6 INSTALLATION – BASEBOARDS AND TRIM

- 3.6.1 Install baseboards continuously unless interrupted by door openings.
- 3.6.2 Cope inside corners.
- 3.6.3 Mitre outside corners.
- 3.6.4 Maintain consistent joints and reveals.
- 3.6.5 Install trim free of open joints, splits and visible defects.
- 3.6.6 Touch up damaged primer before painting.

3.6.7 Provide smooth transitions at intersections with millwork, window frames, door frames and adjacent finishes.

3.6.8 Apply paintable acrylic latex sealant at junctions between trim and adjacent gypsum board where required to provide a smooth finished appearance.

3.6.9 Coordinate sealant with Section 07 92 00 – Joint Sealants.

3.7 TOLERANCES

3.7.1 Variation from plumb or level:

.1 Maximum 2 mm in 2400 mm

3.8 FIELD QUALITY CONTROL

3.8.1 Inspect:

.1 Alignment.

.2 Plumb.

.3 Level.

.4 Tight joints.

.5 Mitred corners.

.6 Surface condition.

.7 Nail hole filling.

.8 Readiness for painting.

3.8.2 Replace defective work.

3.9 PROTECTION

3.9.1 Protect installed work from:

.1 Damage

.2 Moisture

.3 Impact

3.10 CLEANING

3.10.1 Remove:

.1 Dust, debris, and excess materials

3.10.2 Leave surfaces ready for finishing trades.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes fabrication and installation of architectural woodwork, including:

- .1 Casework and cabinets (kitchen, utility, storage areas)
- .2 Countertops and work surfaces
- .3 Shelving systems and built-in units
- .4 Wood panels and trim integrated with millwork
- .5 Backing and supports integral to millwork systems

1.1.2 Work includes complete assemblies including:

- .1 Hardware
- .2 Supports
- .3 Fasteners
- .4 Accessories required for a complete installation

1.1.3 Coordinate with:

- .1 06 20 00 – Finish Carpentry
- .2 08 14 00 – Wood Doors
- .3 10 28 00 – Washroom Accessories

1.2 REFERENCES

1.2.1 Ontario Building Code (OBC)

1.2.2 National Building Code of Canada (NBC)

1.2.3 AWMAC – Architectural Woodwork Standards (AWS), latest edition

1.2.4 CSA O86 – Engineering Design in Wood

1.3 SUBMITTALS

1.3.1 Submit shop drawings indicating:

- .1 Layouts and dimensions
- .2 Construction details

- .3 Materials and finishes
- .4 Interface with walls, floors, and adjacent systems

1.3.2 Indicate:

- .1 Locations of supports and anchorage
- .2 Integration with mechanical and electrical systems

1.3.3 Submit:

- .1 Product data.
- .2 Hardware schedules.
- .3 Finish samples.
- .4 Colour and finish selection samples.
- .5 Laminate manufacturer's complete colour range for each laminate type specified.
- .6 Minimum 300 x 300 mm laminate samples illustrating the proposed wood-look plastic laminate.
- .7 Edge banding samples.
- .8 Countertop laminate samples.
- .9 Submit samples sufficiently in advance of fabrication to permit Owner and Consultant colour selection.

1.3.4 Colour Selection

- .1 Cabinet laminate colours have not been finalized.
- .2 Submit the manufacturer's complete standard wood-look laminate colour range.
- .3 Consultant and Owner will select colours following review of submitted samples.
- .4 Do not commence fabrication until written colour selections have been issued by the Consultant.

1.4 QUALITY ASSURANCE

1.4.1 Conform to AWMAC AWS "Custom Grade" unless noted otherwise.

1.4.2 Fabricate work to:

- .1 Maintain consistent appearance
- .2 Ensure durability for intended use

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Deliver prefabricated components protected from damage.

1.5.2 Store:

.1 In dry, conditioned environment

.2 Off ground

1.5.3 Protect from:

.1 Moisture

.2 Temperature fluctuations

1.6 COORDINATION

1.6.1 Coordinate with:

.1 Rough and finish carpentry

.2 Mechanical and electrical installations

.3 Door hardware and accessibility devices

1.6.2 Confirm:

.1 Exact locations and dimensions prior to fabrication

.2 Clearances for barrier-free access and operation

1.6.3 Coordinate backing and support requirements with wall assemblies

2 PRODUCTS

2.1 MATERIALS

2.1.1 Wood Panels and Casework

.1 Plywood core panels conforming to CSA O121 / O151

.2 Minimum thickness:

.1 Casework: 19 mm

.2 Shelving: 19 mm minimum

2.1.2 Exposed Cabinet Components

.1 Cabinet doors, drawer fronts, exposed ends and finished panels shall be plastic laminate over plywood or composite core as specified.

.2 Solid wood shall be limited to concealed blocking, nailers or trim where specifically indicated.

.3 Plastic laminate finish shall simulate natural wood grain.

2.2 CABINETS AND CASEWORK

2.2.1 Provide casework in:

- .1 Kitchen (Room 013)
- .2 Utility room (Room 012)
- .3 Storage areas (Room 014)
- .4 Other areas as indicated on drawings

2.2.2 Construction:

- .1 Factory-fabricated modular units
- .2 Fully assembled or knock-down

2.2.3 Provide:

- .1 Adjustable shelves
- .2 Concealed fasteners

2.2.4 Exposed cabinet doors, drawer fronts, finished end panels and valances shall receive wood-look plastic laminate.

2.2.5 Cabinet interiors shall receive white melamine finish unless noted otherwise.

2.2.6 Cabinet edges shall receive matching PVC edge banding.

2.3 COUNTERTOPS

2.3.1 Provide countertops:

- .1 In kitchen and washroom areas

2.3.2 Materials:

- .1 High-pressure laminate (HPL) on plywood substrate
- .2 Moisture-resistant core

2.3.3 Edges:

- .1 Square edge or post-formed

2.4 SHELVING

2.4.1 Provide:

- .1 Fixed and adjustable shelving

2.4.2 Support:

- .1 Concealed brackets or integral supports

2.5 HARDWARE

2.5.1 Provide:

- .1 Hinges, pulls, and supports

2.5.2 Requirements:

- .1 Commercial-grade
- .2 Corrosion-resistant

2.6 FINISHES

2.6.1 General

- .1 Provide factory-applied decorative plastic laminate finishes.
- .2 Finish shall be durable and suitable for institutional occupancy.
- .3 Colour and pattern shall be selected by the Consultant and Owner from the manufacturer's complete standard range.

2.6.2 Cabinet Faces

- .1 Plastic laminate.
- .2 Wood-look pattern.
- .3 Matte finish.
- .4 Colour selected by Owner and Consultant during construction.

2.6.3 Cabinet Interiors

- .1 White melamine.

2.6.4 Exposed Ends

- .1 Match adjacent cabinet faces.

2.6.5 Edge Treatment

- .1 3 mm PVC edge banding.
- .2 Colour matched to adjacent laminate.

2.6.6 Countertops

- .1 High-pressure plastic laminate as specified.
- .2 Colour selected separately by Consultant and Owner.

2.6.7 Acceptable Plastic Laminate Manufacturers

- .1 Arborite.
- .2 Wilsonart.
- .3 Formica.
- .4 Nevamar.
- .5 Lamin-Art.
- .6 Approved equivalent.

2.6.8 Samples

- .1 Submit complete manufacturer's colour collection.
- .2 Submit minimum three proposed wood-look laminate selections for review.
- .3 Final colour selections will be made by the Owner and Consultant after review of submitted samples.
- .4 Do not order materials until colour selections have been approved.

2.7 ACCESSIBILITY REQUIREMENTS

2.7.1 Comply with OBC and AODA requirements for:

- .1 Reach ranges
- .2 Clearances
- .3 Operability

2.7.2 Controls and operable components:

- .1 Operable with one hand
- .2 Maximum force per code requirements

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Dimensions and site conditions
- .2 Wall readiness and backing

3.1.2 Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

3.2.1 Confirm:

- .1 Layouts with drawings and field measurements
- .2 Locations of services and penetrations

3.2.2 Do not fabricate cabinet doors, drawer fronts or finished end panels until written approval of laminate colours has been received from the Consultant.

3.3 INSTALLATION – GENERAL

3.3.1 Install:

- .1 Plumb, level, and aligned
- .2 Securely anchored

3.3.2 Provide:

- .1 Tight joints
- .2 Smooth transitions

3.4 INSTALLATION – CASEWORK

3.4.1 Install casework:

- .1 Fully supported
- .2 Anchored to structural backing

3.4.2 Provide:

- .1 Alignment between adjacent units

3.5 INSTALLATION – COUNTERTOPS

3.5.1 Install:

- .1 Level and continuous

3.5.2 Provide:

- .1 Moisture-resistant sealant at joints

3.6 INSTALLATION – ACCESSIBLE COMPONENTS

3.6.1 Install components to meet:

- .1 Barrier-free clearances
- .2 Mounting heights

3.6.2 Coordinate with:

- .1 Washroom layouts
- .2 Accessible equipment requirements

3.7 TOLERANCES

3.7.1 Variation from plumb or level:

- .1 Maximum 2 mm in 2400 mm

3.8 FIELD QUALITY CONTROL

3.8.1 Inspect:

- .1 Alignment
- .2 Fastening
- .3 Finish quality

3.8.2 Replace defective work.

3.9 PROTECTION

3.9.1 Protect installed work from:

- .1 Damage
- .2 Moisture
- .3 Impact

3.10 CLEANING

3.10.1 Remove debris and dust.

3.10.2 Leave surfaces ready for occupancy.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes

- .1 Hardware for manufactured casework specified in Section 06 40 00.
- .2 Hinges.
- .3 Drawer slides.
- .4 Pulls.
- .5 Shelf supports.
- .6 Adjustable shelving hardware.
- .7 Cabinet catches and latches.
- .8 Locks and keying.
- .9 Countertop support brackets where not specified elsewhere.
- .10 Miscellaneous cabinet hardware required for complete installation.

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 01 00 00 – General Requirements.
- 1.2.2 Section 06 20 00 – Finish Carpentry.

1.3 REFERENCES

1.3.1 Latest editions of:

- .1 Ontario Building Code (OBC).
- .2 BHMA – Builders Hardware Manufacturers Association Standards.
- .3 ANSI/BHMA A156 Series – Cabinet Hardware.
- .4 Architectural Woodwork Standards (AWS), where applicable.
- .5 Manufacturer's published installation instructions.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 General

- .1 Provide commercial-grade cabinet hardware suitable for institutional use.

- .2 Hardware shall withstand repeated operation without excessive wear, deformation, loosening, or failure.
- .3 Exposed hardware shall have a consistent appearance throughout the Project.
- .4 Hardware shall be corrosion resistant.
- .5 Hardware shall be compatible with adjoining materials.

1.4.2 Operating Requirements

- .1 Hinges shall permit full intended door movement without binding.
- .2 Drawer slides shall operate smoothly under full design load.
- .3 Adjustable shelf supports shall safely support the specified shelf loads.
- .4 Hardware shall remain securely attached during normal use.

1.5 SUBMITTALS

1.5.1 Submit in accordance with Section 01 00 00.

1.5.2 Product Data

- .1 Submit manufacturer's literature for:
 - .1 Hinges.
 - .2 Drawer slides.
 - .3 Pulls.
 - .4 Locks.
 - .5 Shelf supports.
 - .6 Miscellaneous hardware.

1.5.3 Hardware Schedule

- .1 Submit schedule indicating:
 - .1 Hardware type.
 - .2 Manufacturer.
 - .3 Model numbers.
 - .4 Finish.
 - .5 Locations.

1.5.4 Samples

- .1 If requested, submit:
 - .1 One sample of each exposed hardware item.
 - .2 Finish samples.

1.6 QUALITY ASSURANCE

1.6.1 Manufacturer shall have minimum five years documented experience producing commercial cabinet hardware.

- 1.6.2 Hardware shall be supplied by one manufacturer wherever practical.

1.7 DELIVERY, STORAGE AND HANDLING

- 1.7.1 Deliver hardware in manufacturer's unopened packaging.
- 1.7.2 Protect finished hardware from damage.
- 1.7.3 Store indoors in dry conditions.

1.8 CLOSEOUT SUBMITTALS

- 1.8.1 Submit:
- .1 Maintenance information.
 - .2 Adjustment instructions.
 - .3 Warranty documentation.

1.9 WARRANTY

- 1.9.1 Provide manufacturer's standard warranty.

2 PRODUCTS

2.1 MANUFACTURERS

- 2.1.1 Subject to compliance with this specification, acceptable manufacturers include:
- .1 Richelieu Hardware.
 - .2 Häfele Canada Ltd.
 - .3 Blum Canada Ltd.
 - .4 Hettich Canada.
 - .5 Knape & Vogt.
 - .6 Approved equivalent.

2.2 GENERAL

- 2.2.1 Provide commercial-grade cabinet hardware throughout.
- 2.2.2 Hardware shall be supplied by one manufacturer wherever practical.
- 2.2.3 Hardware shall be compatible with cabinet construction and adjacent materials.
- 2.2.4 Exposed hardware shall have a uniform finish.

2.3 FINISH

2.3.1 Exposed hardware finish:

.1 Satin stainless steel.

or

.2 Satin nickel.

.1 As selected by Consultant.

2.3.2 Concealed hardware shall have manufacturer's standard corrosion-resistant finish.

2.3.3 Finish shall resist:

.1 Corrosion.

.2 Wear.

.3 Cleaning chemicals.

.4 Discolouration.

2.4 HINGES

2.4.1 Provide concealed European-style hinges.

2.4.2 Minimum opening:

.1 110 degrees.

2.4.3 Clip-on type.

2.4.4 Six-way adjustable.

2.4.5 Integrated soft-close mechanism.

2.4.6 Minimum load rating suitable for door size.

2.4.7 Provide quantity recommended by hinge manufacturer.

2.5 DRAWER SLIDES

2.5.1 Full-extension concealed undermount slides.

2.5.2 Soft-close.

2.5.3 Minimum load capacity:

.1 45 kg.

2.5.4 Positive stop.

2.5.5 Self-closing.

2.5.6 Adjustment without removing drawer.

2.6 PULLS

2.6.1 Type:

.1 Contemporary bar pull.

2.6.2 Material:

.1 Stainless steel.

2.6.3 Finish:

.1 Satin.

2.6.4 Projection:

.1 Minimum 30 mm.

2.6.5 Centre-to-centre spacing:

.1 128 mm unless indicated otherwise.

2.6.6 Pulls shall be supplied complete with concealed machine screws.

2.7 SHELF SUPPORTS

2.7.1 Nickel-plated steel.

2.7.2 Locking type.

2.7.3 Minimum four supports per adjustable shelf.

2.7.4 Capable of supporting specified shelf loads without deformation.

2.8 ADJUSTABLE SHELVING HARDWARE

2.8.1 32 mm system.

2.8.2 Shelf pin holes factory drilled.

2.8.3 Hole spacing:

.1 32 mm.

2.8.4 Provide shelf supports compatible with drilling system.

2.9 LOCKS

2.9.1 Provide locks where indicated on Drawings or Casework Schedule.

2.9.2 Cylinder type:

.1 Pin tumbler.

2.9.3 Master-key compatible.

2.9.4 Provide two keys per lock.

2.9.5 Coordinate keying with Owner.

2.10 CATCHES

2.10.1 Concealed magnetic catches.

2.10.2 Minimum pull:

.1 4.5 kg.

2.10.3 Provide resilient bumpers where required.

2.11 COUNTERTOP SUPPORTS

2.11.1 Provide concealed steel countertop support brackets where required.

2.11.2 Powder-coated steel.

2.11.3 Capable of supporting imposed loads.

2.11.4 Fasteners supplied by bracket manufacturer.

2.12 FASTENERS

2.12.1 Provide manufacturer's recommended fasteners.

2.12.2 Exposed screws:

.1 Stainless steel.

2.12.3 Machine screws for pulls.

2.12.4 Corrosion-resistant concealed fasteners.

2.13 ACCESSORIES

2.13.1 Provide:

.1 Mounting plates.

.2 Shelf clips.

.3 Bumpers.

.4 Strike plates.

- .5 Spacer plates.
- .6 Adjustment tools.
- .7 Touch-up caps.
- .8 Installation templates where required.

2.14 SOURCE QUALITY CONTROL

- 2.14.1 Inspect hardware before shipment.
- 2.14.2 Replace defective items.
- 2.14.3 Supply matching hardware from same production series.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Verify that casework has been installed plumb, level, square, rigid, and ready to receive hardware.
- 3.1.2 Verify dimensions and locations of hardware.
- 3.1.3 Verify doors and drawers are free from warp or damage.
- 3.1.4 Do not proceed until deficiencies have been corrected.

3.2 PREPARATION

- 3.2.1 Review approved Shop Drawings and manufacturer's installation instructions before installation.
- 3.2.2 Lay out hardware accurately.
- 3.2.3 Protect finished cabinet surfaces during installation.
- 3.2.4 Pre-drill holes where required to prevent splitting of wood members.

3.3 INSTALLATION

3.3.1 General

- .1 Install hardware in accordance with:
 - .1 Manufacturer's written instructions.
 - .2 Approved Shop Drawings.
 - .3 Reviewed hardware schedule.
- 3.3.2 Install hardware plumb, level and aligned.
- 3.3.3 Install hardware using concealed fasteners wherever possible.

- 3.3.4 Secure hardware rigidly.
- 3.3.5 Do not overtighten fasteners.
- 3.3.6 Install hardware so it does not interfere with adjacent work.
- 3.3.7 Use manufacturer's recommended fasteners only.
- 3.3.8 Do not substitute fasteners.

3.4 HINGES

- 3.4.1 Install hinges to permit full opening of doors.
- 3.4.2 Adjust hinges for:
 - .1 Alignment.
 - .2 Uniform reveals.
 - .3 Smooth operation.
 - .4 Soft-close operation.
- 3.4.3 Provide equal door clearances.
- 3.4.4 Doors shall remain stationary in partially open positions where designed to do so.

3.5 DRAWER SLIDES

- 3.5.1 Install drawer slides level.
- 3.5.2 Adjust for smooth operation.
- 3.5.3 Drawers shall:
 - .1 Fully extend.
 - .2 Operate freely.
 - .3 Self-close smoothly.
 - .4 Close flush.
 - .5 Maintain alignment under full load.

3.6 PULLS

- 3.6.1 Install pulls in consistent locations.
- 3.6.2 Mount using machine screws through cabinet members.
- 3.6.3 Do not use wood screws for exposed pulls.

3.6.4 Align pulls vertically and horizontally.

3.7 LOCKS

3.7.1 Install locks where indicated.

3.7.2 Coordinate keying with Owner.

3.7.3 Provide two keys per lock.

3.7.4 Tag keys for identification.

3.8 SHELF SUPPORTS

3.8.1 Install shelf supports level.

3.8.2 Provide four supports minimum per shelf.

3.8.3 Install locking shelf supports where specified.

3.9 ADJUSTMENT

3.9.1 Adjust all moving hardware after installation.

3.9.2 Doors shall:

- .1 Open freely.
- .2 Close without binding.
- .3 Maintain uniform clearances.
- .4 Engage catches positively.

3.9.3 Drawers shall:

- .1 Open smoothly.
- .2 Fully extend.
- .3 Close completely.
- .4 Self-close properly.

3.9.4 Replace defective hardware.

3.10 FIELD QUALITY CONTROL

3.10.1 Inspect completed installation.

3.10.2 Verify:

- .1 Alignment.

- .2 Operation.
- .3 Secure attachment.
- .4 Finish condition.
- .5 Uniform installation.

3.10.3 Replace damaged hardware.

3.10.4 Replace scratched exposed hardware.

3.11 CLEANING

- 3.11.1 Remove protective films.
- 3.11.2 Clean exposed hardware.
- 3.11.3 Remove fingerprints.
- 3.11.4 Use cleaners recommended by the manufacturer.
- 3.11.5 Do not use abrasive cleaners.

3.12 PROTECTION

- 3.12.1 Protect installed hardware from damage.
- 3.12.2 Replace damaged hardware prior to Substantial Performance.
- 3.12.3 Protect finished cabinet surfaces during remaining construction.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes supply and installation of thermal insulation systems, including:

- .1 Batt insulation in wood stud wall cavities
- .2 Rigid insulation in exterior wall assemblies
- .3 Roof/ceiling insulation in attic and truss spaces
- .4 Perimeter slab and foundation insulation
- .5 Acoustic insulation in interior partitions
- .6 Accessories required for complete and continuous insulation systems

1.1.2 Provide complete thermal envelope continuity in conjunction with:

- .1 Air barrier systems
- .2 Vapour barrier systems
- .3 Structural and cladding systems

1.2 RELATED REQUIREMENTS

1.2.1 Section 06 10 00 – Rough Carpentry

1.2.2 Section 07 27 00 – Air-Vapour Barriers

1.2.3 Section 09 21 16 – Gypsum Board Assemblies

1.3 REFERENCES

1.3.1 Comply with latest editions of referenced standards.

- .1 Ontario Building Code (OBC) – Energy Efficiency (SB-10 / SB-12 as applicable)
- .2 National Building Code of Canada (NBC)
- .3 CAN/ULC-S702 – Mineral Fibre Thermal Insulation
- .4 CAN/ULC-S701 – Polystyrene Insulation
- .5 ASTM C518 – Thermal Resistance
- .6 ASTM E96 – Water Vapour Transmission

1.4 PERFORMANCE REQUIREMENTS

- 1.4.1 Provide thermal insulation to achieve:
 - .1 Continuous thermal barrier across assemblies
 - .2 No thermal bridging except where structurally unavoidable
- 1.4.2 Slab assemblies (F1):
 - .1 Perimeter slab 100 mm rigid insulation.
- 1.4.3 Foundation (FW1):
 - .1 70mm Concrete faced insulation.
- 1.4.4 Exterior wall assembly (EW1):
 - .1 Continuous exterior insulation layer (100 mm rigid insulation)
 - .2 Cavity batt insulation fully filling stud space
- 1.4.5 Ceiling assemblies:
 - .1 Minimum 200 mm batt insulation in ceiling assemblies (C1)
- 1.4.6 Roof assemblies:
 - .1 Thickness batt insulation (R1B): As per drawings.
- 1.4.7 Acoustic performance:
 - .1 Provide sound attenuation insulation in washroom partitions

1.5 SUBMITTALS

- 1.5.1 Submit:
 - .1 Product data indicating thermal resistance (RSI/R-value)
 - .2 Manufacturer installation instructions
 - .3 Certificates confirming compliance with CAN/ULC standards
- 1.5.2 Submit shop drawings where required for:
 - .1 Continuous insulation systems
 - .2 Complex interfaces (roof/wall transitions)

1.6 QUALITY ASSURANCE

- 1.6.1 Install insulation in accordance with:

- .1 Manufacturer's instructions
- .2 Applicable codes and standards

1.6.2 Ensure:

- .1 Full contact with substrates
- .2 No gaps, voids, or compression

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Deliver materials in original packaging.

1.7.2 Store:

- .1 Off ground
- .2 Protected from moisture

1.7.3 Replace wet or damaged insulation.

1.8 COORDINATION

1.8.1 Coordinate with:

- .1 Air/vapour barrier installation
- .2 Mechanical and electrical penetrations
- .3 Structural framing

1.8.2 Ensure:

- .1 Continuity at all transitions (wall to roof, wall to slab)
- .2 Insulation is installed prior to enclosure

2 PRODUCTS

2.1 BATT INSULATION

2.1.1 Mineral fibre batt insulation:

- .1 Conforming to CAN/ULC-S702
- .2 Friction-fit within stud cavities

2.1.2 Thickness:

- .1 Full depth of studs:
 - .1 89 mm, 140 mm, or 184 mm cavities as applicable

2.2 RIGID INSULATION

2.2.1 Extruded polystyrene (XPS) or equivalent:

- .1 Conforming to CAN/ULC-S701
- .2 Minimum thickness:
 - .1 100 mm exterior wall insulation (EW1)
 - .2 100 mm perimeter slab insulation (F1)

2.2.2 Provide:

- .1 Mechanically fastened insulation at exterior walls

2.3 CONCRETE FACED INSULATION

2.3.1 Concrete faced Extruded polystyrene (XPS)

- .1 Basis of design: T-Clear WALLGUARD by Form and Build.

2.4 ROOF / ATTIC INSULATION

2.4.1 Batt insulation:

- .1 Mineral fibre
- .2 Installed between trusses or joists

2.4.2 Thickness:

- .1 Minimum 200 mm in ceiling assemblies
- .2 As per drawings for joist insulation

2.5 ACOUSTIC INSULATION

2.5.1 Provide sound attenuation insulation:

- .1 Mineral fibre batt

2.5.2 Locations:

- .1 Washroom partitions
- .2 Interior partitions where indicated

2.6 ACCESSORIES

2.6.1 Fasteners:

- .1 Compatible with insulation type

2.6.2 Supports:

- .1 Insulation supports where required

2.6.3 Sealants:

- .1 Compatible with air/vapour barrier systems

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Framing is complete
- .2 Surfaces are dry and clean

3.1.2 Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

3.2.1 Coordinate installation with:

- .1 Air barrier
- .2 Vapour barrier
- .3 Services

3.3 INSTALLATION – GENERAL

3.3.1 Install insulation:

- .1 Without gaps, voids, or compression
- .2 Continuous across assemblies

3.3.2 Fit tightly around:

- .1 Framing
- .2 Penetrations

3.4 INSTALLATION – EXTERIOR WALLS

3.4.1 Install batt insulation:

- .1 Full cavity depth
- .2 Continuous without gaps

3.4.2 Install rigid insulation:

- .1 Continuous exterior layer
- .2 Securely fastened
- .3 Aligned with cladding support system

3.5 INSTALLATION – ROOF AND CEILING

3.5.1 Install batt insulation:

- .1 Between trusses or joists
- .2 Thickness: As per drawings

3.5.2 Maintain:

- .1 Continuity at roof-to-wall junction

3.6 INSTALLATION – SLAB PERIMETER

3.6.1 Install rigid insulation:

- .1 At slab perimeter
- .2 Minimum 1220 mm width from foundation wall

3.7 INSTALLATION – ACOUSTIC INSULATION

3.7.1 Install:

- .1 In washroom partitions
- .2 Full cavity depth

3.7.2 Ensure:

- .1 No gaps or compression

3.8 FIELD QUALITY CONTROL

3.8.1 Inspect installation prior to enclosure.

3.8.2 Verify:

- .1 Continuity
- .2 Absence of voids

3.8.3 Replace defective work.

3.9 PROTECTION

3.9.1 Protect insulation from:

.1 Moisture

.2 Damage

3.10 CLEANING

3.10.1 Remove waste materials.

3.10.2 Leave work ready for enclosure.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 Vapour barrier systems at interior side of envelope
 - .1 Air barrier systems within exterior wall, roof and ceiling assemblies
 - .2 Underslab vapour barrier for slab-on-grade assemblies
- .2 Sealing of penetrations and transitions
- .3 Accessories required to provide a continuous vapour barrier system

1.1.2 Provide complete air barrier continuity across:

- .1 Exterior walls
- .2 Interfaces with slab-on-grade construction
- .3 Accessories required to provide a continuous air barrier system

1.1.3 Air/vapour barrier locations are indicated in assemblies and include:

- .1 Perimeter of foundation as indicated on the drawings.

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 06 10 00 – Rough Carpentry
- 1.2.2 Section 07 21 00 – Thermal Insulation
- 1.2.3 Section 07 62 00 – Sheet Metal Flashing and Trim
- 1.2.4 Section 09 21 16 – Gypsum Board Assemblies

1.3 REFERENCES

1.3.1 Comply with latest editions of referenced standards.

- .1 Ontario Building Code (OBC), including:
 - .1 9.25 – Heat Transfer, Air Leakage, and Condensation Control
- .2 National Building Code (NBC)
- .3 ASTM E2178 – Air Permeance of Building Materials
- .4 ASTM E2357 – Air Leakage of Wall Assemblies
- .5 CAN/ULC-S741 – Air Barrier Materials

- .6 ASTM E96 – Vapour Transmission

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Air Barrier Performance:

- .1 Maximum air leakage of assembly: 0.2 L/s·m² @ 75 Pa (target)
- .2 Provide continuous air barrier system across entire building envelope

1.4.2 Vapour Barrier Performance:

- .1 Vapour permeance not greater than 60 ng/(Pa·s·m²) (OBC compliant)

1.4.3 Continuity:

- .1 Maintain continuous air/vapour barrier:
 - .1 Across wall assemblies (EW1, EW1a, EW1b, EW2)
 - .2 At roof/ceiling interfaces (R1A, R1B, C1)
 - .3 At slab edge and foundation transitions

1.4.4 System Requirements:

- .1 Air barrier to be continuous across:
 - .1 Structural joints
 - .2 Penetrations
 - .3 Openings

1.5 SUBMITTALS

1.5.1 Submit:

- .1 Product data for membranes, sealants, and accessories
- .2 Air permeance test data (ASTM E2178 / E2357)
- .3 Installation details for:
 - .1 Wall-to-roof transitions
 - .2 Window/door interfaces
 - .3 Service penetrations

1.5.2 Submit shop drawings showing:

- .1 Air barrier continuity strategy
- .2 Interface coordination with other trades

1.6 QUALITY ASSURANCE

1.6.1 Installer qualifications:

- .1 Minimum 3 years experience with air barrier systems

1.6.2 Mock-up:

- .1 Provide mock-up of typical wall assembly including:
- .2 Sheathing membrane
- .3 Penetrations
- .4 Transition detailing

1.6.3 Field review:

- .1 Consultant review required prior to enclosure

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Store materials:

- .1 Protected from moisture and UV exposure

1.7.2 Handle to prevent damage to membranes and accessories

1.8 COORDINATION

1.8.1 Coordinate with:

- .1 Structural framing and sheathing
- .2 Mechanical and electrical penetrations
- .3 Window and door installation

1.8.2 Ensure sequencing:

- .1 Exterior air barrier installed prior to cladding
- .2 Interior vapour barrier installed prior to gypsum board

2 PRODUCTS

2.1 EXTERIOR AIR BARRIER MEMBRANE

2.1.1 Self-adhered or fluid-applied membrane:

- .1 Installed on exterior sheathing

2.1.2 Properties:

- .1 Air permeance $\leq 0.02 \text{ L/s}\cdot\text{m}^2 @ 75 \text{ Pa}$

- .2 Vapour permeable (to allow outward drying)

2.1.3 Compatible with:

- .1 Exterior gypsum sheathing (DensGlass)
- .2 Plywood

2.2 INTERIOR VAPOUR BARRIER

2.2.1 Polyethylene sheet vapour barrier:

- .1 Minimum 0.15 mm (6 mil) thickness

2.2.2 Installed:

- .1 On warm side of insulation
- .2 Behind gypsum board

2.2.3 Locations:

- .1 Exterior walls
- .2 Roof/ceiling assemblies

2.3 UNDERSLAB VAPOUR BARRIER

2.3.1 Provide polyethylene vapour barrier:

- .1 Minimum thickness: 0.25 mm (10 mil)
- .2 Conforming to ASTM E1745, Class B or better

2.3.2 Performance:

- .1 Vapour permeance: ≤ 0.1 perms (5.7 ng/Pa·s·m²)
- .2 Puncture resistance suitable for placement over granular base

2.4 FOUNDATION AIR/VAPOUR BARRIER

2.4.1 Self-adhered membrane:

- .1 Installed on concrete or sheathing

2.4.2 Performance:

- .1 Meet OBC requirements for Air and Vapour permeance.

2.5 ACCESSORIES

2.5.1 Tapes:

- .1 Compatible with membrane systems

2.5.2 Sealants:

- .1 Non-hardening, flexible, airtight

2.5.3 Penetration seals:

- .1 Pre-manufactured boots or liquid-applied seal

2.5.4 Transition membranes:

- .1 Flexible membrane for:
- .2 Wall-to-roof
- .3 Wall-to-foundation

2.6 SUPPORTING MATERIALS

2.6.1 Sheathing:

- .1 Fibreglass faced gypsum sheathing (as substrate)
- .2 Exterior grade plywood (as substrate)

2.6.2 Fasteners:

- .1 Compatible with air barrier system

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Substrates are clean, dry, and continuous
- .2 Sheathing is properly installed

3.1.2 Do not proceed until deficiencies are corrected

3.2 PREPARATION

3.2.1 Seal:

- .1 Joints in sheathing

- .2 Gaps and penetrations

- 3.2.2 Prime substrates where required

3.3 INSTALLATION – GENERAL

- 3.3.1 Install air barrier to:

- .1 Form continuous plane of airtightness

- 3.3.2 Ensure:

- .1 No discontinuities
- .2 No unsealed joints

3.4 INSTALLATION – EXTERIOR WALLS

- 3.4.1 Install membrane:

- .1 Over exterior sheathing
- .2 Continuous behind cladding system

- 3.4.2 Seal:

- .1 All joints, fasteners, and penetrations

- 3.4.3 Coordinate with:

- .1 Z-girts and cladding supports to maintain continuity

3.5 INSTALLATION – INTERIOR VAPOUR BARRIER

- 3.5.1 Install polyethylene:

- .1 Continuous across entire wall and ceiling surfaces

- 3.5.2 Seal:

- .1 All joints with tape
- .2 Around electrical boxes and penetrations

- 3.5.3 Lap joints:

- .1 Minimum 150 mm

3.6 INSTALLATION – ROOF / CEILING

- 3.6.1 Install air/vapour barrier:

- .1 At ceiling plane below insulation

3.6.2 Ensure continuity:

- .1 At wall-to-roof interface
- .2 Around trusses and framing

3.7 INSTALLATION – UNDERSLAB VAPOUR BARRIER

3.7.1 Install vapour barrier:

- .1 Directly over compacted granular base or below insulation as indicated
- .2 Continuous across entire slab area

3.7.2 Lap joints:

- .1 Minimum 150 mm
- .2 Seal continuously with compatible tape

3.7.3 Seal:

- .1 Around all penetrations (pipes, conduits)
- .2 At slab edges and foundation interfaces

3.7.4 Coordinate with:

- .1 Underslab insulation (100 mm rigid insulation at perimeter per F1)
- .2 Concrete placement sequencing

3.7.5 Protect membrane:

- .1 Prevent punctures during reinforcement and concrete placement
- .2 Repair all damage prior to concrete placement

3.8 PENETRATIONS AND TRANSITIONS

3.8.1 Seal all penetrations including:

- .1 Electrical boxes
- .2 Mechanical ducts
- .3 Plumbing

3.8.2 Provide:

- .1 Airtight seals at all transitions

3.9 FIELD QUALITY CONTROL

3.9.1 Inspect:

- .1 Continuity of air barrier prior to enclosure

3.9.2 Perform:

- .1 Visual inspection of all joints and penetrations

3.9.3 Repair:

- .1 All deficiencies before covering

3.10 PROTECTION

3.10.1 Protect installed systems from:

- .1 Damage
- .2 UV exposure

3.11 CLEANING

3.11.1 Remove waste materials

3.11.2 Leave surfaces ready for subsequent work

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

- 1.1.1 Section 07 92 00 - Joint Sealants

1.2 REFERENCES

- 1.2.1 Comply with latest editions of referenced standards. American Society of Mechanical Engineers (ASME)

- .2 ASTM International (ASTM)
- .3 CSA Group (CSA)
- .4 Underwriters Laboratories (UL)
- .5 ULC Standards

1.3 ADMINISTRATIVE REQUIREMENTS

- 1.3.1 Preinstallation Meetings:

- .1 Convene preinstallation meeting 1 week before beginning work of this Section, with Contractor's Representative and Consultant in accordance with Division 1 to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other construction subtrades.
 - .4 Review [manufacturer's] written installation instructions and warranty requirements.

- 1.3.2 Sequencing: sequence with other work. Comply with manufacturer's written recommendations for sequencing construction operations.

- 1.3.3 Scheduling: schedule with other work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- 1.4.1 Submit in accordance with Division 1.

- 1.4.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for metal siding and include product characteristics, performance criteria, physical size, finish and limitations.

- 1.4.3 Shop Drawings:

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

- .2 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, soffits, metal furring and related work.

1.4.4 Samples:

- .1 Submit duplicate samples of siding material, of colour and profile specified.

1.5 CLOSEOUT SUBMITTALS

1.5.1 Submit in accordance with Division 1.

1.5.2 Operation and Maintenance Data: submit operation and maintenance data for installed products for incorporation into manual.

1.5.3 Warranty Documentation: submit warranty documents specified.

1.6 QUALITY ASSURANCE

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

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

1.6.3 Mock-Up:

- .1 Provide site mock-up for work of this Section indicating methods and materials, and procedures proposed to achieve final results in accordance with Division 1, and to comply with following requirements, using materials indicated for completed work:
 - .1 Build mock-ups in location and of size as directed Consultant.
 - .2 Mock-up may form part of permanent structure when accepted by Consultant] repair or replace unacceptable mock-ups at no additional cost to Owner.

1.7 DELIVERY, STORAGE AND HANDLING

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

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

1.7.3 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 metal siding from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

1.8 SITE CONDITIONS

- 1.8.1 Execute work of this Section within environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer.

1.9 WARRANTY

- 1.9.1 Manufacturer's warranty: Submit, for Consultant acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty in addition to and not limit other rights Owner may have under Contract Documents.

2 PRODUCTS

2.1 MATERIALS

- 2.1.1 Basis of Design Manufacturer

.1 Mabec Architectural

- 2.1.2 Basis of Design Product

.1 Aluminum Siding MAE Series, 6F Plank

- 2.1.3 Aluminum siding and soffit: to ASTM B209.

.1 Aluminum: 6063-T5

.2 Thickness: 1.6 mm base metal thickness.

.3 Profile: 13mm deep, 154 mm wide, extruded shape with interlocking joints, fastener holes pre punched.

.4 Pattern: Wood pattern surface selected by Consultant from full colour range..

.5 Finish: factory precoated finish, 3 coat system; primer, print coat and clear coat.

.6 Provide vented soffit planks at 600mm on center maximum.

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

- 2.1.5 Exterior wall Air Barrier: in accordance with Section 07 25 00 - Air/Vapour Barriers.

- 2.1.6 Rigid Insulation: in accordance with Section 07 21 00 - Thermal Insulation.

- 2.1.7 Wood batten support for soffit: Provide wood batten and shims at intervals to provide straight substrate for the soffit to be installed as required by the manufacturer and shown on drawings.

- 2.1.8 Metal Z-girts:

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

- .2 CSSBI 51, Lightweight Steel Framing Design Manual.
- .3 CSSBI Technical Bulletin Vol. 7, No. 2, Standard Thicknesses for Canadian Lightweight Steel Framing Applications.
- .4 Installer to provide engineered shop drawings stamped by and engineer in the province of Ontario for the design and installation including fasteners of the Z-girts supporting the Aluminum Siding.
- .5 Provided under this Section.

2.2 ACCESSORIES

- 2.2.1 Fasteners: nails to CSA B111, screws to ASME B18.6.3 stainless steel, purpose made.
- 2.2.2 Exposed trim: inside corners, outside corners, cap strip, drip cap, under sill trim, starter strip and window/door trim of same material and pattern as cladding, with fastener holes pre-punched.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts acceptable in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- 3.2.1 Clean surfaces thoroughly before installation.
- 3.2.2 Repair substrate flaws or defects before applying siding or soffits.
- 3.2.3 Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under project conditions.

3.3 MANUFACTURER'S INSTRUCTIONS

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

3.4 INSTALLATION

- 3.4.1 Install cladding in accordance with CGSB 93.5, and manufacturer's written instructions.
- 3.4.2 Install Air Barrier.

- 3.4.3 Install continuous starter strips, inside and outside corners, edgings, soffit, drip, cap, sill and window/door opening flashings as indicated.
- 3.4.4 Install outside corners, fillers and closure strips with carefully formed and profiled work.
- 3.4.5 Install soffit and fascia cladding as indicated.
- 3.4.6 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.
- 3.4.7 Attach components in manner not restricting thermal movement.
- 3.4.8 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 92 00 - Joint Sealants. Ensure all gaps are sealed to ensure insects and animals cannot gain access behind the siding.

3.5 CLEANING

- 3.5.1 Progress Cleaning: clean in accordance with Division 1.
- 3.5.2 Leave Work area clean at end of each day.
- 3.5.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 1.

3.6 PROTECTION

- 3.6.1 Protect installed products and components from damage during construction.
- 3.6.2 Repair damage to adjacent materials caused by preformed metal siding installation.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 Pre-finished standing seam sheet metal roofing systems
- .2 Associated flashings and trim
- .3 Ridge caps and closures
- .4 Snow guards
- .5 Roofing accessories and attachment systems
- .6 Sealants and closures required for complete weathertight installation

1.1.2 Roofing assemblies include:

- .1 R1A – Sloped standing seam roofing over truss framing
- .2 R1B – Sloped standing seam roofing over roof joist framing

1.1.3 Related work includes:

- .1 Roof sheathing
- .2 Underlayment
- .3 Air/vapour barrier systems
- .4 Roof ventilation
- .5 Mechanical and electrical roof penetrations

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 06 10 00 – Rough Carpentry
- 1.2.2 Section 07 21 00 – Thermal Insulation
- 1.2.3 Section 07 27 00 – Air/Vapour Barriers
- 1.2.4 Section 07 62 00 – Sheet Metal Flashing and Trim
- 1.2.5 Section 07 92 00 – Joint Sealants

1.3 REFERENCES

1.3.1 Comply with latest editions of referenced standards.

- .1 Ontario Building Code (OBC)

- .2 National Building Code of Canada (NBC)
- .3 CSA S136 – North American Specification for Cold Formed Steel Structural Members
- .4 ASTM A792/A792M – Steel Sheet, Metallic-Coated by Hot-Dip Process
- .5 ASTM E1592 – Structural Performance of Sheet Metal Roof Systems
- .6 Canadian Sheet Steel Building Institute (CSSBI) standards
- .7 CAN/CSA-A123.3 – Asphalt Saturated Organic Roofing Felt

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Roof system shall:

- .1 Resist wind uplift loads in accordance with OBC requirements and site exposure conditions
- .2 Provide complete weather protection and drainage
- .3 Accommodate thermal movement without deformation or failure

1.4.2 Roofing system shall:

- .1 Maintain watertight performance under design snow loads and freeze/thaw conditions

1.4.3 Coordinate roof penetrations to maintain:

- .1 Air barrier continuity
- .2 Vapour barrier continuity
- .3 Thermal continuity

1.4.4 Roof slope:

- .1 4:12 minimum as indicated on roof plans

1.5 SUBMITTALS

1.5.1 Submit:

- .1 Product data
- .2 Manufacturer specifications
- .3 Colour selection data
- .4 Fastener and accessory information

1.5.2 Submit shop drawings indicating:

- .1 Panel layout
- .2 Ridge details
- .3 Eave and rake conditions
- .4 Penetration flashing details
- .5 Snow guard layout

1.5.3 Submit:

- .1 Engineering data for wind uplift resistance
- .2 Installation instructions

1.6 QUALITY ASSURANCE

1.6.1 Roofing installer:

- .1 Minimum 5 years documented experience with standing seam roofing systems

1.6.2 Manufacturer:

- .1 Single-source roofing system manufacturer

1.6.3 Perform installation in accordance with:

- .1 Manufacturer's requirements
- .2 CSSBI recommendations

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Store materials:

- .1 Off ground
- .2 Dry and ventilated
- .3 Protected from moisture and damage

1.7.2 Prevent:

- .1 Oil canning
- .2 Distortion
- .3 Finish damage

1.8 COORDINATION

1.8.1 Coordinate with:

- .1 Structural framing and sheathing
- .2 Mechanical roof penetrations
- .3 Electrical penetrations and equipment
- .4 Air/vapour barrier installation

1.8.2 Confirm:

- .1 Roof vent locations
- .2 Snow guard locations
- .3 Ridge vent continuity

2 PRODUCTS

2.1 STANDING SEAM METAL ROOFING

2.1.1 Factory-formed standing seam metal roofing system:

- .1 Concealed fastener type

2.1.2 Material:

- .1 Pre-finished galvanized steel
- .2 Minimum 24 ga unless noted otherwise

2.1.3 Finish:

- .1 Factory-applied fluoropolymer coating (PVDF)

2.1.4 Profile:

- .1 Standing seam profile suitable for:
 - .1 4:12 roof slope
 - .2 Snow conditions at project site
- .2 Colour:
 - .1 To be selected by Consultant from Manufacturers standard range of colours.
 - .2 Basis of design: Charcoal

2.2 UNDERLAYMENT

2.2.1 Waterproof underlayment:

- .1 As indicated in R1A and R1B assemblies

2.2.2 Conforming to:

- .1 Self-adhered, high-temperature rubberized asphalt membrane complying with ASTM D1970, suitable for installation beneath metal roofing and capable of continuous exposure to temperatures generated by metal roof panels.

2.3 FLASHINGS AND TRIM

2.3.1 Provide:

- .1 Ridge flashings
- .2 Eave flashings
- .3 Rake flashings
- .4 Penetration flashings
- .5 Closure strips

2.3.2 Fabricate from:

- .1 Same material and finish as roofing panels
- .2 Colour:
 - .1 To be selected by Consultant from Manufacturers standard range of colours.
 - .2 Basis of design: Charcoal

2.4 SNOW GUARDS

2.4.1 Provide snow guards:

- .1 At locations indicated on roof plan

2.4.2 Type:

- .1 Manufacturer's standard compatible with roofing system

2.5 FASTENERS

2.5.1 Concealed fasteners:

- .1 Stainless steel or corrosion-resistant coated steel

2.5.2 Exposed fasteners:

- .1 Colour matched
- .2 Gasketed

2.6 SEALANTS

2.6.1 Non-staining sealants compatible with:

- .1 Roofing finish
- .2 Adjacent materials

2.7 ACCESSORIES

2.7.1 Provide:

- .1 Closures
- .2 Foam fillers
- .3 Vent components
- .4 Attachment clips

2.7.2 Components to accommodate:

- .1 Thermal movement
- .2 Wind uplift

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Roof framing is complete
- .2 Sheathing is secure and dry
- .3 Roof slopes conform to drawings

3.1.2 Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

3.2.1 Ensure:

- .1 Substrates are clean and dry
- .2 Penetrations and openings are coordinated prior to installation

3.3 INSTALLATION – UNDERLAYMENT

3.3.1 Install waterproofing:

- .1 Continuously over roof sheathing

3.3.2 Lap and seal:

- .1 In accordance with manufacturer's requirements

3.4 INSTALLATION – METAL ROOFING

3.4.1 Install roofing panels:

- .1 Plumb and aligned
- .2 In straight uniform courses

3.4.2 Allow for:

- .1 Thermal expansion and contraction

3.4.3 Install:

- .1 Concealed clip fastener system

3.4.4 Prevent:

- .1 Oil canning
- .2 Distortion

3.5 RIDGES, EAVES AND EDGES

3.5.1 Install:

- .1 Ridge flashings
- .2 Eave closures
- .3 Rake trims

3.5.2 Maintain:

- .1 Continuous weather seal
- .2 Ventilation continuity where applicable

3.6 ROOF PENETRATIONS

3.6.1 Coordinate all penetrations with:

- .1 Mechanical
- .2 Electrical
- .3 Structural trades

3.6.2 Flash all penetrations:

- .1 Using manufacturer-approved assemblies

3.6.3 Seal:

- .1 Airtight and watertight

3.7 SNOW GUARDS

- 3.7.1 Install snow guards:

- .1 In locations indicated on roof drawings

- 3.7.2 Coordinate attachment with roofing manufacturer requirements.

3.8 FIELD QUALITY CONTROL

- 3.8.1 Inspect roofing installation for:

- .1 Alignment
 - .2 Fastener installation
 - .3 Sealant continuity
 - .4 Damage to finishes

- 3.8.2 Replace damaged panels.

3.9 PROTECTION

- 3.9.1 Protect installed roofing from:

- .1 Traffic damage
 - .2 Scratching
 - .3 Staining

- 3.9.2 Remove metal filings immediately to prevent corrosion.

3.10 CLEANING

- 3.10.1 Remove debris and unused materials from roof surfaces.

- 3.10.2 Leave completed roof clean and free of damage.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 Pre-finished sheet metal flashings and trim
- .2 Gutters and downspouts
- .3 Fascia and soffit flashings
- .4 Eave, rake, ridge, and parapet flashings
- .5 Closure strips and sealants
- .6 Expansion joints and sheet metal accessories
- .7 Penetration flashings and counterflashings
- .8 Snow guard interface flashings

1.1.2 Work includes complete weatherproof sheet metal assemblies associated with:

- .1 Standing seam roofing systems (R1A and R1B)
- .2 Composite cladding systems (EW1)
- .3 Roof drainage systems

1.1.3 Coordinate with:

- .1 Roofing systems
- .2 Air/vapour barriers
- .3 Roof penetrations
- .4 Exterior wall cladding systems

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 07 21 00 – Thermal Insulation
- 1.2.2 Section 07 27 00 – Air/Vapour Barriers
- 1.2.3 Section 07 61 00 – Sheet Metal Roofing
- 1.2.4 Section 07 92 00 – Joint Sealants

1.3 REFERENCES

- 1.3.1 Ontario Building Code (OBC)

- 1.3.2 National Building Code of Canada (NBC)
- 1.3.3 Canadian Sheet Steel Building Institute (CSSBI) standards
- 1.3.4 ASTM A653/A653M – Zinc-Coated Galvanized Steel Sheet
- 1.3.5 ASTM A792/A792M – Aluminum-Zinc Alloy-Coated Steel Sheet
- 1.3.6 CSA S136 – Cold Formed Steel Structural Members
- 1.3.7 SMACNA – Architectural Sheet Metal Manual

1.4 PERFORMANCE REQUIREMENTS

- 1.4.1 Fabricate and install sheet metal systems to:
 - .1 Prevent water infiltration
 - .2 Accommodate thermal movement
 - .3 Resist wind uplift and snow loads
- 1.4.2 Maintain:
 - .1 Continuous weather protection
 - .2 Air barrier continuity at penetrations and interfaces
- 1.4.3 Gutters and downspouts:
 - .1 Sized to accommodate roof drainage from sloped standing seam roof assemblies shown on roof plan
- 1.4.4 Flashings shall:
 - .1 Shed water to exterior
 - .2 Prevent moisture intrusion into wall and roof assemblies

1.5 SUBMITTALS

- 1.5.1 Submit:
 - .1 Product data
 - .2 Colour selections
 - .3 Shop drawings
- 1.5.2 Shop drawings shall indicate:
 - .1 Profiles and dimensions

- .2 Jointing and fastening methods
- .3 Gutter and downspout layouts
- .4 Roof edge and penetration flashing details

1.5.3 Submit:

- .1 Samples of exposed finishes
- .2 Manufacturer installation instructions

1.6 QUALITY ASSURANCE

1.6.1 Fabricate flashings and trims in accordance with:

- .1 SMACNA recommendations
- .2 CSSBI standards

1.6.2 Installer:

- .1 Minimum 5 years experience with architectural sheet metal systems

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Store materials:

- .1 Dry and ventilated
- .2 Off ground

1.7.2 Prevent:

- .1 Distortion
- .2 Scratching
- .3 Finish damage

1.8 COORDINATION

1.8.1 Coordinate with:

- .1 Roofing installation
- .2 Cladding systems
- .3 Mechanical and electrical penetrations
- .4 Snow guard installation

1.8.2 Confirm:

- .1 Roof edge conditions
- .2 Soffit and fascia interfaces
- .3 Downspout discharge locations

2 PRODUCTS

2.1 SHEET METAL MATERIALS

2.1.1 Material:

- .1 Pre-finished galvanized steel

2.1.2 Minimum thickness:

- .1 Flashings and trims: 24 ga
- .2 Gutters and downspouts: 24 ga minimum

2.1.3 Finish:

- .1 Factory-applied PVDF fluoropolymer finish

2.1.4 Colour:

- .1 As selected by Consultant from manufacturer's standard range

2.2 FLASHINGS

2.2.1 Provide:

- .1 Eave flashings
- .2 Rake flashings
- .3 Ridge flashings
- .4 Transition flashings
- .5 Counterflashings
- .6 Penetration flashings

2.2.2 Fabricate:

- .1 Brake formed
- .2 Hemmed exposed edges

2.2.3 Minimum exposed flange:

- .1 100 mm unless noted otherwise

2.3 FASCIA AND SOFFIT TRIMS

2.3.1 Provide:

- .1 Pre-finished fascia flashings
- .2 Soffit edge trims

2.3.2 Coordinate with:

- .1 Composite cladding
- .2 Roof edge detailing shown in elevations

2.4 GUTTERS

2.4.1 Gutters:

- .1 Continuous pre-finished metal gutters

2.4.2 Minimum size:

- .1 150 mm unless hydraulic calculations require otherwise

2.4.3 Configuration:

- .1 Sloped to outlets
- .2 Continuous concealed hangers

2.4.4 Provide:

- .1 Expansion joints where required for thermal movement

2.5 GUTTER LEAF GUARDS

2.5.1 Provide continuous gutter leaf protection system at all gutters.

2.5.2 System:

- .1 Manufacturer's standard aluminum / galvanized steel / stainless steel structural leaf guard system compatible with gutter profile and roofing assembly.
- .2 Contractor shall verify compatibility between leaf guard system, snow guards, and standing seam metal roofing attachment methods.

2.5.3 Material:

- .1 Pre-finished aluminum / galvanized steel / stainless steel mesh
- .2 Corrosion-resistant
- .3 UV stable

2.5.4 Performance Requirements:

- .1 Prevent entry of:
 - .1 Leaves
 - .2 Pine needles
 - .3 Organic debris
 - .4 Maintain positive drainage flow under:
 - .1 Ontario freeze/thaw conditions
 - .2 Snow melt conditions
 - .3 Heavy rainfall events

2.5.5 Configuration:

- .1 Continuous full-length installation at gutters
- .2 Securely fastened and removable for maintenance access

2.5.6 Finish:

- .1 Colour matched to gutter system.

2.6 DOWNSPOUTS

2.6.1 Downspouts:

- .1 Rectangular pre-finished metal downspouts

2.6.2 Minimum size:

- .1 100 x 100 mm unless noted otherwise

2.6.3 Provide:

- .1 Straps and supports at maximum 2400 mm spacing

2.6.4 Discharge:

- .1 Into below grade piping
- .2 Coordinate with site grading and civil drawings

2.7 ACCESSORIES

2.7.1 Provide:

- .1 Closure strips
- .2 Sealants
- .3 Backer plates
- .4 Fasteners

- .5 Expansion joints

2.7.2 Fasteners:

- .1 Stainless steel or corrosion-resistant coated steel
- .2 Colour matched where exposed

2.8 SEALANTS

2.8.1 Sealants:

- .1 Compatible with adjacent materials and finishes

2.8.2 Maintain flexibility under:

- .1 Thermal movement
- .2 Freeze/thaw cycling

2.8.3 Refer to 07 92 00 - Joint Sealants

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Roof and wall substrates are complete
- .2 Roof slopes and drainage conditions are correct

3.1.2 Do not proceed until deficiencies are corrected.

3.2 PREPARATION

3.2.1 Coordinate:

- .1 Roofing penetrations
- .2 Air/vapour barrier continuity
- .3 Cladding interfaces

3.2.2 Confirm:

- .1 Mechanical and electrical penetration locations prior to fabrication

3.3 INSTALLATION – GENERAL

3.3.1 Install sheet metal work:

- .1 Plumb, level, and aligned

.2 Watertight and weatherproof

3.3.2 Allow for:

.1 Thermal movement

.2 Expansion and contraction

3.3.3 Fabricate and install:

.1 Minimal exposed fasteners

3.4 FLASHINGS

3.4.1 Install flashings:

.1 In shingle fashion to shed water

3.4.2 Lap joints:

.1 Minimum 100 mm

3.4.3 Seal:

.1 Penetrations

.2 Joints

.3 Terminations

3.5 GUTTERS

3.5.1 Install gutters:

.1 Sloped minimum 1:500 toward outlets

3.5.2 Provide:

.1 Continuous support brackets

.2 End dams and expansion joints

3.5.3 Coordinate:

.1 Snow guard layout to prevent ice/snow damage to gutters

3.6 LEAF GUARDS

3.6.1 Install leaf guards:

.1 In accordance with manufacturer's written instructions

.2 Continuous over full gutter length

3.6.2 Coordinate installation with:

- .1 Snow guards
- .2 Standing seam roofing
- .3 Eave flashings

3.6.3 Ensure:

- .1 No interference with roof drainage flow
- .2 Proper drainage into gutter system

3.6.4 Secure system to:

- .1 Prevent displacement due to:
 - .1 Snow loads
 - .2 Ice movement
 - .3 Thermal expansion

3.6.5 Install without:

- .1 Penetrating roofing panels where avoidable.

3.7 DOWNSPOUTS

3.7.1 Install:

- .1 True and plumb

3.7.2 Secure:

- .1 With concealed or colour-matched straps

3.7.3 Discharge:

- .1 Minimum 1500 mm away from foundation where splash pads are used

3.7.4 Coordinate:

- .1 Discharge locations with site grading and existing propane tank clearances

3.8 PENETRATIONS

3.8.1 Flash and seal:

- .1 Mechanical penetrations
- .2 Electrical penetrations
- .3 Roof vents

3.8.2 Maintain:

- .1 Air/vapour barrier continuity at penetrations

3.9 FIELD QUALITY CONTROL

3.9.1 Inspect:

- .1 Alignment
- .2 Fastening
- .3 Sealant continuity
- .4 Drainage performance

3.9.2 Water test areas where deficiencies are suspected.

3.10 PROTECTION

3.10.1 Protect installed work from:

- .1 Scratching
- .2 Distortion
- .3 Construction damage

3.10.2 Remove metal filings immediately.

3.11 CLEANING

3.11.1 Remove debris and unused materials.

3.11.2 Clean exposed sheet metal surfaces.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

- .1 Engineered snow retention system for standing seam metal roofing.
- .2 Attachment clamps, connectors, fasteners and accessories.
- .3 Shop drawings and engineering design.
- .4 Installation of complete snow guard system.

1.1.2 Related Requirements:

- .1 Section 01 00 00 – General Requirements.
- .2 Section 07 61 00 – Sheet Metal Roofing.
- .3 Section 07 62 00 – Sheet Metal Flashing and Trim.

1.2 REFERENCES

1.2.1 Latest editions of:

- .1 Ontario Building Code.
- .2 Roofing manufacturer's published requirements.
- .3 Snow guard manufacturer's published engineering design guidelines.

1.3 SYSTEM DESCRIPTION

1.3.1 Provide complete engineered snow retention system designed specifically for the project roof configuration.

1.3.2 Design system to:

- .1 Prevent sudden release of accumulated snow and ice.
- .2 Retain snow uniformly over roof surface.
- .3 Reduce hazards to occupants and pedestrians.
- .4 Protect entrances, walkways, equipment and landscaping below.
- .5 Maintain roof manufacturer's warranty.

1.3.3 Snow guard system shall be designed specifically for the standing seam roof profile specified under Section 07 61 00.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Design snow retention system for:

- .1 Roof geometry.
- .2 Roof slope.
- .3 Roof length.
- .4 Roof orientation.
- .5 Local ground snow loads.
- .6 Ontario Building Code requirements.

1.4.2 Snow guard spacing shall not be based solely on manufacturer's standard spacing tables.

1.4.3 Provide layout designed or reviewed by manufacturer for this specific project.

1.4.4 Snow retention system shall resist anticipated snow loads without:

- .1 Permanent deformation.
- .2 Clamp slippage.
- .3 Fastener failure.
- .4 Damage to roofing.

1.5 SUBMITTALS

1.5.1 Submit in accordance with Section 01 33 00.

- .1 Product Data.
- .2 Manufacturer's installation instructions.
- .3 Shop Drawings indicating:
 - .1 Roof plan.
 - .2 Snow guard layout.
 - .3 Number of rows.
 - .4 Spacing.
 - .5 Attachment details.
 - .6 Clamp locations.
 - .7 Roof seam profile compatibility.
 - .8 Engineering calculations, signed and sealed by a Professional Engineer licensed in the Province of Ontario, confirming the proposed snow guard layout is suitable for the roof geometry and design snow loads.
- .4 Samples:
 - .1 One complete snow guard assembly.

.2 Finish colour sample.

1.6 QUALITY ASSURANCE

- 1.6.1 Manufacturer shall have minimum five years documented experience manufacturing engineered snow retention systems.
- 1.6.2 Installer shall have minimum three years experience installing snow retention systems on standing seam metal roofs.
- 1.6.3 Installation shall comply with both roofing manufacturer and snow guard manufacturer requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- 1.7.1 Deliver materials in manufacturer's unopened packaging.
- 1.7.2 Protect from damage.
- 1.7.3 Store under cover.
- 1.7.4 Replace damaged components.

1.8 WARRANTY

- 1.8.1 Provide manufacturer's standard warranty.
- 1.8.2 Snow guard installation shall not void roof manufacturer's weather-tightness warranty.

2 PRODUCTS

2.1 MANUFACTURERS

- 2.1.1 Subject to compliance with specification requirements, acceptable manufacturers include:

- .1 S-5!
- .2 TRA Snow and Sun.
- .3 Alpine SnowGuards.
- .4 Approved equivalent.

2.2 SNOW RETENTION SYSTEM

- 2.2.1 Complete engineered snow retention system consisting of:

- .1 Clamping devices.
- .2 Snow guards or continuous snow retention bars.
- .3 Connectors.
- .4 End caps.

- .5 Mechanical fasteners.
- .6 Splices.
- .7 Accessories required for complete installation.

2.3 MATERIALS

2.3.1 Snow Guard Components

- .1 Factory-fabricated components specifically designed for use with the specified standing seam metal roofing system.
- .2 Components shall be manufactured from corrosion-resistant materials suitable for exterior exposure and Ontario climatic conditions.
- .3 Components shall be compatible with adjacent roofing materials to prevent galvanic corrosion.

2.3.2 Attachment Hardware

- .1 Stainless steel fasteners, clamps, bolts, set screws and hardware as recommended by the snow guard manufacturer.
- .2 Hardware shall be corrosion resistant and compatible with both the snow guard system and roofing materials.

2.4 FINISH

- 2.4.1 Exposed snow retention components shall have the manufacturer's standard factory finish.
- 2.4.2 Colour of exposed components shall be selected by the Consultant from the manufacturer's standard colour range and shall closely match the adjacent roof finish.
- 2.4.3 Factory-applied finishes shall be suitable for exterior exposure and resistant to ultraviolet degradation, fading, chalking, peeling and corrosion.
- 2.4.4 Components not intended by the manufacturer to receive a factory-applied finish, including aluminum clamps and stainless-steel hardware, may be supplied with the manufacturer's standard mill finish.

2.5 FABRICATION

- 2.5.1 Factory fabricate components.
- 2.5.2 Pre-engineered components only.
- 2.5.3 Field fabrication not permitted except as approved by manufacturer.

2.6 SOURCE QUALITY CONTROL

- 2.6.1 Manufacture components to uniform dimensions.

2.6.2 Inspect components before shipment.

2.6.3 Replace defective materials.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify roofing installation is complete.

3.1.2 Verify standing seam profile matches approved clamp assembly.

3.1.3 Verify roof is ready to receive snow retention system.

3.1.4 Report deficiencies prior to installation.

3.2 PREPARATION

3.2.1 Clean roof surfaces.

3.2.2 Remove debris.

3.2.3 Protect completed roofing.

3.3 INSTALLATION

3.3.1 Install in accordance with:

- .1 Approved Shop Drawings.
- .2 Manufacturer's written instructions.
- .3 Roofing manufacturer's requirements.

3.3.2 Install system without penetrating roof panels.

3.3.3 Install clamps only on approved standing seams.

3.3.4 Tighten clamp fasteners using manufacturer's specified torque.

3.3.5 Install rows straight and parallel to roof edge.

3.3.6 Maintain consistent spacing.

3.3.7 Install connectors and splices in accordance with manufacturer's recommendations.

3.3.8 Install accessories required for complete functioning system.

3.3.9 Do not damage roofing finish during installation.

3.4 FIELD QUALITY CONTROL

3.4.1 Verify:

- .1 Clamp engagement.
- .2 Proper torque.
- .3 Alignment.
- .4 Spacing.
- .5 Secure attachment.
- .6 Replace damaged materials.

3.5 ADJUSTING

- 3.5.1 Replace damaged components.
- 3.5.2 Re-tighten clamps where required.
- 3.5.3 Correct misalignment.

3.6 CLEANING

- 3.6.1 Remove debris.
- 3.6.2 Clean roofing.
- 3.6.3 Remove metal filings immediately.
- 3.6.4 Leave roof clean and free of stains.

3.7 PROTECTION

- 3.7.1 Repair damage at no additional cost to Owner.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes

- .1 Firestopping systems for through-penetrations in fire-resistance-rated floor, wall and roof assemblies.
- .2 Firestopping systems for membrane penetrations.
- .3 Fire-resistive joint systems where indicated on the Drawings or required to maintain the fire-resistance rating of fire-resistance-rated assemblies.
- .4 Firestopping around building service penetrations including mechanical, plumbing, electrical and communication services.
- .5 Smoke seals where required as part of listed firestop systems.
- .6 Firestop accessories and identification.

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 01 00 00 – General Requirements.
- 1.2.2 Division 03 – Concrete.
- 1.2.3 Division 07 – Thermal and Moisture Protection.
- 1.2.4 Division 08 – Openings.
- 1.2.5 Division 09 – Finishes.
- 1.2.6 Division 21 – Fire Protection.
- 1.2.7 Division 22 – Plumbing.
- 1.2.8 Division 23 – Heating, Ventilating and Air Conditioning (HVAC).
- 1.2.9 Division 26 – Electrical.
- 1.2.10 Division 27 – Communications.

1.3 REFERENCES

1.3.1 Latest editions of:

- .1 Ontario Building Code (OBC).
- .2 CAN/ULC-S115 – Fire Tests of Firestop Systems.

- .3 ASTM E814 / UL 1479 – Fire Tests of Through-Penetration Fire Stops.
- .4 UL 2079 – Tests for Fire Resistance of Building Joint Systems.
- .5 Firestop manufacturer's published installation instructions.

1.4 DEFINITIONS

1.4.1 Firestop System:

- .1 Complete assembly of materials designed to restore the fire-resistance rating of a fire-rated assembly after installation of penetrating items.

1.4.2 F Rating:

- .1 Time period that the firestop system prevents flame passage.

1.4.3 T Rating:

- .1 Time period that the unexposed surface remains below specified temperature limits.

1.4.4 L Rating:

- .1 Air leakage rating where required.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Provide tested and listed firestop systems having fire-resistance ratings equal to the fire-resistance rating of the assembly being penetrated.

1.5.2 Firestop systems shall be listed by one of the following agencies:

- .1 ULC.
- .2 UL.
- .3 Intertek/Warnock Hersey.

1.5.3 Firestop systems shall:

- .1 Restore fire resistance.
- .2 Restrict smoke migration.
- .3 Accommodate anticipated movement where required.
- .4 Be compatible with adjoining materials.
- .5 Firestop systems shall be selected for actual construction conditions encountered.
- .6 Do not modify listed systems without written approval from the manufacturer.

1.6 SUBMITTALS

1.6.1 Submit in accordance with Section 01 33 00.

1.6.2 Product Data

.1 Submit manufacturer's literature for each firestop product.

1.6.3 Firestop Schedule

.1 Submit schedule identifying:

- .1 Penetration type.
- .2 Fire-resistance rating.
- .3 Tested system number.
- .4 Manufacturer.
- .5 Proposed materials.

1.6.4 Shop Drawings

.1 Include:

- .1 Locations.
- .2 Penetrating items.
- .3 Assembly ratings.
- .4 Joint locations.
- .5 System numbers.

1.6.5 Engineering Judgements

.1 Where no listed system exists, submit Engineering Judgement:

- .1 Prepared by firestop manufacturer.
- .2 Based on tested assemblies.
- .3 Prepared by the firestop manufacturer and, where required by the Authority Having Jurisdiction or Consultant, signed and sealed by a Professional Engineer licensed in the Province of Ontario.
- .4 Acceptable to Consultant prior to installation.

1.6.6 Samples

.1 If requested:

- .1 Manufacturer's colour samples.
- .2 Firestop identification labels.

1.7 QUALITY ASSURANCE

1.7.1 Firestop manufacturer shall have minimum ten years documented experience manufacturing tested firestop systems.

1.7.2 Installer shall:

.1 Be trained by the firestop manufacturer and have documented experience installing listed firestop systems.

- .2 Firestop installation shall comply with tested and listed systems.

1.8 DELIVERY, STORAGE AND HANDLING

- 1.8.1 Deliver materials in original unopened containers.
- 1.8.2 Store in dry heated location.
- 1.8.3 Protect from freezing.
- 1.8.4 Protect from contamination.

1.9 ENVIRONMENTAL CONDITIONS

- 1.9.1 Install only within manufacturer's recommended temperature limits.
- 1.9.2 Protect installed materials until cured.

1.10 COORDINATION

- 1.10.1 Coordinate installation with all trades.
- 1.10.2 Ensure penetrations are complete before firestopping.
- 1.10.3 Coordinate sequencing to avoid removal and replacement of completed firestop systems.
- 1.10.4 Notify Consultant where proposed penetrations differ from tested systems.

1.11 CLOSEOUT SUBMITTALS

- 1.11.1 Submit:
 - .1 Product data.
 - .2 Maintenance information.
 - .3 Firestop schedule identifying all installed listed systems.
 - .4 Engineering Judgements.
 - .5 Warranty documentation.

1.12 WARRANTY

- 1.12.1 Provide manufacturer's standard warranty.
- 1.12.2 Installer shall warrant installation for period specified in Division 01.

2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Subject to compliance with this specification, acceptable manufacturers include:

- .1 Hilti (Canada) Corporation.
- .2 3M Fire Protection Products.
- .3 Specified Technologies Inc. (STI)
- .4 Approved equivalent.

2.2 GENERAL

2.2.1 Firestop systems shall be:

- .1 Tested and listed.
- .2 Compatible with adjoining construction.
- .3 Compatible with penetrating items.
- .4 Compatible with movement anticipated in service.
- .5 Installed in accordance with manufacturer's published instructions.
- .6 Do not use products containing asbestos.

2.2.2 Firestop products shall be supplied by a single manufacturer wherever practical.

2.2.3 Do not combine products from different manufacturers within a single listed firestop system.

2.3 PERFORMANCE REQUIREMENTS

2.3.1 Provide firestop systems having:

- .1 Fire-resistance rating equal to or greater than the fire-resistance rating of the assembly penetrated.
- .2 F Rating as required by the Ontario Building Code.
- .3 T Rating where required by the listed system.
- .4 L Rating where required by the Contract Documents.
- .5 Movement capability where required for dynamic joints.

2.3.2 Firestop systems shall be compatible with adjacent construction materials and penetrating items and shall not adversely affect the roofing, waterproofing, vapour barrier or air barrier systems.

2.4 FIRESTOP MATERIALS

2.4.1 Provide products appropriate for the tested and listed firestop system selected.

.1 Materials may include:

- .1 Elastomeric sealants.
- .2 Intumescent sealants.
- .3 Intumescent collars.
- .4 Intumescent wrap strips.
- .5 Firestop mortar.
- .6 Firestop pillows.
- .7 Firestop blocks.
- .8 Firestop putty.
- .9 Firestop foam where specifically tested and listed as part of a ULC/UL firestop system.
- .10 Mineral wool insulation.
- .11 Composite sheet systems.
- .12 Preformed penetration devices.

2.5 INTUMESCENT MATERIALS

2.5.1 Intumescent materials shall expand when exposed to fire.

2.5.2 Suitable for combustible penetrating items including:

- .1 PVC piping.
- .2 CPVC piping.
- .3 ABS piping.
- .4 PEX piping.
- .5 Cable bundles.

2.6 ELASTOMERIC FIRESTOP SEALANTS

2.6.1 Non-shrinking.

2.6.2 Permanently flexible.

2.6.3 Paintable where exposed.

2.6.4 Suitable for movement anticipated.

2.6.5 Tested as part of listed system.

2.7 FIRESTOP MORTAR

2.7.1 Premixed or field mixed in accordance with manufacturer.

2.7.2 Non-combustible.

2.7.3 Suitable for large floor openings.

2.7.4 Compatible with concrete construction.

2.8 MINERAL WOOL

2.8.1 Non-combustible.

2.8.2 Density as required by tested assembly.

2.8.3 Thickness as required by listed system.

2.9 FIRESTOP COLLARS

2.9.1 Factory manufactured.

2.9.2 Stainless steel shell.

2.9.3 Intumescent insert.

2.9.4 Complete with attachment hardware.

2.10 FIRESTOP WRAP STRIPS

2.10.1 Flexible intumescent wrap.

2.10.2 Width and number of layers in accordance with listed system.

2.11 FIRESTOP PILLOWS AND BLOCKS

2.11.1 Suitable for re-enterable cable tray and cable bundle penetrations where indicated by the listed system.

2.11.2 Installed in listed assemblies only.

2.12 JOINT FIRESTOP SYSTEMS

2.12.1 Provide listed fire-resistive joint systems at:

.1 Fire-rated wall joints.

.2 Fire-rated floor joints.

.3 Head-of-wall joints.

.4 Construction joints.

.5 Seismic joints where required.

2.12.2 Systems shall accommodate anticipated movement while maintaining fire rating.

2.13 ACCESSORIES

2.13.1 Provide:

- .1 Primers where required.
- .2 Backing materials.
- .3 Bond breakers.
- .4 Dam materials.
- .5 Forming materials.
- .6 Mechanical fasteners.

2.14 SOURCE QUALITY CONTROL

- 2.14.1 Manufacture products under an established quality control program.
- 2.14.2 Deliver products bearing manufacturer's identification.
- 2.14.3 Shelf life shall not be exceeded before installation.
- 2.14.4 Replace expired materials.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Verify that substrates, openings, penetrating items and surrounding construction are suitable for installation of firestop systems.
- 3.1.2 Verify that penetrations have been completed and no further work affecting the firestop system is anticipated.
- 3.1.3 Verify that annular spaces conform to the dimensions permitted by the listed firestop system.
- 3.1.4 Do not commence installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- 3.2.1 Prepare substrates in accordance with the firestop manufacturer's written instructions.
- 3.2.2 Remove dust, laitance, oil, grease, curing compounds, frost, loose materials and contaminants that may impair adhesion.
- 3.2.3 Protect adjacent finished surfaces from damage.
- 3.2.4 Prime substrates only where specifically recommended by the firestop manufacturer.

3.3 INSTALLATION – GENERAL

- 3.3.1 Install firestop systems in strict accordance with:
 - .1 Manufacturer's written instructions.

- .2 Tested and listed ULC/UL system.
- .3 Approved Shop Drawings.
- .4 Approved Engineering Judgements, where applicable.

- 3.3.2 Install only complete listed systems.
- 3.3.3 Do not combine components from different manufacturers within a single firestop system.
- 3.3.4 Maintain the required fire-resistance rating of the assembly.
- 3.3.5 Do not install firestop systems until penetrating services have been permanently supported.
- 3.3.6 Coordinate installation with mechanical, electrical, plumbing and fire suppression trades.
- 3.3.7 Do not install firestop materials around temporary penetrations.

3.4 THROUGH-PENETRATION FIRESTOPPING

- 3.4.1 Seal penetrations through fire-resistance-rated:
 - .1 Walls.
 - .2 Floors.
- 3.4.2 Install systems providing an F Rating not less than the fire-resistance rating of the assembly penetrated.
- 3.4.3 Install T Rating where required by the Ontario Building Code or Contract Documents.

3.5 MEMBRANE PENETRATIONS

- 3.5.1 Install listed membrane penetration systems.
- 3.5.2 Seal penetrations for:
 - .1 Electrical outlet boxes.
 - .2 Data outlets.
 - .3 Mechanical sleeves.
 - .4 Plumbing sleeves.
 - .5 Membrane penetrations requiring firestopping by the Ontario Building Code.

3.6 FIRE-RESISTIVE JOINT SYSTEMS

- 3.6.1 Install listed fire-resistive joint systems at:
 - .1 Head-of-wall joints.

- .2 Control joints in fire-resistance-rated assemblies.
- .3 Floor-to-wall intersections where required.

3.6.2 Install systems capable of accommodating anticipated building movement while maintaining the required fire-resistance rating.

3.7 PENETRATING ITEMS

3.7.1 Install appropriate listed systems for:

- .1 Metallic pipes.
- .2 Insulated metallic pipes.
- .3 Plastic piping.
- .4 Conduit.
- .5 Cable trays.
- .6 Electrical cables.
- .7 Communication cables.
- .8 Ducts.
- .9 Blank openings.
- .10 Mixed penetrations.

3.8 ENGINEERING JUDGEMENTS

3.8.1 Where no tested and listed firestop system exists for the actual field condition, submit an Engineering Judgement before installation.

3.8.2 Engineering Judgements shall:

- .1 Be prepared by the firestop system manufacturer.
- .2 Be based on an existing tested and listed firestop system.
- .3 Be specific to the project conditions.
- .4 Be reviewed and accepted by the Consultant prior to installation.

3.8.3 Contractor shall bear all costs associated with Engineering Judgements.

3.9 FIELD QUALITY CONTROL

3.9.1 Notify Firestopping manufacturer when firestop installations are ready for inspection.

3.9.2 Do not conceal firestop installations prior to manufacturer inspection.

3.9.3 Inspect completed installations for:

- .1 Correct listed system.
- .2 Proper depth.
- .3 Complete filling of annular space.
- .4 Required backing materials.
- .5 Continuity.
- .6 Damage.
- .7 Proper identification.

3.9.4 Remove and replace deficient firestop installations.

3.9.5 Firestopping manufacturer to provide a signed field report within 5 days of inspection.

3.10 FIELD TESTING

3.10.1 Where directed by the Consultant, destructive examination of selected firestop installations may be undertaken.

3.10.2 Restore disturbed assemblies using new listed firestop systems.

3.10.3 Repair work at no additional cost to the Owner where deficiencies are identified.

3.11 IDENTIFICATION

3.11.1 Permanently identify each firestop system where concealed above accessible ceilings or within accessible service spaces.

3.11.2 Identification shall include:

- .1 Firestop manufacturer.
- .2 Listed system number.
- .3 Fire-resistance rating.
- .4 Installer contractor.
- .5 Installation date.

3.12 CLEANING

3.12.1 Remove excess materials from adjacent surfaces immediately.

3.12.2 Clean exposed finished surfaces using methods recommended by the manufacturer.

3.12.3 Replace damaged finishes.

3.13 PROTECTION

- 3.13.1 Protect completed firestop systems from damage until Substantial Performance.
- 3.13.2 Replace damaged firestop systems with new listed systems.
- 3.13.3 Do not patch damaged firestop installations unless permitted by the manufacturer.

3.14 SCHEDULE

- 3.14.1 Provide listed firestop systems for:
 - .1 Through penetrations through fire-resistance-rated walls.
 - .2 Through penetrations through fire-resistance-rated floor assemblies.
 - .3 Membrane penetrations in fire-resistance-rated assemblies.
 - .4 Blank openings in fire-resistance-rated assemblies.
 - .5 Head-of-wall joints.
 - .6 Fire-resistance-rated construction joints.
 - .7 Firestop systems required by the Ontario Building Code.
- 3.14.2 Coordinate firestop system selection with the Architectural, Structural, Mechanical and Electrical Contract Documents.
- 3.14.3 Select systems appropriate to the penetrating item, substrate, annular space and required fire-resistance rating.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 Interior and exterior joint sealants
- .2 Backer rods and bond breaker tapes
- .3 Sealants at control joints, movement joints, penetrations, and perimeter joints
- .4 Air and vapour seal continuity at envelope penetrations
- .5 Acoustic and smoke sealant applications
- .6 Sealants associated with:
 - .1 Curtain wall systems (CW1)
 - .2 Exterior wall assemblies (EW1)
 - .3 Roofing and flashing systems
 - .4 Doors, frames, glazing, and plumbing fixtures

1.1.2 Provide complete sealant systems to:

- .1 Prevent air leakage
- .2 Prevent water infiltration
- .3 Accommodate thermal movement
- .4 Maintain fire, acoustic, and vapour control continuity

1.1.3 Seal all penetrations through:

- .1 Fire separations
- .2 Air/vapour barriers
- .3 Exterior assemblies

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 07 21 00 – Thermal Insulation
- 1.2.2 Section 07 27 00 – Air/Vapour Barriers
- 1.2.3 Section 07 61 00 – Sheet Metal Roofing
- 1.2.4 Section 07 62 00 – Sheet Metal Flashing and Trim
- 1.2.5 Section 08 44 13 – Glazed Aluminum Curtain Walls

1.2.6 Section 08 50 00 – Windows

1.2.7 Section 09 21 16 – Gypsum Board Assemblies

1.3 REFERENCES

1.3.1 Ontario Building Code (OBC)

1.3.2 National Building Code of Canada (NBC)

1.3.3 CAN/CGSB-19.13 – Joint Sealants

1.3.4 ASTM C920 – Elastomeric Joint Sealants

1.3.5 ASTM C1193 – Use of Joint Sealants

1.3.6 ULC Listed Firestopping Systems where applicable

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Sealants shall:

- .1 Remain flexible under expected thermal movement
- .2 Maintain adhesion and cohesion without failure

1.4.2 Exterior sealants:

- .1 UV resistant
- .2 Weather resistant
- .3 Freeze/thaw resistant

1.4.3 Interior sealants:

- .1 Low VOC
- .2 Paintable where exposed in finished areas

1.4.4 Fire-rated joints:

- .1 Maintain required fire-resistance rating continuity

1.4.5 Air/vapour sealant joints:

- .1 Maintain continuity of:
 - .1 Air barrier system
 - .2 Vapour barrier system

1.5 SUBMITTALS

1.5.1 Submit:

- .1 Product data
- .2 Manufacturer installation instructions
- .3 Colour samples

1.5.2 Submit:

- .1 Sealant compatibility documentation for:
 - .1 Cladding systems
 - .2 Air barrier membranes
 - .3 Roofing systems

1.5.3 Submit sealant schedule identifying:

- .1 Sealant types
- .2 Locations
- .3 Colours

1.6 QUALITY ASSURANCE

1.6.1 Installer:

- .1 Minimum 5 years experience with similar work

1.6.2 Perform work in accordance with:

- .1 ASTM C1193
- .2 Manufacturer's instructions

1.6.3 Mock-up:

- .1 Provide representative sealant installation if requested

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Store sealants:

- .1 In original unopened containers
- .2 Within manufacturer's temperature limits

1.7.2 Protect from:

- .1 Moisture
- .2 Freezing
- .3 Direct sunlight

1.8 COORDINATION

1.8.1 Coordinate with:

- .1 Air/vapour barrier installation
- .2 Roofing and flashing installation
- .3 Door and glazing systems
- .4 Mechanical and electrical penetrations

1.8.2 Verify:

- .1 Joint dimensions
- .2 Substrate compatibility
- .3 Backing requirements

2 PRODUCTS

2.1 GENERAL

2.1.1 Provide sealants from single manufacturer where possible.

2.1.2 Colours:

- .1 Selected by Consultant from manufacturer's standard range.

2.2 SEALANT TYPES

2.2.1 Type S1 – Exterior Silicone Sealant

- .1 Neutral cure silicone sealant:
 - .1 ASTM C920, Type S, Grade NS, Class 25
- .2 Use for:
 - .1 Exterior perimeter joints
 - .2 Curtain wall joints
 - .3 Window and door perimeter joints
 - .4 Metal flashing joints
- .3 Properties:
 - .1 UV resistant
 - .2 Non-staining
 - .3 Compatible with metal roofing and cladding finishes

2.2.2 Type S2 – Polyurethane Sealant

- .1 One-component polyurethane sealant:

- .1 ASTM C920, Class 25
- .2 Use for:
 - .1 Exterior control joints
 - .2 Concrete-to-metal joints
 - .3 Slab perimeter joints
- .3 Traffic-rated where exposed to foot traffic.

2.2.3 Type S3 – Interior Acrylic Latex Sealant

- .1 Paintable acrylic latex sealant.
- .2 Use for:
 - .1 Interior drywall joints
 - .2 Trim and frame joints
 - .3 Concealed interior joints

2.2.4 Type S4 – Acoustic Sealant

- .1 Non-hardening acoustic sealant:
 - .1 Permanently flexible
- .2 Use for:
 - .1 Acoustic partitions
 - .2 Perimeter of rated drywall partitions (P3/P3A)

2.2.5 Type S5 – Firestop Sealant

- .1 ULC-listed firestop sealant system.
- .2 Use for:
 - .1 Penetrations through fire-rated assemblies
 - .2 Fire-rated wall and floor joints
- .3 Maintain:
 - .1 Fire-resistance rating continuity

2.2.6 Type S6 – Air/Vapour Barrier Sealant

- .1 Non-skinning elastomeric sealant compatible with:
 - .1 Polyethylene vapour barriers
 - .2 Air barrier membranes
- .2 Use for:
 - .1 Vapour barrier terminations

- .2 Penetrations
- .3 Slab edge interfaces

2.3 BACKING MATERIALS

2.3.1 Closed-cell polyethylene backer rod:

- .1 Non-gassing
- .2 Compatible with sealants

2.3.2 Bond breaker tape:

- .1 Polyethylene tape where backer rod cannot be installed

2.4 ACCESSORIES

2.4.1 Primers:

- .1 As recommended by sealant manufacturer

2.4.2 Cleaning agents:

- .1 Compatible with substrates

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Joint dimensions
- .2 Substrate conditions
- .3 Compatibility of adjacent materials

3.1.2 Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

3.2.1 Clean substrates:

- .1 Free of dust, oil, frost, moisture, and debris

3.2.2 Prime substrates where required.

3.3 INSTALLATION – GENERAL

3.3.1 Install sealants:

- .1 In accordance with ASTM C1193 and manufacturer's instructions

3.3.2 Install:

- .1 Continuous, uniform beads
- .2 Without voids or air pockets

3.3.3 Tool exposed sealants to:

- .1 Smooth concave profile

3.4 BACKER RODS

3.4.1 Install backer rods:

- .1 Uniformly compressed
- .2 At depth recommended by manufacturer

3.4.2 Prevent:

- .1 Three-sided adhesion

3.5 EXTERIOR JOINTS

3.5.1 Seal:

- .1 Window and door perimeters
- .2 Curtain wall joints
- .3 Flashing terminations
- .4 Roof penetrations
- .5 Cladding transitions

3.5.2 Maintain:

- .1 Continuous weather seal
- .2 Air barrier continuity

3.6 INTERIOR JOINTS

3.6.1 Seal:

- .1 Drywall perimeters
- .2 Frame-to-wall joints
- .3 Millwork interfaces
- .4 Plumbing fixture joints

3.7 FIRE-RATED JOINTS

3.7.1 Install firestop sealants:

- .1 In accordance with ULC-listed assemblies

3.7.2 Maintain:

- .1 Fire-resistance continuity at penetrations and joints

3.8 AIR/VAPOUR BARRIER JOINTS

3.8.1 Seal:

- .1 Polyethylene laps
- .2 Penetrations
- .3 Membrane terminations

3.8.2 Coordinate with:

- .1 Section 07 27 00 – Air/Vapour Barriers

3.9 FIELD QUALITY CONTROL

3.9.1 Inspect:

- .1 Adhesion
- .2 Continuity
- .3 Joint geometry

3.9.2 Remove and replace defective sealant work.

3.10 PROTECTION

3.10.1 Protect sealants from:

- .1 Damage
- .2 Moisture
- .3 Premature curing conditions

3.11 CLEANING

3.11.1 Remove excess sealant from adjacent surfaces.

3.11.2 Leave joints clean and uniform.

3.12 SEALANT SCHEDULE

Sealant Type	Location	Colour	Notes
S1	Exterior windows and doors	Match adjacent finish	Weatherproof perimeter seal
S1	Curtain wall joints (CW1)	Match mullions	UV resistant
S1	Metal flashing and roofing joints	Match roofing	Compatible with standing seam roofing
S2	Slab control joints	Grey	Traffic-rated
S2	Exterior concrete joints	Grey	Freeze/thaw resistant
S3	Interior drywall control joints	Paintable	Interior finish sealant
S3	Millwork and trim joints	Paintable	Interior applications
S4	Acoustic partition perimeters	Concealed	Non-hardening
S4	P3/P3A partition perimeter joints	Concealed	Maintain acoustic continuity
S5	Fire-rated penetrations	Red	ULC-listed firestop
S5	Fire-rated wall head joints	Red	Maintain FRR continuity
S6	Polyethylene vapour barrier laps	Concealed	Air/vapour continuity
S6	Slab edge vapour barrier transitions	Concealed	Coordinate with F1 assembly
S6	Mechanical/electrical penetrations	Concealed	Air barrier continuity

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 Hollow metal doors
- .2 Hollow metal frames
- .3 Insulated exterior doors
- .4 Interior metal doors and frames
- .5 Borrowed lites and sidelites associated with metal frame systems
- .6 Reinforcements for hardware and accessories
- .7 Glazed openings in hollow metal doors
- .8 Anchors, fillers, and accessories required for complete installation

1.1.2 Work includes coordination with:

- .1 Door hardware systems
- .2 Barrier-free operators
- .3 Fire-rated wall assemblies
- .4 Curtain wall and glazing systems

1.1.3 Doors and frames identified as HM in Door Schedule are included in this Section

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 06 10 00 – Rough Carpentry
- 1.2.2 Section 07 27 00 – Air/Vapour Barriers
- 1.2.3 Section 07 92 00 – Joint Sealants
- 1.2.4 Section 08 14 00 – Wood Doors
- 1.2.5 Section 08 71 00 – Door Hardware
- 1.2.6 Section 08 80 00 – Glazing

1.3 REFERENCES

1.3.1 Comply with latest editions of:

- .1 Ontario Building Code (OBC)

- .2 National Building Code of Canada (NBC)
- .3 CAN/CSA-A440 – Windows and Doors
- .4 CAN/CGSB-82.5 – Insulated Steel Doors
- .5 ANSI/SDI A250 Series – Steel Door Standards
- .6 NFPA 80 – Fire Doors and Other Opening Protectives
- .7 ASTM A653/A653M – Galvanized Steel Sheet

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Exterior insulated hollow metal doors:

- .1 Thermally broken where required
- .2 Weatherstripped and sealed

1.4.2 Fire-rated assemblies:

- .1 Maintain required fire-resistance ratings and smoke control continuity

1.4.3 Accessibility:

- .1 Comply with OBC and AODA requirements for:
 - .1 Clear widths
 - .2 Thresholds
 - .3 Hardware operation
 - .4 Power door operators

1.4.4 Air leakage:

- .1 Exterior assemblies shall maintain continuity of:
 - .1 Air barrier
 - .2 Vapour barrier
 - .3 Weather seal

1.5 SUBMITTALS

1.5.1 Submit:

- .1 Shop drawings
- .2 Door and frame schedules
- .3 Product data
- .4 Hardware reinforcement details

1.5.2 Shop drawings shall indicate:

- .1 Frame profiles
- .2 Anchoring methods
- .3 Glazing openings
- .4 Fire ratings
- .5 Door elevations

1.5.3 Submit:

- .1 Manufacturer certification for fire-rated assemblies
- .2 Finish samples

1.6 QUALITY ASSURANCE

1.6.1 Manufacturer:

- .1 Minimum 5 years experience producing hollow metal door systems

1.6.2 Fire-rated assemblies:

- .1 Labeled and listed by recognized testing agency

1.6.3 Fabrication:

- .1 In accordance with ANSI/SDI standards

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Deliver doors and frames:

- .1 Wrapped and protected from damage

1.7.2 Store:

- .1 Off floor
- .2 Dry and ventilated

1.7.3 Prevent:

- .1 Warping
- .2 Corrosion
- .3 Finish damage

1.8 COORDINATION

1.8.1 Coordinate with:

- .1 Door hardware supplier
- .2 Electrical contractor for barrier-free operators
- .3 Air/vapour barrier systems
- .4 Firestopping systems

1.8.2 Confirm:

- .1 Rough openings
- .2 Threshold conditions
- .3 Hardware locations prior to fabrication

2 PRODUCTS

2.1 HOLLOW METAL DOORS

2.1.1 Exterior doors:

- .1 Insulated hollow metal doors
- .2 Flush style unless noted otherwise

2.1.2 Interior hollow metal doors:

- .1 Flush steel doors
- .2 Reinforced for hardware

2.1.3 Steel faces:

- .1 Minimum 18 ga galvanized steel for exterior doors
- .2 Minimum 20 ga steel for interior doors

2.2 HOLLOW METAL FRAMES

2.2.1 Welded hollow metal frames:

- .1 Factory fabricated

2.2.2 Minimum thickness:

- .1 16 ga for exterior frames
- .2 16 ga for interior frames unless noted otherwise

2.2.3 Provide:

- .1 Reinforcements for hardware

- .2 Anchors suitable for wall construction

2.3 INSULATED EXTERIOR DOORS

- 2.3.1 Exterior HM doors identified as insulated in Door Schedule:

- .1 D03, D04, D11

- 2.3.2 Core:

- .1 Polyurethane insulated core

- 2.3.3 Provide:

- .1 Thermal break where required
 - .2 Continuous weatherstripping

2.4 GLAZING OPENINGS

- 2.4.1 Provide glazing stops:

- .1 Removable interior stops

- 2.4.2 Doors with glazing:

- .1 As indicated in Door Schedule:
 - .1 Vision glass
 - .2 Full lite
 - .3 IGU assemblies

2.5 FIRE-RATED ASSEMBLIES

- 2.5.1 Provide fire-rated doors and frames:

- .1 Where required by OBC, partition schedules and door schedules.

- 2.5.2 Labels:

- .1 Permanently affixed and visible after installation

2.6 WEATHERSTRIPPING AND THRESHOLDS

- 2.6.1 Exterior doors:

- .1 Complete with:
 - .1 Compression weatherstripping
 - .2 Door sweeps
 - .3 Thresholds

- 2.6.2 Thresholds:

- .1 Maximum 13 mm height with beveled edges in barrier-free applications

2.7 HARDWARE REINFORCEMENTS

2.7.1 Reinforce doors and frames for:

- .1 Closers
- .2 Power operators
- .3 Electric strikes
- .4 Barrier-free devices

2.7.2 Coordinate with:

- .1 Section 08 71 00 – Door Hardware
- .2 Electrical drawings E-102 and E-601

2.8 FINISHES

2.8.1 Factory prime steel doors and frames.

2.8.2 Finish:

- .1 Suitable for field painting

2.9 ACCESSORIES

2.9.1 Provide:

- .1 Frame anchors
- .2 Reinforcement plates
- .3 Grouting materials
- .4 Silencers

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Rough openings
- .2 Wall construction
- .3 Frame support conditions

3.1.2 Do not proceed until deficiencies are corrected.

3.2 INSTALLATION – FRAMES

3.2.1 Install frames:

- .1 Plumb, level, and aligned

3.2.2 Secure:

- .1 Rigidly anchored to adjacent construction

3.2.3 Fill frames:

- .1 With insulation or grout where required

3.3 INSTALLATION – DOORS

3.3.1 Install doors:

- .1 True and aligned
- .2 Swinging freely without binding

3.3.2 Adjust:

- .1 Clearances uniformly

3.4 EXTERIOR DOORS

3.4.1 Install:

- .1 Weatherstripping
- .2 Thresholds
- .3 Sweeps

3.4.2 Seal perimeter joints:

- .1 In accordance with Section 07 92 00

3.4.3 Maintain:

- .1 Air/vapour barrier continuity at perimeter interfaces

3.5 FIRE-RATED ASSEMBLIES

3.5.1 Install:

- .1 In accordance with NFPA 80

3.5.2 Maintain:

- .1 Label visibility

- .2 Fire-resistance continuity

3.6 ACCESSIBLE OPENINGS

- 3.6.1 Install doors and frames to comply with:

- .1 AODA requirements
- .2 OBC barrier-free provisions

- 3.6.2 Coordinate:

- .1 Barrier-free operators
- .2 Emergency assistance systems
- .3 Push-button controls

3.7 GLAZING PREPARATION

- 3.7.1 Coordinate glazing installation with:

- .1 Section 08 80 00

- 3.7.2 Ensure:

- .1 Frames are prepared for glazing types indicated in schedule

3.8 FIELD QUALITY CONTROL

- 3.8.1 Inspect:

- .1 Alignment
- .2 Hardware preparation
- .3 Operation
- .4 Seal continuity

- 3.8.2 Replace damaged or defective work.

3.9 PROTECTION

- 3.9.1 Protect installed doors and frames from:

- .1 Damage
- .2 Corrosion
- .3 Construction impacts

3.10 CLEANING

3.10.1 Remove protective coverings.

3.10.2 Clean exposed surfaces.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 Interior wood flush doors
- .2 Wood frames where indicated
- .3 Solid core wood doors
- .4 Vision lite wood doors
- .5 Wood doors in fire-rated assemblies where applicable
- .6 Hardware preparation
- .7 Accessories required for complete installation

1.1.2 Work includes doors identified as wood doors in Door Schedule

1.1.3 Coordinate with:

- .1 Hollow metal frames
- .2 Door hardware systems
- .3 Barrier-free operators
- .4 Fire-rated wall assemblies

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 06 20 00 – Finish Carpentry
- 1.2.2 Section 07 92 00 – Joint Sealants
- 1.2.3 Section 08 11 00 – Metal Doors and Frames
- 1.2.4 Section 08 71 00 – Door Hardware
- 1.2.5 Section 08 80 00 – Glazing

1.3 REFERENCES

- 1.3.1 Ontario Building Code (OBC)
- 1.3.2 National Building Code of Canada (NBC)
- 1.3.3 CAN/CSA-O132.2 – Wood Flush Doors
- 1.3.4 AWMAC – Architectural Woodwork Standards (AWS)

1.3.5 NFPA 80 – Fire Doors and Other Opening Protectives

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Wood doors shall:

- .1 Resist warping, twisting, and delamination
- .2 Maintain dimensional stability under interior environmental conditions

1.4.2 Fire-rated wood doors:

- .1 Maintain required fire-resistance ratings and smoke control continuity

1.4.3 Accessibility:

- .1 Comply with OBC and AODA requirements for:
- .2 Clear opening widths
- .3 Maneuvering clearances
- .4 Hardware operation

1.5 SUBMITTALS

1.5.1 Submit:

- .1 Product data
- .2 Shop drawings
- .3 Door schedule coordination information

1.5.2 Shop drawings shall indicate:

- .1 Door construction
- .2 Core type
- .3 Veneer or finish type
- .4 Glazing openings
- .5 Hardware preparation

1.5.3 Submit:

- .1 Fire-rating certifications where applicable
- .2 Finish samples

1.6 QUALITY ASSURANCE

1.6.1 Manufacturer:

- .1 Minimum 5 years experience manufacturing architectural wood doors

1.6.2 Fire-rated doors:

- .1 Labeled and listed by recognized testing agency

1.6.3 Fabrication:

- .1 In accordance with AWMAC AWS standards

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Deliver doors:

- .1 Wrapped and protected from moisture and damage

1.7.2 Store:

- .1 Flat and level
- .2 In conditioned interior environment

1.7.3 Do not install damaged or warped doors.

1.8 COORDINATION

1.8.1 Coordinate with:

- .1 Door hardware supplier
- .2 Electrical contractor for power operators
- .3 Metal frame installation
- .4 Wall finish schedules

1.8.2 Confirm:

- .1 Hardware locations
- .2 Glazing requirements
- .3 Rough opening dimensions prior to fabrication

2 PRODUCTS

2.1 WOOD FLUSH DOORS

2.1.1 Interior wood doors:

- .1 Solid core flush wood doors

2.1.2 Construction:

- .1 AWMAC Custom Grade unless noted otherwise

2.1.3 Thickness:

- .1 45 mm typical unless noted otherwise

2.2 CORE CONSTRUCTION

2.2.1 Core:

- .1 Solid particleboard core or structural composite lumber core

2.2.2 Fire-rated doors:

- .1 Mineral core where required by rating

2.3 DOOR FACES

2.3.1 Finish:

- .1 Paint-grade unless noted otherwise

2.3.2 Veneer:

- .1 Hardwood veneer where transparent finish is required

2.4 GLAZED OPENINGS

2.4.1 Provide glazing cutouts and vision lite kits where indicated in Door Schedule.

2.4.2 Vision lite frames:

- .1 Manufacturer's standard wood lite kit

2.5 FIRE-RATED DOORS

2.5.1 Fire-rated doors:

- .1 As required by wall assembly ratings and OBC requirements

2.5.2 Labels:

- .1 Permanently affixed and visible after installation

2.6 WOOD FRAMES

2.6.1 Wood frames where indicated:

- .1 Solid wood frame and stops.

- .2 Finger jointed wood not acceptable.

2.6.2 Coordinate:

- .1 Frame dimensions with wall assemblies and finishes

2.7 HARDWARE PREPARATION

2.7.1 Factory prepare doors for:

- .1 Hinges
- .2 Locks
- .3 Closers
- .4 Vision lite kits
- .5 Barrier-free hardware

2.7.2 Reinforce doors where required for:

- .1 Power operators
- .2 Closers

2.8 FINISHES

2.8.1 Factory seal top and bottom edges of all doors.

- .1 Finish:
 - .1 Compatible with field painting or staining systems

2.9 ACCESSORIES

2.9.1 Provide:

- .1 Louvers where indicated
- .2 Blocking reinforcement
- .3 Edge protection where required

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Frame installation
- .2 Rough openings

.3 Wall construction and readiness

3.1.2 Do not proceed until deficiencies are corrected.

3.2 INSTALLATION – GENERAL

3.2.1 Install doors:

.1 Plumb and aligned

.2 Swinging freely without binding

3.2.2 Maintain:

.1 Uniform clearances

3.3 INSTALLATION – HARDWARE PREPARATION

3.3.1 Coordinate installation with:

.1 Section 08 71 00 – Door Hardware

3.3.2 Verify:

.1 Hardware reinforcement and preparation prior to hanging doors

3.4 FIRE-RATED DOORS

3.4.1 Install:

.1 In accordance with NFPA 80

3.4.2 Maintain:

.1 Label visibility

.2 Integrity of rated assemblies

3.4.3 Do not:

.1 Field modify rated doors without approval

3.5 ACCESSIBLE OPENINGS

3.5.1 Install doors to comply with:

.1 OBC barrier-free requirements

.2 AODA accessibility provisions

3.5.2 Coordinate:

.1 Power operators

- .2 Push-button devices
- .3 Clearances at barrier-free washrooms

3.6 GLAZING PREPARATION

3.6.1 Coordinate glazing installation with:

- .1 Section 08 80 00 – Glazing

3.6.2 Ensure:

- .1 Vision lite openings are properly reinforced and sealed

3.7 ADJUSTING

3.7.1 Adjust doors for:

- .1 Smooth operation
- .2 Proper latching
- .3 Alignment

3.8 FIELD QUALITY CONTROL

3.8.1 Inspect:

- .1 Alignment
- .2 Clearances
- .3 Surface defects
- .4 Hardware preparation

3.8.2 Replace damaged or defective doors.

3.9 PROTECTION

3.9.1 Protect installed doors from:

- .1 Moisture
- .2 Damage
- .3 Construction impacts

3.10 CLEANING

3.10.1 Remove protective coverings.

3.10.2 Clean surfaces ready for finishing.

END OF SECTION

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1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes

- .1 Thermally broken glazed aluminum storefront systems.
- .2 Thermally broken glazed aluminum curtain wall systems.
- .3 Insulated glazing units.
- .4 Aluminum framing members.
- .5 Entrance framing integrated with hollow metal door systems.
- .6 Perimeter sealants and accessories integral to glazed systems.
- .7 Flashings, anchorage, attachment devices, and thermal isolation materials required for complete installation.

1.1.2 Related Sections

- .1 Section 07 21 00 – Thermal Insulation.
- .2 Section 07 25 00 – Air Barriers.
- .3 Section 07 92 00 – Joint Sealants.
- .4 Section 08 11 00 – Metal Doors and Frames.
- .5 Section 08 71 00 – Door Hardware.
- .6 Section 08 80 00 – Glazing.
- .7 Section 09 21 16 – Gypsum Board Assemblies.
- .8 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

Latest editions of:

1.2.1 Aluminum

- .1 CAN/CSA-S157 – Strength Design in Aluminum.
- .2 AA ADM-1 – Aluminum Design Manual.
- .3 AAMA CW-10 – Care and Handling of Architectural Aluminum.
- .4 AAMA 611 – Anodized Architectural Aluminum.

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- .5 AAMA 2605 – High Performance Organic Coatings.

1.2.2 Glazing

- .1 CAN/CGSB-12.8 – Insulating Glass Units.
- .2 CAN/CGSB-12.20 – Structural Design of Glass for Buildings.
- .3 ASTM E1300 – Determining Load Resistance of Glass.

1.2.3 Performance Testing

- .1 ASTM E283 – Air Leakage.
- .2 ASTM E330 – Structural Performance.
- .3 ASTM E331 – Water Penetration.
- .4 ASTM E547 – Cyclic Water Penetration.
- .5 AAMA 501 – Methods of Test for Exterior Walls.

1.2.4 Building Code

- .1 Ontario Building Code (OBC), current edition.
- .2 National Building Code of Canada (NBC), current edition.
- .3 Accessibility for Ontarians with Disabilities Act (AODA).

1.3 **SYSTEM DESCRIPTION**

1.3.1 General

- .1 Provide complete thermally broken glazed aluminum storefront and curtain wall systems as indicated.
- .2 Systems to accommodate:
 - .1 structural movement,
 - .2 thermal movement,
 - .3 dead load deflection,
 - .4 live load deflection,
 - .5 differential movement between structure and glazing system,
 - .6 without failure of glazing, seals, or anchorage.
- .3 Coordinate with:
 - .1 wood-framed exterior wall assembly EW1,
 - .2 air/moisture barrier,
 - .3 rigid insulation,
 - .4 vapour barrier continuity,
 - .5 adjacent roofing,

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- .6 hollow metal doors and frames,
- .7 electrical door operator requirements.

1.3.2 Design Requirements

- .1 Design glazed systems to withstand:
 - .1 positive and negative wind pressures in accordance with OBC,
 - .2 serviceability deflection limits,
 - .3 thermal movement,
 - .4 dead load conditions.
- .2 Maximum mullion deflection:
 - .1 $L/175$ of span or 19 mm maximum,
 - .2 without damage to components or glazing.
- .3 Design systems to prevent:
 - .1 uncontrolled water penetration,
 - .2 condensation accumulation,
 - .3 air leakage beyond specified limits.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Air Leakage

- .1 Maximum air leakage:
- .2 $0.30 \text{ L/s}\cdot\text{m}^2$ at 75 Pa differential pressure when tested in accordance with ASTM E283.

1.4.2 Water Penetration

- .1 No uncontrolled water penetration when tested in accordance with ASTM E331 at:
- .2 minimum 300 Pa static pressure differential.

1.4.3 Thermal Performance

- .1 Provide thermally broken framing throughout exterior glazed assemblies.
- .2 Overall system thermal performance:
 - .1 maximum U-value: $2.5 \text{ W/m}^2\cdot\text{K}$.
- .3 Maintain continuity of:
 - .1 thermal insulation,
 - .2 air barrier,
 - .3 vapour barrier,
 - .4 across perimeter conditions.

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1.4.4 Accessibility

- .1 Provide assemblies complying with:
 - .1 OBC Section 3.8,
 - .2 AODA requirements.
- .2 Including:
 - .1 barrier-free clear openings,
 - .2 power operator compatibility,
 - .3 accessible thresholds,
 - .4 visual contrast requirements at glazed doors.

1.5 SUBMITTALS

1.5.1 Product Data

- .1 Submit:
 - .1 framing system data,
 - .2 finishes,
 - .3 glazing data,
 - .4 thermal break information,
 - .5 accessories,
 - .6 sealants,
 - .7 anchorage systems.

1.5.2 Shop Drawings

- .1 Submit shop drawings indicating:
 - .1 plans,
 - .2 elevations,
 - .3 sections,
 - .4 connection details,
 - .5 mullion profiles,
 - .6 anchorage,
 - .7 perimeter conditions,
 - .8 drainage provisions,
 - .9 glazing details,
 - .10 integration with air barrier and insulation systems.
- .2 Include:
 - .1 structural calculations sealed by Professional Engineer licensed in Ontario.

1.5.3 Samples

- .1 Submit:
 - .1 300 mm long framing samples,
 - .2 colour samples,

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- .3 finish samples,
- .4 glazing samples.

1.5.4 Closeout Submittals

- .1 Submit:
 - .1 maintenance data,
 - .2 cleaning procedures,
 - .3 warranty documentation.

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

- .1 Installer to have:
 - .1 minimum 5 years documented experience,
 - .2 successful completion of comparable projects.

1.6.2 Mock-Up

- .1 If requested by Consultant:
 - .1 construct representative mock-up including glazing, anchorage, flashing, and sealants.
 - .2 Approved mock-up may remain as part of Work.

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Deliver materials in original packaging.

1.7.2 Protect aluminum surfaces from:

- .1 staining,
- .2 corrosion,
- .3 distortion,
- .4 physical damage.

1.7.3 Store off ground in dry ventilated area.

1.8 WARRANTY

1.8.1 Provide:

- .1 two-year warranty for workmanship and materials.

1.8.2 Provide manufacturer finish warranty:

- .1 minimum 20 years for fluoropolymer finish.

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2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Acceptable Manufacturers

- .1 Kawneer.
- .2 Alumaticor.
- .3 Oldcastle Building Envelope.
- .4 Wausau Window and Wall Systems.
- .5 Flynn.
- .6 Approved equivalent.

2.2 MATERIALS

2.2.1 Aluminum

- .1 Extruded aluminum alloy:
 - .1 AA 6063-T5 or T6.
- .2 Minimum wall thickness:
 - .1 2.0 mm unless otherwise required structurally.

2.2.2 Fasteners

- .1 Stainless steel:
 - .1 ASTM F593/F594.
- .2 Isolate dissimilar metals to prevent galvanic corrosion.

2.2.3 Thermal Isolation

- .1 Provide:
 - .1 non-conductive thermal separators,
 - .2 continuous thermal breaks,
 - .3 compatible isolation pads and shims.

2.3 STOREFRONT SYSTEM

2.3.1 General

- .1 Provide thermally broken aluminum storefront systems identified as CW1 on drawings.

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2.3.2 Framing

- .1 Nominal framing dimensions:
 - .1 50 mm x 150 mm aluminum mullions.
- .2 Factory-fabricated and prefinished.
- .3 Internal drainage and pressure equalization system.

2.3.3 Glazing

- .1 Double insulated glazing units.
- .2 Minimum glazing thickness:
 - .1 6 mm insulated glazing as indicated.
- .3 Safety glazing:
 - .1 tempered where required by OBC.

2.4 CURTAIN WALL SYSTEM

2.4.1 General

- .1 Provide thermally broken curtain wall assemblies where indicated on plans and elevations.

2.4.2 Performance

- .1 Curtain wall assemblies to accommodate:
 - .1 building movement,
 - .2 structural deflection,
 - .3 thermal expansion and contraction.
- .2 Drainage to exterior.

2.5 GLAZING

2.5.1 Insulated Glass Units

- .1 Double glazed hermetically sealed units.
- .2 Low-E coating.
- .3 Argon-filled cavities.
- .4 Warm-edge spacers.
- .5 Exterior lite:

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.1 fully tempered safety glass.

.6 Interior lite:

.1 tempered or laminated as required by OBC.

2.6 FINISHES

2.6.1 Exterior Finish

.1 Factory-applied fluoropolymer coating complying with:

.1 AAMA 2605.

.2 Colour:

.1 selected by Consultant from manufacturer's standard range.

2.6.2 Interior Finish

.1 Match exterior unless noted otherwise.

2.7 ACCESSORIES

2.7.1 Provide:

.1 flashings,

.2 closures,

.3 end dams,

.4 setting blocks,

.5 glazing gaskets,

.6 pressure plates,

.7 caps,

.8 sealants,

.9 anchors,

.10 shims,

.11 back pans,

.12 thermal isolators,

.13 perimeter insulation,

.14 required for complete installation.

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3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 openings,
- .2 dimensions,
- .3 tolerances,
- .4 substrate conditions,
- .5 before commencing installation.

3.1.2 Report deficiencies to Consultant.

3.1.3 Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

3.2.1 Coordinate installation with:

- .1 air barrier installation,
- .2 vapour barrier installation,
- .3 adjacent cladding,
- .4 roofing,
- .5 hollow metal frames,
- .6 door operators,
- .7 electrical rough-ins.

3.2.2 Ensure continuity of:

- .1 air barrier,
- .2 vapour barrier,
- .3 insulation systems.

3.3 INSTALLATION

3.3.1 General

- .1 Install in accordance with:

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- .1 manufacturer's written instructions,
- .2 reviewed shop drawings,
- .3 applicable standards.

- .2 Install plumb, level, square, and true.

3.3.2 Anchorage

- .1 Anchor assemblies securely to structure.
- .2 Allow for differential movement without:
 - .1 distortion,
 - .2 stress transfer,
 - .3 glazing failure.

3.3.3 Thermal and Moisture Control

- .1 Install perimeter insulation continuously.
- .2 Maintain continuity of:
 - .1 thermal barrier,
 - .2 air barrier,
 - .3 vapour barrier.
- .3 Seal all penetrations airtight and watertight.

3.3.4 Glazing Installation

- .1 Install glazing in accordance with:
 - .1 Section 08 80 00,
 - .2 glazing manufacturer recommendations.

3.3.5 Accessibility

- .1 Provide:
 - .1 maximum 13 mm threshold height,
 - .2 beveled thresholds where exceeding 6 mm,
 - .3 compatible interfaces with power operators and barrier-free hardware.

3.3.6 Electrical Coordination

- .1 Coordinate with electrical contractor for:
 - .1 door operators,
 - .2 emergency assistance systems,
 - .3 push-button devices,
 - .4 concealed conduit,
 - .5 access control interfaces.

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3.4 FIELD QUALITY CONTROL

3.4.1 Consultant may inspect installation for:

- .1 alignment,
- .2 seal continuity,
- .3 drainage provisions,
- .4 thermal continuity,
- .5 glazing quality.

3.4.2 Correct deficiencies at no additional cost.

3.5 CLEANING

3.5.1 Remove protective films after installation.

3.5.2 Clean aluminum and glazing surfaces using manufacturer-approved materials.

3.5.3 Remove debris and surplus materials from site.

3.6 PROTECTION

3.6.1 Protect completed work from:

- .1 damage,
- .2 staining,
- .3 impact,
- .4 construction activities.

3.6.2 Replace damaged components.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section includes:

- .1 Thermally broken aluminum-clad wood windows (fixed and operable)
- .2 Factory glazing (where specified)
- .3 Window hardware and accessories
- .4 Perimeter interface requirements

1.1.2 Related Sections:

- .1 07 27 00 – Air Barriers
- .2 07 92 00 – Joint Sealants
- .3 08 44 13 – Glazed Aluminum Curtain Walls
- .4 08 80 00 – Glazing

1.2 REFERENCES

1.2.1 National Building Code of Canada (NBC) / Ontario Building Code (OBC)

1.2.2 CSA A440 Series (latest edition):

- .1 CSA A440 – Windows and Door Systems
- .2 CSA A440.2 / A440.3 – Installation
- .3 CSA A440S1 – Canadian Supplement (NAFS)

1.2.3 AAMA / WDMA / CSA 101/I.S.2/A440 – NAFS Standard

1.2.4 CAN/CSA A123.3 – Self-adhering membranes (interface)

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Window assemblies shall be tested and certified in accordance with CSA A440 and NAFS requirements applicable to project location and building height.

1.3.2 Provide window systems with thermal performance sufficient to satisfy Ontario Building Code energy requirements and project energy model.

1.3.3 Factory-assembled aluminum-clad wood windows shall be designed to accommodate differential movement between wood and aluminum components without impairment of weather-tightness or operation.

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1.4 SUBMITTALS

1.4.1 Submit in accordance with Section 01 33 00.

.1 Product Data:

- .1 Manufacturer's specifications
- .2 Performance ratings (CSA A440)

.2 Shop Drawings:

- .1 Door sizes, profiles, hardware
- .2 Window sizes, profiles, anchorage
- .3 Integration with wall assemblies and air barrier

.3 Samples:

- .1 Door and Frame finish samples (min. 50 x 50 mm)

.4 Closeout Submittals:

- .1 Warranty documentation
- .2 Maintenance instructions

1.5 QUALITY ASSURANCE

1.5.1 Manufacturer: Minimum 5 years experience in aluminum-clad wood window fabrication.

1.5.2 Installer: Qualified installer experienced in CSA A440 installation standards.

1.5.3 Doors and Windows shall bear certification label indicating compliance with CSA A440.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Deliver units in manufacturer's packaging with labels intact.

1.6.2 Store off ground, protected from weather and damage.

1.7 WARRANTY

1.7.1 Provide:

- .1 2-year warranty for materials and workmanship
- .2 Extended manufacturer warranty for finishes (min. 10 years for coating)

2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Acceptable manufacturer:

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- .1 Windsor Windows and Doors.
- .2 Basis of Design:
 - .1 Doors: Pinnacle Series Aluminum-Clad Wood Narrow Out-swing Door.
 - .2 Windows: Pinnacle Series Aluminum-Clad Wood Direct Set Window.
- .3 Substitutions:
 - .1 In accordance with Division 01 requirements and subject to Consultant approval.

2.2 MATERIALS

2.2.1 Interior Frame and Sash:

- .1 Factory-fabricated kiln-dried clear select pine.
- .2 Clear or paint-grade appearance suitable for transparent or opaque finish.
- .3 Moisture content controlled in accordance with manufacturer's standards.

2.2.2 Exterior Cladding:

- .1 Extruded aluminum cladding mechanically attached to wood frame members.
- .2 Minimum thickness as required by manufacturer.
- .3 Factory-finished fluoropolymer or polyester powder-coated finish.
- .4 Colour selected by Consultant from manufacturer's full range.

2.2.3 Thermal Performance:

- .1 Frame construction shall incorporate continuous thermal separation and insulating characteristics inherent in wood framing.
- .2 Entire assembly shall meet specified OBC U-value requirements.

2.3 TYPES

2.3.1 Fixed windows where indicated.

2.3.2 Operable doors:

- .1 Provide factory-installed weatherstripping and compression seals.

2.4 GLAZING

2.4.1 Factory-glazed insulating glass units.

2.4.2 Triple glazing where required to achieve energy performance criteria.

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- 2.4.3 Low-E coatings on surface 2 locations.
- 2.4.4 Argon-filled insulating glass units.
- 2.4.5 Safety glazing where required by Ontario Building Code.
- 2.4.6 Refer to Section 08 80 00 - Glazing

2.5 HARDWARE

- 2.5.1 Manufacturer's hardware:
 - .1 Heavy duty NRP Hinges.
 - .2 Flush bolts.
 - .3 Weather Stripping.
 - .4 Sweeps.
- 2.5.2 Other Hardware refer to Section 08 71 00 - Door Hardware:
 - .1 Lockset
 - .2 Power Door Operator
 - .3 Electric Strike
 - .4 Closer
 - .5 Kick plate
 - .6 Threshold
- 2.5.3 Hardware finish as selected by Consultant from manufacturer's standard range.

2.6 FINISHES

- 2.6.1 Exterior Aluminum Cladding:
 - .1 Factory-applied baked fluoropolymer coating, powder coating, or equivalent manufacturer's premium finish.
 - .2 Colour selected by Consultant.
- 2.6.2 Interior Wood Surfaces:
 - .1 Factory primed for field painting; or
 - .2 Factory stained and clear coated as scheduled.

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2.7 ACCESSORIES

- 2.7.1 Perimeter flashings and trims
- 2.7.2 Anchors and fastening devices
- 2.7.3 Backer rods and sealant interfaces (by Section 07 92 00)
- 2.7.4 Manufacturer's insulated extension jambs.
- 2.7.5 Interior wood trim and casing around all doors and windows and as indicated on drawings.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Verify rough openings:
 - .1 Dimensions
 - .2 Plumb, level, and alignment
- 3.1.2 Report deficiencies prior to installation.

3.2 INSTALLATION

- 3.2.1 Install in accordance with:
 - .1 Install aluminum-clad wood doors and windows in strict accordance with manufacturer's written instructions and CSA A440.4.
 - .2 Protect exposed wood components from moisture intrusion during construction.
 - .3 Coordinate perimeter flashing, air and vapour barrier continuity, and thermal insulation with adjacent wall assemblies.

3.3 SEALING AND INTERFACE

- 3.3.1 Provide:
 - .1 Continuous perimeter air seal
 - .2 Exterior weather seal
- 3.3.2 Coordinate with:
 - .1 Vapour Barrier and Air barrier systems (07 25 00)
 - .2 Sealants (07 92 00)

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3.4 TOLERANCES

3.4.1 Install plumb and level within:

.1 ± 2 mm in 1 m

3.5 CLEANING

3.5.1 Clean glazing and frames after installation.

3.5.2 Remove protective coatings.

3.6 PROTECTION

3.6.1 Protect installed windows from damage during construction.

3.7 FIELD QUALITY CONTROL

3.7.1 Inspect installation for:

.1 Air and water tightness

.2 Verify proper operation of all operable sash and hardware.

.3 Replace damaged wood members, finishes, or aluminum cladding components.

END OF SECTION

1 GENERAL

1.1 SUMMARY

Section Includes

1.1.1 Finish hardware for:

- .1 hollow metal doors and frames,
- .2 wood doors,
- .3 glazed aluminum storefront entrance doors,
- .4 barrier-free washroom doors,
- .5 vestibule doors,
- .6 exterior insulated doors,
- .7 interior swing doors.

1.1.2 Electrified door hardware including:

- .1 power door operators,
- .2 push plate actuators,
- .3 emergency assistance interfaces,
- .4 electric strikes,
- .5 door contacts,
- .6 low-voltage raceways and coordination.

1.1.3 Thresholds, gasketing, weatherstripping and door seals.

1.1.4 Door closers, locksets, hinges, stops and accessories.

1.1.5 Coordination with:

- .1 Division 26,
- .2 Division 28,
- .3 storefront assemblies,
- .4 accessibility systems,
- .5 fire separations.

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 08 11 00 – Metal Doors and Frames.
- 1.2.2 Section 08 14 16 – Flush Wood Doors.
- 1.2.3 Section 08 44 13 – Glazed Aluminum Curtain Walls and Storefronts.
- 1.2.4 Section 08 80 00 – Glazing.
- 1.2.5 Section 26 05 00 – Common Work Results for Electrical.
- 1.2.6 Section 28 13 00 – Access Control.

1.3 REFERENCES

Latest editions of:

1.3.1 Standards

- .1 CAN/CSA-B651 – Accessible Design for the Built Environment.
- .2 CSA A440 – Windows and Doors.
- .3 BHMA A156 Series:
 - .1 A156.1 Butts and Hinges,
 - .2 A156.2 Bored and Preassembled Locks,
 - .3 A156.3 Exit Devices,
 - .4 A156.4 Door Controls,
 - .5 A156.5 Auxiliary Locks,
 - .6 A156.13 Mortise Locks,
 - .7 A156.16 Auxiliary Hardware,
 - .8 A156.18 Materials and Finishes,
 - .9 A156.19 Power Assist and Low Energy Operators.
- .4 NFPA 80 – Fire Doors and Other Opening Protectives.
- .5 Ontario Building Code (OBC).
- .6 Accessibility for Ontarians with Disabilities Act (AODA).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Product Data

- .1 Submit:
 - .1 manufacturer data,
 - .2 catalogue cuts,
 - .3 electrified hardware requirements,
 - .4 templates,
 - .5 mounting details,
 - .6 finish information.

1.4.2 Hardware Schedule

.1 Submit complete hardware schedule indicating:

- .1 door numbers,
- .2 hardware groups,
- .3 handing,
- .4 mounting heights,
- .5 functions,
- .6 finishes,
- .7 electrified hardware requirements,
- .8 wiring diagrams,
- .9 keying requirements.

1.4.3 Shop Drawings

.1 Submit shop drawings for:

- .1 automatic operators,
- .2 access control interfaces,
- .3 barrier-free washroom emergency systems,
- .4 electric strikes,
- .5 door coordination devices.
- .6 Coordinate with electrical rough-in requirements shown on drawings.

1.4.4 Samples

.1 Submit finish samples upon request.

1.5 QUALITY ASSURANCE

1.5.1 Supplier Qualifications

.1 Hardware supplier to:

- .1 specialize in commercial architectural hardware,
- .2 employ Architectural Hardware Consultant (AHC).

1.5.2 Installer Qualifications

.1 Installer to have minimum:

- .1 5 years documented experience.

1.5.3 Regulatory Requirements

.1 Provide hardware complying with:

- .1 OBC accessibility requirements,
- .2 AODA,
- .3 fire code requirements,
- .4 life safety requirements.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Deliver hardware in manufacturer's original packaging.

1.6.2 Clearly label packages by:

- .1 opening number,
- .2 hardware group.

1.6.3 Store in secure dry location.

1.7 WARRANTY

1.7.1 General Warranty

- .1 Provide:
 - .1 two-year warranty on hardware.

1.7.2 Automatic Operators

- .1 Provide:
 - .1 minimum two-year manufacturer warranty.

2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Acceptable Manufacturers

- .1 Hinges
 - .1 Hager.
 - .2 McKinney.
 - .3 Stanley.
- .2 Offset Pivot
 - .1 ASSA Abloy
 - .2 DormaKaba
 - .3 Fritsjurgens
- .3 Locksets and Latches
 - .1 Schlage.
 - .2 Sargent.
 - .3 Corbin Russwin.
- .4 Closers
 - .1 LCN.
 - .2 Norton.
 - .3 Dormakaba.

- .5 Exit Devices
 - .1 Von Duprin.
 - .2 Precision.
- .6 Automatic Operators
 - .1 Besam.
 - .2 Dormakaba.
 - .3 Horton.
- .7 Weatherstripping and Seals
 - .1 Pemko.
 - .2 Zero.
 - .3 National Guard.
- .8 Substitutions: As per Division 1

2.2 HARDWARE GENERAL REQUIREMENTS

- 2.2.1 Hardware finish:
 - .1 US32D satin stainless steel unless noted otherwise.
- 2.2.2 Fasteners:
 - .1 tamper-resistant where exposed to public areas.
- 2.2.3 Exterior hardware:
 - .1 corrosion-resistant.
- 2.2.4 Provide barrier-free compliant lever hardware throughout.
- 2.2.5 Door hardware mounting heights:
 - .1 in accordance with CAN/CSA-B651 and manufacturer recommendations.

2.3 HINGES

- 2.3.1 Interior Doors
 - .1 Heavy duty ball-bearing hinges.
 - .2 Stainless steel.
 - .3 Quantity:
 - .1 3 hinges for doors up to 2100 mm height,
 - .2 additional hinge for each additional 750 mm height.

- .4 NRP: Provide NRP hinges where hinges are located on locked side of a door.

2.3.2 Exterior Doors

- .1 Non-removable pin hinges at outswing doors.
- .2 Stainless steel construction.

2.4 OFFESET PIVOT

2.4.1 Stainless steel:

2.4.2 Heavy duty

2.5 LOCKSETS

2.5.1 General

- .1 Cylindrical heavy-duty commercial locksets:
 - .1 ANSI/BHMA Grade 1.
- .2 Lever handles:
 - .1 return type,
 - .2 barrier-free compliant,
 - .3 Freewheeling trim/lever.

2.5.2 Cylinders

- .1 Construction cores during construction.
- .2 Final keying:
 - .1 coordinated with Owner requirements.

2.6 DOOR CLOSERS

2.6.1 Heavy-duty surface-mounted closers:

- .1 ANSI Grade 1.

2.6.2 Adjustable spring power.

2.6.3 Delayed action at barrier-free doors.

2.6.4 Closers to permit opening forces complying with OBC accessibility requirements.

2.7 WEATHERSTRIPPING AND THRESHOLDS

2.7.1 Exterior Doors

- .1 Provide:

- .1 continuous perimeter weatherstripping,
- .2 door sweeps,
- .3 thermally broken aluminum thresholds.

2.7.2 Accessibility

- .1 Thresholds:
 - .1 maximum 13 mm height,
 - .2 beveled where exceeding 6 mm,
 - .3 in accordance with AODA and OBC.

2.8 AUTOMATIC DOOR OPERATORS

2.8.1 General

- .1 Provide low-energy power operators complying with:
 - .1 BHMA A156.19,
 - .2 OBC barrier-free requirements.

2.8.2 Components

- .1 Provide:
 - .1 operator,
 - .2 actuators,
 - .3 electric strike,
 - .4 door contacts,
 - .5 safety controls,
 - .6 wiring interfaces.
- .2 Coordinate with electrical drawings and emergency assistance systems.

2.8.3 Push Plate Actuators

- .1 Stainless steel.
- .2 Wall flush mounted.
- .3 Mounting heights and locations:
 - .1 as indicated on architectural/electrical drawings,
 - .2 coordinated with AODA clearances.

2.9 ELECTRIFIED HARDWARE

2.9.1 General

- .1 Provide:
 - .1 concealed raceways,
 - .2 low-voltage interfaces,
 - .3 electric strikes,

- .4 power transfer devices,
- .5 Push-to-lock actuators,
- .6 Connection to all other devices required for complete operation.

2.9.2 Emergency Assistance Hardware

- .1 Provide emergency assistance integration for barrier-free washrooms including:
 - .1 emergency call button,
 - .2 audible/visual annunciator,
 - .3 push-to-lock interfaces,
 - .4 Door contacts,
 - .5 associated wiring pathways.

2.10 STOPS

- 2.10.1 Wall stops where wall construction permits.

2.11 KICK PLATES

- 2.11.1 Stainless steel:

- .1 1.2 mm minimum thickness,
- .2 300 mm high.

2.12 EXIT DEVICES

2.13 FLUSH BOLTS

2.14 PUSH PLATES

2.15 ASTRAGAL

2.16 LATCH GUARD

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Verify:

- .1 door/frame preparation,
- .2 electrical rough-ins,
- .3 reinforcement,
- .4 clearances,
- .5 prior to installation.

- 3.1.2 Report deficiencies before proceeding.

3.2 INSTALLATION

3.2.1 General

- .1 Install hardware in accordance with:
 - .1 reviewed hardware schedule,
 - .2 manufacturer instructions,
 - .3 NFPA 80,
 - .4 accessibility requirements.
- .2 Install hardware plumb, level and secure.

3.2.2 Automatic Operators

- .1 Coordinate installation with:
 - .1 Division 26 electrical,
 - .2 access control,
 - .3 emergency assistance systems.
- .2 Conceal wiring wherever possible.
- .3 Verify operational clearances.

3.2.3 Electrified Hardware

- .1 Coordinate conduit and back boxes with electrical contractor.
- .2 Provide power transfer devices where wiring passes through moving doors.
- .3 Coordinate emergency assistance interfaces with barrier-free washroom layouts.

3.2.4 Weatherstripping

- .1 Install continuously around perimeter of exterior doors.

3.2.5 Fire-Rated Openings

- .1 Install hardware at rated assemblies in accordance with:
 - .1 NFPA 80,
 - .2 ULC listed requirements.
- .2 Do not field-modify fire-rated openings without approval.

3.3 FIELD QUALITY CONTROL

3.3.1 Adjusting

- .1 Adjust hardware for:
 - .1 smooth operation,
 - .2 proper latching,

- .3 accessibility opening force requirements,
- .4 proper closer operation.

3.3.2 Operational Testing

.1 Test:

- .1 automatic operators,
- .2 electric strikes,
- .3 emergency assistance systems,
- .4 door coordination devices.

3.3.3 Accessibility Verification

.1 Verify:

- .1 opening forces,
- .2 maneuvering clearances,
- .3 actuator locations,
- .4 threshold compliance,
- .5 meet OBC and AODA requirements.

3.4 CLEANING

3.4.1 Clean exposed hardware surfaces.

3.4.2 Remove protective films and labels.

3.5 PROTECTION

3.5.1 Protect installed hardware from damage during construction.

3.5.2 Replace damaged hardware.

3.6 HARDWARE GROUP INDEX

HARDWARE GROUP	DOOR NUMBERS	DESCRIPTION
HW-1	D03	Exterior HM service room double door
HW-2	D04	Exterior HM storage single door
HW-3	D11	Exterior HM universal washroom single door

HW-4	D22	Interior wood storage function single door
HW-5	D14, D21, D26	Interior wood office function single door
HW-6	D02, D05, D09, D10, D12	Exterior alum/wood single door
HW-7	D15, D16, D18, D19, D20	Interior wood washroom single door
HW-8	D01	Exterior full glass barrier-free single door
HW-9	D27, D28	Interior HM service room single door
HW-10	D06, D08	Exterior alum/wood double door
HW-11	D23	Interior wood server single door
HW-12	D13	Exterior full glass single door
HW-13	D24, D25	Interior wood passage function single door
HW-14	D17	Interior wood Classroom function single door
HW-15	D07	Exterior alum/wood accessible double door

3.7 HARDWARE SCHEDULE

3.7.1 HW-1 – Exterior HM Service Double Room

- .1 6 Hinges
- .2 1 Rim exit devices c/w Exterior cylindrical Storage keyed trim
- .3 2 Door closers c/w cush stop and hold open arm
- .4 Astragal
- .5 Weatherstripping

.6 2 Sweeps

.7 Threshold

.8 2 Kick plates

.9 2 Flush bolts

3.7.2 HW-2 – Exterior HM Storage Single Door

.1 3 Hinges

.2 Cylindrical storage lockset

.3 Door closer c/w cush stop and hold open arm

.4 Latch guard

.5 Weatherstripping

.6 Threshold

.7 Sweep

.8 Kick plate

3.7.3 HW-3 – Exterior HM Universal Washroom Single Door

.1 3 Hinges

.2 Cylindrical storage lockset

.3 Automatic operator

.4 2 Push plate actuators

.5 Push-to-lock actuator

.6 Electric strike

.7 Door contacts

.8 Emergency assistance interface

.9 Kick plate

.10 Coordinate with emergency assistance wiring with Electrical.

3.7.4 HW-4 – Interior Wood Storage Function Single Door

.1 3 Hinges

.2 Cylindrical storage lockset

.3 Door closer

.4 Wall stop

.5 Kick plate

3.7.5 HW-5 – Interior Wood Office Function Single Door

.1 3 Hinges

.2 Cylindrical office lockset (Interior push button lock)

.3 Wall stop

.4 Kick plate

3.7.6 HW-6 – Exterior Alum/Wood Single Door

.1 Manufacturer standard Alum/Wood hardware

.1 Heavy Duty NRP Hinges

.2 Weather stripping

.3 Sweep

.2 Cylindrical Classroom lockset (No internal push button)

.3 Door closer c/w cush stop

.4 Threshold

.5 Kick plate

3.7.7 HW-7 – Interior Wood Washroom Single Door

.1 3 Hinges

.2 Cylindrical privacy lockset, with visual occupancy display exterior key override

.3 Door closer c/w cush stop

.4 Kick plate

3.7.8 HW-8 – Exterior Full Glass Barrier-Free Single Door

.1 Manufacturer standard storefront hardware

.1 Heavy Duty offset pivot

.2 Cylindrical Classroom lockset (No internal push button)

.3 Weather stripping

.4 Sweep

.2 Automatic operator

.3 2 Push plate actuators

- .4 Electric strike
- .5 Threshold
- .6 Coordinate with electrical rough-ins and low-voltage wiring.

3.7.9 HW-9 – Interior HM Service Room Single Door

- .1 3 Hinges
- .2 Cylindrical storage lockset
- .3 Door closer c/w cush stop
- .4 Kick plate

3.7.10 HW-10 – Exterior Alum/Wood Double Door

- .1 Manufacturer standard storefront hardware
- .2 Manufacturer standard storefront hardware
 - .1 3 Hinges
 - .2 2 Flush Bolts
 - .3 Weather stripping
 - .4 2 Sweeps
- .3 Cylindrical Classroom lockset (No internal push button)
- .4 2 Door closers c/w cush stop
- .5 Threshold
- .6 2 Kick plates

3.7.11 HW-11 – Interior Wood Server Single Door

- .1 3 Double action hinges
- .2 2 Push plates
- .3 2 Kick plates

3.7.12 HW-12 – Exterior Full Glass Single Door

- .1 Manufacturer standard storefront hardware
 - .1 Heavy Duty offset pivot
 - .2 Cylindrical Classroom lockset (No internal push button)
 - .3 Weather stripping
 - .4 Sweep
- .2 Door closer c/w cush stop

- .3 Threshold
- 3.7.13 HW-13 – Interior Wood Passage Function Single Door
 - .1 3 Hinges
 - .2 Cylindrical passage set
 - .3 Door closer c/w cush stop
 - .4 Kick plate
- 3.7.14 HW-14 – Interior Wood Classroom Function Single Door (Push button lock)
 - .1 3 Hinges
 - .2 Cylindrical office lockset
 - .3 Wall stop
 - .4 Kick plate
- 3.7.15 HW-15 – Exterior Alum/Wood Accessible Double Door
 - .1 Manufacturer standard storefront hardware
 - .1 Heavy Duty NRP Hinges
 - .2 2 Flush Bolts
 - .3 Weather stripping
 - .4 2 Sweeps
 - .2 Cylindrical Classroom lockset (No internal push button)
 - .3 Automatic operator
 - .4 2 Push plate actuators
 - .5 Electric strike
 - .6 Threshold
 - .7 2 Kick plates
 - .8 Coordinate with electrical rough-ins and low-voltage wiring.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 Insulated glazing units (IGUs)
- .2 Tempered safety glazing
- .3 Laminated safety glazing where required
- .4 Glazing for:
 - .1 aluminum storefront systems (CW1),
 - .2 hollow metal doors,
 - .3 wood doors with vision panels,
 - .4 sidelites,
 - .5 clerestory glazing,
 - .6 punched windows
 - .7 Glazing accessories, sealants, setting blocks, gaskets, and glazing tapes
 - .8 Fire-rated glazing where required by OBC

1.1.2 Provide complete glazing systems for:

- .1 exterior weather protection,
- .2 thermal performance,
- .3 safety glazing compliance,
- .4 air and water infiltration resistance,
- .5 acoustic separation where applicable.

1.1.3 Coordinate glazing systems with:

- .1 Section 08 11 00 – Metal Doors and Frames,
- .2 Section 08 14 00 – Wood Doors and Frames,
- .3 Section 08 44 13 – Glazed Aluminum Curtain Walls and Storefronts,
- .4 Section 07 92 00 – Joint Sealants.

1.2 REFERENCES

1.2.1 Latest editions of:

- .1 Ontario Building Code (OBC).
- .2 National Building Code of Canada (NBC).

- .3 CAN/CGSB-12.1 – Tempered or Laminated Safety Glass.
- .4 CAN/CGSB-12.8 – Insulating Glass Units.
- .5 CAN/CGSB-12.9 – Spandrel Glass.
- .6 ASTM C1036 – Flat Glass.
- .7 ASTM C1048 – Heat-Treated Flat Glass.
- .8 ASTM E1300 – Determining Load Resistance of Glass in Buildings.
- .9 GANA Glazing Manual.
- .10 AAMA standards applicable to curtain wall and storefront glazing systems.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 General

- .1 Glazing systems shall:
 - .1 resist wind pressures,
 - .2 accommodate thermal movement,
 - .3 maintain weather tightness,
 - .4 resist air infiltration,
 - .5 resist water penetration,
 - .6 without failure.
- .2 Thermal Performance
 - .1 Exterior glazing assemblies shall:
 - .1 comply with OBC and SB-10 thermal performance requirements,
 - .2 maintain continuity of thermal envelope.
 - .2 Exterior insulated glazing units shall include:
 - .1 Low-E coating,
 - .2 argon gas fill,
 - .3 warm-edge spacers.
- .3 Safety Glazing
 - .1 Provide safety glazing:
 - .1 in hazardous locations,
 - .2 at doors,
 - .3 sidelites,
 - .4 barrier-free locations,
 - .5 full-lite assemblies,
 - .6 in accordance with OBC requirements.
- .4 Accessibility

- .1 Glazed doors and sidelites in barrier-free paths of travel shall include:
 - .1 continuous opaque visual markers,
 - .2 visually contrasting elements,
 - .3 in accordance with OBC and AODA requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Product Data

- .1 Submit:
 - .1 glazing product data,
 - .2 performance characteristics,
 - .3 sealant compatibility information,
 - .4 thermal performance data.

1.4.2 Shop Drawings

- .1 Submit shop drawings indicating:
 - .1 glazing types,
 - .2 thicknesses,
 - .3 safety glazing locations,
 - .4 edge conditions,
 - .5 framing interfaces,
 - .6 sealant details,
 - .7 setting methods.

1.4.3 Samples

- .1 Submit:
 - .1 glass samples,
 - .2 colour samples,
 - .3 fritted or opaque strip samples where applicable.

1.4.4 Closeout Submittals

- .1 Submit:
 - .1 maintenance instructions,
 - .2 warranty documentation,
 - .3 glazing cleaning recommendations.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualifications

- .1 Installer shall:
 - .1 specialize in commercial glazing systems,
 - .2 have minimum 5 years experience.

1.5.2 Standards

.1 Perform glazing work in accordance with:

- .1 GANA Glazing Manual,
- .2 manufacturer recommendations.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Store glazing materials:

- .1 vertically,
- .2 dry,
- .3 protected from impact and weather.

1.6.2 Prevent:

- .1 edge damage,
- .2 scratching,
- .3 staining,
- .4 seal failure.

1.7 WARRANTY

1.7.1 Provide:

- .1 two-year warranty for glazing installation.

1.7.2 Insulated glazing units:

- .1 minimum 10-year seal warranty.

2 PRODUCTS

2.1 GLASS MATERIALS

2.1.1 Float Glass

- .1 ASTM C1036 Type I transparent flat glass.

2.1.2 Tempered Safety Glass (GL-2)

- .1 Fully tempered safety glazing complying with:
 - .1 CAN/CGSB-12.1,
 - .2 ASTM C1048.
- .2 Use at:
 - .1 doors,

- .2 sidelites,
- .3 full-lite glazing,
- .4 low glazing locations,
- .5 hazardous locations.

2.1.3 Laminated Safety Glass

- .1 Laminated safety glazing:
 - .1 where required by OBC,
 - .2 where indicated for security or acoustic performance.

2.2 GLAZING ACCESSORIES

2.2.1 Setting Blocks

- .1 Neoprene setting blocks compatible with glazing system.

2.2.2 Sealants

- .1 Compatible with:
 - .1 aluminum framing,
 - .2 steel framing,
 - .3 wood framing,
 - .4 insulated glazing seals.
- .2 Refer to Section 07 92 00.

2.2.3 Gaskets

- .1 EPDM or silicone glazing gaskets compatible with glazing system.

2.2.4 Low-E Coating:

- .1 To meet requirements of the OBC:
 - .1 Basis of design: Solarban 70 clear by Vitro.

2.3 INSULATED GLAZING UNITS (GL-1)

2.3.1 General

- .1 Double glazed hermetically sealed units complying with:
 - .1 CAN/CGSB-12.8.

2.3.2 Configuration

- .1 Exterior insulated glazing units shall include:
 - .1 6 mm exterior lite,
 - .2 Low-E coating on surface 2,
 - .3 sealed argon filled airspace,

- .4 warm-edge spacers,
- .5 6 mm min. Interior lite.
- .2 Exterior lite:
 - .1 tempered safety glass.
- .3 Interior lite:
 - .1 tempered or laminated as required.

2.3.3 Curtain Wall and Storefront Glazing

- .1 Provide glazing for storefront assemblies.
- .2 Glazing system:
 - .1 25 mm double insulated glazing units within thermally broken aluminum framing.

2.4 DOOR GLAZING

2.4.1 Hollow Metal Doors

- .1 Provide glazing as indicated on the drawings:

2.4.2 Wood Doors

- .1 Provide glazing as indicated on the drawings:

2.4.3 Vision Panels

- .1 Vision glazing:
 - .1 tempered safety glazing minimum.
- .2 Wire glass:
 - .1 prohibited unless specifically permitted by OBC and provided as approved fire-rated safety glazing product.

2.4.4 Glass Door

- .1 12mm tempered and laminated safety glass (GL-3)

2.5 VISUAL MARKERS

2.5.1 Barrier-Free Glazing

- .1 Provide continuous opaque visual strips at:
 - .1 fully glazed doors,
 - .2 sidelites,
 - .3 storefront glazing in barrier-free paths.

2.5.2 Configuration

- .1 Minimum 50 mm wide opaque strip.
- .2 Install at:
 - .1 1350 mm to 1500 mm AFF,
 - .2 additional lower marker where required by OBC/AODA.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 framing tolerances,
- .2 opening dimensions,
- .3 substrate conditions,
- .4 before glazing installation.

3.1.2 Report deficiencies to Consultant.

3.2 PREPARATION

3.2.1 Clean glazing rabbets and framing surfaces.

3.2.2 Verify compatibility of:

- .1 glazing materials,
- .2 gaskets,
- .3 sealants,
- .4 coatings.

3.3 INSTALLATION

3.3.1 General

- .1 Install glazing in accordance with:
 - .1 GANA Glazing Manual,
 - .2 manufacturer instructions,
 - .3 reviewed shop drawings.
- .2 Install glazing:
 - .1 plumb,

- .2 square,
- .3 free from distortion.

3.3.2 Insulated Glazing Units

- .1 Install with:
 - .1 proper edge clearances,
 - .2 drainage provisions,
 - .3 continuous support.
- .2 Prevent:
 - .1 edge damage,
 - .2 stress concentrations,
 - .3 seal failure.

3.3.3 Safety Glazing

- .1 Install safety glazing at all locations required by OBC including:
 - .1 doors,
 - .2 sidelites,
 - .3 barrier-free washrooms,
 - .4 low glazing locations.

3.3.4 Curtain Wall and Storefront Glazing

- .1 Coordinate with Section 08 44 13.
- .2 Maintain continuity of:
 - .1 air barrier,
 - .2 thermal barrier,
 - .3 weather barrier,
 - .4 at perimeter conditions.

3.3.5 Sealants

- .1 Install perimeter sealants in accordance with:
 - .1 Section 07 92 00.
- .2 Ensure:
 - .1 airtight,
 - .2 watertight,
 - .3 continuous seals.

3.3.6 Accessibility Requirements

- .1 Install visual markers at glazed doors and sidelites in barrier-free paths of travel.
- .2 Ensure glazing does not create visual hazards.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspect glazing for:

- .1 scratches,
- .2 seal failure,
- .3 edge damage,
- .4 distortion,
- .5 improper installation.

3.4.2 Replace defective glazing.

3.5 CLEANING

3.5.1 Remove labels and protective coatings.

3.5.2 Clean glazing using manufacturer-approved methods.

3.6 PROTECTION

3.6.1 Protect installed glazing from:

- .1 welding damage,
- .2 impact,
- .3 construction debris,
- .4 scratching.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 gypsum board wall assemblies,
- .2 fire-rated gypsum board assemblies,
- .3 gypsum board ceilings,
- .4 gypsum board dropped ceilings,
- .5 gypsum board bulkheads and soffits,
- .6 shaft and service enclosure board,
- .7 cementitious backing board at wet areas,
- .8 wood furring and blocking associated with gypsum board work,
- .9 acoustic insulation within partitions,
- .10 joint treatment and finishing,
- .11 trim accessories and control joints.

1.1.2 Work includes assemblies identified on drawings as:

- .1 P1, P2, P3A, P3B, P4, C1
- .2 and related gypsum board ceiling systems.

1.1.3 Coordinate work with:

- .1 Section 06 10 00 – Rough Carpentry,
- .2 Section 07 21 00 – Thermal Insulation,
- .3 Section 07 84 00 – Firestopping,
- .4 Section 07 92 00 – Joint Sealants,
- .5 Section 09 91 00 – Painting,
- .6 Division 23 – HVAC,
- .7 Division 26 – Electrical.

1.2 REFERENCES

1.2.1 Latest editions of:

- .1 Ontario Building Code (OBC).
- .2 National Building Code of Canada (NBC).
- .3 ASTM C36/C36M – Gypsum Wallboard.
- .4 ASTM C475/C475M – Joint Compound and Tape.
- .5 NLGA Standard Grading Rules for Canadian Lumber.
- .6 CSA O86 – Engineering Design in Wood.
- .7 ASTM C840 – Application and Finishing of Gypsum Board.
- .8 ASTM C1047 – Accessories for Gypsum Board.
- .9 CAN/CSA-A82.27 – Gypsum Board Application.
- .10 CAN/ULC-S101 – Fire Endurance Tests.
- .11 ULC Fire Resistance Directory.
- .12 GA-214 – Levels of Gypsum Board Finish.
- .13 GA-216 – Application and Finishing of Gypsum Panel Products.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 General

- .1 Provide complete gypsum board systems capable of:
 - .1 accommodating building movement,
 - .2 maintaining fire-resistance ratings,
 - .3 maintaining acoustic performance,
 - .4 resisting surface cracking,
 - .5 supporting applied finishes and accessories.

1.3.2 Fire-Resistance Ratings

- .1 Construct rated assemblies in strict accordance with:
 - .1 ULC listed assemblies,
 - .2 tested assembly requirements,
 - .3 OBC requirements.
- .2 Provide fire-rated assembly corresponding to drawing designations.
- .3 **P3** assembly:
 - .1 minimum 1-hour fire-resistance rating,
 - .2 ULC W301,
 - .3 minimum STC 32.

.4 Maintain continuity of fire separations:

- .1 full height to underside of structure,
- .2 through concealed spaces,
- .3 at all penetrations,
- .4 at perimeter conditions.

1.3.3 Acoustic Performance

- .1 Provide sound attenuation batt insulation within:
 - .1 washroom partitions,
 - .2 partitions surrounding barrier-free washrooms,
 - .3 partitions noted on plans.
- .2 Install insulation continuously without gaps or compression.

1.3.4 Deflection and Movement

- .1 Accommodate structural deflection without cracking or failure.
- .2 Coordinate gypsum board assemblies with structural wood framing to accommodate anticipated building movement without cracking or damage.
- .3 Do not rigidly connect gypsum board assemblies across structural movement joints.

1.3.5 Moisture Resistance

- .1 Provide moisture-resistant gypsum board:
 - .1 at washrooms,
 - .2 janitorial spaces,
 - .3 sink areas,
 - .4 adjacent to plumbing fixtures.
- .2 Provide cementitious tile backer board:
 - .1 at tiled wet wall areas,
 - .2 shower or washdown areas if applicable.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Product Data

- .1 Submit:
 - .1 gypsum board data,
 - .2 framing data,
 - .3 fire-rated assembly documentation,
 - .4 acoustic assembly data,
 - .5 accessory data,
 - .6 fastener data.

1.4.2 Shop Drawings

.1 Submit shop drawings for:

- .1 suspended gypsum board ceilings,
- .2 bulkheads,
- .3 soffits,
- .4 framing details at bulkheads, soffits and suspended gypsum board ceilings,
- .5 fire-rated penetrations,
- .6 control joints,
- .7 support framing.

1.4.3 Samples

.1 Submit:

- .1 gypsum board finish samples,
- .2 corner bead samples,
- .3 trim accessory samples.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

.1 Installer shall:

- .1 specialize in gypsum board systems,
- .2 have minimum 5 years experience.

1.5.2 Mock-Ups

.1 Provide mock-up of:

- .1 Level 4 finish,
- .2 typical corner treatment,
- .3 ceiling/wall transition,
- .4 if requested by Consultant.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Store materials:

- .1 dry,
- .2 elevated above floor,
- .3 protected from moisture and weather.

1.6.2 Reject damaged or wet gypsum products.

1.7 SITE CONDITIONS

1.7.1 Maintain ambient temperature minimum 10°C before, during and after installation and finishing.

1.7.2 Ventilate areas during joint treatment and drying.

1.8 WARRANTY

1.8.1 Provide:

- .1 one-year warranty for gypsum board assemblies and finishes.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Gypsum Board

.1 Interior gypsum board:

- .1 16 mm thickness unless noted otherwise.

.2 Ceiling gypsum board:

- .1 13 mm gypsum board for ceiling assemblies C1, R1A and R1B.

2.1.2 Type X Gypsum Board

.1 Type X gypsum board:

- .1 ASTM C1396,
- .2 fire-rated,
- .3 16 mm thickness.

.2 Use in all fire-rated assemblies.

2.1.3 Moisture-Resistant Gypsum Board

.1 ASTM C1396 moisture-resistant gypsum board.

.2 Use:

- .1 washrooms,
- .2 janitor areas,
- .3 plumbing fixture walls.

2.1.4 Cementitious Backer Board

.1 Cementitious tile backer board:

- .1 ASTM C1325,
- .2 minimum 12 mm thick.

2.2 FRAMING MATERIALS

2.2.1 General

.1 Provide wood framing supporting gypsum board assemblies as indicated on the Drawings.

.2 Lumber:

- .3 SPF No.2 or better.
- .4 Kiln dried.
- .5 Maximum moisture content 19 percent.

2.2.2 Wood Stud Framing

- .1 Provide:
 - .1 38 x 89 mm studs.
 - .2 38 x 140 mm studs.
 - .3 38 x 184 mm studs.
 - .4 As indicated on Drawings.

2.2.3 Wood Furring

- .1 Provide wood furring where required to support gypsum board soffits, bulkheads and ceiling assemblies.

2.2.4 Wood Blocking

- .1 Provide continuous blocking where required for:
 - .1 millwork;
 - .2 washroom accessories;
 - .3 grab bars;
 - .4 door hardware;
 - .5 wall-mounted equipment;
 - .6 signage;
 - .7 fire extinguishers;
 - .8 other wall-mounted accessories.

2.2.5 Fasteners

- .1 Provide corrosion-resistant fasteners suitable for wood framing.

2.2.6 Resilient Channels

- .1 Provide resilient channels only where specifically required by the tested acoustic or fire-rated assembly indicated on the Drawings.
- .2 Install in accordance with the tested assembly requirements.

2.3 INSULATION

2.3.1 Acoustic Insulation

- .1 Mineral fibre batt insulation:
 - .1 semi-rigid,
 - .2 friction fit,
 - .3 sound attenuation type.

- .2 Install at:
 - .1 washroom partitions,
 - .2 partitions noted on plans.

2.3.2 Thermal Insulation

- .1 Coordinate with Section 07 21 00.
- .2 Ceiling assemblies:
 - .1 200 mm batt insulation in attic spaces.

2.4 ACCESSORIES

2.4.1 Joint Treatment Materials

- .1 ASTM C475 joint compounds and tapes.

2.4.2 Corner Beads and Trim

- .1 Zinc-coated steel corner beads.
- .2 Use prefabricated trim accessories at:
 - .1 exposed edges,
 - .2 bulkheads,
 - .3 suspended ceiling perimeters.

2.4.3 Fasteners

- .1 Corrosion-resistant screws compatible with substrate.

2.4.4 Sealants

- .1 Fire-rated acoustical sealant:
 - .1 non-hardening,
 - .2 paintable,
 - .3 compatible with gypsum board systems.

2.5 GYPSUM BOARD ASSEMBLIES

2.5.1 P1 Partition

- .1 Assembly:
 - .1 38x89 mm wood studs at 300 mm o.c.,
 - .2 16 mm gypsum board each side,
 - .3 taped and painted finish.

2.5.2 P2 Partition

- .1 Assembly:

- .1 38x140 mm wood studs at 300 mm o.c.,
- .2 16 mm gypsum board each side.

2.5.3 P2A Partition

- .1 Assembly:
 - .1 38x184 mm wood studs at 300 mm o.c.,
 - .2 16 mm gypsum board each side.

2.5.4 P2B Partition

- .1 Assembly:
 - .1 38x184 mm wood studs at 300 mm o.c.,
 - .2 batt insulation,
 - .3 air/vapour barrier at attic side where indicated,
 - .4 16 mm gypsum board each side.

2.5.5 P3 Fire-Rated Partition

- .1 Assembly:
 - .1 ULC W301,
 - .2 1-hour fire-resistance rating,
 - .3 minimum STC 32,
 - .4 38x89 mm wood studs at 300 mm o.c.,
 - .5 16 mm Type X gypsum board each side.

2.5.6 Ceiling Assembly C1

- .1 Ceiling assembly:
 - .1 wood trusses,
 - .2 200 mm batt insulation,
 - .3 air/vapour barrier,
 - .4 13 mm gypsum board finish.

2.5.7 Gypsum Board Dropped Ceilings

- .1 Provide suspended gypsum board ceilings at:
 - .1 corridors,
 - .2 washrooms,
 - .3 utility spaces,
 - .4 areas indicated on reflected ceiling plans.
- .2 Ceiling height:
 - .1 approximately 3987 mm AFF unless otherwise indicated.
- .3 Coordinate wood framing, wood furring and gypsum board ceiling construction with:
 - .1 lighting,

- .2 ductwork,
- .3 fire dampers,
- .4 access panels,
- .5 diffusers,
- .6 speakers,
- .7 emergency systems.

2.6 ACCESS PANELS

2.6.1 Provide gypsum board access panels for:

- .1 fire dampers,
- .2 valves,
- .3 cleanouts,
- .4 concealed electrical and mechanical equipment.

2.6.2 Fire-rated access panels:

- .1 rating to match adjacent assembly.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 wood framing is complete, securely fastened, plumb, straight and ready to receive gypsum board.
- .2 substrate conditions,
- .3 moisture conditions,
- .4 penetrations,
- .5 before commencing work.

3.1.2 Report deficiencies to Consultant.

3.2 PREPARATION

3.2.1 Coordinate:

- .1 mechanical rough-ins,
- .2 electrical rough-ins,
- .3 blocking,
- .4 backing,

- .5 supports,
 - .6 before board installation.
- 3.2.2 Confirm wall backing locations for:
 - .1 washroom accessories,
 - .2 grab bars,
 - .3 change tables,
 - .4 millwork,
 - .5 wall-mounted equipment.
- 3.2.3 Verify all required wood blocking has been installed prior to enclosure.
- 3.2.4 Do not install gypsum board over wet, warped, twisted or damaged framing members.
- 3.2.5 Wood Framing
 - .1 Install supplementary wood framing required to support:
 - .1 bulkheads;
 - .2 soffits;
 - .3 gypsum board ceiling edges;
 - .4 control joints;
 - .5 access panels;
 - .6 wall-mounted accessories;
 - .7 millwork;
 - .8 suspended equipment.
 - .2 Secure framing rigidly to structural framing.

3.3 INSTALLATION

3.3.1 General

- .1 Install gypsum board in accordance with:
 - .1 ASTM C840,
 - .2 GA-216,
 - .3 CAN/CSA-A82.27,
 - .4 manufacturer instructions.

3.3.2 Moisture Control

- .1 Wood framing shall not be enclosed until moisture content complies with specification requirements.
- .2 Replace warped, twisted or damaged framing prior to installing gypsum board.

3.3.3 Fire-Rated Assemblies

- .1 Install rated assemblies exactly as tested.
- .2 Seal all penetrations with approved firestopping systems.
- .3 Extend rated partitions:
 - .1 to underside of structure,
 - .2 continuously through concealed spaces.

3.3.4 Ceiling Installation

- .1 Install suspended gypsum board ceilings:
 - .1 level,
 - .2 rigid,
 - .3 free from visible deflection.
- .2 Provide additional wood framing and blocking at:
 - .1 access panels;
 - .2 lighting fixtures;
 - .3 diffusers;
 - .4 grilles;
 - .5 suspended equipment;
 - .6 speakers;
 - .7 other ceiling-mounted devices.
- .3 Coordinate ceiling work with reflected ceiling plans and MEP systems.

3.3.5 Control Joints

- .1 Install control joints:
 - .1 where indicated,
 - .2 at maximum spacing recommended by GA-216,
 - .3 at building movement joints.
- .2 Coordinate with structural slab control joints where applicable.

3.3.6 Joint Treatment

- .1 Finish gypsum board to GA-214 Level 4 minimum unless otherwise noted.
- .2 Sand smooth and feather joints.
- .3 Provide Level 5 finish where specifically required by reflected lighting conditions.

3.3.7 Coordinate gypsum board installation with:

- .1 wood roof trusses;
- .2 structural timber framing;

- .3 rough carpentry;
- .4 millwork;
- .5 firestopping;
- .6 mechanical work;
- .7 electrical work;
- .8 architectural wood ceilings.

3.3.8 Acoustic Sealing

- .1 Seal perimeter of partitions and ceilings continuously with acoustical sealant.
- .2 Seal around:
 - .1 penetrations,
 - .2 electrical boxes,
 - .3 ducts,
 - .4 conduit.

3.3.9 Field Quality Control

- .1 Inspect:
 - .1 fastener spacing,
 - .2 board alignment,
 - .3 joint finish quality,
 - .4 fire-resistance continuity,
 - .5 acoustic insulation continuity.
- .2 Replace damaged or defective work.

3.4 TOLERANCES

3.4.1 Maximum surface variation:

- .1 3 mm in 3000 mm.

3.5 CLEANING

- 3.5.1 Remove debris and waste materials daily.
- 3.5.2 Leave surfaces ready for painting.

3.6 PROTECTION

3.6.1 Protect completed gypsum board work from:

- .1 moisture,
- .2 impact damage,

- .3 staining,
- .4 excessive loading.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes

- .1 Solid wood tongue-and-groove ceiling boards.
- .2 Wood strapping, furring, blocking, and supplementary supports required for installation of wood ceiling boards.
- .3 Matching wood perimeter trim, closure boards, and associated finish carpentry.
- .4 Concealed fasteners and accessories.
- .5 Factory-applied transparent finish.
- .6 Field finishing of cut edges, exposed end grain, minor repairs, and touch-ups.
- .7 Coordination of wood ceiling installation with exposed structural timber, lighting, ceiling fans, mechanical equipment, sprinklers, fire alarm devices, speakers, and other ceiling-mounted components.

1.2 RELATED REQUIREMENTS

1.2.1 Related Sections

- .1 Section 01 00 00 – General Requirements.
- .2 Section 06 10 00 – Rough Carpentry.
- .3 Section 06 17 53 – Shop Fabricated Wood Trusses.
- .4 Section 07 21 00 – Thermal Insulation.
- .5 Section 07 25 00 – Air/Vapour Barriers.
- .6 Section 07 84 00 – Firestopping.
- .7 Section 07 92 00 – Joint Sealants.
- .8 Section 09 91 00 – Painting.
- .9 Division 21 – Fire Protection.
- .10 Division 23 – Heating, Ventilating and Air Conditioning.
- .11 Division 26 – Electrical.
- .12 Division 27 – Communications.
- .13 Division 28 – Electronic Safety and Security.

1.3 REFERENCES

1.3.1 Latest Editions of the Following

- .1 Ontario Building Code.
- .2 CAN/ULC-S102 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CSA O141 – Softwood Lumber.
- .4 NLGA – Standard Grading Rules for Canadian Lumber.
- .5 Manufacturer's published product data and installation instructions.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

1.4.1 General

- .1 Provide complete tongue-and-groove wood ceiling installation that is straight, secure, uniform in appearance, and free from visible distortion.
- .2 Install boards directly to wood strapping or supporting construction indicated on the Drawings.
- .3 Wood ceiling boards and finish strapping are not permitted to support luminaires, ceiling fans, mechanical equipment, piping, ductwork, conduits, speakers, or other building services.
- .4 Support ceiling-mounted equipment independently of the wood ceiling boards and finish strapping, from structural framing or supplementary supports designed for the imposed loads.

1.4.2 Dimensional Stability

- .1 Provide kiln-dried wood conditioned for interior use.
- .2 Moisture content at time of installation: minimum 8 percent and maximum 12 percent.
- .3 Select and install boards to minimize:
 - .1 Cupping.
 - .2 Bowing.
 - .3 Twisting.
 - .4 Splitting.
 - .5 Open joints.
 - .6 Differential movement.
- .4 Accommodate normal seasonal expansion and contraction of solid wood without buckling or displacement.

1.4.3 Fire Performance

- .1 Provide the exposed wood ceiling board and transparent finish assembly with a maximum flame-spread rating of 75, complying with the Ontario Building Code requirements applicable to the occupancy, location, and building construction.
- .2 Submit CAN/ULC-S102 test data for the complete proposed assembly, including:
 - .1 Wood species.
 - .2 Board profile and thickness.
 - .3 Factory-applied sealer and transparent finish.
 - .4 Fire-retardant coating, where used.
- .3 Where required to achieve the specified flame-spread rating, provide a clear fire-retardant coating tested on Eastern White Pine and compatible with the complete transparent finish system.
- .4 Fire-retardant treatment shall not materially obscure the grain, alter the approved natural pine colour, or produce a visibly cloudy or painted appearance.
- .5 Do not substitute untreated materials or modify the tested coating system after acceptance.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

1.5.1 Submit in Accordance with Section 01 33 00

1.5.2 Product Data

- .1 Submit product data for:
 - .1 Tongue-and-groove boards.
 - .2 Wood species and appearance grade.
 - .3 Board profile and dimensions.
 - .4 Moisture content.
 - .5 Factory finish system.
 - .6 Wood strapping and blocking.
 - .7 Fasteners.
 - .8 Trim and accessories.
 - .9 Cleaning and maintenance requirements.

1.5.3 Shop Drawings

- .1 Submit coordinated wood ceiling installation drawings indicating:
 - .1 Direction of boards.
 - .2 Starting point and installation sequence.
 - .3 Board widths.
 - .4 Locations and arrangement of end joints.
 - .5 Perimeter conditions.
 - .6 Changes in ceiling plane.
 - .7 Interfaces with walls, bulkheads, clerestories, and exposed structural timber.
 - .8 Locations of trim and closure boards.
 - .9 Expansion and movement provisions.
 - .10 Access openings, where required.

- .11 Penetrations for lighting, ceiling fans, air devices, sprinklers, fire alarm devices, speakers, and other services.
- .2 Coordinate Shop Drawings with architectural, structural, mechanical, electrical, fire suppression, communications, and security drawings.
- .3 Do not commence ceiling installation until coordinated ceiling layouts have been reviewed.

1.5.4 Samples

- .1 Submit two assembled samples, minimum 600 x 600 mm, consisting of not fewer than three adjoining boards and showing:
 - .1 Specified knotty pine.
 - .2 Tongue-and-groove V-joint profile.
 - .3 Typical knot character.
 - .4 Surface preparation.
 - .5 Transparent finish.
 - .6 Sheen.
- .2 Submit one linear sample, minimum 600 mm long, of each proposed trim profile.
- .3 Approved samples establish the acceptable range for colour, grain, knot character, finish, and workmanship.

1.5.5 Test Reports

- .1 Where required to demonstrate code compliance, submit CAN/ULC-S102 test reports for the proposed wood and finish assembly.

1.5.6 Closeout Submittals

- .1 Submit:
 - .1 Cleaning and maintenance instructions.
 - .2 Product data for installed materials.
 - .3 Finish manufacturer and product identification.
 - .4 Touch-up procedures.
 - .5 Warranty documentation.
 - .6 Minimum 1 L of matching touch-up finish in sealed, labelled containers.
- .2 Extra Materials:
 - .1 Provide not less than 2 percent of installed quantity of each board width and profile, but not fewer than 10 full-length boards.
 - .2 Provide matching trim equal to not less than 2 percent of each installed trim profile.
 - .3 Clearly label and store extra materials at a location designated by the Owner.

1.6 **QUALITY ASSURANCE**

1.6.1 Qualifications

- .1 Installer shall have minimum three years documented experience installing exposed tongue-and-groove wood ceilings of similar material, area, and complexity.
- .2 Finishing applicator, where field finishing is required, shall be experienced with transparent wood finishes of the specified type.

1.7 MOCK-UP

1.7.1 Construct one mock-up, minimum 1200 x 2400 mm, demonstrating:

- .1 Board species, grade, width, and profile.
- .2 Typical range of knots and grain.
- .3 Board direction and joint arrangement.
- .4 Concealed fastening.
- .5 Perimeter trim.
- .6 Interface with exposed timber or adjacent gypsum board.
- .7 One typical recessed lighting penetration.
- .8 One typical service penetration.
- .9 Factory and field-applied finish.

1.7.2 Locate mock-up where directed by Consultant.

1.7.3 Obtain acceptance before proceeding with remaining Work.

1.7.4 Accepted mock-up may remain as part of completed Work if undamaged and located appropriately.

1.8 DELIVERY, STORAGE, AND HANDLING

1.8.1 Deliver products in original protective packaging.

1.8.2 Protect boards from:

- .1 Moisture.
- .2 Direct contact with concrete or masonry.
- .3 Excessive heat.
- .4 Direct sunlight.
- .5 Dirt and staining.
- .6 Physical damage.

1.8.3 Store boards:

- .1 Flat and fully supported.
- .2 Within the enclosed and conditioned building.
- .3 In installation areas or areas having similar environmental conditions.
- .4 In accordance with manufacturer's recommendations.

1.8.4 Do not store wood in unconditioned exterior storage, temporary shelters, or areas subject to construction moisture.

1.9 AMBIENT CONDITIONS

1.9.1 Do not install wood ceilings until:

- .1 Building is enclosed and weather-tight.
- .2 Wet work is complete and sufficiently dry.
- .3 Permanent heating and ventilation systems are operational or temporary systems maintain equivalent conditions.
- .4 Interior temperature and relative humidity have stabilized.
- .5 Substrates and concealed spaces are dry.

1.9.2 Maintain temperature and relative humidity within the wood product manufacturer's recommended limits during acclimatization and installation and until Substantial Performance.

1.9.3 Acclimatize boards within the installation area for minimum 7 days and until the moisture content of the boards is within 2 percentage points of the supporting wood construction.

1.9.4 Do not install boards having moisture content below 8 percent or above 12 percent.

1.10 COORDINATION

1.10.1 Coordinate ceiling layout with:

- .1 Exposed structural wood trusses, beams, columns, and associated connections.
- .2 Structural roof framing and ceiling strapping.
- .3 Clerestory windows and adjacent glazed assemblies.
- .4 Walls, bulkheads, and gypsum board ceilings.
- .5 Recessed and surface-mounted luminaires.
- .6 Pendant luminaires.
- .7 Ceiling fans and independent supports.
- .8 Mechanical air devices.

- .9 Fire protection components, where applicable.
- .10 Fire alarm devices.
- .11 Speakers and communication devices.
- .12 Security devices.
- 1.10.2 Confirm final locations and sizes of ceiling penetrations before cutting wood boards.
- 1.10.3 Arrange penetrations symmetrically and centre devices within boards or coordinated ceiling modules where practicable.

1.11 WARRANTY

- 1.11.1 Provide warranty in accordance with Division 01.
- 1.11.2 Warrant materials and installation against defects including:
 - .1 Loose or displaced boards.
 - .2 Failed fasteners.
 - .3 Joint opening exceeding the product manufacturer's acceptable tolerances and attributable to defective materials, improper acclimatization, or installation.
 - .4 Cupping, bowing, twisting, or splitting exceeding the accepted sample and attributable to defective materials or installation.
 - .5 Peeling, flaking, clouding, or delamination of the factory-applied finish.
 - .6 Warranty does not exclude normal minor dimensional variation inherent in solid wood where maintained within the environmental conditions specified by the manufacturer.

2 PRODUCTS

2.1 TONGUE-AND-GROOVE WOOD CEILING BOARDS

- 2.1.1 Material
 - .1 Species: Eastern White Pine.
 - .2 Type: solid wood.
 - .3 Grade: NLGA Select Knotty, manufacturer's equivalent appearance grade, or better, complying with the accepted samples. Appearance: knotty pine suitable for exposed architectural interior finish.
 - .4 Grade characteristics:
 - .1 Predominantly sound, tight knots.
 - .2 Natural variation in grain, colour, and knot distribution permitted.

- .3 Small, firmly repaired knots permitted where repairs are neat and colour-compatible.
- .4 Loose knots, open knot holes, decay, insect damage, excessive pitch pockets, splits, shakes, wane on exposed surfaces, and other defects adversely affecting appearance or performance are not permitted.
- .5 Wood shall be kiln dried and uniformly conditioned.

2.1.2 Board Dimensions

- .1 Nominal size: 19 x 140 mm.
- .2 Minimum actual thickness: 16 mm after machining.
- .3 Exposed face width: 127 mm nominal, subject to accepted product profile.
- .4 Use one board width throughout each continuous ceiling area unless otherwise indicated.
- .5 Lengths:
 - .1 Provide longest practical lengths.
 - .2 Select lengths to minimize end joints.
 - .3 Minimum board length: 1200 mm, except at perimeters, transitions, and penetrations.
 - .4 Do not use short random offcuts in exposed ceiling areas.

2.1.3 Profile

- .1 Tongue-and-groove edges.
- .2 End-matched tongue-and-groove ends.
- .3 V-joint at exposed longitudinal board joints.
- .4 Uniformly machined profile permitting tight engagement without visible damage.
- .5 Back relief or stress-relief kerfs where standard for the manufacturer.

2.1.4 Surface

- .1 Exposed face: smooth, factory sanded, ready for transparent finish.
- .2 Surface shall be free from planer chatter, machine marks, torn grain, dirt, oil, and handling damage.

2.2 2.2 SOURCE AND PRODUCT REQUIREMENTS

- 2.2.1 Provide the complete quantity of tongue-and-groove ceiling boards from one manufacturer or lumber processor and from one coordinated production run.
- 2.2.2 Manufacturer or processor shall regularly produce kiln-dried, end-matched tongue-and-groove Eastern White Pine for exposed interior applications.
- 2.2.3 Product shall demonstrate:

- .1 Availability through an Ontario supplier.
- .2 Consistent board profile and appearance grade.
- .3 Controlled kiln drying and moisture content.
- .4 Factory sanding and finishing capability.
- .5 Sufficient production capacity to supply the complete ceiling area and specified extra materials.

2.2.4 Substitutions shall comply with Division 01 and shall be evaluated against the specified species, grade, dimensions, profile, finish, fire performance, samples, and mock-up.

2.3 WOOD STRAPPING, FURRING, AND BLOCKING

2.3.1 Kiln-dried SPF lumber, NLGA No. 2 grade or better.

2.3.2 Moisture content at installation: maximum 15 percent.

2.3.3 Dimensions and spacing:

- .1 As indicated on the Drawings.
- .2 Where not indicated, as recommended by the ceiling board manufacturer for the board thickness, orientation, and fastening system.
- .3 Sufficient to provide a true ceiling plane and minimum required fastener penetration.

2.3.4 Provide continuous support at:

- .1 Perimeters.
- .2 Board ends not using manufacturer-approved end-matched joints.
- .3 Changes in board direction.
- .4 Openings and penetrations.
- .5 Trim and transition conditions.

2.4 FASTENERS

2.4.1 Concealed fasteners:

- .1 Hot-dip galvanized, stainless steel, or manufacturer-approved corrosion-resistant fasteners suitable for interior concealed installation.
- .2 Type, gauge, length, and spacing as recommended by the board manufacturer for the supporting substrate and installation orientation.
- .3 Provide minimum 32 mm penetration into solid wood support, unless the manufacturer requires greater penetration.

- .4 Fasteners shall not split, stain, or discolour the wood.

2.4.2 Exposed fasteners are not permitted except where specifically accepted by Consultant.

2.4.3 Where exposed fasteners are unavoidable:

- .1 Use colour-matched or countersunk fasteners.
- .2 Fill countersunk holes with matching wood plugs.

2.5 TRIM AND CLOSURES

2.5.1 Provide solid Eastern White Pine trim matching ceiling boards in species, knot character, colour, and finish.

2.5.2 Provide:

- .1 Perimeter trim.
- .2 Edge closures.
- .3 Transition trim.
- .4 Trim around columns and beams where indicated.
- .5 Trim around openings where exposed cut edges cannot be concealed by device flanges.

2.5.3 Fabricate trim in longest practical lengths.

2.5.4 Mitre or cope exposed corners.

2.6 TRANSPARENT FINISH

2.6.1 Factory Finish

- .1 Factory apply transparent finish to exposed face, edges, tongue, groove, end grain, and concealed back face.
- .2 Back-seal boards to reduce unequal moisture absorption and dimensional movement.
- .3 Finish system:
 - .1 Clear, waterborne polyurethane or clear waterborne architectural wood coating.
 - .2 Low-VOC.
 - .3 Non-yellowing.
 - .4 UV resistant.
 - .5 Washable.
 - .6 Suitable for institutional interior use.
- .4 Sheen: satin, approximately 20 to 35 gloss units at 60 degrees.

- .5 Colour: natural pine; no stain unless otherwise selected by Consultant.
- .6 Number of coats: manufacturer's recommended system providing uniform, fully sealed finish, minimum one sealer coat and two finish coats.

2.6.2 Appearance

- .1 Maintain natural variation of knotty pine.
- .2 Finish shall not obscure grain or produce a heavy plastic appearance.
- .3 Provide uniform sheen without runs, sags, lap marks, cloudiness, or excessive colour variation.

2.6.3 Field Touch-Up

- .1 Provide finish compatible with factory coating.
- .2 Apply to:
 - .1 Field cuts.
 - .2 Exposed end grain.
 - .3 Minor abrasions.
 - .4 Filled fastener holes.
 - .5 Repaired areas.

2.7 FIRE-RETARDANT COATING

- 2.7.1 Provide a factory-applied clear fire-retardant finish system tested on Eastern White Pine in accordance with CAN/ULC-S102 and achieving a flame-spread rating not exceeding 75.
- 2.7.2 Fire-retardant and transparent finish materials shall form one compatible manufacturer-approved system.
- 2.7.3 Finished appearance shall comply with accepted samples and mock-up.
- 2.7.4 Field application of the primary fire-retardant coating is not permitted except for manufacturer-approved treatment of field cuts and touch-up areas.

2.8 ACCESSORIES

- 2.8.1 Provide:
 - .1 Matching wood filler.
 - .2 Matching wood plugs.
 - .3 Compatible touch-up finish.
 - .4 Concealed clips, where recommended.

- .5 Shims.
- .6 Blocking.
- .7 Closure materials.
- .8 Accessories required for complete installation.

2.8.2 Adhesives, where permitted:

- .1 Low-VOC.
- .2 Compatible with wood, finish, and substrate.
- .3 Concealed after installation.
- .4 Adhesive attachment alone is not permitted.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify:

- .1 Supporting framing and strapping are complete, dry, securely attached, and correctly spaced.
- .2 Substrates are true, level, plumb where applicable, and suitable for fastening.
- .3 Moisture-producing work is complete.
- .4 Concealed services have been installed and tested.
- .5 Required insulation, air barrier, vapour retarder, fire blocking, and firestopping associated with concealed roof and wall assemblies are complete where applicable.
- .6 Locations and supports for ceiling-mounted devices have been coordinated.
- .7 Building environmental conditions comply with this Section.

3.1.2 Measure moisture content of wood boards and supporting wood immediately before installation using a calibrated moisture meter.

3.1.3 Record moisture readings and make them available to Consultant upon request.

3.1.4 Do not commence installation until unsatisfactory conditions have been corrected.

3.1.5 Beginning installation constitutes acceptance of substrates and environmental conditions.

3.2 PREPARATION

3.2.1 Sort boards before installation.

- 3.2.2 Distribute colour, grain, and knot patterns to provide a balanced and natural appearance.
- 3.2.3 Reject boards having defects exceeding the specified appearance requirements.
- 3.2.4 Install supplementary strapping and blocking at:
 - .1 Board ends.
 - .2 Perimeters.
 - .3 Changes in direction.
 - .4 Openings and penetrations.
 - .5 Trim.
 - .6 Other locations required for secure attachment.
- 3.2.5 Establish reference lines to maintain straight and parallel board alignment.

3.3 INSTALLATION

- 3.3.1 Install wood ceilings in accordance with:
 - .1 Reviewed Shop Drawings.
 - .2 Accepted mock-up.
 - .3 Manufacturer's written instructions.
 - .4 Requirements of this Section.
- 3.3.2 Install boards in the direction indicated on the Drawings.
- 3.3.3 Begin installation from established reference line to avoid tapered boards at opposing perimeters.
- 3.3.4 Install boards:
 - .1 With tongues fully engaged.
 - .2 Without crushing or damaging exposed edges.
 - .3 Straight and parallel.
 - .4 With uniform V-joints.
 - .5 Tight to adjacent boards without forced assembly.
- 3.3.5 Blind fasten through tongues at each supporting member.
- 3.3.6 Provide fastener penetration into supporting wood sufficient for permanent attachment.

- 3.3.7 Do not face-nail exposed board surfaces except where accepted.
- 3.3.8 Stagger end joints between adjacent board rows.
- 3.3.9 Distribute end joints uniformly and avoid repetitive stair-step or H-joint patterns.
- 3.3.10 Locate square-cut board ends over supporting strapping.
- 3.3.11 Fully engaged end-matched joints may occur between supports only where:
 - .1 Permitted by the board manufacturer for overhead installation.
 - .2 Board length and support spacing comply with the manufacturer's requirements.
 - .3 The joint remains tight, aligned, and free from visible deflection.
- 3.3.12 Separate adjacent end joints by not fewer than two board widths.
- 3.3.13 Provide perimeter clearances and movement spaces recommended by the board manufacturer.
- 3.3.14 Conceal perimeter movement spaces with matching trim.
- 3.3.15 Do not install warped, split, wet, damaged, or visibly defective boards.

3.4 INTERFACES WITH STRUCTURE AND ADJACENT FINISHES

- 3.4.1 Neatly fit boards and trim around exposed structural timber, clerestory framing, walls, bulkheads, and adjacent ceiling finishes.
- 3.4.2 Provide uniform reveals or fitted trim at interfaces as indicated.
- 3.4.3 Do not rigidly restrain boards where seasonal movement must occur.
- 3.4.4 Scribe exposed trim neatly to adjacent construction.
- 3.4.5 Do not fill movement joints with rigid filler.

3.5 CEILING PENETRATIONS

- 3.5.1 Coordinate and cut openings accurately for ceiling-mounted components.
- 3.5.2 Make openings no larger than required for device bodies and cover flanges.
- 3.5.3 Centre devices within board faces or coordinated ceiling layout where practicable.
- 3.5.4 Support devices independently of wood ceiling boards.
- 3.5.5 Seal field-cut edges and exposed end grain before installing devices.
- 3.5.6 Provide matching wood trim around penetrations where device flanges do not fully conceal cut edges.
- 3.5.7 Do not install split, cracked, or excessively notched boards around penetrations.

3.5.8 Maintain clearances from luminaires, heat-producing equipment, electrical components, and mechanical devices required by their manufacturers and applicable codes.

3.5.9 Do not attach ceiling fans, pendant luminaires, or other suspended equipment to wood ceiling boards or finish strapping.

3.6 TRIM INSTALLATION

3.6.1 Install trim in longest practical lengths.

3.6.2 Fit joints tightly and align adjacent profiles.

3.6.3 Mitre external and internal corners unless another joint is indicated.

3.6.4 Blind fasten trim where practicable.

3.6.5 Fill and finish unavoidable exposed fastener holes to match surrounding wood.

3.7 FIELD FINISHING AND TOUCH-UP

3.7.1 Seal field-cut edges and end grain before installation.

3.7.2 Touch up minor abrasions and repairs using materials supplied or recommended by the finish manufacturer.

3.7.3 Do not use filler or touch-up materials producing visible colour or sheen differences.

3.7.4 Replace boards where repair would remain visible from normal viewing distance.

3.8 FIELD QUALITY CONTROL

3.8.1 Inspect completed Work for:

- .1 Straight alignment.
- .2 Uniform joints.
- .3 Tight engagement.
- .4 Balanced distribution of colour and knots.
- .5 Secure fastening.
- .6 Proper perimeter clearances.
- .7 Neat penetrations.
- .8 Uniform finish.
- .9 Absence of visible damage, excessive movement, and unacceptable defects.

3.8.2 Replace Work that is:

- .1 Loose.

- .2 Misaligned.
- .3 Split.
- .4 Excessively cupped, bowed, or twisted.
- .5 Stained or damaged.
- .6 Improperly matched.
- .7 Defective in finish.

3.8.3 Completed ceiling tolerances:

- .1 Variation from straight alignment: maximum 3 mm in 3000 mm.
- .2 Variation from intended ceiling plane: maximum 3 mm in 3000 mm.
- .3 Adjacent board faces: flush within the tolerance of the machined profile.
- .4 Perimeter trim joints: tight and visually closed from normal viewing distance.
- .5 Visible end-joint openings are not permitted at time of acceptance.

3.9 CLEANING

- 3.9.1 Remove dust, fingerprints, adhesive, and construction residue using methods recommended by the finish manufacturer.
- 3.9.2 Do not use abrasive cleaners, strong solvents, or excessive water.
- 3.9.3 Leave completed ceiling clean and uniform in appearance.

3.10 PROTECTION

3.10.1 Protect completed ceiling from:

- .1 Impact.
- .2 Moisture.
- .3 Dust.
- .4 Paint overspray.
- .5 Damage from subsequent trades.

- 3.10.2 Maintain environmental conditions specified in Article 1.9 until Substantial Performance.
- 3.10.3 Replace damaged boards and trim before Substantial Performance.
- 3.10.4 Do not use the completed wood ceiling to support temporary wiring, protection, signage, scaffolding, or construction equipment.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Work of this Section includes:

- .1 interior painting,
- .2 surface preparation,
- .3 priming,
- .4 field finishing,
- .5 exposed primed mechanical and electrical items where specified,
- .6 touch-up painting,
- .7 sealing and coating of exposed substrates.

1.1.2 Work includes painting of:

- .1 gypsum board walls and ceilings,
- .2 exposed wood trim and wood doors where scheduled,
- .3 hollow metal doors and frames,
- .4 exposed ferrous metals,
- .5 exposed mechanical and electrical items not factory-finished,
- .6 exposed piping and conduit in finished areas.

1.1.3 Work does not include:

- .1 factory-finished items,
- .2 prefinished metal roofing,
- .3 prefinished cladding,
- .4 anodized aluminum,
- .5 storefront framing,
- .6 finished flooring,
- .7 concealed surfaces unless specifically indicated.

1.2 REFERENCES

1.2.1 Latest editions of:

- .1 Ontario Building Code (OBC).
- .2 National Building Code of Canada (NBC).
- .3 MPI – Master Painters Institute Architectural Painting Specification Manual.
- .4 MPI Approved Products List.
- .5 CGSB 1-GP-71 – Method for Sampling and Testing Paints and Pigments.
- .6 ASTM D3359 – Measuring Adhesion by Tape Test.
- .7 ASTM D4258 – Surface Cleaning Concrete for Coating.
- .8 ASTM D4259 – Abrading Concrete.
- .9 SSPC-SP standards for metal preparation.
- .10 CAN/CGSB-1.181 – Ready-Mixed Organic Zinc-Rich Coating.

1.3 DESCRIPTION OF WORK

1.3.1 Provide complete painting systems including:

- .1 preparation,
- .2 priming,
- .3 caulking associated with painting,
- .4 intermediate coats,
- .5 finish coats,
- .6 touch-up and repair.

1.3.2 Provide paint systems suitable for:

- .1 occupancy type,
- .2 substrate conditions,
- .3 moisture exposure,
- .4 cleanability requirements,
- .5 expected traffic and wear.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 General

- .1 Paint systems shall:

- .1 provide uniform appearance,
- .2 resist premature failure,
- .3 resist moisture damage in washrooms,
- .4 permit cleaning and maintenance,
- .5 maintain adhesion under anticipated environmental conditions.

1.4.2 Indoor Air Quality

- .1 Interior coatings:
 - .1 low VOC,
 - .2 compliant with applicable federal and provincial regulations.
- .2 Maximum VOC content:
 - .1 in accordance with MPI Green Performance standards.

1.4.3 Washroom and High-Humidity Areas

- .1 Provide mildew-resistant coating systems in:
 - .1 washrooms,
 - .2 universal washrooms,
 - .3 barrier-free washrooms,
 - .4 janitorial/utility areas.

1.4.4 Accessibility

- .1 Maintain visual contrast requirements for:
 - .1 barrier-free spaces,
 - .2 door frames,
 - .3 signage backgrounds where applicable,
 - .4 in accordance with OBC and AODA requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

1.5.1 Product Data

- .1 Submit:
 - .1 manufacturer's product data,
 - .2 MPI listings,
 - .3 VOC content information,
 - .4 application instructions,
 - .5 maintenance recommendations.

1.5.2 Samples

- .1 Submit:
 - .1 colour samples,
 - .2 sheen samples,
 - .3 drawdown samples on actual substrates.

.2 Provide:

.1 minimum 200 mm x 200 mm samples.

1.5.3 Closeout Submittals

.1 Submit:

- .1 maintenance data,
- .2 touch-up materials list,
- .3 final colour schedule.

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

.1 Painting Contractor:

- .1 minimum 5 years documented experience,
- .2 experienced in institutional and commercial work.

1.6.2 Mock-Ups

.1 Prepare sample areas for review:

- .1 one wall finish,
- .2 one ceiling finish,
- .3 one door and frame finish.

.2 Accepted mock-ups:

- .1 standard for workmanship.

1.6.3 Standards

.1 Conform to:

- .1 MPI requirements,
- .2 manufacturer instructions,
- .3 referenced standards.

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Deliver products in:

- .1 sealed containers,
- .2 clearly identified with manufacturer labels.

1.7.2 Store materials:

- .1 protected from freezing,

- .2 in ventilated dry areas,
- .3 at temperatures recommended by manufacturer.

1.8 SITE CONDITIONS

1.8.1 Do not apply finishes when:

- .1 ambient temperature below 10°C,
- .2 relative humidity outside manufacturer recommendations,
- .3 substrate moisture exceeds manufacturer limits.

1.8.2 Maintain ventilation during and after application.

1.9 EXTRA MATERIALS

1.9.1 Provide:

- .1 5 L of each paint colour and sheen type, minimum.

1.9.2 Package and label for Owner.

2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Acceptable manufacturers:

- .1 Benjamin Moore,
- .2 Sherwin-Williams,
- .3 Dulux,
- .4 Cloverdale,
- .5 approved equivalent meeting MPI standards.

2.2 MATERIALS

2.2.1 General

- .1 Paint materials:
 - .1 MPI approved,
 - .2 compatible with substrates,
 - .3 from single manufacturer for each system.

2.2.2 Primers

- .1 Provide primers specifically suited to:

- .1 gypsum board,
- .2 wood,
- .3 galvanized steel,
- .4 ferrous metal,
- .5 previously primed surfaces.

2.2.3 Interior Latex Finishes

- .1 Acrylic latex:
 - .1 washable,
 - .2 low VOC,
 - .3 scrubbable finish.

2.2.4 Metal Primers

- .1 Ferrous metal primer:
 - .1 rust-inhibitive alkyd or epoxy.
- .2 Galvanized metal primer:
 - .1 acrylic bonding primer.

2.3 ACCESSORIES

2.3.1 Fillers and Compounds

- .1 Non-shrinking fillers compatible with substrate.

2.3.2 Caulking

- .1 Paintable acrylic latex sealant:
 - .1 interior applications.

2.3.3 Abrasives

- .1 Sandpaper and abrasives:
 - .1 suitable for substrate and finish.

2.4 PAINT SYSTEMS

2.4.1 Interior Gypsum Board Walls; (MPI #52)

- .1 Substrate:
 - .1 gypsum board walls.
- .2 System:
 - .1 prime coat,
 - .2 two finish coats.

- .3 Finish:
 - .1 eggshell acrylic latex.

- .4 Locations:
 - .1 offices,
 - .2 corridors,
 - .3 multipurpose rooms,
 - .4 flex spaces,
 - .5 vestibules.

2.4.2 Interior Gypsum Board Ceilings; (MPI #53)

- .1 Substrate:
 - .1 gypsum board ceilings.
- .2 System:
 - .1 drywall primer,
 - .2 two finish coats.
- .3 Finish:
 - .1 flat acrylic latex.
- .4 Locations:
 - .1 all GWB ceilings.

2.4.3 Washroom Walls; (MPI #54)

- .1 Substrate:
 - .1 gypsum board walls in wet or humid spaces.
- .2 System:
 - .1 mildew-resistant primer,
 - .2 two finish coats.
- .3 Finish:
 - .1 satin acrylic latex.
- .4 Locations:
 - .1 washrooms,
 - .2 universal washroom,
 - .3 barrier-free washroom.

2.4.4 Hollow Metal Doors and Frames; (MPI #141)

- .1 Substrate:
 - .1 primed hollow metal doors and frames.
- .2 System:
 - .1 spot prime,
 - .2 two finish coats.
- .3 Finish:
 - .1 semi-gloss alkyd or waterborne enamel.

2.4.5 Wood Doors and Trim; (MPI #57)

- .1 Substrate:
 - .1 interior wood doors and exposed wood trim.
- .2 System:
 - .1 wood primer,
 - .2 filler,
 - .3 two finish coats.
- .3 Finish:
 - .1 Two coats of Clear coat.

2.4.6 Exposed Mechanical and Electrical Items; (MPI #141)

- .1 Substrate:
 - .1 exposed conduit,
 - .2 exposed piping,
 - .3 exposed duct accessories,
 - .4 exposed junction boxes.
- .2 System:
 - .1 primer as required,
 - .2 two finish coats.
- .3 Finish:
 - .1 semi-gloss acrylic enamel.
- .4 Colour:
 - .1 match adjacent surfaces unless otherwise directed.

2.4.7 Utility and Service Areas; (MPI #54)

- .1 Substrate:

- .1 exposed gypsum board and miscellaneous surfaces in utility/service rooms.
- .2 System:
 - .1 prime coat,
 - .2 two finish coats.
- .3 Finish:
 - .1 washable semi-gloss acrylic latex.
- .4 Locations:
 - .1 utility room,
 - .2 IT room,
 - .3 storage room.

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Verify:
 - .1 substrates are acceptable,
 - .2 surfaces are dry,
 - .3 gypsum board finishing is complete,
 - .4 environmental conditions are suitable.
- 3.1.2 Do not commence painting until deficiencies corrected.

3.2 PREPARATION

- 3.2.1 General
 - .1 Protect:
 - .1 adjacent finishes,
 - .2 equipment,
 - .3 glazing,
 - .4 flooring,
 - .5 mechanical/electrical devices.
- 3.2.2 Surface Preparation
 - .1 Clean surfaces free of:
 - .1 dust,
 - .2 grease,
 - .3 laitance,
 - .4 loose materials,
 - .5 contaminants.

.2 Sand and feather irregularities.

.3 Fill:

- .1 holes,
- .2 joints,
- .3 cracks,
- .4 imperfections.

3.2.3 Gypsum Board

- .1 Confirm gypsum board finish ready for painting.
- .2 Remove surface dust prior to priming.

3.2.4 Metal Surfaces

- .1 Remove rust, scale, oil and contaminants.
- .2 Spot-prime damaged shop primer.

3.2.5 Wood Surfaces

- .1 Sand smooth.
- .2 Fill nail holes and imperfections.

3.3 APPLICATION

3.3.1 General

- .1 Apply materials in accordance with:
 - .1 MPI standards,
 - .2 manufacturer instructions.
- .2 Apply each coat uniformly.
- .3 Do not thin materials beyond manufacturer recommendations.

3.3.2 Finish Quality

- .1 Provide:
 - .1 uniform colour,
 - .2 uniform sheen,
 - .3 smooth finish,
 - .4 no visible lap marks,
 - .5 no runs or sags.

3.3.3 Number of Coats

- .1 Minimum coats specified are mandatory.

- .2 Additional coats required where:
 - .1 substrate show-through occurs,
 - .2 finish is non-uniform,
 - .3 coverage insufficient.

3.3.4 Mechanical and Electrical Coordination

- .1 Coordinate painting with:
 - .1 access panels,
 - .2 fire alarm devices,
 - .3 emergency devices,
 - .4 barrier-free door operators,
 - .5 grilles and diffusers.
- .2 Do not paint:
 - .1 identification labels,
 - .2 fire ratings,
 - .3 equipment nameplates,
 - .4 operating instructions.

3.3.5 Fire-Rated Assemblies

- .1 Maintain integrity of fire-rated assemblies.
- .2 Do not obscure:
 - .1 fire labels,
 - .2 rated assembly markings, required by OBC and ULC assemblies.

3.4 FIELD QUALITY CONTROL

3.4.1 Consultant may inspect:

- .1 surface preparation,
- .2 coating thickness,
- .3 finish appearance,
- .4 colour consistency.

3.4.2 Repair unacceptable work.

3.5 CLEANING

- .1 Remove:
 - .1 paint spills,
 - .2 splatter,
 - .3 masking materials,
 - .4 debris.

.2 Leave project clean and ready for occupancy.

3.6 PROTECTION

3.6.1 Protect completed work from:

- .1 damage,
- .2 abrasion,
- .3 moisture,
- .4 contamination.

3.7 PAINTING AND FINISHING SCHEDULE

Surface	Primer	Finish Coats	Finish / Sheen	Typical Location
Interior gypsum board walls	Acrylic drywall primer	2	MPI #52: Latex, Interior, Eggshell (Gloss Level 3)	Office, corridors, multipurpose rooms, vestibule
Gypsum board ceilings	Ceiling primer	2	MPI #53: Latex, Interior, Flat (Gloss Level 1)	All GWB ceilings
Washroom gypsum board walls	Mildew-resistant primer	2	MPI #54: Latex, Interior, Semi-Gloss (Gloss Level 5), mildew resistant	Washrooms and barrier-free washrooms
Hollow metal doors and frames	Rust-inhibitive primer	2	MPI #141: Waterborne, Interior, Semi-Gloss (Gloss Level 5)	HM doors and frames
Interior wood doors and trim	Wood primer	2	MPI #57: Clear Interior, Semi-Gloss (Gloss Level 5)	Wood doors and trim

Exposed mechanical / electrical items	Appropriate metal primer	2	MPI #141: Waterborne, Interior, Semi-Gloss (Gloss Level 5)	Exposed conduit, piping, boxes
Utility / service spaces	Acrylic primer	2	MPI #54: Latex, Interior, Semi-Gloss (Gloss Level 5)	Utility room, storage, IT room

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section includes:

- .1 Manually operated, top-supported, acoustical operable panel partition system.
- .2 Suspension track system and structural attachment hardware.
- .3 Panel seals, stacking system, carriers and operating accessories.
- .4 Manufacturer's standard operating hardware and closure panels.

1.2 RELATED REQUIREMENTS

- 1.2.1 Section 05 50 00 – Metal Fabrications: Structural supports and supplemental steel framing.
- 1.2.2 Section 06 10 00 – Rough Carpentry: Wood blocking and supports.
- 1.2.3 Section 09 21 16 – Gypsum Board Assemblies.
- 1.2.4 Section 09 91 00 – Painting.
- 1.2.5 Section 26 05 00 – Common Work Results for Electrical: Power for accessories where applicable.

1.3 REFERENCES

- 1.3.1 ASTM E90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss.
- 1.3.2 ASTM E413 – Classification for Rating Sound Insulation.
- 1.3.3 ASTM E557 – Standard Guide for Architectural Acoustics.
- 1.3.4 ASTM E336 – Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms.
- 1.3.5 CAN/ULC-S102 – Surface Burning Characteristics of Building Materials.
- 1.3.6 Ontario Building Code (OBC), latest edition.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Operable partition system shall:

- .1 Be top-supported and free of floor tracks.
- .2 Permit complete opening and stacking in location indicated.
- .3 Operate smoothly without binding or excessive operating force.

- .4 Accommodate building structural deflection without impairing operation.

1.4.2 Acoustical Performance:

- .1 Minimum laboratory tested STC rating: STC 45 when tested in accordance with ASTM E90 and ASTM E413.
- .2 Provide continuous perimeter acoustical seals.

1.4.3 Structural Performance:

- .1 Design track and support system to safely support imposed loads with maximum live-load deflection not exceeding L/360.
- .2 Provide independent structural support above partition; ceiling suspension systems shall not support partition loads.

1.4.4 Fire Performance:

- .1 Surface burning characteristics meeting CAN/ULC-S102.
- .2 Flame spread rating not greater than 25.
- .3 Smoke developed classification not greater than 450.

1.5 SUBMITTALS

1.5.1 Product data:

- .1 Manufacturer's specifications.
- .2 Operating descriptions.
- .3 Acoustical test reports.
- .4 Maintenance requirements.

1.5.2 Shop Drawings:

- .1 Partition layout.
- .2 Track configuration.
- .3 Stacking arrangement.
- .4 Structural support requirements.
- .5 Ceiling interface details.

1.5.3 Samples:

- .1 Minimum 300 x 300 mm finish sample.
- .2 Full range of finish colours available.

1.5.4 Closeout Submittals:

- .1 Operation and maintenance manuals.
- .2 Warranty documentation.

1.6 QUALITY ASSURANCE

1.6.1 Manufacturer:

- .1 Minimum 10 years experience manufacturing operable wall systems.

1.6.2 Installer:

- .1 Approved by partition manufacturer.
- .2 Minimum 5 years documented experience with similar installations.

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Deliver materials in manufacturer's original packaging.

1.7.2 Store in dry, secure location protected from moisture and damage.

1.8 WARRANTY

1.8.1 Provide written manufacturer's warranty for:

- .1 Operable wall system: 2 years minimum.
- .2 Suspension system and carriers: 2 years minimum.

2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Acceptable manufacturers:

- .1 Modernfold.
- .2 Hufcor.
- .3 Dormakaba / Skyfold (where manual operable system is provided).
- .4 Panelfold.
- .5 Approved equivalent.

2.2 OPERABLE PANEL PARTITION SYSTEM

2.2.1 Type:

- .1 Manually operated.

.2 Individual panel construction.

.3 Top-supported.

.4 No floor track.

2.2.2 Configuration:

.1 As indicated on drawings.

.2 Single-point stacking location unless noted otherwise.

2.2.3 Panel Thickness:

.1 Minimum 100 mm.

2.2.4 Panel Height:

2.2.5 Floor-to-structure height as indicated on drawings.

2.2.6 Field verified prior to fabrication.

2.2.7 Acoustical Rating:

.1 Minimum STC 45.

2.3 PANEL CONSTRUCTION

2.3.1 Internal frame:

.1 Roll-formed steel or aluminum frame.

2.3.2 Core:

.1 Acoustical composite core engineered to achieve specified STC rating.

2.3.3 Faces:

.1 Impact-resistant hardboard, MDF, steel-faced composite or manufacturer's standard acoustical facing.

2.3.4 Vertical panel edges:

.1 Tongue-and-groove profile.

.2 Interlocking acoustical seals.

2.4 TRACK SYSTEM

2.4.1 Extruded aluminum track.

2.4.2 Heavy-duty trolley and carrier assemblies.

2.4.3 Track configuration:

- .1 Straight.
- .2 Curved where required for stacking arrangement.

2.4.4 Finish:

- .1 Clear anodized or manufacturer's standard finish.

2.5 SEALS

2.5.1 Retractable top and bottom seals:

- .1 Mechanical operation.
- .2 Operated by removable crank handle or manufacturer's standard mechanism.

2.5.2 Vertical seals:

- .1 Continuous acoustical gasket system.

2.6 CLOSURE PANEL

2.6.1 Provide manufacturer's standard hinged closure panel.

2.6.2 Locking:

- .1 Key-operated locking mechanism.
- .2 Secure partition in closed position.

2.7 FINISHES

2.7.1 Exposed panel finish:

- .1 Factory-applied high-pressure laminate.

2.7.2 Colour and pattern:

- .1 Selected by Consultant from manufacturer's full range.

2.7.3 Exposed trim:

- .1 Anodized aluminum.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify structural support framing is installed and capable of supporting imposed loads.

3.1.2 Verify dimensions and clearances before commencing installation.

- 3.1.3 Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- 3.2.1 Install in accordance with manufacturer's written instructions.
- 3.2.2 Install track system plumb, level and aligned.
- 3.2.3 Secure supports to structural framing only.
- 3.2.4 Maintain clearances required for smooth operation.
- 3.2.5 Coordinate installation with ceiling systems, lighting, HVAC and fire protection systems.

3.3 FIELD QUALITY CONTROL

- 3.3.1 Demonstrate complete operation of partition.
- 3.3.2 Verify:
- .1 Panels align properly.
 - .2 Seals fully engage.
 - .3 Locking mechanisms function correctly.
 - .4 No binding occurs during operation.

3.4 ADJUSTING

- 3.4.1 Adjust operating hardware and seals for smooth operation.
- 3.4.2 Replace damaged components.

3.5 CLEANING

- 3.5.1 Remove protective coverings.
- 3.5.2 Clean exposed surfaces in accordance with manufacturer's recommendations.

3.6 DEMONSTRATION

- 3.6.1 Instruct Owner's representatives in:
- .1 Operation.
 - .2 Locking procedures.
 - .3 Maintenance requirements.
 - .4 Recommended inspection intervals.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the general requirements for the design, supply, complete installation, verification, and testing of the fire suppression system.
- 1.1.2 All sections under division 21 shall be read as part of this section.
- 1.1.3 Provide all labour, materials, equipment, services, and accessories required to complete the work specified and to ensure complete and operational systems.
- 1.1.4 The systems shall be installed as per all codes and requirements.

1.2 Reference Standards

- 1.2.1 Ontario Building Code, current version
- 1.2.2 Ontario Fire Code, current version
- 1.2.3 Underwriters Laboratories of Canada standards
- 1.2.4 National Fire Protection Association standards

1.3 Coordination

- 1.3.1 This Contractor shall coordinate with other trades prior to the installation of work covered under this contract.
- 1.3.2 Additional material, cutting and patching required resulting from lack of coordination are the responsibility of this Contractor with no additional cost to the Owner.

1.4 Design

- 1.4.1 Submit complete shop drawings to Consultant for review and to City for building permit.

1.5 Submittals

- 1.5.1 Shop Drawings:
 - .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
 - .3 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
 - .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

- .5 Submit completed Material and Test Certificates, signed and dated by the Contractor's representative and witness, at the completion of the project to the Consultant.

1.5.2 Closeout Submittals

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Include the following into the maintenance manuals:
 - .1 Sign-off letter from System Design Engineer;
 - .2 Material and Test Certificates;
 - .3 All stamped reviewed shop drawings;
 - .4 Operating and Maintenance Instructions;
 - .5 Warranty Letter.

2 Products

2.1 General

- 2.1.1 This Contractor shall provide all labour and materials for a complete installation of all fire extinguishers.

3 Execution

3.1 General Installation

- 3.1.1 Provide signage as required by Fire Department and authorities having jurisdiction.

3.2 Tags, Nameplates, and Data Plates

- 3.2.1 Mount tags and nameplates securely to ensure permanent installation.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of fire extinguishers and fire extinguisher cabinets.

1.2 Reference Standards

- 1.2.1 N.F.P.A. 10, Standard for Portable Fire Extinguishers

1.3 Submittals

1.3.1 Shop Drawings:

- .1 Submit fire extinguishers and fire extinguisher cabinets drawings.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.3.2 Closeout Submittals:

- .1 Provide operation and maintenance literature indicating manufacturer and model, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

2 Products

2.1 General

- 2.1.1 This Contractor shall provide all fire extinguishers and fire extinguisher cabinets.

2.2 Fire Extinguishers (with cabinets)

- 2.2.1 Cabinets and extinguishers shall be U.L.C. listed, F.M. approved, and conform to N.F.P.A. 10.
- 2.2.2 Fire extinguisher cabinets shall be recessed National Fire Equipment Limited with glass front.
- 2.2.3 Fire Extinguishers:
- .1 Fire extinguishers shall be U.L.C. listed and approved by local authorities.

- .2 Fire extinguishers shall be multi-purpose, dry chemical, U.L. listed for Class A, B, and C fires.
- .3 Fire extinguishers shall have heavy duty cylinder with glossy red, corrosion resistant finish.
- .4 Allow for type K extinguisher in kitchen.
- .5 2.25 kilogram (5 pound) fire extinguishers shall be equal to National Fire Equipment ABC-050WWD, with a U.L.C. rating of 3A.10B.C.
- .6 4.5 kilogram (10 pound) fire extinguishers shall be equal to National Fire Equipment ABC-100WWD, with a U.L.C. rating of 6A.80B.C.
- .7 Standard of Acceptance:
 - .1 National Fire Equipment Limited,
 - .2 Flag, Wilson,
 - .3 Cousins.

2.2.4 Cabinets:

- .1 Cabinets shall be white with baked enamel finish.
- .2 For 2.25 kilogram (5 pound) fire extinguishers: Equal to National Fire Equipment Model 102F, 8 by 17 by 5 inches (203 by 432 by 127 millimetres), fully recessed, with 22 gauge steel tub, 16 gauge steel door and trim with ¼ inch (6 millimetre) return frame, full-length semi-concealed piano hinge, flush stainless steel door latch, baked enamel paint, and glazed with 3/16 inch (5 millimetre) clear glass, 4 by 13 inches (101 by 330 millimetres).
- .3 For 4.5 kilogram (10 pound) fire extinguishers (fully recessed in 6 inch walls): Equal to National Fire Equipment Model C950-3, tub size 9 by 24 by 6 inches (229 by 610 by 152 millimetres), fully recessed, 22 gauge steel tub, 16 gauge steel door and trim with ¼ inch (6 millimetre) return frame, full length semi-concealed piano hinge, flush stainless steel door latch, baked enamel paint, glazed with 3/16 inch (5 millimetre) clear glass, 5 by 20 inches (127 by 508 millimetres).

3 Execution

3.1 Fire Extinguishers (with or without cabinets)

- 3.1.1 Install fire extinguishers where indicated on drawings, as per N.F.P.A. 10 requirements, and local Fire Prevention standards. Confirm acceptance of all fire extinguisher locations with local Fire Prevention prior to installation.
- 3.1.2 Fire extinguishers shall be mounted in a location easily accessible by occupants and fire department as indicated on the drawings.
- 3.1.3 Confirm exact locations and mounting type with General Contractor. General Contractor to prepare wall for recessed or semi-recessed mounting where applicable.

- 3.1.4 Allow for the supply and installation of up to two (2) extra fire extinguishers, based on final requests of local Fire Prevention officer.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This Section covers general requirements for the supply and installation, and testing of plumbing systems and associated equipment as indicated in Contract Documents.
- 1.1.2 Refer to other Divisions and Specification Sections as necessary to ensure a complete and operational system is provided.
- 1.1.3 Provide plumbing components and accessories which may not be specifically shown on the Drawings or stipulated in the Specifications but are required to ensure complete and operational systems.
- 1.1.4 Mention in the Specifications or indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.
- 1.1.5 The installation shall be complete with all accessories required for a complete and operational installation.
- 1.1.6 The Specifications are an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
- 1.1.7 Contractor shall be responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective material, equipment and part of equipment and repair related damages.

1.2 General Requirements

- 1.2.1 The requirements of this section shall apply to all sections in Division 22.
- 1.2.2 All material, labour, equipment, and services required under this section shall be the full responsibility of the Mechanical Contractor including any material, labour, equipment, and services provided by their subcontractors.
- 1.2.3 Provide materials, equipment and labour to install plumbing as required by Provincial and local codes as specified herein.
- 1.2.4 All material, labour, equipment, and services required under this section shall be the full responsibility of the Mechanical Contractor including any material, labour, equipment, and services provided by their subcontractors.
- 1.2.5 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.3 Definitions

- 1.3.1 "Supply" shall mean supply only.
- 1.3.2 "Install" shall mean install and connect.

- 1.3.3 "Provide" shall mean supply, install, and connect.
- 1.3.4 "Drawings and Specifications" shall mean Contract Documents.
- 1.3.5 "Authorities" or "Authorities having jurisdiction" shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.
- 1.3.6 "Work" shall mean all equipment, materials, labour, and permits to provide a complete and operational plumbing system as detailed in the drawings and specifications.
- 1.3.7 "Owner" or GRCA shall mean Ganaraska Region Conservation Authority.

1.4 Related Sections

- 1.4.1 Division 01 - General
- 1.4.2 Division 23 - HVAC
- 1.4.3 Division 26 - Electrical
- 1.4.4 Division 22 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions.

1.5 Reference Standards

- 1.5.1 The plumbing system shall comply with the latest editions and revisions of applicable codes, bylaws, standards, and regulations including but not limited to:
 - .1 Ontario Building Code
 - .2 ASHRAE
 - .3 Canadian Standards Association
 - .4 Local Building Bylaws
 - .5 Ontario Occupational Health and Safety Act
- 1.5.2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.
- 1.5.3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.
- 1.5.4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

1.6 Intent

- 1.6.1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.
- 1.6.2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.
- 1.6.3 Supply all labour, equipment, and materials necessary to install a complete and operational plumbing system described herein and shown on the drawings.
- 1.6.4 It is the intent of these drawings and specifications to provide for a plumbing installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.
- 1.6.5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.
- 1.6.6 All work must be done by qualified, certified and experienced persons in such line of work. Trade certificates must be available on demand.
- 1.6.7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.
- 1.6.8 This Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.
- 1.6.9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation, and finish.

1.7 Permits and Fees

- 1.7.1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes.
- 1.7.2 Coordinate all required inspections and give necessary notice to all authorities.
- 1.7.3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction for all applicable disciplines.

1.8 Contract Breakdown

- 1.8.1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.
- 1.8.2 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.

1.9 Shop Drawings

- 1.9.1 Within 30 days of award, the Contractor shall submit shop drawings of all equipment for the project.
- 1.9.2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in P.D.F. format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5 by 11 inches. 11 by 17 inches will be acceptable where appropriate for content and scale.
- 1.9.3 Submittals shall contain but not be limited to:
- .1 Construction information
 - .2 Product data
 - .3 Performance data including performance curves
 - .4 Acoustical sound power data
 - .5 Dimensional layout and clearances
 - .6 Mounting arrangements
 - .7 Certification of compliance to applicable codes
 - .8 Operating and Maintenance information
 - .9 Wiring, single line and schematic diagrams (where applicable)
- 1.9.4 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable material. Note on the submittal specified features such as special tank linings, pump seals, materials or painting.
- 1.9.5 Prior to submission to the Consultant, the General and Plumbing Contractors shall review all shop drawings. By this review the Contractor represents that they have determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that they have checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents.
- 1.9.6 The Contractor's review of each shop drawing shall be indicated by his approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Plumbing Contractor.
- 1.9.7 Review comments from the Consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval within 1 week.

1.9.8 Review of the shop drawings by the Consultant does not relieve the Contractor or his Supplier of the responsibility to provide the correct and complete equipment, material or installation.

1.9.9 Keep 1 complete set of shop drawings at the job site during construction.

1.9.10 Include stamped reviewed shop drawings in the Maintenance Manuals.

1.10 Product Delivery Schedule

1.10.1 Within two weeks from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.

1.11 Construction Meetings

1.11.1 The Plumbing Contractor shall attend all site meetings unless otherwise pre-approved.

1.11.2 Sub-trades shall attend site meetings as requested or as required.

1.12 Job Condition

1.12.1 Visit site and examine existing conditions which may affect work of this Division.

1.12.2 Examine all Contract Documents to ensure that work of this Division may be satisfactorily completed.

1.12.3 Notify Consultant upon discovery of conditions which adversely affect work of this division. No allowance will be made after letting of contract for any expenses incurred through failure to do so.

1.12.4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications unless exceptions are specifically noted in the Bid.

1.13 Warranty

1.13.1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.

1.13.2 Make submissions necessary to register product warranties to the benefit of the Owner.

1.13.3 Submit to Consultant, prior to Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one (1) year or offering greater benefits than required in specifications and in the Owner's name.

1.14 As-Built Drawings

1.14.1 Maintain accurate, neat, and clean as-built drawings on an on-going basis during construction to be reviewed periodically by the Consultant during construction.

1.14.2 As-Built drawing mark-ups shall be made available at every site meeting or inspection.

1.14.3 As-Built drawings shall include but not be limited to final location of any access doors on same for future service requirements.

- 1.14.4 Upon completion of the work, submit to the Consultant for review, 1 complete set of clear, legible, certified as-built drawings.

1.15 Reports

- 1.15.1 Provide the following reports upon completion of work by certified Contractors for review and approval by the Consultant:

- .1 Equipment Start-Up Reports
- .2 Piping Pressure Test Reports
- .3 Backflow Preventer and Cross Connection Test Reports
- .4 Water quality Test Reports.
- .5 Other equipment startup reports and test sheets
- .6 Demonstration Reports/Logs

- 1.15.2 All reports shall be dated and signed by the Technician who performed the start-up or the tests.

1.16 Operation and Maintenance Manuals

- 1.16.1 Provide the Owner with 2 indexed, hard cover maintenance manuals plus 1 electronic copy on labeled USB. Manuals shall contain and be tabbed in the following order:

- .1 Table of Contents
- .2 Contractor's, Manufacturer's and Supplier's Contact Information
- .3 Warranty Letter
- .4 Valve schedule
- .5 Colour coding charts for access areas
- .6 Reports as specified herein and as applicable
- .7 Shop drawings (stamped reviewed by Consultant)
- .8 Equipment maintenance instructions and manuals
- .9 As-Built drawings

- 1.16.2 Submit 1 complete copy to the Consultant for review and approval. Revise based on any comments and resubmit all copies and electronic copy to Consultant.

1.17 Testing and Startup

- 1.17.1 Refer to Section 22 05 93 under this Division.
- 1.17.2 Test and startup all equipment and work.
- 1.17.3 Fully coordinate all testing and startups with all trades, the Consultant, and authorities having jurisdiction.
- 1.17.4 The Controls Contractor shall be present during all equipment start-ups. Coordinate scheduling with Controls Contractor.
- 1.17.5 Provide adequate notice to all parties.

1.18 Demonstration

- 1.18.1 Demonstrate to the Owner on proper operation of the system.
 - 1.18.2 The Contractor shall arrange for all necessary personnel and equipment specialists to be in attendance for purposes of demonstration.
 - 1.18.3 Provide instruction by a manufacturer's representatives as required to fully demonstrate the systems.
 - 1.18.4 The Contractor shall arrange and coordinate all demonstration for all equipment including any Owner supplied equipment. Coordination for Owner supplied equipment shall include arrangement with supplier start-up technicians.
 - 1.18.5 Demonstration shall include but not be limited to:
 - .1 Demonstration in the normal, abnormal and emergency operation of all systems provided under this Division.
 - .2 Review of all necessary maintenance procedures, including winterization, of all systems provided under this Division.
 - .3 Provision of a documented maintenance program covering all systems provided or modified under this contract.
 - .4 Review of all close-out documentation including complete maintenance manuals and As-Built drawings.
 - 1.18.6 Prepare a Demonstration Agenda and Log for signature by all Participants. Submit to Consultant and include in Manuals.
 - 1.18.7 Complete and accepted maintenance manuals and As-Built drawings shall be submitted and available for use during the Demonstration.
- 1.19 Substantial Completion and Performance**
- 1.19.1 Substantial completion and performance shall be determined and awarded by the Consultant.

- 1.19.2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:

- .1 Fire Stopping
- .2 System Testing and Startups including report
- .3 Maintenance Manuals
- .4 As-Built Drawings
- .5 Demonstration

1.20 Warranty

- 1.20.1 Provide a one-year full parts and labour warranty for the new system from date of substantial completion.
- 1.20.2 Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

2 Products

2.1 Materials

- 2.1.1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.
- 2.1.2 Major equipment shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.
- 2.1.3 The same manufacturer shall be used for types of equipment used in similar applications.
- 2.1.4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.
- 2.1.5 Materials shall be stored in original containers.
- 2.1.6 Submit current Material Safety Data Sheets to the Consultant and the Owner for any products being used on the job site where they exist.
- 2.1.7 Remove and dispose of all redundant materials and garbage from site.
- 2.1.8 Supply anchor bolts and templates for installation by other Divisions.

2.2 Selected Products and Equivalents

- 2.2.1 Sections within Division 22 list the Acceptable Manufacturers that must meet characteristics of the specified equipment and products for each section.

- 2.2.2 Base specified products are specified or shown on the drawings, and identified by manufacturer's name, type, and catalogue number.
- 2.2.3 Any acceptable manufacturers from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions (for example, electrical changes).
- 2.2.4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.
- 2.2.5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 Quality of Product

- 2.3.1 All products provided shall be listed or approved by relevant authorities.
- 2.3.2 All products shall be new, unless otherwise specified.
- 2.3.3 If products specified are not listed or approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- 2.3.4 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.4 Product Finishes

- 2.4.1 Shop drawings shall indicate finishes. Use standard finish unless otherwise specified.
- 2.4.2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

2.5 Access Doors

- 2.5.1 Provide access doors or panels, as required, for access, adjustment, operation, service, and maintenance.
- 2.5.2 Minimum size of panels shall be 18 inches by 18 inches (450 millimetres by 450 millimetres) at ceiling and 12 inches by 12 inches (300 millimetres by 300 millimetres) at wall. Wherever possible, 24 inches by 24 inches (600 millimetres by 600 millimetres) panels shall be used.
- 2.5.3 Access doors and panels shall have concealed hinges and screwdriver locking device.
- 2.5.4 Where access doors and panels are installed in fire rated surfaces, they shall have a fire resistance rating to match.
- 2.5.5 Standard of Acceptance:

- .1 Acudor,
- .2 Zurn,
- .3 Nailor Industries,
- .4 Le Hage,

2.5.6 Base specification:

- .1 Access doors and covers, flush installation, drywall area
 - .1 Acudor, model D.W. 5040 Series, flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.
- .2 Access doors and covers, flush installation, universal
 - .1 Acudor, model U.F. 5000 Universal Access Doors, 14 gauge. 1.7 millimetre steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.

2.6 Guards

2.6.1 Provide guards for unprotected drives.

2.6.2 Guards for belt drives:

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 millimetre (18 gauge) thick sheet metal tops and bottoms.
- .3 40 millimetre (1.5 inch) diameter holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

2.6.3 Provide means to permit lubrication and use of test instruments with guards in place.

2.6.4 Install belt guards to allow movement of motors for adjusting belt tension.

2.6.5 Guard for flexible coupling:

- .1 U-shaped, minimum 106 millimetre (16 gauge) thick galvanized mild steel.
- .2 Securely fasten in place.
- .3 Removable for servicing.

2.7 Equipment Supports

- 2.7.1 Refer to Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment.
- 2.7.2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of Structural Steel Section. Submit structural calculations with shop drawings.
- 2.7.3 Install base mounted equipment on chamfered edge housekeeping pads, minimum of 100 millimetre (4 inches) high and 150 millimetre (6 inches) larger than equipment dimensions all around.

2.8 Sleeves

- 2.8.1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
- 2.8.2 Schedule 40 steel pipe.
- 2.8.3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
 - .3 Through fire rated walls and floors.
- 2.8.4 Sizes: minimum 6 millimetre ($\frac{1}{4}$ inch) clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.
- 2.8.5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 millimetres (1 inch) above other floors.
- 2.8.6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
 - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to standard CAN C.G.S.B. 1.181-99.
- 2.8.7 Provide minimum 20-gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25-millimetre clearance all around or to the requirements of the authority having jurisdiction. Seal at all as indicated.

2.9 Fire Stopping

- 2.9.1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.
- 2.9.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation or fire rating.
- 2.9.3 Do not use cementitious or rigid seals around penetrations for pipe, ductwork, or other plumbing items.
- 2.9.4 Insulated pipes and ducts; ensure integrity of insulation and vapour barrier at fire separation.
- 2.9.5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- 2.9.6 Comply with the requirements of standard CAN U.L.C. S115, and do not exceed opening sized for which they have been tested.
- 2.9.7 Systems to have an F or F.T. rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide fire wrap blanket around services penetrating fire walls. Extent of blanket must correspond to U.L.C. recommendations.
- 2.9.8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- 2.9.9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- 2.9.10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
- 2.9.11 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.
- 2.9.12 Install material and components in accordance with U.L.C. certification, manufacturer's instructions and local authority.
- 2.9.13 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.
- 2.9.14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
- 2.9.15 Standards of Acceptance:
 - .1 Fryesleeve Industries,
 - .2 General Electric Pensil Firestop Systems,

- .3 International Protective Coatings,
- .4 Rectorseal Corporation (Metacaulk),
- .5 Proset Systems,
- .6 3M,
- .7 A.D. Systems,
- .8 Hilti.

2.9.16 Ensure firestop manufacturer representative performs on-site inspections and certifies installation. Submit inspection reports and certification at time of substantial completion.

2.10 Escutcheons

- 2.10.1 On pipes and ductwork passing through walls, partitions, floors and ceilings in finished areas.
- 2.10.2 Chrome or nickel-plated brass, or Type 302 stainless steel, one piece type with set screws.
- 2.10.3 Outside diameter to cover opening or sleeve.
- 2.10.4 Inside diameter to fit around finished pipe.

2.11 Spare Parts

- 2.11.1 Provide spare parts as specified under this Division.
- 2.11.2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

2.12 Special Tools

- 2.12.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

3 Execution

3.1 General

- 3.1.1 Apply for permit before beginning any work. Have drawings approved for construction by authorities having jurisdiction or local agencies prior to beginning work.
- 3.1.2 Have the entire installation inspected, at various stages where required, to ensure approval at completion of project.

3.2 Site examination

- 3.2.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.
- 3.2.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.
- 3.2.3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.3 Interference and Coordination Drawings

- 3.3.1 Examine the drawings and all divisions of the specifications.
- 3.3.2 Prepare interference and equipment layout drawings to ensure all components will be properly accommodated within the spaces provided.
- 3.3.3 Lay out the work and equipment with due regard to architectural, structural and electrical features, and service requirements.
- 3.3.4 Submit interference drawings to the Consultant.
- 3.3.5 Before commencing any work, obtain a ruling from the Consultant if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

3.4 Separation of Services

- 3.4.1 Contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- 3.4.2 All pipes, ductwork and wiring shall be supported from permanent building structure. Use of other services for support is not permitted.

3.5 Workplace Safety

- 3.5.1 The workplace must be kept safe at all times.
- 3.5.2 Conform to all ministries of labour, and health and safety regulations at all times.
- 3.5.3 Use ladders and proper techniques as approved by the Ministry of Labour to perform all work.
- 3.5.4 Cover all holes and openings, and provide barriers around hazards, etc. to ensure occupants and workers are not at risk.
- 3.5.5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner's representative or Consultant or rectify the situation immediately.
- 3.5.6 Report any hazards or concerns to the Owner's representative immediately.
- 3.5.7 Conform to Owner's safety requirements and construction regulations.

3.6 Temporary Requirements

- 3.6.1 All temporary requirements to complete plumbing work during construction shall be the responsibility of the Plumbing Contractor except temporary power or water.

3.7 Location of Equipment

- 3.7.1 Approximate distances and dimensions may be obtained by scaling off the drawings. Figured dimensions shall govern over scaled dimensions.
- 3.7.2 Equipment locations shown on the drawings are approximate. Locations may be revised to suit construction and equipment arrangements provided design intent is not jeopardized and there is no additional cost to the Owner.

3.8 Mounting Heights

- 3.8.1 Mounting height of equipment is from finished floor to equipment unless otherwise specified or indicated. Coordinate with block coursing if applicable.
- 3.8.2 Where mounting heights are not indicated on the drawings, obtain verification from the Consultant before proceeding.
- 3.8.3 Install plumbing equipment at the following heights unless otherwise indicated on the architectural drawings. Architectural drawings supersede heights noted below. Confirm all heights prior to installation. Where confirmation or coordination has not been done and changes are required, the Contractor shall cover all costs.
- .1 Wall hung lavatory: 787 millimetres (31 inches) to rim
 - .2 Barrier free wall hung lavatory: 840 millimetres (33 inches) max to top of rim, 737 millimetres (29 inches) to underside of rim front
 - .3 Urinals: 1 urinal installed at 432 millimetres (17 inches) to top of rim, others at 533 millimetres (21 inches) to top of rim. Coordinate with Architectural Drawings and General Contractor prior to installation.
 - .4 Washfountains: Conform to Manufacturer's installation requirements to meet A.O.D.A. requirements.

3.9 Excavating and Backfilling

- 3.9.1 Provide all excavating and backfilling inside and to 1.5 metres outside the building for plumbing pipes, drains and equipment. All backfilling shall be new clean granular A fill brought in specifically for the purpose of backfilling to the underside of floor slab. All backfilling shall be compacted at intervals not more than 150 millimetres (6 inches) layer to the satisfaction of the Consultant.
- 3.9.2 Provide excavating and backfilling outside the building with granular A fill brought in specifically for backfilling to a minimum of 450 millimetres (18 inches) over the pipe. Backfilling outside building over and above the 450 millimetres (18 inches) backfill as previously specified herein shall be by the Plumbing Contractor as specified under Division 2. Where backfilling outside the building is not specified under Division 2, the Plumbing Contractor shall provide new clean granular A fill to grade level.

- 3.9.3 Bottoms of trenches shall be excavated so that the pipe will be supported on a 150 millimetres (6 inches) compacted bed of clean granular A fill. Provide all necessary pumping to maintain excavation free of water.
- 3.9.4 Should water be encountered during excavation, the Plumbing Contractor shall provide all labour and material, including all equipment required for dewatering the excavation. After the water has been removed, this Contractor shall install a 300-millimetre (12 inches) base of compacted 50 millimetre (2 inches) clear stone covered with filter cloth before installing backfill as detailed and/or as specified.
- 3.9.5 Be responsible for all weather protection required to install piping and/or equipment to the satisfaction of the Consultant.
- 3.9.6 Be responsible for providing all clear stone or granular A material suitable for application to replace existing soil not suitable for backfilling above the 450 millimetres (18 inches) bedding material.
- 3.9.7 It is the responsibility of the Contractor to review the soils report. Additional work requested due to failure of soil conditions due to Contractor not reviewing report will not be entertained.

3.10 Repairs, Cutting and Restoration

- 3.10.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
- 3.10.2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- 3.10.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- 3.10.4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.11 Painting

- 3.11.1 Refer to other Divisions for Painting unless otherwise specified herein.
- 3.11.2 Apply at least 1 coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- 3.11.3 Prime and touch up marred finished paintwork to match original.
- 3.11.4 Restore to new condition, or replace equipment at discretion of Consultant, finishes which have been damaged too extensively to be merely primed, painted and touched up.

3.12 Concealment

- 3.12.1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls in finished areas.
- 3.12.2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit parallel to building lines, tight to roof deck and down columns.

3.13 Access Doors

- 3.13.1 Provide access doors as required for access, adjustment, operation, service, and maintenance.

3.14 Clearances and Accessibility

- 3.14.1 Install all work for easy access for adjustment, operation, service, and maintenance.
- 3.14.2 Maintain clearances for all equipment as per local codes and manufacturer's instructions.
- 3.14.3 Access panels shall be Acudor or equivalent with concealed hinges and screwdriver locking device.
- 3.14.4 Provide access panels of adequate size as required to access equipment and components in concealed areas. Do not install access doors in specialty walls or ceilings.
- 3.14.5 Provide fire rated access doors where installed in fire separations to match rating of separation.
- 3.14.6 Install all services in exposed areas so that a minimum head clearance of 2200 millimetres (88 inches) is maintained.

3.15 Equipment and System Protection

- 3.15.1 Protect equipment and materials from damage in storage and on site before, during, and after installation until final acceptance.
- 3.15.2 Protect equipment and system openings from dust and debris with appropriate covers that will withstand through the construction.
- 3.15.3 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant and the Owner at no expense to the Owner.

3.16 Supports

- 3.16.1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all equipment, ductwork, piping, and all other work in Division 22.
- 3.16.2 All supports must be securely mounted to structures.

3.17 Fire Stopping

3.17.1 Refer to Part 2 herein.

3.18 Cleaning

3.18.1 Clean interior and exterior of all systems including strainers.

3.18.2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

3.19 Identification and Labeling

3.19.1 All equipment, valves, panels and devices shall be labeled under this Division.

3.20 Demonstration

3.20.1 Refer to 1.15 herein.

3.21 Field Review and Deficiencies

3.21.1 The Contractor shall notify the Consultant when the job is ready for field review at various stages, including rough-in stages.

3.21.2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.

3.21.3 The Contractor shall correct all deficiencies within the work period prior to the next review.

3.21.4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.

3.21.5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of Plumbing Specialties and Accessories.

1.2 Related sections

- 1.2.1 Section 22 05 00 – Common Work Results for Plumbing.

1.3 Codes and Standards

- 1.3.1 Ontario Building Code
- 1.3.2 Comply with Provincial Government Regulations.

1.4 Submittals

- 1.4.1 Pressure vessels: Submit with shop drawings for tanks, specifications of tank lining and installation instructions.
- 1.4.2 Fixtures and Cleanouts: Dimensions and installation details
- 1.4.3 Floor drains: Accessories, dimensions and installation details

1.5 Inspections

- 1.5.1 Obtain inspection certificates for pressure vessels from Provincial Authorities as required.

2 Products

2.1 Cleanouts

- 2.1.1 Conform to C.S.A. B79, Commercial and Residential Drains and Cleanouts.
- 2.1.2 Acceptable Manufacturers: Watts, Zurn, Ancon, Smith

2.2 Domestic Expansion Tanks: Bladder Type

- 2.2.1 A.S.M.E. tank, constructed in accordance with Section 8 of the A.S.M.E. *Boiler and Pressure Vessel Code*.
- 2.2.2 Lead free for potable water service.
- 2.2.3 Operation temperature of 93 degrees Celsius (200 degrees Fahrenheit), working pressure of 10.5 bars (150 P.S.I.G.).
- 2.2.4 Pre-charged steel thermal expansion tank with a fixed heavy duty butyl bladder, polypropylene liner material, steel shell and red oxide primer finish.

2.2.5 The tank shall have an N.P.T. stainless steel system connection and a .301-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements.

2.2.6 Pre-charged to 55 P.S.I. (field adjustable)

2.2.7 Acceptable manufacturers: Amtrol, Expanflex, Watts, I.T.T.

2.3 Fixture trim

2.3.1 Provide trim for plumbing fixtures as per schedule.

2.3.2 Trim to be suitable for exposed piping application where applicable.

2.3.3 Acceptable Manufacturers: McGuire, Cambridge Brass, Delta, Zurn

2.4 Floor drains

2.4.1 Conform to C.S.A. B79, Commercial and Residential Drains and Cleanouts

2.5 Grease interceptors

2.5.1 Conform to C.S.A. B481.

2.6 Hose bibbs

2.6.1 Acceptable manufacturers: Watts, Zurn

2.7 Thermostatic Mixing Valves

2.7.1 Acceptable manufacturers: Lawler, Leonard, Symmons, Powers, RADA

2.8 Water Hammer Arresters

2.8.1 Engineered water hammer arresters shall be conform to A.S.S.E. 1010.

2.8.2 Acceptable manufacturers.

3 Execution

3.1 Installation

3.1.1 Install as per manufacturer's recommendations.

3.2 Pressure tanks

3.2.1 Construct pressure tanks to A.S.M.E. *Code for Unfired Pressure Vessels*.

3.3 Cleanouts

3.3.1 Ensure ample clearance at cleanout for rodding of drainage systems.

3.3.2 Provide cleanouts at the base of each stack.

- 3.3.3 Cleanouts shall be installed in horizontal lines at the end of main runs and branches; at 50 ft (15 metres) intervals in long runs of pipe 4 inches (100 millimetres) and smaller; at 100 ft (30 metres) intervals of pipe runs 4 inches (100 millimetres) and larger; as required by Ontario Building Code.

3.4 Domestic Expansion Tanks: Bladder Type

- 3.4.1 Confirm that the air charge is preset or adjusted and correct prior to requesting approval to open water valves.
- 3.4.2 Follow manufacturer's recommendations for tank charging and commissioning. Submit report on final pressure.
- 3.4.3 Adjust charge to suit site operating conditions.

3.5 Floor Drains

- 3.5.1 Provide trap primer connected to intermittent operating cold water service on suitable fixture.
- 3.5.2 Provide sealed drains where indicated.
- 3.5.3 Set drain at elevation to allow finished floor to slope to mouth. Coordinate setting elevation with floor finish thickness and General Contractor prior to installation.
- 3.5.4 Place clear pea gravel around the top of the anchor flange to protect the primary and secondary weeping drainage openings from being plugged with concrete or other flooring material.
- 3.5.5 Provide flashing of sheet lead or approved nonmetallic membrane where floor drains are located over occupied spaces.
- 3.5.6 All floor drains and trap primer lines shall be covered, sealed and protected during construction to ensure construction waste or other debris does not fall in. If any drainage problems occur due to floor drains not being covered, the Contractor shall rectify at no cost to the Owner.

3.6 Grease interceptors

- 3.6.1 Install as per C.S.A. B481.
- 3.6.2 Coordinate exact location on site.
- 3.6.3 Refer to plumbing drawings.

3.7 Trap Seal Primers

- 3.7.1 Coordinate location of all trap seal primers with site and drawings.
- 3.7.2 Coordinate 120V power connection with Electrical Contractor.

3.8 Water Hammer Arresters

- 3.8.1 Sizing and positioning shall conform to P.D.I.-W.H. 201 and Ontario Building Code requirements.
- 3.8.2 The use of air chambers is prohibited.
- 3.8.3 Refer to plumbing drawings.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of Valves for Plumbing systems.

1.2 Related Sections

- 1.2.1 Section 22 05 00 – Common Work Results for Plumbing
- 1.2.2 Section 22 13 16 – Sanitary Waste and Vent Piping
- 1.2.3 Section 22 42 13 – Commercial Water Closets and Urinals
- 1.2.4 Section 22 42 16 – Commercial Lavatories and Sinks

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code (OBC).
- .2 Regulations of Province, City, or local authority having jurisdiction.
- .3 Ontario Plumbing Code.
- .4 Ontario Regulation 169, Ontario Drinking Water Quality Standards.
- .5 PDI-WH 201, Standard for Water Hammer Arresters.
- .6 American National Standards Institute (ANSI).
- .7 American Water Works Association (AWWA).
- .8 The American Society of Mechanical Engineers (ASME).
- .9 Manufacturers Standardization Society of Valve and Fittings Industry (MSS):
 - .1 MSS SP-67, Butterfly Valves.
 - .2 MSS SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-80, Bronze Gate, Globe, Angle and Check Valves.
 - .4 MSS SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
 - .5 MSS SP-139, Copper Alloy Gate, Globe, Angle, and Check Valves for Low Pressure/Low Temperature Plumbing Applications.

1.4 Quality Assurance

- 1.4.1 Provide valves of same manufacturer throughout where possible.
- 1.4.2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
- 1.4.3 All valves shall be acceptable for domestic water use, lead free.
- 1.4.4 Valves shall be suitable for solder or threaded connections. Provide solder to threaded adapters where applicable.

1.5 Submittals

1.5.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.5.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Final pressure test report.
 - .4 Copy of valve identification chart.
 - .5 Warranty information.

- 1.5.3 Manufacturer's data and shop drawings for all valves and accessories including dimensions, pressure ratings, materials, service acceptability.

2 Products

2.1 Check Valves

- 2.1.1 2 inches and smaller: Class 125, 200 P.S.I., lead free bronze body and cap, bronze seat, solder or threaded ends. Equal to Kitz 822 and 823, Jenkins, N.H., Red-White, M.A.S.
- 2.1.2 2.5 inches and larger: Class 150, stainless steel body, hard face seat, 13 percent chrome, flanged ends. Equal to Kitz 150-U.O.A.M., Jenkins, N.H., Red-White, M.A.S.

2.2 Ball Valves

- 2.2.1 600 W.O.G., lead free brass, two or three piece body, chrome plate ball, full port, Teflon seats, blow-out proof stem, threaded or soldered ends, lever handle. Soldered up to 3 inches, threaded up to 4 inches.
- 2.2.2 Standard of Acceptance:
 - .1 Jenkins,
 - .2 N.H.,
 - .3 Kitz 858 and 859,
 - .4 Red-White Toyo 5044A-L.F. and 5049-L.F.,
 - .5 M.A.S. B3-L.F. and B4-L.F.

2.3 Drain Valves

- 2.3.1 Bronze compression stop with $\frac{3}{4}$ inch hose thread.
- 2.3.2 Brass ball valve with $\frac{3}{4}$ inch hose thread.
- 2.3.3 Provide hose thread connection on valve or piping.
- 2.3.4 Equal to Kitz 868C (Lead Free), KITZ 68AC (Non Lead Free)

2.4 Pressure Ratings

- 2.4.1 Unless otherwise indicated, use valves suitable for minimum 860 kilopascals (125 P.S.I.) and 232 degrees Celsius (450 degrees Fahrenheit).

3 Execution

3.1 General

- 3.1.1 All valves shall be located such that the removal of their bonnets is possible.
- 3.1.2 Install valves with stems upright or horizontal, not inverted.

- 3.1.3 All valves shall be installed to allow for ease of access, service and reading of devices from the floor.
- 3.1.4 Use the following colour identification dots on ceiling grid to locate valves enclosed in ceiling space
- 3.1.5 Location of serviceable mechanical items in ceiling space:
 - .1 Dark Blue Dots for Domestic Cold Water;
 - .2 Orange Dots for Domestic Hot Water;
 - .3 Red Dots for Heating and Chilled Water;
 - .4 Yellow Dots for any Gas valves that are above ceiling;

3.2 Application

- 3.2.1 Use ball valves on pressure gauges.
- 3.2.2 Use plug cocks, globe valves, ball valves, butterfly valves, and metering valves in water systems for throttling service.

3.3 Isolation Valves

- 3.3.1 Isolation valves are to be ball type valves, pipe size as required, but in no case less than ½-inch diameter.
- 3.3.2 For equipment removal purposes. Install valves as close as possible to isolated equipment in order to minimize the amount of water lost during maintenance, replacement or drain down operations.
- 3.3.3 Isolation drain valves are to be provided with combination air inlet fitting as required to relieve vacuum during draining operations.
- 3.3.4 Install ball valves where approved for shutoff and isolating service, or to isolate equipment, parts of systems or vertical risers.

3.4 Drain Valves

- 3.4.1 Provide drain valves at main shutoff valves, low points of piping and equipment.
- 3.4.2 Provide ball valves for drains on open systems.
- 3.4.3 Provide unions downstream of the valve to allow breaking the piping system.
- 3.4.4 Provide hose thread connection on drain valve and piping.

END OF SECTION

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1 General

1.1 Summary

1.1.1 This section specifies hangers and supports for Plumbing systems.

1.1.2 This section does not include seismic restraint.

1.2 Related Sections

1.2.1 Section 22 05 00 – Common Work Results for Plumbing.

1.2.2 Section 22 13 16 – Sanitary Waste and Vent Piping

1.3 Reference Standards

1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code.
- .2 Regulations of Province, City, or local authority having jurisdiction.
- .3 Ontario Plumbing Code.
- .4 National Fire Protection Association (NFPA).
- .5 Manufacturers Standardization Society of Valve and Fittings Industry (MSS).
 - .1 MSS SP-127 Bracing for Piping Systems Seismic - Wind - Dynamic Design, Selection, Application.
- .6 Standard method of fire tests of firestop system CAN4-S115-M85.
- .7 UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (ULc1479).
- .8 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by FM and certified by UL or ULC for the service application.

1.4 Submittals

1.4.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.

- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
 - .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- 1.4.2 Closeout Submittals:
- 1.4.3 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- 1.4.4 Operation and maintenance data shall be included in the maintenance manual.
- 1.4.5 Submit the following for incorporation into Operation and Maintenance Manuals:
- .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Warranty information.
- 1.4.6 Firestop materials: Submit service limitations, installation instructions, UL certification and FM listing.
- 1.4.7 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, UL certification and FM listing.

2 Products

2.1 General Requirements

- 2.1.1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade and provide for expansion and contraction.
- 2.1.2 Provide spring, rubber or neoprene isolators for all pipes connected to isolated equipment.
- 2.1.3 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- 2.1.4 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- 2.1.5 Obtain approval prior to drilling for inserts and supports for piping systems.
- 2.1.6 Obtain approval prior to using percussion type fastenings.
- 2.1.7 Use of other piping or equipment for hangers and supports is not permitted.
- 2.1.8 Use of perforated band iron, wire or chain as hangers is not permitted.

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2.2 Inserts

- 2.2.1 Inserts shall be malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.
- 2.2.2 Size inserts to suit threaded hanger rods.

2.3 Pipe Hangers and Supports

- 2.3.1 Pipe hangers shall wrap around outside of insulation for all sizes. Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.
- 2.3.2 Hangers:
 - .1 Pipe Sizes ½ inch to 1½ inch: Adjustable wrought steel ring, or plated strap.
 - .2 Pipe Sizes 2 inches and over: Adjustable wrought steel clevis.
 - .3 Hanger Rods: Provide steel hanger rods, threaded both ends or continuous threaded, complete with lock nuts on both ends.
 - .4 Saddles shall wrap around the outside of the insulation for all piping and be sized accordingly.
- 2.3.3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 6 inches and over.
- 2.3.4 Wall Support:
 - .1 Pipe Sizes to 3 inches: Cast iron hook, or fabricated bracket of 1 inch by 1 inch by ¼ inch angle bar.
 - .2 Pipe Sizes 4 inches and over: Welded steel bracket and wrought steel clamp.
- 2.3.5 Vertical Support:
 - .1 Steel riser clamp.
- 2.3.6 Floor Support:
 - .1 Fabricated stand and pipe clamp or saddle.

3 Execution

3.1 General

- 3.1.1 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural

bearings do not exist, provide angle or channel iron from nearest structural bearings to support hangers.

3.2 Inserts

- 3.2.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- 3.2.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4 inches or ducts over 1500 millimetres (60 inches) wide.
- 3.2.3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- 3.2.4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.
- 3.2.5 Expansion bolt type connections will be approved under certain conditions. Obtain approval from the Consultant. Generally, pipe 2 inches or smaller, and ducts less than 600 millimetres by 300 millimetres (24 inches by 12 inches) will be approved, subject to adequate number of support points.

3.3 Pipe Hangers and Support

- 3.3.1 Fasten hangers and supports to building structure or inserts in concrete construction.
- 3.3.2 Support horizontal metallic piping as follows (or see table on drawings):
 - .1 For N.P.S. $\frac{1}{2}$, distance between supports shall be 1.8 metre (6 feet), and hanger rod diameter shall be 9.5 millimetres (0.375 inch);
 - .2 For N.P.S. $\frac{3}{4}$ to $1\frac{1}{2}$, distance between supports shall be 2.4 metres (8 feet), and hanger rod diameter shall be 9.5 millimetres (0.375 inch);
 - .3 For N.P.S. 2 to $2\frac{1}{2}$, distance between supports shall be 3.0 metres (10 feet), and hanger rod diameter shall be 9.5 millimetres (0.375 inch);
 - .4 For N.P.S. 3 to 4, distance between supports shall be 3.6 metres (12 feet), and hanger rod diameter shall be 13 millimetres ($\frac{1}{2}$ inch);
 - .5 For N.P.S. 6 to 12, distance between supports shall be 4.3 metres (14 feet), and hanger rod diameter shall be 13 millimetres ($\frac{1}{2}$ inch).
- 3.3.3 Install hangers to provide minimum 32 millimetres ($1\frac{1}{4}$ inch) clear space between finished covering and adjacent work.
- 3.3.4 Place a hanger within 300 millimetres (12 inches) of each horizontal elbow.
- 3.3.5 Use hangers which are vertically adjustable 38 millimetres ($1\frac{1}{2}$ inch) minimum after piping is erected.
- 3.3.6 Support vertical piping at every floor.

- 3.3.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- 3.3.8 Where practical, support riser piping independently of connected horizontal piping.
- 3.3.9 Exposed piping, with less than 2.6 metres (8½ feet) clearance to floors shall be provided with two times the number of hangers normally required. Spacing shall be equal or adjusted for maximum benefit.
- 3.3.10 Provide copper plated hangers and supports for copper piping or provide nonferrous packing between hanger or support and piping.
- 3.3.11 Large capacity piping with vibration potential shall not be suspended from any building structure that will allow transfer of vibrations to the occupied spaces.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This Section specifies the materials and requirements for the identification of Plumbing systems, valves, pumps, panels and other related equipment, including the installation and location of identification systems.

1.2 Related Sections

- 1.2.1 Section 22 05 00 - Common Work Results for Plumbing

1.3 References

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 National Fire Protection Association (NFPA):
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 170, Standard for Standard for Fire Safety and emergency Symbols.
- .2 Ontario Fire Code, O.Reg. 213 - Part 4, Flammable and Combustible Liquids.
- .3 R.R.O. 1990, Reg. 860 - Workplace Hazardous Materials Information System (WHMIS), under the Occupational Health and Safety Act.
- .4 Canadian General Standards Board
 - .1 CAN C.G.S.B. 1.60:M89, Interior Alkyd Gloss Enamel
 - .2 CAN C.G.S.B. 24.3:92, Identification of Piping Systems

1.4 Submittals

1.4.1 Shop Drawings

- .1 Submit in accordance with indicating:
 - .1 Catalogue cut sheets, technical data, standard details.
 - .2 Manufacturer's installation requirements and instructions.
- .2 Samples:
 - .1 Submit samples of each identification Product. Product data to include paint colour chips and all other products specified in this section.

- 1.4.1 Product literature to include nameplates, labels, tags, lists of proposed legends.

2 Products

2.1 Manufacturer's Equipment Nameplates

- 2.1.1 Metal or plastic lamacoid nameplate mechanically fastened to each piece of equipment by manufacturer.
- 2.1.2 Lettering and numbers to be raised or recessed.
- 2.1.3 Information to include, as appropriate:
- .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hertz, phase, power factor, duty, frame size.

2.2 System Nameplates

- 2.2.1 Colours:
- .1 Hazardous: red letters, white background
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- 2.2.2 Construction:
- .1 3 millimetre (0.125 inch) thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- 2.2.3 Sizes conform to the following table:

Size	Dimensions	Number of lines	Height of letters
1	10 millimetres by 50 millimetres	1	3 millimetres (0.125 inch)
2	15 millimetres by 75 millimetres	1	6 millimetres (0.25 inch)
3	15 millimetres by 75 millimetres	2	3 millimetres (0.125 inch)
4	20 millimetres by 100 millimetres	1	10 millimetres (0.375 inch)
5	20 millimetres by 100 millimetres	2	6 millimetres (0.25 inch)
6	20 millimetres by 200 millimetres	1	10 millimetres (0.375 inch)

7	25 millimetres by 125 millimetres	1	15 millimetres (0.5 inch)
8	25 millimetres by 125 millimetres	2	10 millimetres (0.375 inch)
9	32 millimetres by 200 millimetres	1	20 millimetres (0.75 inch)

- .2 Use a maximum of 25 characters per line.

2.2.4 Locations:

- .1 Equipment in Mechanical Rooms: Use size number 9.
- .2 Equipment above ceiling: Use size number 1, riveted to ceiling suspension system.

2.3 Identification of Piping Systems

2.3.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. Conform to CAN C.G.S.B. 24.3, except where specified otherwise.

2.3.2 Legend:

- .1 Block capitals to sizes and colours listed in CAN C.G.S.B. 24.3.

2.3.3 Arrows showing direction of flow:

- .1 Outside diameter of pipe insulation less than 3 inches: 100 millimetres (4 inches) long by 50 millimetres (2 inches) high.
- .2 Outside diameter of pipe or insulation 3 inches and greater: 150 millimetres (6 inches) long by 50 millimetres (2 inches) high.
- .3 Use double-headed arrows where flow is reversible.

2.3.4 Extent of background colour marking:

- .1 To full circumference of pipe or insulation.
- .2 Length to accommodate pictogram, full length of legend and arrows.

2.3.5 Materials for background colour marking, legend, arrows:

- .1 Pipes and tubing $\frac{3}{4}$ inches and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
- .2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating suitable for ambient of 100 percent relative humidity and continuous operating temperature of 150 degrees Celsius (300 degrees

Fahrenheit) and intermittent temperature of 200 degrees Celsius (395 degrees Fahrenheit).

2.3.6 Colours and Legends:

- .1 Where not listed, obtain direction from Consultant.
- .2 Colours for legends and arrows:

Background colour	Legend	Arrows
Yellow	White	Black
Green	White	Black
Red	White	Black

2.4 Concrete Pads for Mechanical Equipment

- 2.4.1 General Contractor to paint all sides and top 12 inch (300 millimetres) edge of all concrete pads for mechanical equipment with 2 coats of yellow paint. Paint colour to match Benjamin Moore Safety Yellow 343.

2.5 Valves, Controllers

- 2.5.1 Brass tags with 15 millimetre (½ inch) stamped identification data filled with black paint.
- 2.5.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
- 2.5.3 Provide coloured adhesive label indication on ceiling grid to locate valves/equipment above. Label description to match device. Size, colour and description to be pre-approved by Consultant.

2.6 Language

- 2.6.1 Identification to be in English.

3 Execution

3.1 Timing

- 3.1.1 Provide identification only after all painting specified has been completed.

3.2 Installation

- 3.2.1 Perform work in accordance with CAN C.G.S.B. 24.3, except as specified otherwise.
- 3.2.2 Provide U.L.C. or C.S.A. registration plates as required by respective agency.

3.3 Nameplates

3.3.1 Locations:

- .1 In conspicuous location to facilitate easy reading and identification from operating floor.

3.3.2 Standoffs:

- .1 Provide for nameplates on hot or insulated surfaces.

3.3.3 Protection:

- .1 Do not paint, insulate or cover in any way.

3.4 Location of Identification on Piping Systems

- 3.4.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 metres (5 feet and 8 inches) intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

- 3.4.2 Adjacent to each change in direction.

- 3.4.3 At least once in each small room through which piping passes.

- 3.4.4 On both sides of visual obstruction or where run is difficult to follow.

- 3.4.5 On both sides of separations such as walls, floors, partitions.

- 3.4.6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.

- 3.4.7 At beginning and end points of each run and at each piece of equipment in run.

- 3.4.8 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 Valves

- 3.5.1 Valves, except at plumbing fixtures or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or close S hooks.

- 3.5.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.

- 3.5.3 Apply colour identification dots on ceiling grid to identify locations of valves enclosed in ceiling space. Identification scheme:

- .1 Dark Blue Dots: Domestic Cold Water

- .2 Orange Dots: Domestic Hot Water
 - .3 Green Dots: Balancing Valves, including domestic hot water recirculation
- 3.5.4 Number valves in each system consecutively.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section specifies testing for Plumbing systems.
- 1.1.2 This section does not include commissioning for Plumbing systems.
- 1.1.3 Balance and adjust all the new domestic water equipment and cold, hot and recirculation hot water piping systems under this Division and submit reports.
- 1.1.4 Provide services necessary for testing, adjusting and balancing (TAB) Plumbing Systems.
- 1.1.5 All equipment and products necessary to perform tests shall be covered under this Division at no cost to the Owner.

1.2 Related Sections

- 1.2.1 Section 22 05 00 - Common Work Results for Plumbing

1.3 Reference Standards

- 1.3.1 Test equipment and material where specified as required by authorities having jurisdiction to demonstrate its proper and safe operation.
- 1.3.2 The Contractor shall notify the Plumbing Inspector when systems are available for testing. The Contractor shall document all tests performed and shall arrange for the Plumbing Inspector to sign for tests completed. The forms shall be forwarded to the Consultant.
- 1.3.3 Test procedures shall be in accordance with applicable portions of:
 - .1 Ontario Building Code
 - .2 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .3 American Society of Mechanical Engineers (A.S.M.E.)
 - .4 Ontario Ministry of Health
 - .5 Plumbing Code under the Ontario Water Resources Act
 - .6 Local codes and ordinances
 - .7 Other recognized test codes
- 1.3.4 Provide additional tests and re-testing as required and requested by the Consultant or Owner.

1.4 Submittals

- 1.4.1 Obtain certificates of approval and acceptance from authorities having jurisdiction and include in Operating and Maintenance Manuals.
- 1.4.2 On completion of mechanical installation, provide certification of tests with detailed data as required. Itemize tests as to time performed and personnel responsible. Include a copy of field data in Operating and Maintenance Manuals.
- 1.4.3 Prior to commencing Work, shop drawings shall be submitted showing equipment, proof of calibration, testing methods to be used.
- 1.4.4 Submit draft copies of balance reports for approval prior to proceeding.
- 1.4.5 Revise reports as required and provide for inclusion in Maintenance Manuals.
- 1.4.6 Reports shall include balance and equipment data listed in imperial units.
- 1.4.7 Report data shall include system description, manufacturer, arrangements, motor size, electrical characteristics, equipment size, design and actual temperature, flows, RPM, power, amperage, etc.

1.5 Liability

- 1.5.1 During tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration.

1.6 Coordination

- 1.6.1 Review design drawings and general function of each system including associated equipment, control sequences and operation cycles. Confirm listing of flow and terminal measurements to be performed.
- 1.6.2 Confirm valve locations are adequate for system functionality. Recommend additional locations to Contractor and Consultant if required to complete system startup and testing.
- 1.6.3 Provide the assistance of a qualified mechanic to assist and make all necessary adjustments as directed by the independent company and replace system components to achieve the specified system conditions.
- 1.6.4 Co-operate with installing Contractor(s) in advising them of specific scheduling requirements for systems verification.
- 1.6.5 Provide advice to installing Contractors regarding the location and installation of devices required to permit system filtration and measurements, prior to start of the installation work.
- 1.6.6 The Mechanical Contractor shall cooperate with the independent company and perform the functions described below with respect to the startup and testing of the systems.
- 1.6.7 Outline procedures for taking test measurements to establish compliance with requirements. Specify type of instrument to be used, method of instrument application and correct factors.

- 1.6.8 Contact Consultant during or immediately following balancing procedures to discuss any concerns or issues prior to issuing any reports.
- 1.6.9 Submit one copy of the Water Quality Test Report to the Consultant for review.
- 1.6.10 Make adjustments as directed by the Consultant. Include for a minimum of one return visit for any adjustments and/or to work with the Contractor to investigate any issues.
- 1.6.11 Revise report and resubmit to the Consultant for review.

1.7 Quality Assurance

- 1.7.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.
- 1.7.2 Testing and measuring equipment used in the verification of the mechanical systems shall be calibrated to give true readings within the accuracy specifications of the equipment used. A certificate of calibration from an independent testing laboratory may be required by the Consultant if there is any reason to suspect that the equipment used is giving erroneous readings. In such an event the verification agency shall reconduct its verifications.

2 Products

- 2.1 **Not applicable.**

3 Execution

3.1 General

- 3.1.1 Test and adjust all new water systems and equipment and submit reports.
- 3.1.2 Allow for a minimum of 1 return visit for any adjustments and to work with the Contractor to investigate any issues.
- 3.1.3 Mark settings on valves and other adjustment devices.
- 3.1.4 Include any required site investigation and system balancing based on any system deficiencies as noted herein.
- 3.1.5 Contact Consultant during or immediately following startup and testing procedures to discuss any concerns or issues prior to issuing any reports.
- 3.1.6 At final inspection, recheck and prove random selections of data recorded in report at discretion and direction of the Consultant.

3.2 Pressure tests

- 3.2.1 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Consultant.

- 3.2.2 Provide equipment, materials and labour for tests. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy.
- 3.2.3 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.
- 3.2.4 Provide 4 days notice to the Consultant before tests.
- 3.2.5 Carry out hydraulic tests for 8 hours and maintain pressure. Where leakage occurs, repair and retest.
- 3.2.6 Domestic Water Piping: Test to 1½ time maximum working pressure or 1034 kilopascals (150 P.S.I.) water pressure, measured at system low point.
- 3.2.7 Drainage Systems: Test by filling with water to produce water pressure of 35 kilopascals (5 P.S.I.) minimum and 83 kilopascals (12 P.S.I.) maximum. Check for proper grade and obstruction by ball test, or other approved means.

3.3 Equipment Tests

- 3.3.1 Perform testing of all equipment as per manufacturer's recommendations and requirements under full operational ranges and submit reports.
- 3.3.2 Use the services of a qualified Technician and submit report. Use the services of manufacturer's representative for major equipment.

3.4 Test Reports

- 3.4.1 Submit written reports for all balancing in a format pre-approved by the Consultant as per Scope of Work above.
- 3.4.2 Submit 1 copy of the Water Quality Test Report to the Consultant for review.
- 3.4.3 Make adjustments as directed by the Consultant. Include for a minimum of 1 return site visit as noted herein.
- 3.4.4 Revise report and resubmit to the Consultant for review.
- 3.4.5 Submit all test reports as requested by the municipal plumbing inspector, within 1 week of each test completion.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This Section specifies thermal insulation for Plumbing piping and piping accessories in a commercial type application.

1.2 Related Sections

- 1.2.1 Section 22 05 00 – Common Works Results for Plumbing
- 1.2.2 Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
- 1.2.3 Section 22 11 16 – Domestic Water Piping

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Canadian General Standards Board (CGSB).
- .2 American Society for Testing and Materials (ASTM):
- .3 ASTM C 195 Specification for Mineral Fiber Thermal Insulating Cement.
- .4 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C 534, Specification for Mineral Fiber Preformed Pipe Insulation.
- .6 ASTM C553, Specification for Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C 921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .8 ASTM E 84, Test Methods for Surface Burning Characteristics of Building Materials.
- .9 ASTM E 96, Test Methods for Water Vapor Transmission of Materials.
- .10 ASTM C411-82.
- .11 Underwriter's Laboratories of Canada (ULC):
- .12 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .13 Thermal Insulation Association of Canada (TIAC):
- .14 TIAC National Insulation Standards, Section 4 Insulation Materials and Properties.
- .15 TIAC National Insulation Standards, Section 5 Commercial Piping.

- .16 TIAC National Insulation Standards, Section 13 Installation Details.
- .17 TIAC National Insulation Standards, Section 14 Glossary and Definitions.
- .18 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- .19 National Fire Protection Association (NFPA).

1.4 Submittals

1.4.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Warranty information.

1.5 Quality Assurance

- 1.5.1 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site. Trades Qualification certificates must be submitted prior to commencing work and must be on site for inspection.

1.6 Job Conditions

- 1.6.1 Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
- 1.6.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

2 Products

2.1 General

- 2.1.1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed, per CAN U.L.C. S102.
- 2.1.2 Adhesives, coatings and sealers shall be waterproof.

2.2 Materials

- 2.2.1 Pipe insulation shall be rigid, sectional fiberglass type pre-covered, preformed insulation complete with factory supplied foil or kraft all purpose jacket unless otherwise noted.
- 2.2.2 Pre-formed insulation should be used at pipe fittings, valves, and so on.
- 2.2.3 Provide non-crushing insulation at all pipe hangers. Hangers shall wrap around outside of insulation for all piping systems greater than 1¼ inch in size.
- 2.2.4 Insulation shall be 1 inch thick for domestic piping 1¼ inch N.P.S. and less, and 1½ inch thick for domestic piping 1½ inch N.P.S. and greater.
- 2.2.5 Cold Piping: Fine fibrous glass insulation with factory applied vapour barrier jacket suitable for piping conveying medium at a temperature of 16 degrees Celsius or less, molded to conform to piping, K value of 0.24 B.T.U.-inch per hour-square-feet-degrees Fahrenheit.
- 2.2.6 Hot and Tempered Water Piping: Fine fibrous glass insulation with factory applied general purpose jacket, molded to conform to piping, K value of 0.24 B.T.U.-inch per hour-square-feet-degrees Fahrenheit.
- 2.2.7 Condensate Piping: Fine fibrous glass insulation with factory applied vapour barrier jacket, molded to conform to piping, K value of 0.24 B.T.U.-inch per hour-square-feet-degrees Fahrenheit.
- 2.2.8 Roof Drainage and Vent Terminals: Flexible fibrous glass insulation, K value of 0.26 B.T.U.-inch per hour-square-feet-degrees Fahrenheit.
- 2.2.9 Recovering Jackets in all Exposed Areas: PVC pre-formed, minimum 20 mil thickness, with permeability not more than 0.09 perms. Fitting covers, 1 or 2 pieces, pre-moulded.
- 2.2.10 Vapour barrier tape: U.L. 181A listed, colour matched and foil faced.
- 2.2.11 Standard of Acceptance:

- .1 Fibreglass Canada,
- .2 Knauf,
- .3 Mason,
- .4 Pittsburgh Corning.

3 Execution

3.1 Preparation

- 3.1.1 Do not install covering before piping and equipment has been tested, approved and where applicable, heat tracing is installed.
- 3.1.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation

- 3.2.1 In non fire rated surfaces, ensure insulation is continuous through inside walls. Pack around pipes with fireproof self-supporting insulation material, properly sealed.
- 3.2.2 Finish insulation neatly at hangers, supports and other protrusions.
- 3.2.3 Provide recovering jackets on exposed insulation as specified herein.
- 3.2.4 Coat recovering jacket with two coats of waterproof fire retardant coating.
- 3.2.5 Do not install and seal vapour proof insulation if ambient air has a high humidity.
- 3.2.6 Pipe hangers shall wrap around outside of insulation for all sizes. Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.

3.3 Domestic Water Piping: Hot, Cold and Tempered

- 3.3.1 Insulate all new domestic hot, cold and tempered water piping.
- 3.3.2 Insulate valves, unions, flanges, strainers, flexible connections and expansion joints for all cold water systems. Not required for hot or tempered water systems.
- 3.3.3 Insulate straight pipe sections by staggering adjacent longitudinal seams ¼ turn each butt joint.
- 3.3.4 Cover elbows, tees and similar fittings with equivalent thickness of insulation material.

3.4 Condensate Piping

- 3.4.1 Insulate all new condensate piping off heat pumps and other mechanical equipment.
- 3.4.2 Cover elbows, tees and similar fittings with equivalent thickness of insulation material.

3.5 Roof Drainage and Vent Terminals

- 3.5.1 Insulate all roof hoppers with flexible blanket insulation of same type as pipe insulation, where applicable.
- 3.5.2 Insulate all new, interior roof drainage piping, including horizontal and vertical piping, where applicable.
- 3.5.3 Insulate all new terminal vent piping, including horizontal and vertical piping, as indicated on drawings.

3.6 Equipment Insulation

- 3.6.1 Insulate equipment drain piping, fittings, and condensate drains in concealed areas. Insulation shall be with vapour barrier where condensation may occur.
- 3.6.2 Insulate valves at water meter header including water meter body. Water meters to be insulated with elastomeric foam insulation.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of domestic water piping and fittings.

1.2 Related Sections

- 1.2.1 Section 22 05 00 – Common Work Results for Plumbing.
- 1.2.2 Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
- 1.2.3 Section 22 05 93 – Testing for Plumbing
- 1.2.4 Section 22 07 19 – Plumbing Piping Insulation.

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code.
- .2 Regulations of Province, City, or local authority having jurisdiction.
- .3 ASTM B42, Standard Specification for Seamless Copper Pipe, Standard Sizes
- .4 National Research Council Canada publications (NRCC):
 - .1 NRCC No. 30619, National Building Code of Canada 1990 and NRCC No. 30629, Supplement to National Building Code of Canada 1990.
 - .2 NRCC No. 30625, Canadian Plumbing Code 1990.
- .5 American National Standards Institute (ANSI):
 - .1 ANSI B36.10, ASTM-197-47 (Materials).

- 1.3.2 ANSI B16.24, ANSI/ASME B16.15, ANSI B16.8, ANSI/ASME B16.22 (Copper Fittings).

1.4 Firestop Sealants and Collars

- 1.4.1 Standard method of fire tests of firestop system: CAN U.L.C. S115.
- 1.4.2 U.L. Classified or F.M. Systems Approved and tested to the requirements of A.S.T.M. E814 or U.L. 1479.
- 1.4.3 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by F.M. and certified by Underwriters Laboratories or Underwriters Laboratories of Canada for the service application.
- 1.4.4 Firestop materials: Submit service limitations, installation instructions, U.L. certification and F.M. listing.

- 1.4.5 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, U.L. certification and F.M. listing.

1.5 Submittals

1.5.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.5.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Final pressure test report.
 - .4 Copy of valve identification chart.
 - .5 Warranty information.
 - .6 Operation and maintenance data

2 Products

2.1 Domestic Water (Aboveground)

- 2.1.1 For all domestic hot water, cold water and tempered water distribution piping inside the building and above: Type L hard copper.

- 2.1.2 For service pipe inside the building and above ground from termination of underground main to and including meter connection and bypass and similar service entrance connections: Type K hard drawn copper.
- 2.1.3 Copper pipe shall be hard drawn seamless copper to C.S.A. H7.6 and certified to A.S.T.M. B88.
- 2.1.4 Fittings shall be forged copper, solder joint, pressure type.
- 2.1.5 Solder to threaded adapters shall be provided at screwed valves or equipment.
- 2.1.6 Unions shall be all bronze construction with ground joint and either solder joint or screwed ends as required. Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping.
- 2.1.7 Provide commercial type water hammer arrestors on all plumbing lines serving fixtures and equipment with quick closing or solenoid valves.
- 2.1.8 Exposed plumbing brass and metal work shall be heavy chromium plated (including under countertops without cabinets).
- 2.1.9 Hot, cold and tempered water piping to fixtures shall be flexible copper tube complete with angle type screwdriver stop, reducer, and escutcheon plate.
- 2.1.10 Provide isolation valves on domestic water piping to each group of fixtures.

2.2 Domestic Water (Underground)

- 2.2.1 2 inches and smaller: Copper Type K
- 2.2.2 4 inches and larger: Listed P.V.C.

3 Execution

3.1 General

- 3.1.1 Review all inverts and elevations before beginning any installation.
- 3.1.2 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural bearings do not exist, provide angle or channel iron from nearest structural bearings to support hangers.
- 3.1.3 Provide clearance for proper installation of insulation and for access to components including but not limited to valves and drains.
- 3.1.4 Provide drain valves at low points where required.
- 3.1.5 Do not run combustible or non-approved pipe through fire separations or return air ceiling plenums. Use approved materials and methods only.
- 3.1.6 Install piping to allow for expansion and contraction and to eliminate stress on equipment, piping, or connections.

- 3.1.7 Provide isolation valves or shutoff valves at all equipment.
- 3.1.8 Provide sleeves for piping passing through floor slab. Caulk around piping and fill entire space between piping and floor slab with approved fire-retardant material to maintain required fire rating where necessary.
- 3.1.9 Install reduced pressure double check valve assembly to isolate domestic system from hydronic system, where indicated on drawings and as required by code.

3.2 Lead-free domestic water system

- 3.2.1 Make soldered joints on copper tubing for potable water using lead-free solder and matching flux.

3.3 Grades, Routes and Installations

- 3.3.1 Route piping in orderly manner and maintain proper grades for proper drainage. Install to conserve headroom and interfere as little as possible with use of space.
- 3.3.2 Run exposed piping parallel to walls, in a neat and orderly fashion. Group piping wherever practical at common elevations.
- 3.3.3 Install concealed pipes close to the building structure to keep furrings to a minimum.
- 3.3.4 Install concealed pipes close to the building structure to keep furrings to a minimum.

3.4 Sleeves

- 3.4.1 Provide and set sleeves required for piping.
- 3.4.2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.
- 3.4.3 Extend sleeves through potentially wet floors 50 millimetres above finished floor level. Caulk sleeves full depth and provide floor plate.
- 3.4.4 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with non-combustible insulation or approved non-combustible insulation, fire rated as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.
- 3.4.5 Install chrome plated escutcheons where piping passes through finished surfaces including millwork.
- 3.4.6 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3.5 Firestop Sealants and Collars

- 3.5.1 Where pipes pass through fire rated wall, floors and partitions, pack space between with firestopping sealants in accordance with manufacturer's written instructions.
- 3.5.2 Provide firestop sealants around all pipe penetrations through rated separations.

- 3.5.3 Provide firestop collars for all combustible pipe penetrations through rated separations (where combustible piping is approved).
- 3.5.4 Intumescent insert: Flexible, elastomeric strip, two stage expansion, designed to firestop penetrations in fire-rated walls and floors and floor/ceiling assemblies.
- 3.5.5 Provide a minimum of 15 times free expansion.
- 3.5.6 Sealants shall not contain water soluble expansion ingredients.
- 3.5.7 Clean all concrete, masonry and stone penetrations of all contaminants and impurities, concrete form release agents, water repellents, oils, surface dirt and rust, scale, all old sealants and other surface treatments.
- 3.5.8 Metal surfaces shall be cleaned by wiping them with an oil-free absorbent cloth saturated with solvent such as xylol or toluol. Do not use alcohols.
- 3.5.9 Do not apply to polycarbonates or to building materials that bleed oils, plasticizers or solvents, or where sealant is not exposed to atmospheric moisture, or to surfaces which have been or will be painted.
- 3.5.10 Collars are to be installed with steel fasteners or steel expansion anchors. Low melting temperature anchors of lead, plastic or aluminum are not approved.
- 3.5.11 Installation only when temperatures are between 4 degrees Celsius (40 degrees Fahrenheit) and 37 degrees Celsius (98 degrees Fahrenheit).

3.6 Identification

- 3.6.1 Identify all piping with type of service and arrows.

3.7 Testing

- 3.7.1 Test piping according to Ontario Building Code requirements.

3.8 Cleaning

- 3.8.1 Thoroughly flush domestic water systems upon completion of work.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of Sanitary Drainage and Vent Piping Systems, including condensate drainage for HVAC equipment.

1.2 Related Sections

- 1.2.1 Section 22 05 00 – Common Work Results for Plumbing.
- 1.2.2 Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
- 1.2.3 Section 22 05 93 – Testing for Plumbing
- 1.2.4 Section 22 07 19 – Plumbing Piping Insulation

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code.
- .2 Regulations of Province, City, or local authority having jurisdiction.
- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA-B70-M91: Cast iron soil pipe, fittings and means of joining.
 - .2 B158.1-1976: Cast brass solder joint drainage, waste and vent fittings.
 - .3 CAN/CSA-B181.1-M90: ABS drain, waste and vent pipe and pipe fittings.
 - .4 CAN/CSA-B181.2-M90: PVC drain, waste and vent pipe and pipe fittings.
 - .5 CAN/CSA-B181.3: Polyolefin laboratory drainage systems.
 - .6 CAN/CSA-B182.1-M92: Plastic drain and sewer pipe and pipe fittings.
- .4 National Research Council Canada publications (NRCC):
 - .1 NRCC No. 30619, National Building Code of Canada 1990 and NRCC No. 30629, Supplement to National Building Code of Canada 1990.
 - .2 NRCC No. 30625, Canadian Plumbing Code 1990.
- .5 American National Standards Institute (ANSI):
 - .1 ANSI B36.10, ASTM-197-47 (Materials).
- .6 ANSI B16.24, ANSI/ASME B16.15, ANSI B16.8, ANSI/ASME B16.22 (Copper Fittings).

1.4 Firestop Sealants and Collars

- 1.4.1 Standard method of fire tests of firestop system: CAN U.L.C. S115.
- 1.4.2 U.L. Classified or F.M. Systems Approved, and tested to the requirements of A.S.T.M. E814 or U.L. 1479.
- 1.4.3 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by F.M. and certified by Underwriters Laboratories or Underwriters Laboratories of Canada for the service application.
- 1.4.4 Firestop materials: Submit service limitations, installation instructions, U.L. certification and F.M. listing.
- 1.4.5 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, U.L. certification and F.M. listing.

1.5 Submittals

1.5.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.5.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Final pressure test report.
 - .4 Copy of valve identification chart.

- .5 Warranty information.
- .6 Operation and maintenance data

2 Products

2.1 Drainage System (Underground)

2.1.1 Pipe up to and including 3 inches shall be:

- .1 U.L.C. certified P.V.C. 40 D.W.V. pipe conform to CAN C.S.A. B181.2, complete with P.V.C. D.W.V. fittings conform to CAN C.S.A. B181.2 with solvent weld joint.

2.1.2 Pipe 3 and 4 inches shall be:

- .1 U.L.C. certified P.V.C. 40 D.W.V. pipe conform to CAN C.S.A. B181.2, complete with P.V.C. D.W.V. fittings conform to CAN C.S.A. B181.2 with solvent weld joint, or;
- .2 U.L.C. certified P.V.C. S.D.R. 28/35 B.D.S. pipe conform to CAN C.S.A. B182.1, complete with P.V.C. B.D.S. fittings conform to CAN C.S.A. B182.2 with solvent weld joints.

2.1.3 Pipe 6 inches and up shall be:

- .1 U.L.C. certified P.V.C. S.D.R. 28/35 sewer pipe conform to CAN C.S.A. B182.2, complete with P.V.C. fittings conform to CAN C.S.A. B182.2 with ring gasket joints.

2.2 Aboveground Drainage and Vent

2.2.1 Pipe shall be:

- .1 P.V.C. D.W.V. schedule 40, conform to CSA B181.2, complete with P.V.C. D.W.V. fittings conform to C.S.A. B181.2 with solvent weld joint conform to ASTM D2664.

2.3 Plumbing Vent Stacks

2.3.1 Plumbing vent stack flashings shall be 13 inches (330 millimetres) high, 0.064 inches (1.6 millimetres) mill finish 1100-OT alloy aluminum, conform to C.S.A. B272, with aluminum hood and perforated collar, thick pre-molded urethane insulation liner, and E.P.D.M. Base Seal, bituminous painted deck flange, or to match type of roofing system.

2.3.2 Conform to C.S.A. B272.

2.3.3 Models: Equal to Thaler S.J.-38, Stack Jack Flashing.

2.4 Condensate Piping

2.4.1 Type K or L hard copper complete with cast brass or wrought copper drainage fittings with solder joints

3 Execution

3.1 General

- 3.1.1 Review all inverts and elevations before beginning any installation.
- 3.1.2 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural bearings do not exist, provide angle or channel iron from nearest structural bearings to support hangers.
- 3.1.3 Provide clearance for proper installation of insulation and for access to components including but not limited to valves and drains.
- 3.1.4 Do not run combustible or non-approved pipe through fire separations or return air ceiling plenums. Use approved materials and methods only.
- 3.1.5 Provide drain valves at low points where required.
- 3.1.6 Install piping to allow for expansion and contraction and to eliminate stress on equipment, piping, or connections.
- 3.1.7 Provide cleanouts as indicated on drawings and as required by code. Floor cleanouts are not approved in finished floor areas unless otherwise noted. Ensure adequate clearance to all cleanouts.
- 3.1.8 Provide sleeves for piping passing through floor slab. Caulk around piping and fill entire space between piping and floor slab with approved fire retardant material to maintain required fire rating where necessary.
- 3.1.9 Provide fire stop sealant at all pipe penetrations through fire separations.

3.2 Grades, Routes and Installations

- 3.2.1 All sanitary lines shall be sloped 1 in 50 unless otherwise specified.
- 3.2.2 All sanitary lines in parking above ground shall be sloped minimum 1 in 50 unless otherwise approved.
- 3.2.3 Route piping in orderly manner and maintain proper grades for proper drainage. Install to conserve headroom and interfere as little as possible with use of space.
- 3.2.4 Run exposed piping parallel to walls, in a neat and orderly fashion. Group piping wherever practical at common elevations.
- 3.2.5 Install concealed pipes close to the building structure to keep furring to a minimum.

3.3 Roof Jacks

- 3.3.1 Provide roof jacks as required, and in compliance with the roofing specifications. Generally, S.B.S. torch down roofing requires aluminum roof jacks. Conventional bituminous roofing accepts lead or aluminum roof jacks.

- 3.3.2 Flash pipes projecting above finished roof surface with approved material.

3.4 Flashing

- 3.4.1 Flash all mechanical equipment passes through weather or waterproofed walls and roofs.
- 3.4.2 Flash floor drains over finished areas by extending flashing 250 millimetres (10 inches) clear on sides. Fasten flashing to drain clamp device. Use lead sheet or approved non-metallic waterproofing membrane.

3.5 Sleeves

- 3.5.1 Provide and set sleeves required for piping.
- 3.5.2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.
- 3.5.3 Extend sleeves through potentially wet floors 50 millimetres above finished floor level. Caulk sleeves full depth and provide floor plate.
- 3.5.4 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with non-combustible insulation or approved non-combustible insulation, fire rated as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.
- 3.5.5 Install chrome plated escutcheons where piping passes through finished surfaces including millwork.
- 3.5.6 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3.6 Firestop Sealants and Collars

- 3.6.1 Where pipes pass through fire rated wall, floors and partitions, pack space between with firestopping sealants in accordance with manufacturer's written instructions.
- 3.6.2 Provide firestop sealants around all pipe penetrations through rated separations.
- 3.6.3 Provide firestop collars for all combustible pipe penetrations through rated separations (where combustible piping is approved).
- 3.6.4 Intumescent insert: Flexible, elastomeric strip, two stage expansion, designed to firestop penetrations in fire-rated walls and floors and floor/ceiling assemblies.
- 3.6.5 Provide a minimum of 15 times free expansion.
- 3.6.6 Sealants shall not contain water soluble expansion ingredients.
- 3.6.7 Clean all concrete, masonry and stone penetrations of all contaminants and impurities, concrete form release agents, water repellents, oils, surface dirt and rust, scale, all old sealants and other surface treatments.

- 3.6.8 Metal surfaces shall be cleaned by wiping them with an oil- free absorbent cloth saturated with solvent such as xylol or toluol. Do not use alcohols.
- 3.6.9 Do not apply to polycarbonates or to building materials that bleed oils, plasticizers or solvents, or where sealant is not exposed to atmospheric moisture, or to surfaces which have been or will be painted.
- 3.6.10 Collars are to be installed with steel fasteners or steel expansion anchors. Low melting temperature anchors of lead, plastic or aluminum are not approved.
- 3.6.11 Installation only when temperatures are between 4 degrees Celsius (40 degrees Fahrenheit) and 37 degrees Celsius (98 degrees Fahrenheit).

3.7 Identification

- 3.7.1 Identify all piping with type of service and arrows.

3.8 Testing

- 3.8.1 Test piping according to Ontario Building Code requirements.

END OF SECTION

1 General

1.1 Reference Standards

- .1 Hot Water Tanks shall be CSA certified to the latest edition of ANSI standard Z21.10.3/CSA 4.3.
- .2 Water heaters shall comply with regulations under the Energy Efficiency Act and the current ASHRAE Standard 90.1.

1.2 Warranty

- .1 6-year limited tank warranty.
- .2 6-year limited parts warranty.

1.3 Submittals

- .1 Shop Drawings:
 - .1 Refer to Section 22 05 00 – Common Works for Plumbing.
 - .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .3 Shop drawings shall include:
 - .1 Manufacturer and model numbers
 - .2 Performance data
 - .3 Construction
 - .4 Maintenance requirements
 - .5 Conformance to above reference standards
 - .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- .2 Operation and Maintenance Data:
 - .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
 - .2 Operation and maintenance data shall be included in the maintenance manual.

1.4 Acceptable manufacturers

- .1 Manufacturers of units whose products are approved in principle, but subject to requirements of drawings and specifications are:

- .1 Giant
- .2 AO Smith
- .3 Bradford White
- .4 Hubbell

2 Products

2.1 Domestic water heaters

- .1 Water heaters shall be commercial grade electric for domestic water use of size and capacity as per schedule on drawings.
- .2 Water heaters shall be of voltage and wattage as specified on drawing schedules.
- .3 Water heaters shall meet or exceed NRCan energy efficiency standards and standby losses.
- .4 Water heaters shall have internal glass coating to protect steel tank from corrosion.
- .5 Water heater elements shall be thermostatically controlled for extended life.
- .6 Insulation foam shall be CFC free.
- .7 Water heater complete with brass drain valve and T&P valve.
- .8 UL certified at 300 psi test pressure and 150 psi working pressure.
- .9 Anode rod to be magnesium with stainless steel core.

3 Execution

3.1 Installation

- .1 Install on new concrete housekeeping pad.
- .2 Provide thermometers on inlet and outlet of each heater.
- .3 Tank to include automatic reseating pressure and temperature relief valve. Pipe to drain.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of Commercial Water Closets and Urinals.

1.2 Related Sections

- 1.2.1 Section 22 05 00 – Common Work Results for Plumbing
- 1.2.2 Section 22 05 23 – Valves for Plumbing
- 1.2.3 Section 22 07 19 – Plumbing Piping Insulation
- 1.2.4 Section 22 11 16 – Domestic Water Piping
- 1.2.5 Section 22 13 16 – Sanitary Waste and Vent Piping

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:
- .1 Ontario Building Code.
 - .2 Local Codes and Requirements including barrier free.
 - .3 CAN/CSA-B45.0-02 - General Requirements for Plumbing Fixtures.
 - .4 CAN/CSA-B125.3-12 - Plumbing Fittings.

1.4 Submittals

1.4.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings:
 - .1 Manufacturer name, type, year, serial number, number of units, capacity, and identification of related systems.
 - .2 Warranty information.
 - .3 Operation and maintenance data.

1.5 Coordination

- 1.5.1 Determine fixture quantity and location from Architectural Drawings. Refer to and provide plumbing fixtures as per schedule.
- 1.5.2 Coordinate mounting heights with Architectural Drawings and General Contractor prior to installation.
- 1.5.3 Report any discrepancies of fixtures and mounting heights between Architectural Drawings and Plumbing Drawings/Schedule/Specification to the Consultant.

1.6 Quality Assurance

- 1.6.1 Plumbing Fixtures shall be approved for intended application.
- 1.6.2 Fixtures of same type to be of one manufacturer.
- 1.6.3 Where particular fixture is identified by a manufacturers' catalogue designation, this reference is to establish standard and fixture from manufacturers listed below is equally acceptable when conforming to the same level of quality.
- 1.6.4 Finished surfaces to be clear, smooth and bright, and guaranteed not to craze, discolour or scale.
- 1.6.5 Fixtures to be ordered to suit construction schedule.

2 Products

2.1 Plumbing Fixtures

- 2.1.1 Refer to Plumbing Fixture Schedule on drawings.

2.2 Standard of Acceptance:

- 2.2.1 Vitreous China (water closets, urinals and lavatories): American Standard, Kohler, Crane
- 2.2.2 Wall Carriers: Watts, Zurn, Smith
- 2.2.3 Toilet Seats: Centoco, Moldex, Olsonite, Beneke
- 2.2.4 Flush Valves: Delta Commercial "TECK" only

3 Execution

3.1 Installation

- 3.1.1 Install as per manufacturer's recommendations.
- 3.1.2 Visible parts of wastes, strainers, traps, supplies and stops to be chrome plated.
- 3.1.3 Floor mounted water closets to be fitted with china bolt caps.
- 3.1.4 Support fixtures level and square and connect with supplies, drains, traps and vents. Provide trap easily accessible for service and cleaning.
- 3.1.5 Fixtures on outside walls to have water supplies from floor or in insulated chase.
- 3.1.6 Completely remove and reinstall existing fixtures which are indicated to remain and connect to drain, vent, cold water supply piping, to approval of authorities. Provide new seals and "O" rings.
- 3.1.7 Accurately lay out roughing-in. Offsets will not be accepted.
- 3.1.8 Provide fixtures complete with necessary trim, including traps, supplies, stops, and strainers. Any exposed trim shall be chrome.
- 3.1.9 Provide chrome plated rigid or flexible connections with screwdriver stops, reducers, and escutcheons.
- 3.1.10 Provide trap easily accessible for service and cleaning.
- 3.1.11 Install vacuum breakers on plumbing lines where contamination of domestic water may occur. Generally necessary on flush valves, and shall be integral to fixtures as per schedule.
- 3.1.12 Provide caulking around mounting face to seal with clear or white silicone.

3.2 Fixture Supports

- 3.2.1 Install wall mounted fixtures with approved wall carriers, model to suit installation.
- 3.2.2 Provide plates, brackets, wall carriers, cleats, and supports to rigidly secure fixtures in place.
- 3.2.3 Fasten wall brackets with bolts attached to double steel supporting plates.
- 3.2.4 Bolt fixture to wall through cored holes under lavatory wall flange, using chrome plated carriage bolts with integral washers, and expansion shields.
- 3.2.5 Install extra heavy chair carriers for fixtures not directly supported from floor.
- 3.2.6 Conceal vertical supports and baseplates in wall construction.
- 3.2.7 All floor mounted plumbing fixtures (such as water closet bowls) to be set in mastic.

3.3 Mounting Heights

- 3.3.1 As indicated on architectural details and drawings.
- 3.3.2 Install plumbing fixtures at the following heights unless otherwise indicated on the architectural drawings. Architectural drawings supersede heights noted below. Confirm all heights prior to installation. Where confirmation or coordination has not been done and changes are required, the Contractor shall cover all costs.
- .1 Urinals: 1 urinal installed at 432 millimetres (17 inches) to top of rim, others at 533 millimetres (21 inches) to top of rim. Coordinate with Architectural Drawings and General Contractor prior to installation.

3.4 Protection

- 3.4.1 Plumbing fixtures and trim to be covered with plywood, cardboard or heavy paper and kept protected before, during and after installation and until work is completed and accepted.
- 3.4.2 Clean fixtures and trim immediately prior to building completion.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of Commercial Lavatories and Sinks.

1.2 Related Sections

- .1 Section 22 05 00 – Common Work Results for Plumbing
- .2 Section 22 05 23 – Valves for Plumbing
- .3 Section 22 07 19 – Plumbing Piping Insulation
- .4 Section 22 11 16 – Domestic Water Piping
- .5 Section 22 13 16 – Sanitary Waste and Vent Piping

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:
- .1 Ontario Building Code.
 - .2 Local Codes and Requirements including barrier free.
 - .3 CAN/CSA-B45.0-02 - General Requirements for Plumbing Fixtures.
 - .4 CAN/CSA-B125.3-12 - Plumbing Fittings.

1.4 Submittals

1.4.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
- .4 Copy of full set of reviewed Shop Drawings:
- .5 Manufacturer name, type, year, serial number, number of units, capacity, and identification of related systems.
- .6 Warranty information.
- .7 Operation and maintenance data.

1.5 Coordination

- 1.5.1 Determine fixture quantity and location from Architectural Drawings. Refer to and provide plumbing fixtures as per schedule.
- 1.5.2 Coordinate mounting heights with Architectural Drawings and General Contractor prior to installation.
- 1.5.3 Report any discrepancies of fixtures and mounting heights between Architectural Drawings and Plumbing Drawings/Schedule/Specification to the Consultant.

1.6 Quality Assurance

- 1.6.1 Plumbing Fixtures shall be approved for intended application.
- 1.6.2 Fixtures of same type to be of one manufacturer.
- 1.6.3 Where particular fixture is identified by a manufacturers' catalogue designation, this reference is to establish standard and fixture from manufacturers listed below is equally acceptable when conforming to the same level of quality.
- 1.6.4 Finished surfaces to be clear, smooth and bright, and guaranteed not to craze, discolour or scale.
- 1.6.5 Fixtures to be ordered to suit construction schedule.

2 Products

2.1 Plumbing Fixtures

- 2.1.1 Refer to Plumbing Fixture Schedule on drawings.

2.2 Standard of Acceptance:

- 2.2.1 Vitreous China (lavatories): American Standard, Kohler, Crane
- 2.2.2 Wall Carriers: Watts, Zurn, Smith
- 2.2.3 Faucets: Delta, Chicago Faucet, Emco, American Standard, Moen Commercial
- 2.2.4 Stainless Steel Sinks: Franke/Kindred

2.2.5 Mop Sinks: Stern Williams, Fiat

3 Execution

3.1 Installation

- 3.1.1 Install as per manufacturer's recommendations.
- 3.1.2 Hot water taps to be on left side.
- 3.1.3 Visible parts of faucets, escutcheons, wastes, strainers, traps, shower heads, supplies and stops to be chrome plated.
- 3.1.4 Exposed supply tail pieces, drains and traps on handicapped fixtures are to be insulated and/or covered in conformance with the Ontario Building Code.
- 3.1.5 Swing spouts for sinks shall be sized so spout does not swing beyond sides of bowl. Spouts for sinks shall have stopper to prevent spout from swinging past back of bowl.
- 3.1.6 Water supply faucet spouts to be fitted with modulators (non-aerating).
- 3.1.7 Support fixtures level and square and connect with supplies, drains, traps and vents. Provide trap easily accessible for service and cleaning.
- 3.1.8 Fixtures on outside walls to have water supplies from floor or in insulated chase.
- 3.1.9 Completely remove and reinstall existing fixtures which are indicated to remain and connect to drain, vent, hot and cold water supply piping, to approval of authorities. Provide new seals and "O" rings. Accurately lay out roughing-in. Offsets will not be accepted.
- 3.1.10 Provide fixtures complete with necessary trim, including traps, faucets, supplies, stops, strainers and escutcheons. Any exposed trim shall be chrome.
- 3.1.11 Provide chrome plated rigid or flexible connections with screwdriver stops, reducers, and escutcheons.
- 3.1.12 Provide trap easily accessible for service and cleaning.
- 3.1.13 Provide independent threaded check valves on the hot and cold water supply lines to all thermostatic and pressure balancing faucets prior to mixing valves.
- 3.1.14 Install vacuum breakers on plumbing lines where contamination of domestic water may occur. Generally necessary on janitor sink trim and shall be integral to fixtures as per schedule.
- 3.1.15 Provide caulking around mounting face to seal with clear or white silicone.

3.2 Fixture Supports

- 3.2.1 Install wall mounted fixtures with approved wall carriers, model to suit installation.
- 3.2.2 Provide plates, brackets, wall carriers, cleats, and supports to rigidly secure fixtures in place.

- 3.2.3 Fasten wall brackets with bolts attached to double steel supporting plates.
- 3.2.4 Bolt fixture to wall through cored holes under lavatory wall flange, using chrome plated carriage bolts with integral washers, and expansion shields.
- 3.2.5 Conceal vertical supports and baseplates in wall construction.
- 3.2.6 All floor mounted plumbing fixtures (such as service sinks and mop receptors) to be set in mastic.

3.3 Mounting Heights

- 3.3.1 As indicated on architectural details and drawings.
- 3.3.2 Install plumbing fixtures at the following heights unless otherwise indicated on the architectural drawings. Architectural drawings supersede heights noted below. Confirm all heights prior to installation. Where confirmation or coordination has not been done and changes are required, the Contractor shall cover all costs.
 - .1 Wall hung lavatory: 787 millimetres (31 inches) to rim
 - .2 Barrier free wall hung lavatory: 840 millimetres (33 inches) max to top of rim, 737 millimetres (29 inches) to underside of rim front

3.4 Protection

- 3.4.1 Plumbing fixtures and trim to be covered with plywood, cardboard or heavy paper and kept protected before, during and after installation and until work is completed and accepted.
- 3.4.2 Clean fixtures and trim immediately prior to building completion.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This Section covers general requirements for the supply and installation, and testing of general heating, ventilation and air conditioning systems and associated equipment as indicated in Contract Documents.
- 1.1.2 Instructions in this section apply to and form part of all mechanical specification sections.
- 1.1.3 In general, the portions of the work are:
 - .1 Supply air and ventilation systems.
 - .2 Exhaust air systems.
 - .3 Heating.
 - .4 Air conditioning systems.
- 1.1.4 Refer to other Divisions and Specification Sections as necessary to ensure a complete and operational system is provided.
- 1.1.5 Provide mechanical components and accessories which may not be specifically shown on the Drawings or stipulated in the Specifications but are required to ensure complete and operational systems.
- 1.1.6 Mention in the Specifications or indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.
- 1.1.7 The installation shall be complete with all accessories required for a complete and operational installation.
- 1.1.8 The Specifications are an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
- 1.1.9 Contractor shall be responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective material, equipment and part of equipment and repair related damages.

1.2 General Requirements

- 1.2.1 The requirements of this section shall apply to all sections in Division 23.
- 1.2.2 All material, labour, equipment, and services required under this section shall be the full responsibility of the Mechanical Contractor including any material, labour, equipment, and services provided by their subcontractors.
- 1.2.3 Provide materials, equipment and labour to install HVAC as required by Provincial and local codes as specified herein.

1.2.4 All material, labour, equipment, and services required under this section shall be the full responsibility of the Mechanical Contractor including any material, labour, equipment, and services provided by their subcontractors.

1.2.5 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.3 Definitions

1.3.1 The following are definitions of words found in this specification and on associated drawings under this division:

1.3.2 "Concealed" hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.

1.3.3 "Exposed" mechanical work normally visible to building occupants.

1.3.4 "Provide" (and all tenses of "provide") - supply, install and connect complete.

1.3.5 "Install" (and all tenses of "install") - install and connect complete, products and services specified.

1.3.6 "Supply" shall mean supply only.

1.3.7 "Owner" or GRCA shall mean Ganaraska Region Conservation Authority.

1.3.8 "Consultant" the Consultant as defined in the Contract and/or a Sub-Consultants retained by the Consultant.

1.3.9 "Drawings and Specifications" shall mean Contract Documents.

1.3.10 "Authorities" or "Authorities having jurisdiction" shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.

1.3.11 "Work" shall mean all equipment, materials, labour, and permits to provide a complete and operational mechanical system as detailed in the drawings and specifications.

1.4 Related Sections

1.4.1 Division 01 – General Requirements.

1.4.2 Division 03 – Concrete.

1.4.3 Division 09 – Finishes.

1.4.4 Division 21 – Fire Protection.

1.4.5 Division 22 – Plumbing.

1.4.6 Division 26 – Electrical.

1.4.7 Division 23 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions.

1.5 Reference Standards

- 1.5.1 Provide work in accordance with requirements of Regulatory Agencies and conform to the latest editions and revisions of the following codes, bylaws, standards, and regulations including but not limited to:
- .1 Ontario Building Code.
 - .2 Local Building Bylaws.
 - .3 Associated Air Balance Council (AABC).
 - .4 Air Moving and Conditioning Association (AMCA).
 - .5 American National Standards Institute (ANSI).
 - .6 American Standards Association (ASA).
 - .7 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
 - .8 The American Society of Mechanical Engineers (ASME).
 - .9 American Society of Testing and Materials (ASTM).
 - .10 Canadian General Standards Board (CGSB).
 - .11 Canadian Standards Association (CSA).
 - .12 Electrical & Electronic Manufacturer's Association of Canada (EEMAC).
 - .13 National Environmental Balancing Bureau (NEBB).
 - .14 National Fire Protection Association (NFPA).
 - .15 Sheet Metal & Air Conditioning Contractors National Association Inc. (SMACNA).
 - .16 Underwriter's Laboratories of Canada Ltd (ULC).
 - .17 Ontario Occupational Health and Safety Act.
- 1.5.2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.
- 1.5.3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.
- 1.5.4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

1.6 Intent

- 1.6.1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.
- 1.6.2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.
- 1.6.3 Supply all labour, equipment, and materials necessary to install a complete and operational mechanical system described herein and shown on the drawings.
- 1.6.4 It is the intent of these drawings and specifications to provide for a mechanical installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.
- 1.6.5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.
- 1.6.6 All work must be done by qualified, certified and experienced persons in such line of work. Trade certificates must be available on demand.
- 1.6.7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.
- 1.6.8 This Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.
- 1.6.9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation and finish.

1.7 Permits and Fees

- 1.7.1 Apply for, obtain, and pay for all permits, Notice of Project, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes.
- 1.7.2 Coordinate all required inspections and give necessary notice to all authorities.
- 1.7.3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction for all applicable disciplines.

1.8 Contract Breakdown

- 1.8.1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.
- 1.8.2 Breakdown shall include but not be limited to:
 - .1 Mobilization and shop drawing submission.

- .2 Demolition.
- .3 Plumbing (Division 22).
- .4 HVAC Equipment – Supply.
- .5 HVAC Equipment – Installation.
- .6 Gas Piping.
- .7 Sheet Metal.
- .8 Insulation.
- .9 Testing, Startup & Training.
- .10 Balancing.
- .11 Close-out Submittals / Manuals & As-Built Drawings.

1.8.3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.

1.9 Shop Drawings

1.9.1 Within 30 days of award, the Contractor shall submit shop drawings of all equipment for the project.

1.9.2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in PDF format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5x11". 11x17" will be acceptable where appropriate for content and scale.

1.9.3 Submittals shall contain but not be limited to:

- .1 Construction information.
- .2 Product data.
- .3 Performance data including performance curves.
- .4 Acoustical sound power data.
- .5 Dimensional layout and clearances.
- .6 Mounting arrangements.
- .7 Certification of compliance to applicable codes.
- .8 Operating and Maintenance information.
- .9 Wiring, single line and schematic diagrams (where applicable).

- 1.9.4 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable material.
- 1.9.5 Prior to submission to the Consultant, the General and Mechanical Contractor shall review all shop drawings. By this review the Contractor represents that they have determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that they have checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents.
- 1.9.6 The Contractor's review of each shop drawing shall be indicated by his approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Mechanical Contractor.
- 1.9.7 Review comments from the Consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval within one (1) week.
- 1.9.8 Review of the shop drawings by the Consultant does not relieve the Contractor or his Supplier of the responsibility to provide the correct and complete equipment, material or installation.
- 1.9.9 Keep one complete set of shop drawings at the job site during construction.
- 1.9.10 Include stamped reviewed shop drawings in the Maintenance Manuals.

1.10 Product Delivery, Handling and Storage

- 1.10.1 Within two (2) weeks from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.
- 1.10.2 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- 1.10.3 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

1.11 Construction Meetings

- 1.11.1 The Mechanical Contractor shall attend all site meetings unless otherwise pre-approved.
- 1.11.2 Sub-trades shall attend site meetings as requested or as required.

1.12 Job Condition

- 1.12.1 Visit site and examine existing conditions which may affect work of this Division.
- 1.12.2 Examine all Contract Documents to ensure that work of this Division may be satisfactorily completed.

1.12.3 Notify Consultant upon discovery of conditions which adversely affect work of this division. No allowance will be made after letting of contract for any expenses incurred through failure to do so.

1.12.4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications unless exceptions are specifically noted in the Bid.

1.13 Warranty

1.13.1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.

1.13.2 Make submissions necessary to register product warranties to the benefit of the Owner.

1.13.3 Submit to Consultant, prior to Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one (1) year or offering greater benefits than required in specifications and in the Owner's name.

1.14 As-Built Drawings

1.14.1 Maintain accurate, neat, and clean As-Built drawings on an on-going basis during construction to be reviewed periodically by the Consultant during construction.

1.14.2 As-Built drawing mark-ups shall be made available at every site meeting or inspection.

1.14.3 As-Built drawings shall include but not be limited to final location of any access doors on same for future service requirements.

1.14.4 Upon completion of the work, submit to the Consultant for review, one (1) complete set of clear, legible, certified as-built drawings.

1.14.5 As-Built drawings shall be kept up to date on an ongoing basis during construction for periodic review by the Consultant. As-Built drawings shall always be kept in the same location on site known to the Consultant.

1.14.6 Contractors shall certify that final reproducible As-Built drawings to be correct by notation and signature on the drawings.

1.14.7 As-Built drawings shall precisely identify the configuration, size and location of all systems and equipment installed under this Division, including but not limited to:

1.14.8 Controls: controllers, panels, devices, relay cabinets, sensors, thermostats, valve operators, wiring and conduit runs complete with legend.

1.14.9 Miscellaneous: actual room names and numbers, schematic diagrams, riser diagrams.

1.14.10 Submit to the Consultant for review, one (1) complete set of clear, legible, certified as-built drawings.

1.14.11 As-built drawings shall be submitted to the Consultant.

1.15 Reports

1.15.1 Provide the following reports upon completion of work by certified Contractors for review and approval by the Consultant:

- .1 Equipment Start-Up Reports.
- .2 Piping Pressure Test Reports (Gas, Hot Water Heating, Domestic).
- .3 TSSA Report (where applicable).
- .4 HVAC Systems Cleaning Report (where applicable).
- .5 Balancing Report.
- .6 Other applicable equipment startup reports and test sheets certified by the manufacturer or a qualified technician.
- .7 Demonstration Reports/Logs.

1.15.2 All reports shall be dated and signed by the Technician who performed the start-up and/or tests.

1.16 Operation and Maintenance Manuals

1.16.1 Provide the Owner with two (2) indexed, hard cover maintenance manual plus one (1) electronic copy on labeled USB. Manuals shall contain and be tabbed in the following order:

- .1 Table of Contents.
- .2 Contractor's, Manufacturer's and Supplier's Contact Information.
- .3 Warranty Letter.
- .4 Valve schedule.
- .5 Colour coding charts for access areas.
- .6 Reports as specified herein and as applicable.
- .7 Shop drawings (stamped reviewed by Consultant).
- .8 Equipment maintenance instructions and manuals.
- .9 Controls as-built drawings.
- .10 As-Built drawings.

1.16.2 Submit one (1) complete copy to the Consultant for review and approval. Revise based on any comments and resubmit all copies and electronic copy to Consultant.

1.16.3 A hard copy of the maintenance manual shall be provided immediately upon completion of startup and testing for review by the Consultant and for use during the Demonstration.

The Manual shall include all test and start-up reports. Substantial Completion will not be awarded until the manual is submitted and accepted.

1.16.4 The Consultant will review the manual and provide any comments or changes required. The Contractor shall revise and finalize all manuals within three (3) weeks.

1.16.5 Substantial Performance will not be granted until the final hard copy and electronic copy of the complete manual have been submitted by the Contractor and reviewed and accepted by the Consultant.

1.16.6 Submit a draft copy of the manual to the Consultant for review prior to final submission of final copy.

1.16.7 Provide two (2) final hard copies and one (1) electronic copy in PDF format to the Consultant for final acceptance

1.17 Testing and Startup

1.17.1 Test and startup all equipment and work.

1.17.2 Fully coordinate all testing and startups with all trades, the Consultant, and authorities having jurisdiction.

1.17.3 The Controls Contractor shall be present during all equipment start-ups. Coordinate scheduling with Controls Contractor.

1.17.4 Provide adequate notice to all parties.

1.18 Demonstration

1.18.1 Demonstrate to the Owner on proper operation of the system.

1.18.2 The Contractor shall arrange for all necessary personnel and equipment specialists to be in attendance for purposes of demonstration.

1.18.3 Provide instruction by a manufacturer's representatives as required to fully demonstrate the systems.

1.18.4 The Contractor shall arrange and coordinate a demonstration for all equipment including any Owner supplied equipment. Coordination for Owner supplied equipment shall include arrangement with supplier start-up technicians.

1.18.5 Demonstration shall include but not be limited to:

- .1 Demonstration in the normal, abnormal and emergency operation of all systems provided under this Division.
- .2 Review of all necessary maintenance procedures, including winterization, of all systems provided under this Division.
- .3 Provision of a documented maintenance program covering all systems provided or modified under this contract.

- .4 Review of all close-out documentation including complete maintenance manuals and As-Built drawings.

1.18.6 Prepare a Demonstration Agenda and Log for signature by all Participants. Submit to Consultant and include in Manuals.

1.18.7 Complete and accepted maintenance manuals and As-Built drawings shall be submitted and available for use during the Demonstration.

1.19 Substantial Completion and Performance

1.19.1 Substantial completion and performance shall be determined and awarded by the Consultant.

1.19.2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:

- .1 Fire Dampers and Fire Stopping.
- .2 TSSA inspection and acceptance.
- .3 System Testing and Startups including reports.
- .4 Balancing including report.
- .5 Maintenance Manuals.
- .6 As-Built Drawings.
- .7 Demonstration.

1.19.3 Prior to Substantial Performance submit one (1) complete set of clear, legible, red-lined certified as-built drawings. The contractor shall certify and sign the completed As-built Drawings.

1.19.4 Substantial performance will not be granted until the As-Built drawings have been submitted to the Consultant.

1.20 Warranty

1.20.1 Provide a one (1) year full parts and labour warranty for the new system from date of substantial completion.

1.20.2 Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

2 Products

2.1.1 Materials

2.1.2 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.

- 2.1.3 Major equipment shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.
- 2.1.4 The same manufacturer shall be used for types of equipment used in similar applications.
- 2.1.5 It is the responsibility of the Contractor to store and protect materials supplied by this scope.
- 2.1.6 Materials shall be stored in original containers.
- 2.1.7 Submit to the Consultant and the Owner, current MSDS Sheets for any products being used on the job site where they exist.
- 2.1.8 Remove and dispose of all redundant materials and garbage from site.
- 2.1.9 Supply anchor bolts and templates for installation by other Divisions.

2.2 Selected Products and Equivalents

- 2.2.1 Sections within Division 23 list "Standard of Acceptance" which must meet characteristics of the specified equipment and products for each section.
- 2.2.2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.
- 2.2.3 Any acceptable manufacturer from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified and/or shown and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions (i.e. electrical changes).
- 2.2.4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.
- 2.2.5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 Quality of Product

- 2.3.1 All products provided shall be listed or approved by relevant authorities.
- 2.3.2 All products shall be new, unless otherwise specified.
- 2.3.3 If products specified are not listed and/or approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- 2.3.4 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.4 Product Finishes

- 2.4.1 Shop drawings shall indicate finishes. Use standard finish unless otherwise specified.

- 2.4.2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

2.5 Motors

- 2.5.1 Provide high efficiency motors for HVAC equipment as specified.
- 2.5.2 If delivery of specified motor will delay delivery or installation of any equipment, install a motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- 2.5.3 Motors under 373W, (1/2hp): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.
- 2.5.4 Motors 373W, (1/2hp) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, voltage as indicated.

2.6 Belt Drives

- 2.6.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- 2.6.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- 2.6.3 For motors under 7.5kW (10hp): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- 2.6.4 For motors 7.5kW (10hp) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- 2.6.5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- 2.6.6 Motor slide rail adjustment plates to allow for centre line adjustment.
- 2.6.7 Provide sheave changes as required for final air balancing

2.7 Guards

- 2.7.1 Provide guards for unprotected drives.
- 2.7.2 Guards for belt drives:
- .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm (18 gauge) thick sheet metal tops and bottoms.
 - .3 40mm (1-1/2") diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.

2.7.3 Provide means to permit lubrication and use of test instruments with guards in place.

2.7.4 Install belt guards to allow movement of motors for adjusting belt tension.

2.7.5 Guard for flexible coupling:

.1 "U" shaped, minimum 106 mm (16 gauge) thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

2.7.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 20 mm (3/4") mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

2.8 Escutcheons

2.8.1 On pipes and ductwork passing through walls, partitions, floors and ceilings in finished areas.

2.8.2 Chrome or nickel-plated brass, or Type 302 stainless steel, one piece type with set screws.

2.8.3 Outside diameter to cover opening or sleeve.

2.8.4 Inside diameter to fit around finished pipe.

2.9 Spare Parts

2.9.1 Provide spare parts as specified under this Division.

2.9.2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

2.10 Special Tools

2.10.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

3 Execution

3.1 General

3.1.1 Apply for permit before beginning any work. Have drawings approved for construction by authorities having jurisdiction or local agencies prior to beginning work.

- 3.1.2 Have the entire installation inspected, at various stages where required, to ensure approval at completion of project.

3.2 Site examination

- 3.2.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.
- 3.2.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.
- 3.2.3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.3 Interference and Coordination Drawings

- 3.3.1 Examine the drawings and all divisions of the specifications.
- 3.3.2 Prepare interference and equipment layout drawings to ensure all components will be properly accommodated within the spaces provided.
- 3.3.3 Lay out the work and equipment with due regard to architectural, structural and electrical features, and service requirements.
- 3.3.4 Submit interference drawings to the Consultant.
- 3.3.5 Before commencing any work, obtain a ruling from the Consultant if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

3.4 Separation of Services

- 3.4.1 Contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- 3.4.2 All pipes, ductwork and wiring shall be supported from permanent building structure. Use of other services for support is not permitted.

3.5 Workplace Safety

- 3.5.1 The workplace must be kept safe at all times.
- 3.5.2 Conform to all ministries of labour, and health and safety regulations at all times.
- 3.5.3 Use ladders and proper techniques as approved by the Ministry of Labour to perform all work.
- 3.5.4 Cover all holes and openings, and provide barriers around hazards, etc. to ensure occupants and workers are not at risk.
- 3.5.5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner's representative or Consultant or rectify the situation immediately.
- 3.5.6 Report any hazards or concerns to the Owner's representative immediately.

3.5.7 Conform to Owner's safety requirements and construction regulations.

3.6 Temporary Requirements

3.6.1 All temporary requirements to complete mechanical work during construction shall be the responsibility of the Mechanical Contractor except temporary power or water.

3.7 Location of Equipment

3.7.1 Approximate distances and dimensions may be obtained by scaling off the drawings. Figured dimensions shall govern over scaled dimensions.

3.7.2 Equipment locations shown on the drawings are approximate. Locations may be revised to suit construction and equipment arrangements provided design intent is not jeopardized and there is no additional cost to the Owner.

3.8 Mounting Heights

3.8.1 Mounting height of equipment is from finished floor to equipment unless otherwise specified or indicated. Coordinate with block coursing if applicable.

3.8.2 Where mounting heights are not indicated on the drawings, obtain verification from the Consultant before proceeding.

3.9 Welding, Grinding, Noisy Work, Odours

3.9.1 No welding, grinding, other noisy work or work generating odours shall be done during regular operating/school hours.

3.9.2 All above work shall be done after hours or on weekends outside of regular hours.

3.9.3 Submit hot work permit prior to any welding.

3.10 Repairs, Cutting and Restoration

3.10.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.

3.10.2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

3.10.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

3.10.4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.11 Painting

3.11.1 Refer to other Divisions for Painting unless otherwise specified herein.

- 3.11.2 Apply at least 1 coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- 3.11.3 Prime and touch up marred finished paintwork to match original.
- 3.11.4 Paint all new concrete pads for mechanical equipment with 2 coats of yellow paint on all sides and top 12" (300mm) edge.
- 3.11.5 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed, painted and touched up.

3.12 Concealment

- 3.12.1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls in finished areas.
- 3.12.2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit parallel to building lines, tight to roof deck and down columns.

3.13 Clearances and Accessibility

- 3.13.1 Install all work for easy access for adjustment, operation, service, and maintenance.
- 3.13.2 Maintain clearances for all equipment as per local codes and manufacturer's instructions.
- 3.13.3 Access panels shall be Acudor or equivalent with concealed hinges and screwdriver locking device.
- 3.13.4 Provide access panels of adequate size as required to access equipment and components in concealed areas. Do not install access doors in specialty walls or ceilings.
- 3.13.5 Provide fire rated access doors where installed in fire separations to match rating of separation.
- 3.13.6 Install all services in exposed areas so that a minimum head clearance of 2200 millimetres (88 inches) is maintained.

3.14 Equipment and System Protection

- 3.14.1 Protect equipment and materials from damage in storage and on site before, during, and after installation until final acceptance.
- 3.14.2 Protect equipment and system openings from dust and debris with appropriate covers that will withstand through the construction.
- 3.14.3 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant and the Owner at no expense to the Owner.

3.15 Supports

- 3.15.1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all equipment, ductwork, piping, and all other work in Division 23.
- 3.15.2 All supports must be securely mounted to structures.

3.16 Cleaning

- 3.16.1 Arrange for delivery and installation of Owner supplied equipment where specified in this Division.
- 3.16.2 Connect to equipment supplied by the Owner and make operable.

3.17 Identification and Labeling

- 3.17.1 All equipment, valves, panels and devices shall be labeled under this Division.

3.18 TSSA Inspection

- 3.18.1 Prior to final completion of the project, this Contractor shall make application, arrange, and pay for a TSSA Inspection of all piping systems and equipment installations, including, but not limited to refrigeration, fuel piping, heating plant, and associated equipment installed under the contract.
- 3.18.2 Provide a copy of the TSSA Report in the maintenance manuals for each system.

3.19 Field Review and Deficiencies

- 3.19.1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.
- 3.19.2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.
- 3.19.3 The Contractor shall correct all deficiencies within the work period prior to the next review.
- 3.19.4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.
- 3.19.5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

3.20 Operation and Maintenance Manuals

- 3.20.1 Provide two (2) 8½" x 11", 3 ring type catalogue binders, labeled front and spine, with plastic tab dividers and Table of Contents. Also provide one (1) complete manual in electronic PDF format on labeled USB.
- 3.20.2 Manufacturer's data section is to be indexed and ordered to exactly match the sections of the specifications. Each section of the manufacturer's data section is to include an up to date copy of the equipment schedule for that section. The schedule is to be revised to suit all addenda, change orders and field changes, as well as manufacturers and model numbers matching the equipment supplied.
- 3.20.3 Assemble or develop complete and correct documentation for the operation and maintenance information for equipment and systems provided.
- 3.20.4 Assemble or develop copies of all certified shop drawings and material required to complete the documentation. This generally includes but is not limited to the following:
- .1 Table of Contents.
 - .2 Contractor's and Subcontractor's Information.
 - .3 Contractor's, Manufacturer's and Supplier's Contact Information.
 - .4 Warranty Letter.
 - .5 Valve schedule.
 - .6 Reports:
 - .1 Equipment Start-Up Reports.
 - .2 Piping Pressure Test Reports (Gas, Hot Water Heating, Domestic).
 - .3 TSSA Report.
 - .4 Balancing Report.
 - .5 Other applicable equipment startup reports and test sheets certified by the manufacturer or a qualified technician.
 - .6 Demonstration Reports/Logs, including a copy of the signed and dated Demonstration Log.
 - .7 Shop drawings (stamped reviewed by Consultant).
 - .8 Maintenance instructions, requirements and schedule.
 - .9 Training Log.
 - .10 As-Built drawings.

END OF SECTION

1 General

1.1 Summary

1.1.1 This section covers the common installation requirements for HVAC.

1.2 Related Sections

1.2.1 Section 23 05 00 – Common Work Results for HVAC General Requirements.

1.2.2 Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

1.2.3 Section 23 31 00 – Ductwork.

1.2.4 Section 23 33 00 - Duct Accessories.

1.3 Reference Standards

1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code.
- .2 Regulations of Province, City, or local authority having jurisdiction.
- .3 National Fire Protection Association (NFPA).
- .4 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- .5 Standard method of fire tests of firestop system CAN4-S115-M85.
- .6 UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (ULc1479).
- .7 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by FM and certified by UL or ULC for the service application.
- .8 Sheet Metal & Air Conditioning Contractors National Association Inc. (SMACNA).

1.4 Submittals

1.4.1 Shop Drawings

- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .3 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.

- .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- .5 Firestop materials: Submit service limitations, installation instructions, UL certification and FM listing.
- .6 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, UL certification and FM listing.

1.4.2 Closeout Submittals

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Warranty information.

2 Products

2.1 Flashing

- 2.1.1 Steel Flashing: 26-gauge galvanized steel.
- 2.1.2 Aluminum flashing: 26-gauge sheet aluminum.

2.2 Sleeves

- 2.2.1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
 - .1 Schedule 40 steel pipe.
- 2.2.2 Sleeves with annular fin continuously welded at midpoint:
 - .1 Where sleeve extends above finished floor.
 - .2 Through fire rated walls and floors.
- 2.2.3 Sizes: minimum 6mm (1/4") clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.
- 2.2.4 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25mm (1") above other floors.
- 2.2.5 Fill voids around pipes:

- .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
 - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.
- 2.2.6 Provide minimum 20-gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm clearance all around or to the requirements of the authority having jurisdiction. Seal at all as indicated.
- 2.2.7 Pipes through walls and floor: form with steel pipe, schedule 40.
- 2.2.8 Round Ducts: form with galvanized steel.
- 2.2.9 Rectangular Ducts: form with galvanized steel.

2.3 Fire Stopping

- 2.3.1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.
- 2.3.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- 2.3.3 Do not use cementitious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.
- 2.3.4 Insulated pipes and ducts; ensure integrity of insulation and vapour barrier at fire separation.
- 2.3.5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- 2.3.6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- 2.3.7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
- 2.3.8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- 2.3.9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.

- 2.3.10 Firestop Sealants and collars to provide mechanical fire protection for penetrations utilizing PVC or CPVC pipe, PVC conduit, polyethylene conduit or pipe, other non-metallic pipes, cables, and combustible pipe insulations as the penetrant.
 - 2.3.11 Intumescent insert: Flexible, elastomeric strip, two stage expansion, designed to firestop penetrations in fire-rated walls and floors and floor/ceiling assemblies.
 - 2.3.12 Provide a minimum of 15-time free expansion.
 - 2.3.13 Contain no water-soluble expansion ingredients.
 - 2.3.14 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
 - 2.3.15 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.
 - 2.3.16 Install material and components in accordance with ULC certification, manufacturer's instructions and local authority.
 - 2.3.17 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.
 - 2.3.18 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
 - 2.3.19 Standard of Acceptance:
 - .1 Fryesleeve Industries Inc.,
 - .2 General Electric Pensil Firestop Systems,
 - .3 International Protective Coatings Corp.,
 - .4 Rectorseal Corporation (Metacaulk),
 - .5 Proset Systems,
 - .6 3M,
 - .7 AD Systems,
 - .8 Hilti.
 - 2.3.20 Ensure firestop manufacturer representative performs on-site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.
- 2.4 Roof Jacks and Vent Caps**
- 2.4.1 Aluminum: Compatible with SBS torch down roofing materials and methods, 12 gauge aluminum, 12mm round flange, oversize tube neck TIG welded to flange, aluminum flashing cap.

3 Execution

3.1 Flashing

- 3.1.1 Where mechanical equipment passes through weather or waterproofed walls and roofs, roofing, flashing and counter flashing shall be provided under this Division.
- 3.1.2 Curbs must be minimum 600mm (24") higher than the top of the roof, unless noted otherwise. Flash and counterflash with galvanized steel, to make waterproof.

3.2 Sleeves

- 3.2.1 Provide sleeves required for equipment, including openings required for placing equipment.
- 3.2.2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.
- 3.2.3 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with non-combustible insulation and fire rate as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.
- 3.2.4 Extend sleeves through potentially wet floors 50mm (2") above finished floor level. Caulk sleeves full depth and provide floor plate.
- 3.2.5 Where ductwork passes through floor, ceiling or wall, close off space between duct and sleeve with non-combustible insulation. Provide tight fitting metal caps on both sides.
- 3.2.6 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with non-combustible insulation or approved non-combustible insulation, fire rated as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.
- 3.2.7 Install chrome plated escutcheons where piping passes through finished surfaces.
- 3.2.8 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

3.3 Firestop Sealants and Collars

- 3.3.1 Clean all concrete, masonry and stone penetrations of all contaminants and impurities, concrete form release agents, water repellents, oils, surface dirt and rust, scale, all old sealants and other surface treatments.
- 3.3.2 Metal surfaces shall be cleaned by wiping them with an oil- free absorbent cloth saturated with solvent such as xylol or toluol. Do not use alcohols.
- 3.3.3 Do not apply to polycarbonates or to building materials that bleed oils, plasticizers or solvents, or where sealant is not exposed to atmospheric moisture, or to surfaces which have been or will be painted.
- 3.3.4 Collars are to be installed with steel fasteners or steel expansion anchors. Low melting temperature anchors of lead, plastic or aluminum are not approved.

3.3.5 Installation only when temperatures are between 4°C (40°F) and 37°C (98°F).

3.4 Roof Jacks

3.4.1 Provide roof jacks as required, and in compliance with the roofing specifications. Generally, SBS torch down roofing requires aluminum roof jacks. Conventional bituminous roofing accepts lead or aluminum roof jacks.

3.4.2 Flash pipes projecting above finished roof surface with approved material.

3.4.3 Gas pipes projecting through the roof shall be provided with approved roof jack and flashing flange.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of Hangers and Supports for HVAC piping and equipment.
- 1.1.2 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade and provide for expansion and contraction.
- 1.1.3 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- 1.1.4 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- 1.1.5 Ductwork:
 - .1 rectangular ductwork with cross sectional area 0.55 m² (6 ft²) and greater.
- 1.1.6 Equipment:
 - .1 vibration isolated equipment,
 - .2 rigidly or gravity supported equipment.

1.2 Related Sections

- 1.2.1 Section 23 05 00 – Common Work Results for HVAC General Requirements
- 1.2.2 Section 23 05 15 - Common Installation Requirements for HVAC Pipework
- 1.2.3 Section 23 31 00 - Ductwork
- 1.2.4 Section 23 33 00 - Duct Accessories

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:
 - .1 Ontario Building Code.
 - .2 Regulations of Province, City, or local authority having jurisdiction.
 - .3 National Fire Protection Association (NFPA).
 - .4 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 "HVAC Applications, Seismic and Wind Restraint Design".
 - .5 Standard method of fire tests of firestop system CAN4-S115-M85.

- .6 UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (ULc1479).
- .7 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by FM and certified by UL or ULC for the service application.
- .8 Sheet Metal & Air Conditioning Contractors National Association Inc. (SMACNA).

1.4 Submittals

1.4.1 Shop Drawings:

- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .3 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Warranty information.

2 Products

2.1 General

- 2.1.1 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- 2.1.2 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- 2.1.3 Obtain approval prior to drilling for inserts and supports for piping systems.
- 2.1.4 Obtain approval prior to using percussion type fastenings.

2.1.5 Use of other piping or equipment for hangers and supports is not permitted.

2.1.6 Use of perforated band iron, wire or chain as hangers is not permitted.

2.2 Inserts

2.2.1 Inserts shall be malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.

2.2.2 Size inserts to suit threaded hanger rods.

2.3 Suspended Mechanical Equipment

2.3.1 Suspend mechanical equipment from structure with adjustable length steel rods, threaded both ends or continuous threaded, complete with lock nuts on both ends. Provide spreader beams to distribute weight.

2.3.2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

2.3.3 Provide anchors, bolts and accessories required for mounting and anchoring equipment.

2.4 Duct Hangers and Supports

2.4.1 Hanger Rods

.1 Hanger rods shall be galvanized steel, threaded both ends or continuous threaded, complete with lock nuts on both ends.

2.4.2 Hangers:

.1 Concealed - Round Duct: Galvanized steel band iron.

.2 Concealed - Rectangular Duct: Galvanized steel band iron or rolled angle and 9mm rods.

.3 Exposed - Round Duct: continuous galvanized steel band iron secured to single 9mm (1/4") hanger rod.

2.4.3 Wall Supports: Galvanized steel band iron or fabricated angle brackets.

.1 Vertical Support at Floor: Rolled angle.

.2 Support rectangular ducts 1530mm (60") and less in width or depth with 25mm (1") wide 1.3mm (18 gauge) or heavier galvanized bent hangers fastened to the side and bottom of the duct at a spacing of not greater than 2240mm (88") using bolts, rivets, or metal screws.

.3 Support duct over 1530mm (60") in width or depth with 10mm (1/4") vertical hanger rods, bolted to galvanized steel angles at 610mm (24") intervals.

- .4 Support round ducts up to 910mm (36") with 25mm (1") wide, 1.0mm (20 gauge) thick single galvanized steel straps and 9mm (3/8") diameter rods.
- .5 Support round ducts over 910mm (36") in width with 25mm (1") wide, 1.6mm (16 gauge) thick double, horizontally split galvanized steel strap and two (2) 9mm (3/8") diameter rods. Space support at 3600mm (12'-0") intervals.
- .6 Where vertical ducts pass through floors, support with galvanized steel angles riveted and/or bolted to the cut and bearing on the structure.

2.5 Pipe Hangers and Supports

2.5.1 Pipe hangers shall wrap around outside of insulation for all sizes, except in limited ceiling clearance applications. Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.

2.5.2 Hangers:

- .1 Pipe Sizes 13mm (1/2") to 38mm (1 1/2"): Adjustable wrought steel ring, or plated strap.
- .2 Pipe Sizes 50mm (2") and over: Adjustable wrought steel clevis.
- .3 Hanger Rods: Provide steel hanger rods, threaded both ends or continuous threaded, complete with lock nuts on both ends.
- .4 Saddles shall wrap around the outside of the insulation for all piping and be sized accordingly.
- .5 In limited ceiling clearance applications for pipe sizes up to and including 38mm (1 1/2"), split ring standoff hangers or adjustable band hangers shall be acceptable. Obtain pre-approval from Consultant prior installation on site.

2.5.3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 150mm (6 ") and over.

2.5.4 Wall Support:

- .1 Pipe Sizes to 75mm (3"): Cast iron hook, or fabricated bracket of 1"x1"x1/4" angle bar.
- .2 Pipe Sizes 100mm (4") and over: Welded steel bracket and wrought steel clamp.

2.5.5 Vertical Support:

- .1 Steel riser clamp.

2.5.6 Floor Support:

- .1 Fabricated stand and pipe clamp or saddle.

2.6 Equipment Bases and Curbs

- 2.6.1 Equipment bases and curbs shall be provided by the Mechanical Contractor under this Division.
- 2.6.2 Equipment bases shall be formed concrete housekeeping pads minimum 100mm (4") high, extended 150mm (6") minimum beyond machinery bedplates.
- 2.6.3 Provide mounting plates to be formed into pads.
- 2.6.4 Curbs shall be formed concrete minimum 100mm (4") high around all ducts and pipes through mechanical room floors.

3 Execution

3.1 General

- 3.1.1 Use of other piping or equipment for hanger supports is not permitted.
- 3.1.2 Use of perforated band iron, wire or chain as hangers is not permitted.

3.2 Inserts

- 3.2.1 Inserts shall be malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.
- 3.2.2 Size inserts to suit threaded hanger rods.
- 3.2.3 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- 3.2.4 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100mm (4") or ducts over 1500mm (60") wide.
- 3.2.5 Expansion bolt type connections will be approved under certain conditions. Obtain approval from the Consultant. Generally, pipe 50mm (2") or smaller, and ducts less than 600mm x 300mm (24" x 12") will be approved, subject to adequate number of support points.

3.3 Suspended Mechanical Equipment

- 3.3.1 Suspend mechanical equipment from structure with adjustable length steel rods, threaded both ends or continuous threaded, complete with lock nuts on both ends. Provide spreader beams to distribute weight.
- 3.3.2 The threaded rod shall be secured to trusses or to steel angle bars spanning the building trusses. The steel spanning bars are to be provided by this Division.
- 3.3.3 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- 3.3.4 Provide anchors, bolts and accessories required for mounting and anchoring equipment.

- 3.3.5 Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

3.4 Duct Hangers and Supports

3.4.1 Hanger minimum sizes:

- .1 Up to 750mm (30") wide or 330mm (13") diameter: 1¼" x 16 gauge at 3m (10ft) spacing.
- .2 750mm (30") to 1200mm (48") wide or up to 450mm (18") diameter: 1½" x 16 gauge at 3m (10ft) spacing.
- .3 Over 1200mm (48") wide: 1½" x 16 gauge at 3m (10ft) spacing.

3.4.2 Horizontal duct on wall supports minimum sizes:

- .1 Up to 450mm (18") wide: 1½" x 16 gauge or 1" x 1" x 1/8" at 3m (10') spacing.
- .2 450mm (18") to 1000mm (40") wide: 1½" x 1½" x 2" at 1.8m (6') spacing.

3.4.3 Vertical duct on wall supports minimum sizes:

- .1 Riveted or screwed to duct:
 - .1 Up to 1500mm (60") wide: 1½" x 1½" x 3".
 - .2 Over 1500mm (60") wide: 2" x 1/8".

3.4.4 Vertical duct floor supports minimum sizes:

- .1 Riveted or screwed to duct:
 - .1 Up to 1500mm (60") wide: 1½" x 1½" x 1/8".
 - .2 Over 1500mm (60") wide: 2" x 2" x 1/8".

3.5 Pipe Hangers and Support

3.5.1 Fasten hangers and supports to building structure or inserts in concrete construction.

3.5.2 Support horizontal metallic piping as follows:

Nominal Pipe Size	Distance Between Supports	Hanger Rod Diameter
13mm (½")	1.8m (6')	9.5mm (3/8")
19 to 38mm (¾" to 1½")	2.4m (8')	9.5mm (3/8")
50 to 63mm (2" to 2½")	3.0m (10')	9.5mm (3/8")
63 to 100mm (3" to 4")	3.6m (12')	13mm (½")

150 to 300mm (6" to 12")	4.3m (14')	13mm (½")
350 to 450mm (14" to 18")	5.0m (16')	25mm (1")

- 3.5.3 Install hangers to provide minimum 32mm (1¼") clear space between finished covering and adjacent work.
- 3.5.4 Place a hanger within 300mm (12") of each horizontal elbow.
- 3.5.5 Use hangers which are vertically adjustable 38mm (1½") minimum after piping is erected.
- 3.5.6 Support vertical piping at every floor.
- 3.5.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- 3.5.8 Where practical, support riser piping independently of connected horizontal piping.
- 3.5.9 Exposed piping, with less than 2.6m (8½ ft) clearance to floors shall be provided with two times the number of hangers normally required. Spacing shall be equal or adjusted for maximum benefit.
- 3.5.10 Provide copper plated hangers and supports for copper piping or provide nonferrous packing between hanger support and piping.
- 3.5.11 Large capacity piping with vibration potential shall not be suspended from any building structure that will allow transfer of vibrations to the occupied spaces.
- 3.5.12 Obtain preapproval from Consultant for the use of split ring standoff hangers or adjustable band hangers for use in limited ceiling clearance applications only. Hanger shall not be required to wrap around outside of insulation in this application only.

3.6 Equipment Bases and Curbs

- 3.6.1 Coordinate installation of concrete housekeeping pads for all new floor mounted equipment with supplied equipment.
- 3.6.2 Pads shall be 100mm (4") high minimum, extended 150mm (6") minimum beyond machinery bedplates. Obtain templates, anchor bolts and accessories required for mounting and anchoring equipment.
- 3.6.3 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- 3.6.4 Provide rigid anchors for pipes immediately after vibration connections to equipment.
- 3.6.5 Provide curbs around all ducts and pipes through mechanical room floors.
- 3.6.6 Paint all sides and top 12" (300mm) edge of concrete pads with two (2) coats of yellow paint.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of vibration isolation materials and components, and measures for HVAC piping and ductwork. This includes inertia bases and vibration isolators.
- 1.1.2 Supply vibration isolation equipment and materials by one supplier.
- 1.1.3 Ensure equipment is sufficiently rigid for isolator point loading.
- 1.1.4 All elastomer elements within the restraint shall be bridge bearing neoprene.

1.2 Related Sections

- 1.2.1 Division 03 – Concrete
- 1.2.2 Section 23 05 00 Common Work Results for HVAC
- 1.2.3 Section 23 05 29 Hangers and Supports for HVAC
- 1.2.4 Section 23 31 13 Ductwork
- 1.2.5 Section 23 33 00 Duct Accessories

1.3 Reference Standard

- 1.3.1 Provide and install mechanical equipment so that Average Noise Criteria curves, as outlined in ASHRAE Guide, are not exceeded.

1.4 Description

- 1.4.1 Provide vibration isolation on all motor driven equipment with motors of 0.37 kW and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 0.37 kW, provide neoprene grommets at the support points.
- 1.4.2 Coordinate with Section 23 33 00 Duct Accessories for flexible connections for all ductwork connections to fans or plenums.
- 1.4.3 For all electrical connections to isolated equipment, provide a minimum 90 degree bend of flexible conduit.
- 1.4.4 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified.
- 1.4.5 Use dynamic stiffness for elastomers and do not exceed 60 durometer.
- 1.4.6 Isolators and restraining devices which are factory supplied with equipment shall meet the requirements of this section.

- 1.4.7 Coordinate with Division 3 for the provision of housekeeping pads at least 100 mm high under all isolated equipment. Provide at least 175 mm clearance between drilled inserts and edge of housekeeping pads and follow structural consultant's instructions for drilled inserts.
- 1.4.8 Bolt all equipment to the structure. Do not bridge isolation elements.
- 1.4.9 For isolated equipment, design anchors, bolts, isolators and bases to withstand without failure or yielding a static load of 2g, minimum, acting through the centre of gravity. For larger isolators, where the 2g requirement cannot be met, provide additional restraint meeting the NBCC requirements.
- 1.4.10 Where impact forces may be significant, use ductile materials.

1.5 Qualifications/Submittals

- 1.5.1 All equipment shall be tested in an independent testing laboratory, or certified by a registered professional engineer, to demonstrate that equipment meets the requirements of this section, e.g. static load capability = 2 g, fail safe design, etc. If particular tests are carried out to represent an isolator type, the tests shall be valid for the full load range of the isolator. Submit such tests or certification on request.
- 1.5.2 Obtain all relevant equipment information and provide shop and placement drawings for all vibration isolation elements and steel bases for review before materials are ordered. Provide attachment to both the equipment and the structure meeting the specified forces involved. Attachment details to the structure to be approved by a Provincially registered professional engineer.
- 1.5.3 Submit samples of materials required to complete the work of this section for inspection and review if and when requested.

1.6 Submittals

- 1.6.1 Shop Drawings:
 - .1 Provide vibration isolation shop drawings showing isolator locations, load on each isolator, inertia slab dimensions.
 - .2 Submit samples of materials required to complete the work of this section for inspection and review if and when requested.
 - .3 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .4 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
 - .5 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
 - .6 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- 1.6.2 Closeout Submittals

- .1 Provide operation and maintenance literature for all equipment appurtenances indicating manufacturer and model, instructions for operation and maintenance.
 - .1 Manufacturing name, type, year, serial number, number of units, capacity and identification of related systems.
- .2 Functional description detailing operation of components.
- .3 Performance criteria and maintenance data.
- .4 Operating instructions and precautions.
- .5 Safety precautions
- .6 Maintenance and troubleshooting guidelines.
- .7 Copy of full set of reviewed Shop Drawings and, if applicable, Marked-up Shop Drawings.
- .8 Warranty information.

2 Products

2.1 Isolators

- 2.1.1 Supply all of the vibration isolation equipment by one approved supplier with the exception of isolators which are factory installed and are standard equipment with the machinery.
- 2.1.2 All isolators shall be of the following types, supplied by the manufacturers named, or other acceptable manufacturers listed, or approved:
 - .1 Type 1 - Pad Isolator
 - .1 Neoprene/steel/neoprene pad isolators, manufactured from "Bridge bearing quality neoprene", as defined by CSA Standard CAN3-S6-M78 Section 11.10. Select Type 1 pads for a 2.5 mm (0.1") static deflection or greater. Bolt down equipment mounted on neoprene pad isolators using neoprene grommets. Design is based on Vibron Vibropad VSV or Mason WMW, Super W.
 - .2 Type 4 – Hangers
 - .1 Spring hangers, c/w 6 mm (0.25") thick sound pads sized for 0.5 mm (0.02") minimum deflection, or neoprene hangers. Design is based on Vibron Series VH, approved equal - Mason HD, HS. A neoprene element alone, without a hanger box, is acceptable provided no short circuiting occurs. Hangers shall allow for a minimum of 10° misalignment.
 - .3 Type 5 - Air Isolator
 - .1 Rolling lobe air springs with air spring levelling valves. Design based on Vibron MAS with levelling valves.

- 2.1.3 Select isolators at the supplier's optimum recommended loading, and do not load beyond the limit specified in the manufacturer's literature.
- 2.1.4 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located out of doors or in areas where moisture may cause corrosion.
- 2.1.5 For all electrical connections to isolated equipment, provide a 90 degree bend of flexible conduit for 25 mm conduit and smaller or 90 degree Crouse-Hind EC couplings for larger conduit. Use connections long enough that the conduit will remain intact if the equipment moves laterally 300 mm from the installed position, and flexible enough to transmit less vibration to the structure than is transmitted through the springs.

2.2 Bases

- 2.2.1 Provide concrete inertia bases a minimum of 1.5 times the weight of the isolated equipment. Generally base thickness shall be 1/12 of the longest dimension of the base, but not less than 150 mm (6"). Include with base a steel channel concrete form with required steel reinforcement (as determined necessary by suppliers' registered professional engineer). Provide additional steel as required by sleeves or inserts to receive equipment anchor bolts. Use height saving brackets in all mounting locations to maintain a 50 mm (2") clearance below the base. Bases are Mason type K or approved equal. Bases to be furnished with built-in motor slide rails, Motor location as specified/scheduled.
- 2.2.2 Construct structural steel bases sufficiently rigid to keep deflection and misalignment within acceptable limits as determined by the equipment manufacturer. Use height saving brackets in all mounting locations to provide a base clearance of 50 mm (2"). Bases are Mason type WF or approved equal. Bases to be furnished with built-in motor slide rails. Motor location as specified/scheduled.
- 2.2.3 Construct bases strictly in accordance with the isolation suppliers' drawings.

2.3 Flexible Duct Connectors

- 2.3.1 Provide flexible duct connectors of Durodyne with Durolon fabric or approved equal.

2.4 Flexible Pipe Connectors

- 2.4.1 At the last elbow before piping leaves the mechanical room, and the first elbow entering, provide a bolted flanged 2000 mm long spool piece to facilitate the future installation of silencing equipment

3 Execution

3.1 General requirements

- 3.1.1 Execute the work in accordance with the specifications and, where applicable, in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.
- 3.1.2 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm to other structures, piping, equipment, etc.

- 3.1.3 Isolate all floor or pier mounted equipment on Type 2 isolators, unless otherwise specified.
- 3.1.4 Select Type 4 spring hangers for a minimum static deflection of 25 mm for all ceiling hung fans, and air handling units and any other vibrating sources.
- 3.1.5 Provide spring isolators on all piping in mechanical rooms.

3.2 Duct Connections to Isolated Equipment

- 3.2.1 Provide 75 mm flexible duct connectors and a 40 mm metal to metal gap.
- 3.2.2 Provide stabilizing springs limiting movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start up.
- 3.2.3 Flexible duct connections shall be installed so that duct size is not reduced by the deflection of the flexible connector.

3.3 Inspections

- 3.3.1 The supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment. Prior to substantial completion, submit a report listing deficiencies to the specification.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section specifies the materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 Related Sections

- 1.2.1 Section 20 05 00 – Common Work Results for HVAC.

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 CAN/CGSB-24.3, Identification of Piping Systems.
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 170, Standard for Standard for Fire Safety and emergency Symbols.
- .3 Ontario Fire Code, O.Reg. 213 - Part 4, Flammable and Combustible Liquids.
- .4 R.R.O. 1990, Reg. 860 - Workplace Hazardous Materials Information System (WHMIS), under the Occupational Health and Safety Act
- .5 Canadian General Standards Board:
 - .1 CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CGSB-24.3, Identification of Piping Systems.
- .6 Canadian Standards Association (CSA):
 - .1 Natural Gas Installation Code CSA B149.1

1.4 Submittals

1.4.1 Shop Drawings

- .1 Submit in accordance with indicating:
 - .1 Catalogue cut sheets, technical data, standard details.
 - .2 Manufacturer's installation requirements and instructions.
- .2 Samples:
 - .1 Submit samples of each identification Product.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals.
- .4 Equipment schedule indicating equipment location (including room number), service, identifier, nameplate type, nameplate colour, nameplate location, and method of fastening.
- .5 Manufacturer's installation instructions for the following items:
 - .1 Equipment nameplates.
 - .2 Pipe markers.
 - .3 Duct markers.

2 Products

2.1 Manufacturer's Equipment Nameplates

- 2.1.1 Metal or plastic lamacoid nameplate mechanically fastened to each piece of equipment by manufacturer.
- 2.1.2 Lettering and numbers to be raised or recessed.
- 2.1.3 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 System Nameplates

- 2.2.1 Colours:
 - .1 Hazardous: red letters, white background,
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- 2.2.2 Construction:
 - .1 3mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

2.3 Piping Systems Governed by Code

2.3.1 Natural Gas:

- .1 Natural gas: To CSA B149.1 and authority having jurisdiction and as indicated elsewhere.
- .2 Gas piping shall be painted with 2 coats around complete circumference of piping. Use of bands or markers is not acceptable.
- .3 Paint indoor gas piping with 2 coats of yellow paint.
- .4 Paint outdoor gas piping with 2 coats of weatherproof paint. Colour to match building colour where visible from meter and to be yellow where not visible from meter (i.e. roof).
- .5 Yellow colour shall be Benjamin Moore Metal & Wood Alkyd Enamel (K133) Safety Yellow #343.
- .6 Provide labels on any gas piping of any pressure over 14" (i.e. 2LB, 5LB, etc.)

2.4 Identification of Piping Systems

2.4.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

2.4.2 Materials

- .1 Label piping with pipe markers equal to SMS (Smillie McAdams Summerlin Ltd.) "Coil-Mark".
- .2 Pipe markers shall be semi-rigid plastic vinyl, with surface printing using premium quality ultraviolet inks.
- .3 For outside diameters up to 150mm (6"), markers shall be coiled and wrap completely around the pipe with two rows of wording in alternating directions. For outside diameters larger than 150mm (6"), markers shall be saddle style with four rows of wording and installed using 864mm (34") long nylon cable ties provided with the marker.

2.4.3 Legend:

- .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.

2.4.4 Arrows showing direction of flow:

- .1 Outside diameter of pipe insulation less than 75 mm (3"): 100 mm (4") long x 50 mm (2") high.
- .2 Outside diameter of pipe or insulation 75 mm (3") and greater: 150 mm (6") long x 50 mm (2") high.
- .3 Use double-headed arrows where flow is reversible.

2.4.5 Extent of background colour marking:

- .1 To full circumference of pipe or insulation.
- .2 Length to accommodate pictogram, full length of legend and arrows.

2.4.6 Colours and Legends:

- .1 Where not listed, obtain direction from Consultant.
- .2 Colours for legends, arrows:

Background colour	Legend	Arrows
Yellow	White	Black
Green	White	Black
Red	White	Black

2.5 Concrete Pads for Mechanical Equipment

- 2.5.1 The General Contractor shall paint tops and sides of all concrete pads for mechanical equipment with two (2) coats of yellow paint.

2.6 Identification Ductwork Systems

- 2.6.1 50mm (2") high stenciled letters and directional arrows 150 mm (6") long x 50 mm (2") high.
- 2.6.2 Colours: Black, or coordinated with base colour to ensure strong contrast.

2.7 Valves, Controllers

- 2.7.1 Brass tags with 15mm (1/2") stamped identification data filled with black paint.
- 2.7.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
- 2.7.3 Provide coloured adhesive label indication on ceiling grid to locate valves/equipment above. Label description to match device. Size, colour and description to be pre-approved by Consultant.

2.8 Controls Components Identification

- 2.8.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- 2.8.2 Inscriptions to include function and (where appropriate) fail-safe position.

- 2.8.3 Provide yellow adhesive label indication on ceiling grid to locate control devices above. Label description to match device. Size and description to be pre-approved by Consultant.

2.9 Mechanical Ceiling Components Identification

- 2.9.1 Identify all other mechanical components in ceiling space with system nameplates specified in this section.
- 2.9.2 Inscriptions to include description.
- 2.9.3 Provide lamacoid nameplate or adhesive label indication on ceiling grid to locate component above. Label description to match device. Size and description to be pre-approved by Consultant.

2.10 Language

- 2.10.1 Identification to be in English.

3 Execution

3.1 Timing

- 3.1.1 Provide identification only after all painting specified has been completed.

3.2 Installation

- 3.2.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- 3.2.2 Provide ULC and/or CSA registration plates as required by respective agency.

3.3 Nameplates

- 3.3.1 Install on all equipment unless otherwise noted.
- 3.3.2 Locations:
- .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- 3.3.3 Standoffs:
- .1 Provide for nameplates on hot and/or insulated surfaces.
- 3.3.4 Protection:
- .1 Do not paint, insulate or cover in any way.

3.4 Location of Identification on Piping and Ductwork Systems

- 3.4.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 m (5'-8") intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

- 3.4.2 Adjacent to each change in direction.
- 3.4.3 At least once in each small room through which piping or ductwork passes.
- 3.4.4 On both sides of visual obstruction or where run is difficult to follow.
- 3.4.5 On both sides of separations such as walls, floors, partitions.
- 3.4.6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- 3.4.7 At beginning and end points of each run and at each piece of equipment in run.
- 3.4.8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- 3.4.9 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 Valves, Controllers

- 3.5.1 Valves and operating controllers, except at radiation or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or close "S" hooks.
- 3.5.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- 3.5.3 Apply colour identification dots on ceiling grid to identify locations of valves enclosed in ceiling space. Identification scheme:
 - .1 Yellow Dots – Any gas valves that are above ceiling
 - .2 Green Dots – Balancing Valves / Dampers
- 3.5.4 Number valves in each system consecutively.

3.6 Mechanical Ceiling Components Identification

- 3.6.1 Provide lamacoid nameplate or adhesive label indication on ceiling grid to locate component above. Label description to match device

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section specifies testing, adjusting and balancing of heating, ventilating and air conditioning systems.
- 1.1.2 Balance and adjust all the new ventilation systems under this Division and submit reports.
- 1.1.3 Provide services necessary for testing, adjusting and balancing (TAB) of mechanical HVAC Systems.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC

1.3 Reference Standards

- 1.3.1 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.
 - 1.3.2 Test procedures shall be in accordance with applicable portions of:
 - .1 Ontario Building Code.
 - .2 Regulations of Province, City, or local authority having jurisdiction.
 - .3 Associated Air Balance Council: National Standards (AABC).
 - .4 Air Movement and Control Association International, Inc. (AMCA).
 - .5 ARI 270, Sound Rating of Outdoor Unitary Equipment.
 - .6 National Building Comfort Testing Association (NBCTA).
 - .7 National Environmental Balancing Bureau (NEBB):
 - .8 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.
 - .9 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .10 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - 1.3.3 Provide additional tests and re-testing as required and requested by the Consultant or Owner.
- ### **1.4 Submittals**
- 1.4.1 Obtain certificates of approval and acceptance from authorities having jurisdiction and include in Operating and Maintenance Manuals.

- 1.4.2 Prior to commencing Work, shop drawings shall be submitted showing equipment, proof of calibration, testing methods to be used.
- 1.4.3 On completion of mechanical installation, provide certification of tests with detailed data as required. Itemize tests as to time performed and personnel responsible. Include a copy of field data in Operating and Maintenance Manuals.
- 1.4.4 Submit draft copies of balance reports for approval prior to proceeding.
- 1.4.5 Revise reports as required and provide for inclusion in Maintenance Manuals.
- 1.4.6 Reports shall include balance and equipment data listed in imperial units.
- 1.4.7 Report data shall include system description, manufacturer, arrangements, motor size, electrical characteristics, equipment size, design and actual temperature, flows, RPM, power, amperage, pressure (air, static and velocity), air temperature, space temperature and humidity, outdoor temperature, and humidity, etc.

1.5 Liability

- 1.5.1 During tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration.

1.6 Coordination

- 1.6.1 Review design drawings and general function of each system including associated equipment, control sequences and operation cycles. Confirm listing of flow and terminal measurements to be performed.
- 1.6.2 Confirm balancing valve and damper locations are adequate for system balancing. Recommend additional locations to Contractor and Consultant if required to complete system balancing.
- 1.6.3 Review location of all balancing valves on drawings for air and water systems prior to construction and submit recommendations for additional balancing dampers or balancing valves to perform complete system balancing.
- 1.6.4 Consult with the Balancing Company confirming the locations of all volume dampers prior to the installation of ductwork, location of ductwork air volume measuring ports, etc.
- 1.6.5 Provide the assistance of a qualified mechanic to assist and make all necessary adjustments as directed by the company and replace system components to achieve the specified system conditions for balancing.
- 1.6.6 Co-operate with installing Contractor(s) in advising them of specific scheduling requirements for systems verification.
- 1.6.7 Provide advice to installing Contractors regarding the location and installation of devices required to permit system balancing and measurements, prior to start of the installation work.
- 1.6.8 The Mechanical Contractor shall cooperate with the balancing company and perform the functions described below with respect to the balancing of the systems.

- 1.6.9 Outline procedures for taking test measurements to establish compliance with requirements. Specify type of instrument to be used, method of instrument application and correct factors.
- 1.6.10 Test, balance and adjust entire air system upon completion of the work. Use approved report format as approved by the Consultant to record all results. Submit sample to Consultant for approval prior to balancing.
- 1.6.11 Contact Consultant during or immediately following balancing procedures to discuss any concerns or issues prior to issuing any reports.
- 1.6.12 Submit one (1) copy of the Balance Report to the Consultant for review.
- 1.6.13 Make adjustments as directed by the Consultant. Include for a minimum of one (1) return visit for any adjustments and/or to work with the Contractor to investigate any issues.
- 1.6.14 Revise report and resubmit to the Consultant for review.

1.7 Quality Assurance

- 1.7.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.
- 1.7.2 Testing and measuring equipment used in the verification of the mechanical systems shall be calibrated to give true readings within the accuracy specifications of the equipment used. A certificate of calibration from an independent testing laboratory may be required by the Consultant if there is any reason to suspect that the equipment used is giving erroneous readings. In such an event the verification agency shall reconduct its verifications.

1.8 Balancing Reports

- 1.8.1 Use a format acceptable to the Consultant for Reports.
- 1.8.2 Submit one (1) copy of the report to the Consultant for review within one (1) week from balance completion and prior to inclusion into Maintenance Manuals. Include any comments or concerns from system balancing on report.
- 1.8.3 Reports shall include equipment data, design data and balance results in metric and imperial units.
- 1.8.4 Report shall include but not be limited to:
 - .1 Balancing Company.
 - .2 Balancing Agent who performed the work.
 - .3 Date the balancing was performed.
 - .4 Date of report.

- .5 Tools and apparatus used for testing including calibration information.
- .6 System description.
- .7 Equipment manufacturer, model, arrangement, size, performance, fan size (if applicable), motor size, voltage and amperage.
- .8 Design and actual air flows (supply air, return air, outside air).
- .9 Design and actual pressure drops (air).
- .10 Electrical characteristics.
- .11 Design and actual motor FLA, RPM.
- .12 Comments or concerns on findings.

1.9 Acceptable Balancing Agencies

1.9.1 Independent Agency

- .1 All work of Mechanical Systems Verification shall be undertaken by a single agency, employed under Division 22 and 23.
- .2 The work of the agency consists of the furnishing of all labour, materials, equipment and accessories necessary in the testing, verification and documentation of the operational performance of all equipment and systems installed under the Sections of Division 22 and 23.
- .3 NEBB, CAABC or NBCTA accredited balancing company.

2 Products (Not Applicable)

3 Execution

3.1 Site Verification

- 3.1.1 Provide preliminary review of all new ductwork to verify splitters and balance dampers are in place to allow proper balancing of the system.

3.2 General Procedure

- 3.2.1 Application: Do TAB to the following tolerances of design values:
 - .1 Plus 5%, minus 5%.
- 3.2.2 Accuracy: Measure values accurate to within $\pm 2\%$ of actual values.
- 3.2.3 Mark settings on valves, splitters, dampers and other adjustment devices.
- 3.2.4 Take measurements to verify balance has not been disrupted or that such disruption has been rectified.

- 3.2.5 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Engineer.

3.3 Preparation

- 3.3.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- 3.3.2 Follow special start-up procedures specified in other Sections.

3.4 Operation of systems during TAB

- 3.4.1 Operate systems for length of time required for TAB and for verification of TAB reports.

3.5 Start of TAB

- 3.5.1 Coordinate TAB Work with other Trades and Filed Installation
- 3.5.2 Start TBA only when building/system is essentially completed, including and not limited to:
- .1 Installation of ceilings, doors, windows and other construction affecting TAB.
 - .2 Application of weather stripping, sealing, caulking.
 - .3 Pressure, leakage, other tests done, as specified in other Sections.
 - .4 Provisions for TAB installed and operational.
 - .5 Start up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB.
- .1 Air systems:
- .1 Filters in place and clean.
 - .2 Duct and piping systems clean.
 - .3 Ducts, air shafts, ceiling plenums airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Access doors, installed, closed.
 - .7 Outlets installed, volume control devices open.

3.6 Pressure Tests

- 3.6.1 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Consultant.

- 3.6.2 Provide equipment, materials and labour for tests. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy.
- 3.6.3 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.
- 3.6.4 Provide four (4) days notice to the Consultant before tests.
- 3.6.5 Carry out hydraulic tests for eight (8) hours and maintain pressure. Where leakage occurs, repair and retest.
- 3.6.6 Natural Gas Piping: Conduct a 1 hour test of all gas piping systems up to 11" pressure and a 24 hour chart test at 50 psi of all gas piping systems over 11" pressure. The Contractor shall perform a soap test and electronic test. Arrange and pay for a gas inspection by the local TSSA Inspector.

3.7 Equipment Tests

- 3.7.1 Perform testing of all equipment as per manufacturer's recommendations and requirements under full operational ranges and submit reports.
- 3.7.2 Use the services of a qualified Technician and submit report.

3.8 Fire Dampers

- 3.8.1 Conduct installation tests of all fire dampers, smoke dampers, and combination smoke/fire dampers in accordance with NFPA 80, NFPA 90A and NFPA 105 as applicable to damper type and summarized as follows.
- 3.8.2 Field test all fire dampers, smoke dampers, combination smoke/fire dampers and fire stop flaps as follows:
 - .1 Operate dampers to demonstrate unobstructed operation of the damper from open-to-close-to open state. These tests are to be performed while the fan systems are not in operation (static test),
 - .2 For dynamic dampers, confirm air velocity through the open dampers under normal HVAC system operation, once air balancing is completed. Select dampers to confirm operation for ducts operating within 80% of the maximum air velocity of the damper listing,
 - .3 Confirm accessibility to components of fire damper to permit maintenance and testing,
 - .4 Where a damper is provided with an indicating device, confirm device functions and annunciates to the supervised location or system when the damper is in both the open and closed state, as applicable.
- 3.8.3 In addition, for multiblade fire dampers with electric operators, smoke dampers or combination smoke/fire dampers, cycle test dampers under normal HVAC operating conditions (dynamic test).

3.9 Settings

- 3.9.1 After TAB is performed, replace drive guards, close access doors, lock devices in set positions, ensure sensors and controls are set to required settings.
- 3.9.2 Permanently mark settings to allow restoration at any time during life of facility.

3.10 Completion of TAB

- 3.10.1 TAB is considered complete only after final TAB Report is received and accepted.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This Section describes thermal and acoustic insulation for ductwork and ductwork accessories.
- 1.1.2 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site.
- 1.1.3 Deliver material to job site in original nonbroken factory packaging, labeled with manufacturer's density and thickness.
- 1.1.4 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 05 29 – Hangers and Supports for HVAC
- 1.2.3 Section 23 31 00 - Ductwork
- 1.2.4 Section 23 33 00 - Duct Accessories

1.3 Reference Standards

- 1.3.1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.9, Mineral Fibre Thermal Insulation for Piping and Round Ducting.
 - .2 CAN/CGSB-51.10, Mineral Fibre Board Thermal Insulation.
 - .3 CAN/CGSB-51.11, Mineral Fibre Thermal Insulation Blanket.
 - .4 CAN/CGSB-51.12, Cement, Thermal Insulation and Finishing.
 - .5 CGSB 51-GP-52Ma Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .6 CGSB 51-GP-53M, Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels and Round Ducts.
- 1.3.2 American Society for Testing and materials (ASTM):
 - .1 ASTM C 195 Specification for Mineral Fiber Thermal Insulating Cement.
 - .2 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C 534, Specification for Mineral Fiber Preformed Pipe Insulation.

- .4 ASTM C553, Specification for Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications.
- .5 ASTM C 921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .6 ASTM E 84, Test Methods for Surface Burning Characteristics of Building Materials.
- .7 ASTM E 96, Test Methods for Water Vapor Transmission of Materials.
- .8 ASTM C411-82.
- 1.3.3 Underwriter's Laboratories of Canada (ULC):
- 1.3.4 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- 1.3.5 Thermal Insulation Association of Canada (TIAC):
 - .1 TIAC National Insulation Standards, Section 4 Insulation Materials and Properties.
 - .2 TIAC National Insulation Standards, Section 5 Commercial Piping.
 - .3 TIAC National Insulation Standards, Section 13 Installation Details.
 - .4 TIAC National Insulation Standards, Section 14 Glossary and Definitions.
- 1.3.6 Measures for Energy Conservation in New Buildings, Associate Committee of the National Building Code (ACNBC).
- 1.3.7 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
- 1.3.8 ASHRAE Standard 90.1.
- 1.3.9 SMACNA:
 - .1 HVAC Duct Construction Standards - Metal and Flexible.

1.4 Material Test Criteria

- 1.4.1 Insulation, adhesives, coatings, finishes, sealers, and tapes:
 - .1 maximum flame spread rating of 25 to CAN/ULC-S102,
 - .2 maximum smoke developed rating of 50 to CAN/ULC-S102.
- 1.4.2 Exception: vapor barrier mastics installed outside of building.

1.5 Submittals

- 1.5.1 Shop Drawings:
 - .1 Submit shop drawings and product data sheets for all products specified in this section.

- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.5.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .4 Copy of full set of reviewed Shop Drawings.
 - .5 Operating instructions and Safety precautions.
 - .6 Warranty information.

1.6 Definitions

- 1.6.1 "Concealed" means insulated mechanical services and equipment in trenches, chases, furred spaces, pipe shafts or above suspended ceilings. Services in tunnels will not be considered to be concealed.
- 1.6.2 "Exposed" will mean "not concealed" as defined herein. The following areas are designated as "exposed" where the term is applied to covering:
 - .1 Mechanical equipment rooms.
 - .2 Below suspended ceiling level in occupied areas.
 - .3 In any occupied area where no ceiling is present or where services and equipment are visible.
 - .4 Anywhere else indicated on the drawings or in the specifications.

1.7 Insulation System Samples and Product Data Sheets

- 1.7.1 At least four weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for approval. Mount the samples on a rigid plywood board. Identify each product with the manufacturer's name and insulation type, and the proposed use of the insulation. Include a product data sheet for each insulation sample.

- 1.7.2 Include samples of all insulation jacket materials, each identified as to intended use, and product data sheets for protective coatings.

2 Products

2.1 General

- 2.1.1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed.

- 2.1.2 Adhesives, coatings and sealers shall be waterproof.

2.2 Thermal Duct Insulation

- 2.2.1 Insulation shall be precovered, preformed insulation complete with foil or kraft all purpose jacket unless otherwise noted.
- 2.2.2 Use 25 millimeter (1 inch) thick insulation unless otherwise noted.
- 2.2.3 Exposed Rectangular Ducts: Rigid fibrous glass insulation, "K" value at 0.24 BTU per inch per square foot per degree Fahrenheit per hour with factory applied reinforced aluminum foil vapour barrier.
- 2.2.4 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass insulation, "K" value at 0.26 BTU per inch per square foot per degree Fahrenheit per hour with factory applied reinforced aluminum foil vapour barrier.
- 2.2.5 Recovering Jackets (Interior): U.L.C. listed "Thermo Canvas", treated cotton fabric. Alternatively, U.L.C. listed PVC recovering jacket. PVC recovering jacket shall be suitable for use in plenum (flame spread and smoke developed ratings)
- 2.2.6 Standard of Acceptance:
- .1 Fibreglass Canada,
 - .2 Knauf,
 - .3 Mason,
 - .4 Owens Corning,
 - .5 Johns Manville.

2.3 Acoustic Duct Insulation

- 2.3.1 Fiberglass insulation with "K" value at 0.26 b.t.u. per inch per square foot per degree Fahrenheit per hour absolute roughness of exposed surface not to exceed 0.033 millimeters coated to prevent fibre erosion at air velocities up to 400 f.p.m.
- 2.3.2 All substrate material to be non-darkened, contrasting colour from liner layer.
- 2.3.3 Use 25 millimeter (1 inch) thick insulation unless otherwise noted.

2.4 FASTENERS

2.4.1 Tape:

- .1 Foil Scrim Kraft (FSK) with self adhesive, 100mm (4") wide rated under 25 for flame spread and under 50 for smoke development.
 - .1 Acceptable Manufacturers:
 - .1 Mactac.

2.4.2 Contact Adhesive:

- .1 Quick-setting, non-flammable fire resistive adhesive to adhere fibrous glass to ducts. Flame spread 15 smoke development 0.
 - .1 Acceptable Manufacturers:
 - .1 Foster 85-20 Spark-Fas, Armstrong 520.

2.4.3 Lap Seal Adhesive:

- .1 Quick-setting adhesive for joints and lap sealing of vapour barriers. Flame spread 10 smoke development 0.
 - .1 Acceptable Manufacturers:
 - .1 Foster 85-75 Drion.

2.4.4 Pins:

- .1 Weld pins with 1-1/2" (38mm) diameter head for installation through the insulation. Length to suit thickness of insulation.
 - .1 Acceptable Manufacturers:
 - .1 Duro Dyne AClip-Pin@.
- .2 Weld pins 1/16" (2mm) for installation prior to applying insulation. Length to exceed thickness of insulation by 1/4" (6mm). Nylon retain clips 1-1/4" (32mm) square.
 - .1 Acceptable Manufacturers:
 - .1 Duro Dyne ASpotter Pins@ with spotter clips or stop clips as required.

3 Execution

3.1 Preparation

- 3.1.1 Do not install covering before ductwork and equipment has been tested and approved.
- 3.1.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation - General

- 3.2.1 In non fire rated surfaces, ensure insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material properly sealed.
- 3.2.2 Finish insulation neatly at hangers, supports and other protrusions.
- 3.2.3 Locate insulation or cover seams in least visible locations.

3.3 Thermal Duct Insulation

- 3.3.1 Provide insulation on:
 - .1 All new supply air ductwork, except where internally insulated.
 - .2 All new exhaust air ductwork within 2.4 meters (8 feet) of insulated surface penetration, including plenums
 - .3 All return air ducts within unconditioned spaces
 - .4 All outside air ducts and plenums between exterior walls and air handling units, including plenums
- 3.3.2 Exposed Rectangular Ducts: Secure rigid insulation with 50 percent coverage of adhesive and 12 gauge galvanized impale anchor tabs on 400 millimeter (16 inch) centres. Seal joints with 100 millimeter (4 inch) wide foil tape.
- 3.3.3 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 150 millimeter (6 inch) wide strips on 400 millimeter (16 inch) centres. Provide 16 gauge annealed tie wire, or polypropylene twine, spiral wound or half hitched at 100 millimeter (4 inch) centres for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks with 100 millimeter (4 inch) foil tape.

3.4 Acoustic Duct Insulation

- 3.4.1 Apply to interior of:
 - .1 First 1.5m (5') of supply AND return ducts on inlet and discharge of air handling units.
 - .2 Transfer ducts and elbows.
 - .3 As indicated on drawings.
- 3.4.2 Secure to ductwork with adhesive using 50 percent coverage and 12 gauge impale anchor tabs on 400 millimeter (16 inch) centres. Cut off excess fastener length and cover with brush coat of sealer.
- 3.4.3 Shop fabrication cuts shall be coated with J.M.'s SuperSeal Duct Butter and Edge Treatment products.

END OF SECTION

1 GENERAL

1.1 Summary

- 1.1.1 This Section describes thermal and acoustic insulation for HVAC piping and piping accessories.
- 1.1.2 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site.
- 1.1.3 Deliver material to job site in original nonbroken factory packaging, labeled with manufacturer's density and thickness.
- 1.1.4 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 05 29 – Hangers and Supports for HVAC
- 1.2.3 Section 23 23 00 – Refrigerant Piping

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:
 - .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.9, Mineral Fibre Thermal Insulation for Piping and Round Ducting.
 - .2 CAN/CGSB-51.12, Cement, Thermal Insulation and Finishing.
 - .3 CGSB 51-GP-52Ma Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .4 CGSB 51-GP-53M, Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels and Round Ducts.
 - .2 American Society for Testing and materials (ASTM):
 - .1 ASTM C 195 Specification for Mineral Fiber Thermal Insulating Cement.
 - .2 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C 534, Specification for Mineral Fiber Preformed Pipe Insulation.

- .4 ASTM C553, Specification for Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications.
- .5 ASTM C 921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .6 ASTM E 84, Test Methods for Surface Burning Characteristics of Building Materials.
- .7 ASTM E 96, Test Methods for Water Vapor Transmission of Materials.
- .8 ASTM C411-82.
- .3 Underwriter's Laboratories Of Canada (ULC):
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .4 Thermal Insulation Association of Canada (TIAC):
 - .1 TIAC National Insulation Standards, Section 4 Insulation Materials and Properties.
 - .2 TIAC National Insulation Standards, Section 5 Commercial Piping.
 - .3 TIAC National Insulation Standards, Section 13 Installation Details.
 - .4 TIAC National Insulation Standards, Section 14 Glossary and Definitions.
- .5 Measures for Energy Conservation in New Buildings, Associate Committee of the National Building Code (ACNBC).
- .6 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 ASHRAE Standard 90.1.
- .7 National Fire Protection Association (NFPA):
 - .1 NFPA 255.

1.4 Material Test Criteria

- 1.4.1 Insulation, adhesives, coatings, finishes, sealers, and tapes:
 - .1 maximum flame spread rating of 25 to CAN/ULC-S102,
 - .2 maximum smoke developed rating of 50 to CAN/ULC-S102.
- 1.4.2 Exception: vapor barrier mastics installed outside of building.

1.5 Submittals

- 1.5.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.5.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

1.5.3 Submit the following for incorporation into Operation and Maintenance Manuals:

- .1 Copy of full set of reviewed Shop Drawings.
- .2 Operating instructions and Safety precautions.
- .3 Warranty information.

1.6 Definitions

1.6.1 "Concealed" means insulated mechanical services and equipment in trenches, chases, furred spaces, pipe shafts or above suspended ceilings. Services in tunnels will not be considered to be concealed.

1.6.2 "Exposed" will mean "not concealed" as defined herein. The following areas are designated as "exposed" where the term is applied to covering:

- .1 Mechanical equipment rooms.
- .2 Below suspended ceiling level in occupied areas.
- .3 In any occupied area where no ceiling is present or where services and equipment are visible.
- .4 Anywhere else indicated on the drawings or in the specifications.

1.7 Insulation System Samples and Product Data Sheets

1.7.1 At least four weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for approval. Mount the samples on a rigid plywood board. Identify each product with the manufacturer's

name and insulation type, and the proposed use of the insulation. Include a product data sheet for each insulation sample.

- 1.7.2 Include samples of all insulation jacket materials, each identified as to intended use, and product data sheets for protective coatings.

2 PRODUCTS

2.1 General

- 2.1.1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed.

- 2.1.2 Adhesives, coatings and sealers shall be waterproof.

2.2 Rigid Pipe Insulation

- 2.2.1 Material: moulded glass fibre or mineral wool insulation, longitudinally split, and complete with 1-1/2" (38 mm) jointing lap having pressure sensitive adhesive applied to inside surface. Insulation to have a thermal conductivity (k-factor) at the mean rating temperature as follows:

Operating Temperature Range	Conductivity Range	Mean Rating Temperature
F (C)	Btu.in/(h.ft.2 F) (W/(m. K))	F (C)
>350 (176)	0.32-0.34 (0.046-0.049)	250 (121)
251-350 (122-176)	0.29-0.31 (0.042-0.045)	200 (93)
201-250 (94-121)	0.27-0.30 (0.039-0.043)	150 (66)
141-200 (61 - 93)	0.25-0.29 (0.036-0.042)	125 (52)
105-140 (41-60)	0.24-0.28 (0.035 -0.040)	100 (38)
40-55 (4.4-12.8)	0.23-0.27 (0.034-0.039)	75 (24)
<40 (4.4)	0.23-0.27 (0.034-0.039)	75 (24)

Refer to ASHRAE Std. 90.1 for thermal conductivities outside ranges indicated

.1 Standard of Acceptance:

- .1 Fiberglas Canada Inc. Standard Temp Pipe Insulation with ASJ,
- .2 Manson Insulation Inc. Alley-K with APT/ Knauf Fibreglass,
- .3 Manville Micro-Lok with AP-T Plus,
- .4 Roxul-Seitz.

- 2.2.2 AKoolphen K@ phenolic foam insulation with a thermal conductivity of 0.13 BTU.in/Hr.Ft². F and factory applied ASJ jacket is acceptable. Thickness of insulation shall provide equivalent or better thermal resistance (R-factor).

2.1 Flexible Pipe Insulation

- 2.1.1 Material: fibrous glass wool formed into a flexible blanket and faced with reinforced foil-faced flame resistant kraft factory-applied facing, suitable for a maximum average thermal conductivity (k factor) of 0.264 BTU.in/hr.ft². F (0.038 W/m/ C) at a mean temperature of 75 F (24 C) and faced with factory applied vapour barrier.

.1 Standard of Acceptance:

- .1 Fiberglas Canada Inc.: type 2 with RFFRK; Manson Insulation Inc. Alley-Wrap with FSK,
- .2 Knauf Fibre Glass,
- .3 Manville 812.

2.2 Refrigerant Pipe Insulation

- 2.2.1 Material: closed cell foamed plastic tubular pipe insulation, density of 5.4 lb./ft³ (86 kg/m³). Insulation shall have maximum average thermal conductivity (k factor) of 0.253 BTU.in/hr.ft. F (0.036 W/m/ C) per hour at a mean temperature of 75 F (24 C) and suitable for operating temperatures from -40 F to 220 F (-40 C to +104 C).

.1 Standard of Acceptance:

- .1 Armstrong Armaflex.

2.3 Fastenings

2.3.1 Tape

- .1 Foil Scrim Kraft (FSK) with self adhesive, 4" (100 mm) wide rated under 25 for flame spread and under 50 for smoke development.

.2 Standard of Acceptance:

- .1 Mactac.

2.3.2 Contact Adhesive

- .1 Quick-setting, non-flammable fire resistive adhesive to adhere fibrous glass to ducts. Flame spread 15 smoke development 0.

.2 Standard of Acceptance:

- .1 Foster 85-20 Spark-Fas,
- .2 Armstrong 520.

2.3.3 Lap Seal Adhesive

- .1 Quick-setting adhesive for joints and lap sealing of vapour barriers. Flame spread 10 smoke development 0.
- .2 Standard of Acceptance:
 - .1 Foster 85-75 Drion.

3 EXECUTION

3.1 Installation / Application

- 3.1.1 Install mechanical insulation in accordance with TIAC National Insulation Standards.
- 3.1.2 Apply all insulation, wrapping, vapour barrier, jacket, adhesives, coatings and cement in strict accordance with manufacturer's installation instructions.
- 3.1.3 Work shall be performed by insulation journeymen. All work covered under this Section shall be performed in a workmanlike manner, finished to present a neat appearance.
- 3.1.4 Do not apply insulation and finishing when the ambient temperature is below 10_C in the space.
- 3.1.5 Use insulation materials on cold piping which are non-hygroscopic and which are complete with a continuous fire-resistant vapour barrier. Maintain uninterrupted continuity and integrity of vapour barrier.
- 3.1.6 Do not use wheatpaste or any other material that is prone to formation of moulds.
- 3.1.7 Do not use staples on vapour barriers.
- 3.1.8 Apply insulation in a manner facilitating the replacement of and/or servicing of equipment. Terminate insulation neatly around openings and items that require periodic access. Insulate separately with removable 1.7 mm galvanized sheet steel boxes lined with rigid slab insulating material providing equivalent insulation to that on the adjoining surface.
- 3.1.9 Provide blank ends of covering with 0.7 mm metal caps over insulation but under finish.
- 3.1.10 Make good any existing insulation and covering damaged during the work of this Contract, using materials of equal quality as existing.
- 3.1.11 Make good and refinish cracks, undulations or any other deficiencies occurring in the insulation or vapour barrier.
- 3.1.12 Priming or painting of insulation will be done under Division 9.
- 3.1.13 Cover exposed insulation outside the building with 3 mm thick wet coat of Breather Mastic. While wet, embed a layer of Glass Fabric with all joints lapped 50 mm minimum, and cover with a second 3 mm wet coat of Breather Mastic.
- 3.1.14 Minimum insulation thickness shall conform to ASHRAE 90.1.

3.2 Pipe Insulation

- 3.2.1 Insulate new piping with rigid pipe insulation as follows:

Service	Operating Temperature Range F (C)	Pipe Diameter in. (mm)	Insulation Thickness in. (mm)
Condensate	0 to 850 (-18 to 454)	All sizes	1/2 (13)

- 3.2.2 Insulate fittings and flanges and pipe connections with insulated fitting covers.
- 3.2.3 Wrap butt joints with a 4" (100 mm) strip of fire resistant vapour barrier jacket cemented with lagging adhesive.
- 3.2.4 Where the pipe hanger is around the insulation, provide an insulation protection shield within the pipe saddle. Coordinate with installation of hangers.
- 3.2.5 Insulate all fittings, flanges and valves on pipes to provide equivalent insulation to that on adjoining pipe.
- 3.2.6 Continue insulation through sleeves including specified finish.
- 3.2.7 Protect insulation with protection saddles where insulated pipe is supported by rollers.
- 3.2.8 Insulate pipe hangers supporting new piping carrying water at 70 F (21 C) or less to prevent condensation. Extend insulating material along hanger rod to height 4 times thickness of insulation. Seal insulation with vapour proof sealant.
- 3.2.9 Extend pipe insulation and covering through walls, floors, ceilings, and concrete beams, unless indicated otherwise on drawings. protect exposed insulation extending through floors with 4" (100 mm) wide strip of 18 gauge (1.3 mm) galvanized iron.
- 3.2.10 Pack annular space between pipe sleeves and piping or pipe covering with glass fibre insulation or rockwool insulation. In fire rated assemblies use Dow Silicon RTV or other ULC listed materials. Seal exposed insulation with mastic.

3.3 Refrigeration Pipe Insulation

- 3.3.1 Insulate all refrigerant suction and hot gas piping and fittings with flexible foamed plastic pipe insulation. Insulation shall fit pipe. Thickness shall be as follows: 1/2" (13 mm) thick for pipe 1" (25 mm) O.D. and smaller; 3/4" (20 mm) thick for pipe 1-1/8" (28 mm) to 2" (50 mm) O.D.; 1" (25 mm) thick for pipes 2-1/8" (54 mm) O.D. and larger.
- 3.3.2 Slip insulation on to tubing before tubing sections and fittings are assembled. Keep slitting of insulation to a very minimum. Seal all joints in the insulation with Armaflex 520 or BFG Construction Adhesive #105. Insulate flexible pipe connectors.
- 3.3.3 On insulation exposed outside the building, place "slit" joint seams on bottom of pipe and provide two coats of grey Armaflex finish. Extend insulation through pipe support clamps. Provide a 6" (150 mm) long, 20 gauge (1.1 mm) galvanized steel sleeve around pipe insulation at each support.

END OF SECTION

1 GENERAL

1.1 Summary

- 1.1.1 This Section describes the labour, equipment and services necessary for implementing sequences of operations for mechanical equipment as described in this Section and in accordance with the Contract Documents.

1.2 Design Requirements - General

- 1.2.1 Obtain services of a qualified controls contractor to perform all controls work specified herein.
- 1.2.2 A central building automation system (BAS) is not required for the facility.
- 1.2.3 Comply with requirements of Division 26.
- 1.2.4 Refer to mechanical and electrical Contract Drawings for equipment locations, quantities and capacities.
- 1.2.5 Work shall include but not limited to:
- 1.2.6 Provide new thermostats for new gas fired furnaces GF-1, GF-2, & GF-3.
- .1 Locate thermostats as shown on drawings.
- .2 Refer to furnace controls details.
- 1.2.7 Coordinate with Division 26 for electric heating and fan controls as indicated to ensure a functional system.
- 1.2.8 Provide control shop drawings c/w all components, schematics, thermostats, devices, and wiring details for review by consultant prior to commencing installation or fabrication.
- 1.2.9 Provide one (1) year warranty on all controls material and labour.
- 1.2.10 Provide as-built control drawings and O&M Manuals for devices for inclusion in mechanical O&M Manuals.

1.3 Coordination

- 1.3.1 Coordinate with equipment suppliers to ensure appropriate and compatible components and devices provided to enable implementations for all required control sequences.
- 1.3.2 Coordinate with other trade disciplines for scheduling and work required to complete the Work of this Section.
- 1.3.3 Read the requirements of this Section in conjunction with mechanical and electrical Contract Drawings.

1.4 Submittals

1.4.1 Submit shop drawings and product data sheets for all products specified in this section.

1.4.2 Submit shop drawings to the Consultant for review prior to ordering or installation.

1.4.3 Shop Drawing(s):

- .1 Performance criteria, compliance with appropriate reference standards, characteristics, limitations and troubleshooting protocol.
- .2 Control devices provided and/or installed by this Section, required for satisfactory function of respective systems.
- .3 Detailed individual schematic ladder and interconnection wiring diagrams for mechanical control systems.
- .4 Wiring interconnections within packaged equipment panels and between control system panels and field devices, together with interface connections between Work under this Division and Work under Division 26.
- .5 Wiring diagrams wire numbers.

1.4.4 Closeout Submittal(s):

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 System control schematics identifying all equipment, control points, alarms and sequences of operation descriptions.
 - .3 Identify all control panels, controllers and devices, and all equipment associated with each. Locate each on facility floor plans labelled appropriately.
 - .4 Provide all default values for control and monitoring set points.
 - .5 Final tests, adjustments, and commissioning reports.
 - .6 Warranty information.

2 PRODUCTS

2.1 General

2.1.1 Use control equipment by one manufacturer unless otherwise specified.

- 2.1.2 Select Products as required to make control systems fail safe.
- 2.1.3 Provide conduits, wires and cables, boxes and wiring devices in accordance with respective Sections in Division 26.
- 2.1.4 Perform necessary calibration, adjustments, tests, final commissioning and control system performance tests to ensure control system functioning correctly.

2.2 Control System Components

- 2.2.1 Refer to respective equipment specification sections as required to provide complete and fully functional system.

2.3 Thermostats

- 2.3.1 General: To suit equipment controlled.
- 2.3.2 Standard of Acceptance:
 - .1 Honeywell,
 - .2 White-Rogers,
 - .3 Robertshaw.

2.4 Fan Controls

- 2.4.1 Fan F-1: Wired through light switch.
- 2.4.2 Fan F-2: Continuous operation.
- 2.4.3 Fan F-3: Wired through wall switch.
- 2.4.4 Fan F-4: Wireless wall controller.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install systems and related controls to reviewed Shop Drawings and manufacturer's instructions.
- 3.1.2 Coordinate and give cooperation with other Sections affected by installation.
- 3.1.3 Install conduits, wires and cables and wiring devices in accordance with respective Sections in Division 26.

END OF SECTION

1 GENERAL

1.1 Summary

- 1.1.1 This Section covers the Work required to provide pipe and fittings for natural gas and propane related systems.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 54 16 - Furnaces

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario "Propane Storage, Handling and Utilization" code.
- .2 Ontario Regulation 546/96.
- .3 The Ontario Gas Utilization Code.
- .4 CAN/CSA B149.1, Natural Gas and Propane Installation Code.

1.4 Submittals

- 1.4.1 Closeout Submittals:

- .1 Operation and maintenance data shall be included in the maintenance manual.
 - .1 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Contractor's Material and Test Certificates.

2 PRODUCTS

2.1 Pipe, Fittings and Joints

- 2.1.1 Coated Black Steel - Welded Joints: "Yellow Jacket" Schedule 40 mild black carbon steel, ASTM A53, Grade B, factory coated with yellow plastic, mill or site beveled and complete with forged steel butt welding fittings and welded joints. All bare metal surfaces are to be cleaned, and corrosion protected with a suitable Denso primer and tape corrosion protection system.
- 2.1.2 Uncoated Black Steel - Screwed Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with malleable cast iron screwed fittings to ANSI B2.1, and screwed joints.
- 2.1.3 Uncoated Black Steel - Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, mill or site beveled, complete with factory made forged steel butt welding fittings and welded joints.

2.1.4 Copper-Uncoated: Type "K" seamless copper tubing to ASTM B88, hard temper with wrought copper capillary brazed joint type fittings to ASTM B.61, and brazed joints made with "Sil-Fos" or "Sil-Fos 5" brazing alloy, or, soft temper with flared brass fittings of a single 45o flare type, forged or with a machined long nut and copper to copper threaded connectors, and, where required, flared brass copper to NPS adapters.

2.1.5 Coated Copper: Type "K" soft temper as above but with a factory applied external yellow plastic coating approved by governing authorities.

2.2 Shutoff Valves

2.2.1 Ball Type: CSA certified, minimum 3100 kPa (450 psi) WOG rated, ¼ turn, full port non-lubricated brass ball valves, each complete with a Teflon PTFE seat, chrome plated solid ball, removable lever handle, and screwed ends.

2.2.2 Standard of Acceptance:

- .1 Neo Valves #525,
- .2 Kitz Corp. Code 58,
- .3 Toyo Valve Co. Fig. 5044A,
- .4 MAS B-3,
- .5 Nibco #T-FP-600.

2.2.3 Plug Type: CSA certified, plain face flanged, Class 125, 1380 kPa (200 psi) rated, ¼ turn, cast iron lubricated plug valves, each wrench operated and complete with cylindrical plug with lubricant grooves, lubricant screw, and lubricant receptacle.

2.2.4 Standard of Acceptance:

- .1 Neo Valves #1AS40114,
- .2 Newman Hattersley #171M,
- .3 KITZ 150 SCTAM-FS (flanged, 150 class, ball valve, 13 mm to 250 mm (½" to 10")) CGA/CSA 3.16.

2.3 Propane Pressure Reducing Valve (PRV-1)

2.3.1 Fisher R622S second-stage propane regulator with straight-through body design, 3/4" NPT connections and vent. Capacity up to 1,400 MBH. Outlet pressure: 14 in. wc.

2.4 Pressure Reducing Regulators

2.4.1 Regulators must bear CSA approval markings. Provide pressure reducing regulators to suit the building load complete with relief.

3 EXECUTION

3.1 Propane Service

- 3.1.1 Make all required arrangement with the propane supply utility on behalf of the Owner for installation of propane service piping with gas pressure regulator where shown.

3.2 Propane Piping Installation Requirements

- 3.2.1 Provide all required propane distribution piping and connect gas-fired or operated equipment, and provide all required vent piping to atmosphere, including vent piping from pressure regulators. Do all piping work in accordance with requirements of CSA B149.1, Natural Gas and Propane Installation Code.

- 3.2.2 Piping is to be as follows:

.1 for underground piping,

- .1 corrosion resistant polyethylene piping, ASTM D2513/CSA B137 certified, equal to Drisoplex 6500 PE 2780 with heat fusion fittings. Complete with 14 gauge, HDPE insulated copper tracer wire

.2 Polyethylene coated copper tubing, copper alloy C12200, type L or K

.2 for above ground piping,

- .1 ASTM A53 Schedule 40 seamless wrought steel.

- 3.2.3 Slope gas piping in the direction of flow to low points.

- 3.2.4 Provide full pipe dia. 150 mm (6") long drip pockets at the bottom of all vertical risers, at all piping low points, and wherever else shown and/or required.

- 3.2.5 Identify all propane piping with two coats of safety yellow enamel applied over primer, and SMS Ltd. coil type vinyl identification makers with arrows.

3.3 Installation Of Shut-Off Valves

- 3.3.1 Provide CSA/TSSA approved ball type or lubricated plug type shut-off valves to isolate equipment, and wherever else shown.

- 3.3.2 Ensure that valves are located for easy accessibility and maintenance.

- 3.3.3 Install valves at appliance to isolate each appliance.

- 3.3.4 Install valves at branch take-offs to isolate each piece of equipment.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section outlines requirements for simple refrigeration piping interconnections such as between HVAC equipment.
- 1.1.2 This section includes the specification for refrigerant piping, and insulation and jacketing of such piping.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 05 29 – Hangers and Supports for HVAC

1.3 References

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - .1 Standard 15, Safety Standard for Refrigeration Systems.
 - .2 Standard 34, Designation and Safety Classification of Refrigerants.
- .2 The American Society of Mechanical Engineers (ASME):
 - .1 ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- .3 American Society of Testing and Materials (ASTM):
 - .1 ASTM B280.
 - .2 ASTM B88.
- .4 Underwriter's Laboratories of Canada (ULC).
- .5 C.S.A. B52, Mechanical Refrigeration Code.
- .6 E.P.S. 1/RA/1, Code of Practice for the Reduction of C.F.C.'s (Environment Canada).

1.4 Submittals

- 1.4.1 Shop Drawings:
 - .1 Submit shop drawings and product data sheets for all products specified in this section.
 - .2 Submit shop drawings to the Consultant for review prior to ordering or installation.

- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- .6 Refrigerant Piping Schematics: Submit a schematic piping diagram for each piping system, each diagram indicating pipe sizes, slopes equipment traps, valves and accessories.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Warranty information.
 - .4 Certification Reports: Submit letters from refrigeration equipment suppliers certifying proper start-up installation.

2 Products

2.1 General

- 2.1.1 All refrigerant piping and accessories shall be pressure rated for the refrigerant type and usage of the device or pipe.

2.2 Refrigerant Pipe, Fittings and Joints

- 2.2.1 Type "L" hard drawn seamless copper tubing (ACR) to ASTM B88, factory cleaned in accordance with ASTM B280 and ANSI B9.1-1971, pressurised or pre-purged with nitrogen and supplied with capped ends, and complete with factory washed and capped wrought copper soldering fittings, and solder joints made with high melting point silver brazing alloy conforming to AWS Classification BCuP-5.

2.3 Refrigerant Pipe Valves and Accessories

- 2.3.1 Mueller Brass Co. "Streamline" valves and accessories as follows:
- 2.3.2 Ball Type Shut-off Valves: "Ballmaster", ¼ turn, CSA certified forged brass ball valves, each suitable for a maximum working pressure of 3445 kPa (485 psi), and complete

with carbon filled Teflon ball seals, two O-ring stem seals, a gasketed seal cap, a flow direction arrow cast into the body, a ball position indicator on the stem, and extended copper tube solder connections to permit soldering the valve into the line without disassembling the valve

- 2.3.3 Diaphragm Type Shut-Off Valves: "Linemaster" forged brass, frost-proof, Type 1 Series, CSA certified packless diaphragm type line valves, each suitable for a maximum working pressure of 3445 kPa (485 psi), and each complete with an O-ring to prevent moisture from entering the diaphragm chamber, one phosphor bronze and two stainless steel diaphragms, and extended copper tube solder connections
- 2.3.4 Check Valves: "Checkmaster" check valves, straight through type for valves 6.4mm to 16mm, globe type for valves 22mm and larger, as follows:
 - 2.3.5 Straight through type check valves are to be complete with a machined brass gasketed body, phosphor-bronze spring, neoprene seat, and extended copper tube solder connections.
 - 2.3.6 Globe type check valves are to be complete with a cast bronze body, forged brass cap, phosphor-bronze spring, Teflon seat disc, and neoprene O-ring seal.
- 2.3.7 Piping Traps: Style No. WE-554P solder end type copper "P" traps
- 2.3.8 Pressure Vessel Relief Valves: "Safetymaster", factory set (relief pressure) refrigerant vessel pressure relief valves, straight-through or angle type as required, each constructed in accordance with requirements of ANSI Code B9.1 and the ASME Code for Unfired Pressure Vessels, and each complete with a brass body, neoprene seat disc, and lead seal and locking wire
- 2.3.9 Refrigerant Liquid-Moisture Indicators: "Vuemaster", forged brass, triple sealed, CSA certified liquid-moisture indicators, each suitable for a maximum working pressure of 3445 kPa (485 psi), and complete with a liquid indicator which shows "FULL" when the system is fully charged with refrigerant and remains blank when there is a restriction or shortage of refrigerant in the liquid line, a moisture indicator which changes from blue to pink when moisture is present in the system, a plastic dust cover, and extended copper tube solder connections
- 2.3.10 Liquid Line Filter-Drier: "Drymaster Micro-Guard" CSA certified filter-driers, each suitable for a maximum working pressure of 3445 kPa (485 psi), and complete with a combination of desiccants in a fluted briquette for drying, and a fluted briquette type filter.

2.4 Refrigerant Pipe Flexible Connections

- 2.4.1 Flexonics "VIBRA-SORBERS" or approved equivalent phosphor bronze construction, factory cleaned, dried and sealed flexible pipe connections with soldering ends.

2.5 Insulation

- 2.5.1 Refer to Section 23 07 19 - Thermal Insulation for Piping

3 Execution

3.1 Installation

- 3.1.1 Provide all required refrigerant piping. Pipe is to be type "L" hard copper, factory cleaned, capped, and marked "ACR".
- 3.1.2 Refrigerant piping and direct expansion refrigeration equipment must be installed by skilled and qualified refrigeration mechanics.
- 3.1.3 The exact arrangement and installation of refrigerant piping is to be reviewed with and approved by the direct expansion refrigeration equipment manufacturer both prior to and after installation of the piping and equipment.
- 3.1.4 Make all refrigerant pipe solder joints using a light coat of an approved brazing flux applied to both pipe and fittings. Do not use an acid flux. During the soldering process, ensure that the pipe and fittings are kept full of nitrogen or carbon dioxide to prevent scale formation.
- 3.1.5 Provide shut-off valves to isolate each piece of equipment if shut-off valves are not supplied integral with the equipment. Shut-off valves inside the building are to be ball or diaphragm type. Shut-off valves outside the building are to be diaphragm type.
- 3.1.6 Provide a refrigerant charging valve for each system if such a valve is not supplied integral with equipment.
- 3.1.7 Provide all refrigerant piping system accessories shown. Install in accordance with the manufacturer's instructions. Provide all required refrigerants.
- 3.1.8 Provide flexible connections at piping connections to the roof mounted condensing unit. Install in accordance with the manufacturer's instructions.

3.2 Insulation

- 3.2.1 Install insulation to manufacturer's instructions.
- 3.2.2 Provide insulation on **all suction, liquid and hot gas** piping systems.
- 3.2.3 Insulate all refrigerant suction and hot gas piping and fittings with flexible foamed plastic pipe insulation. Insulation shall fit pipe. Thickness shall be as follows: 1/2" (13mm) thick for pipe 1" (25mm) O.D. and smaller; 3/4" (20mm) thick for pipe 1-1/8" (28mm) to 2" (50mm) O.D.; 1" (25mm) thick for pipes 2-1/8" (54mm) O.D. and larger.
- 3.2.4 Slip insulation on to tubing before tubing sections and fittings are assembled. Keep slitting of insulation to a very minimum. Seal all joints in the insulation with Armaflex 520 or BFG Construction Adhesive #105. Insulate flexible pipe connectors.
- 3.2.5 On insulation exposed outside the building, place "slit" joint seams on bottom of pipe and provide two coats of grey Armaflex finish. Extend insulation through pipe support clamps. Provide a 6" (150mm) long, 20 gauge (1.1mm) galvanized steel sleeve around pipe insulation at each support.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This Section covers the design, supply, complete installation, verification, and testing of Ductwork for low pressure systems, not exceeding 500 Pascals.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 05 29 - Hangers and Supports for HVAC
- 1.2.3 Section 23 54 16 - Furnaces

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code.
- .2 Regulations of Province, City, or local authority having jurisdiction.
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- .4 Sheet Metal & Air Conditioning Contractors National Association Inc. (SMACNA):
- .5 HVAC Duct Construction Standards.
- .6 National Fire Protection Association (NFPA):
- .7 NFPA 90A – Air Conditioning and Ventilation Systems.
- .8 CAN/ULC.
- .9 Canadian Standards Association (CSA).
- .10 Thermal Insulation Association of Canada (TIAC).
- .11 Sheet Metal & Air Conditioning Contractors National Association Inc. (SMACNA)
- .12 Air Moving and Conditioning Association (AMCA).
- .13 American National Standards Institute (ANSI).
- .14 American Society of Testing and Materials (ASTM).

1.4 Submittals

- 1.4.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Final pressure test report.
 - .4 Warranty information.

2 Products

2.1 Noise And Vibration Control

- 2.1.1 All Ductwork: to be constructed to withstand 1-½ times working static pressure and designed for 500 Pa (2") operating pressure minimum.
- 2.1.2 All ducting on fan suction shall be rated to withstand negative pressure of 1-½ fan pressure static, dead head rating.
- 2.1.3 Ductwork: Use the type of isolators on equipment to obtain optimum results, consult with the isolator manufacturer to provide installation instructions for each product.

2.2 Ductwork - General

- 2.2.1 Provide ductwork as recommended and specified in the latest revision of the Sheet Metal and Air Conditioning Contractors National Association incorporated (SMACNA).
- 2.2.2 All Ductwork: to be constructed to withstand 1-½ times working static pressure and designed for 500 Pa (2") operating pressure minimum.

- 2.2.3 Ducts: lock forming quality steel with minimum G90 designation zinc coating to A526/A526M-85. Gauge of ducts shall be in accordance with recommendations of ASHRAE and SMACNA.
- 2.2.4 Fabrication: ducts and fittings configuration in accordance with recommendations of SMACNA and ASHRAE.
- 2.2.5 Joints to SMACNA and ASHRAE.

2.3 Ductwork

- 2.3.1 Ductwork shall be galvanized steel with G90 designation zinc coating lock forming quality to ASTM A525M.
- 2.3.2 Rectangular or Square:
 - .1 Conform to SMACNA standards.
- 2.3.3 Round:
 - .1 Factory fabricated, spiral wound, with matching fittings and specials. Longitudinal seam type is not acceptable.
 - .2 Transverse joints up to 900mm (36"): slip type with tape and sealants.
 - .3 Transverse joints over 900mm (36"): Ductmate or Exanno Nexus Duct System.
- 2.3.4 Exposed Ductwork in Finished Areas:
 - .1 All exposed ductwork in finished areas shall be satin finish (galvannealed) to allow for painting without peeling.
 - .2 All exposed ductwork in finished areas shall be spiral unless otherwise indicated.
 - .3 All exposed ductwork in finished areas shall be painted.
- 2.3.5 Comply with NFPA standards for exhaust ductwork and hoods which are used in applications resulting in airborne grease entrainment. 18 gauge stainless steel continuous welded. Refer to drawings for details and specifications.

2.4 Duct Construction

- 2.4.1 For constant volume systems, all supply air ductwork installed in mechanical rooms shall be constructed to SMACNA 500 Pa (2" wg) duct construction class. All other supply air ductwork shall be constructed to 250 Pa (1" wg) duct construction class.
- 2.4.2 All return air ductwork and all exhaust air ductwork installed in mechanical rooms shall be constructed to SMACNA 500 Pa (2" wg) duct construction class. All other return air ductwork and exhaust air ductwork shall be constructed to 250 Pa (1" wg) duct construction class.
- 2.4.3 Tie rods shall not be used in lieu of external duct reinforcement except where specifically mandated by SMACNA duct construction standards.

- 2.4.4 Duct tapers to be at 14 degrees maximum (1:4 ratio) for all systems with air velocities less than 1500fpm and 8 degrees (1:7 ratio) for velocities 1500 fpm and greater.
- 2.4.5 Provide a schedule of proposed duct construction, meeting SMACNA standards, to be used on the project. Schedule shall include panel width, gauge, transverse connector, reinforcement, longitudinal seam, sealing class and sealing compound. Submit schedule prior to performing any duct fabrication/installation.
- 2.5 Fittings**
 - 2.5.1 Fabrication: to SMACNA.
 - 2.5.2 Radiused elbows:
 - .1 Rectangular: standard radius and or short radius with double thickness turning vanes Centreline radius: 105 times width of duct.
 - .2 Round: in exposed areas one-piece smooth radius, 1.5 times diameter.
 - 2.5.3 Mitred elbows, rectangular:
 - .1 To 400mm (16"): with double thickness turning vanes.
 - .2 Over 400mm (16"): with double thickness turning vanes.
 - 2.5.4 Branches:
 - .1 Rectangular main and branch: with 45° entry on branch.
 - .2 Round main and branch: enter main duct at 45° with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
 - 2.5.5 Diffuser connection to main:
 - .1 High efficiency takeoffs complete with rectangular duct opening and 45° slope body. Takeoffs shall be furnished complete with balancing damper and locking quadrant.
 - .2 Contractor shall notify Consultant if height of takeoff is required to be reduced to suit ceiling clearances and obtain approval from the same prior to installing or fabricating.
 - 2.5.6 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.
 - 2.5.7 Offsets:
 - .1 Full short radiused elbows.

2.5.8 Obstruction deflectors: maintain full cross-sectional area.

2.6 Firestopping

2.6.1 40mm x 40mm x 3mm (1-1/2" x 1-1/2" x 16ga) retaining angles all around duct, on both sides of fire separation.

2.6.2 Firestopping material and installation must not distort duct.

2.6.3 All ductwork passing through partition walls shall be firestopped.

2.7 Fasteners

2.7.1 Fasteners shall be sheet metal screws, rivets, and bolts.

2.8 Flexible Ductwork

2.8.1 Listed in accordance with ULC-S110 and classified Class 1.

2.8.2 Flame spread rating not more than 25. Smoke developed rating not more than 50.

2.8.3 Semi-rigid and lightweight air duct, manufactured using a dead soft aluminum strip which is spirally wound and mechanically joined together to form an air tight and leak-proof three ply mechanical seam. Self-supporting and corrosive resistant that provides excellent strength and rigidity.

2.8.4 Provide insulated or uninsulated as noted.

2.8.5 Performance - Uninsulated:

- .1 Material: Aluminum.
- .2 Maximum rated velocity: 5500 fpm.
- .3 Maximum positive pressure: 2.5 kPa (10 in.wc.).
- .4 Maximum negative pressure: 3.0 kPa (12 in.wc.).
- .5 Temperature Range : -51C to 315C (-60F to 600F).
- .6 Bend Radius : 1.5 times diameter.
- .7 Available sizes : 50mm to 610mm (2 inches to 24 inches).

2.8.6 Performance - Insulated:

- .1 Core material: Aluminum.
- .2 Thermal Resistance: Available in R4.2, R6, R8.
- .3 Maximum rated velocity: 4000 fpm
- .4 Maximum positive pressure: 3.0 kPa (12 in.wc.).

- .5 Maximum negative pressure: 0.25 kPa (1 in.wc.).
- .6 Temperature Range : -40C to 121C (-40F to 250F).
- .7 Bend Radius : 1.5 times diameter.
- .8 Available sizes : 100mm to 500mm (4 inches to 20 inches).

2.8.7 Standard of Acceptance:

- .1 Uninsulated: Flexmaster Triple Lock T/L Aluminum Flexible Ducting.
- .2 Insulated: Flexmaster Triple Lock T/L Aluminum Thermal Flexible Ducting.

2.9 Duct Hangers and Supports

- 2.9.1 Refer to Section 23 05 29 – Hangers and Supports for HVAC.

2.10 Duct Sealer

- 2.10.1 Duct Sealer to be ULC classified for surface burning characteristics and be water based.
- 2.10.2 Duct Sealer shall be Duro-Dyne DWN, grey, water-based for medium and high pressure duct systems, non-flammable (wet state), fire retardant (dry state).
- 2.10.3 Duct Sealer shall be clear silicone type on all exposed ductwork or duct sealer shall be applied to inside of fittings to ensure clean look.

2.11 Instrument Test Ports

- 2.11.1 Provide Durodyne IP-1 test ports in all uninsulated duct branches within mechanical rooms. Standard plugs may be used in uninsulated ducts outside of mechanical rooms.
- 2.11.2 Provide Durodyne IP-2 test ports in all insulated duct branches throughout the building.
- 2.11.3 Ports shall be supplied and installed by the mechanical contractor prior to installation of external insulation.

3 Execution

3.1 Rigid Ductwork

- 3.1.1 Coordinate with other trades prior to installing ductwork.
- 3.1.2 All ductwork and fittings shall be installed in accordance with SMACNA and ASHRAE standards.
- 3.1.3 All exposed ductwork shall be satin finish (galvannealed) to allow for painting. Paint all exposed ductwork in finished areas.
- 3.1.4 Duct tapers to be at 14 degrees maximum (1:4 ratio) for all systems with air velocities less than 1500fpm and 8 degrees (1:7 ratio) for velocities 1500 fpm and greater.

- 3.1.5 Ductwork shall be properly constructed, braced, connected and jointed. Suspend with hangers to SMACNA Standards.
- 3.1.6 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural bearings do not exist, provide angle or channel iron form nearest structural bearings to support hangers.
- 3.1.7 Use of "S and drive" or equivalent slip joint method, or Ductmate flange joint method is permissible. Fabricate and install in accordance with SMACNA reinforcement standards. Leave smooth finish on edges and interior of duct runs. Install internal ends of slip joints in direction of flow.
- 3.1.8 Ducts and joints shall be tight and rigid so as not to leak, rattle, or vibrate.
- 3.1.9 Install ductwork to allow adequate space for normal operation and maintenance of equipment nearby.
- 3.1.10 Where possible, radiused duct elbows with radiused splitter vanes are preferable over square elbows with turning vanes. Where square duct elbows are necessary, turning vanes to be double thickness airfoil type installed in every slot on the vane rail.
- 3.1.11 Direct size duct spin-ons are not acceptable. Conical spin-on or square-to-round fittings shall be provided. Where take-off is same size as main, use a 45 degree lead-in fitting.
- 3.1.12 Where ducts pass through walls, seal around ducts with noncombustible material.
- 3.1.13 All openings through wall must be sleeved and lined as specified. Openings shall be 50mm (2") larger all around than duct or piping and filled with fireproof Rockwool type insulation complete with fire retardant sealant on both sides.
- 3.1.14 All open ductwork, not being worked on, must be completely covered during construction phase until all sanding, plastering, painting, and finishing is complete.
- 3.1.15 Inspect and test ductwork prior to any required painting or insulation for air leakage at joints and connections under normal operating conditions. Air leakage tests shall be performed as specified herein.
- 3.1.16 Paint all ductwork in exposed areas, with the exception of mechanical rooms.
- 3.1.17 Paint ductwork visible through registers, grilles and diffusers flat black.
- 3.1.18 Under no conditions are pipes, rods or wires allowed to penetrate ducts.

3.2 Flexible Ductwork

- 3.2.1 Install in accordance with SMACNA.
- 3.2.2 Maximum length shall be 1.8m (6'). Minimum 12" (300mm) straight vertical duct run to be provided at all diffusers.
- 3.2.3 Provide support at centre of flexible duct.

3.3 Duct Sealing

- 3.3.1 Seal all ductwork with duct sealer as specified herein. Ducts constructed to SMACNA 500Pa (2") duct construction class and under shall be sealed to SMACNA Standard Section 1.6 and 1.7, Class C. Ducts constructed to SMACNA 750Pa (3") duct construction class shall be sealed to SMACNA Standard Section 1.6 and 1.7, Class B. Duct sealer shall be applied behind fittings for all exposed ductwork in finished areas.
- 3.3.2 The sealer shall be stored at room temperature for at least 24 hours prior to use. Surfaces shall be clean, dry and free from oil, grease, and any other foreign material.
- 3.3.3 Clean fittings to a depth of four inches with a solvent, exercising safe practices as recommended by the manufacturer.
- 3.3.4 Stir sealer thoroughly before application.
- 3.3.5 Use a brush, cartridge guns or spatula to apply the sealer to male section of spiral duct or to both fittings of rectangular duct. Join joints while sealer is wet (within approximately 15 minutes) and secure with sheet metal screws applied as close as possible (1/2" or less). Apply sealer to outside of assembly with a 2" wide band of sealer, thoroughly covering joint head and sheet metal screws. Allow sealer to set (approximately 72 hours) before pressure testing. Do not thin.
- 3.3.6 The Consultant shall inspect the duct sealing prior to any insulation being installed. Provide minimum of four (4) working days' notice.

3.4 Instrument Test Ports

- 3.4.1 Ports shall be supplied and installed by the mechanical contractor prior to installation of external insulation.
- 3.4.2 With the assistance of the balancing contractor, the contractor will mark the spacing for the instrument ports on the ductwork after installation of the ductwork.

3.5 Duct Leakage Tests

- 3.5.1 All new duct distribution systems are to be pressure tested for leakage.
- 3.5.2 Tests shall include:
 - .1 All supply ductwork between air handling units and up to & including reheat coils including fire dampers and access doors (ductwork beyond reheat coils not required). Provide temporary blank ends on grilles and open ducts.
 - .2 All return ductwork between new air handling unit and all return grilles including fire dampers and access doors. Provide temporary blank ends on grilles and open ducts.
- 3.5.3 Tests to be performed in accordance with SMACNA procedures. Calibrated orifices shall be used to measure all leakage airflow rates. All ductwork shall be pressure tested at minimum 500 Pa (2"WG). For any system, total leakage at the test pressure shall not exceed 5% of respective fan design air flow rate. Repair all leaks and repeat test. Pressurize with small blower. Test system as a whole, or in parts, provided that all ductwork is accessible for inspection at the time of test.

- 3.5.4 Tests shall be performed before ducts are insulated or enclosed. Submit notice of all tests in ample time to allow the Consultant to be present when the tests are conducted. All tests shall be witnessed by the Consultant or they shall be repeated.
- 3.5.5 Any components of the systems which might be damaged during the tests shall be removed before the tests and reinstalled after the tests.
- 3.5.6 Provide all test holes (including prefabricated insulated capped test hole fittings), dampers, access facilities, etc. as required for air balancing and make any changes required for the final balancing results. Cooperate with the Balancing Contractor to ensure satisfactory completion of his work. Provide test holes prior to application of thermal insulation.
- 3.5.7 Submit report of air tests to Consultant and include in maintenance manuals.

3.6 Painting

- 3.6.1 All exposed ductwork in finished areas shall be painted. Coordinate colour with Owner and General Contractor.

3.7 Cleaning (prior to start-up)

- 3.7.1 Keep ductwork and duct liners clear from dust and debris during construction.
- 3.7.2 Prior to starting HVAC equipment, inspect and clean all equipment, and ductwork on the inside and outside to ensure that they are completely free from dust and debris.
- 3.7.3 Install clean filters in all units.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This Section covers accessories for metal air duct systems such as flexible connections, access doors in ducts, turning vanes, and spin-in collars.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 05 29 – Hangers and Supports
- 1.2.3 Section 23 31 00 - Ductwork

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code.
- .2 ASHRAE.
- .3 SMACNA.
- .4 NFPA 80 – Installation, Testing and Maintenance of Fire Dampers.
- .5 NFPA 90A – Air Conditioning and Ventilation Systems.
- .6 CAN/ULC S112 – Standard Method of Fire Test of Fire Damper Assemblies.
- .7 CAN/ULC S112.1 – Standard for Leakage Rated Dampers for Use in Smoke Control Systems.
- .8 CAN/ULC S505 – Standard for Fusible Links for Fire Protection Service.
- .9 CSA Standards.
- .10 Regulations of Province, City, or local authority having jurisdiction.

1.4 Submittals

- 1.4.1 Shop Drawings:

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.

- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- .6 Submit shop drawings showing location, ratings, sizes of all fire dampers.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Final pressure test report.
 - .4 Copy of valve identification chart.
 - .5 Warranty information.
 - .6 Operation and maintenance data.

1.5 Delivery, Storage and Handling

- 1.5.1 Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- 1.5.2 Storage: Store materials in a dry area indoor, protected from damage and in accordance with manufacturer's instructions.
- 1.5.3 Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage

2 Products

2.1 General

- 2.1.1 All required accessories shall conform to ASHRAE and SMACNA standards and recommendations.

2.2 Fire Dampers

- 2.2.1 Provide fire dampers in ducts penetrating fire rated walls, floors, or ceiling as indicated on the drawings.

- 2.2.2 Fire dampers shall be UL STD 555 to 1-1/2 hour fire ratings.
- 2.2.3 Fire dampers shall be equipped for vertical or horizontal suitable for application.
- 2.2.4 Dampers to be "dynamic" unless otherwise specified. "Static" dampers are restricted to un-ducted transfer openings.
- 2.2.5 Frame: 4-7/8", 20 gauge galvanized steel channel.
- 2.2.6 Blades: 24 gauge galvanized steel blades, curtain type, recessed out of air stream.
- 2.2.7 Fusible link: 165°F.
- 2.2.8 Provide duct access doors of adequate size to service fire dampers. Provide Pull Tab for horizontal dampers where access door is located below the fire damper. Refer to Duct Access Doors within this section.
- 2.2.9 Standard of Acceptance:
 - .1 Ruskin – Series IBD2 Style B,
 - .2 Nailor Industries – 0120 Type B,
 - .3 National Controlled Air (NCA) – FD – 80 Type B,
 - .4 Tamco.

2.3 Balancing Dampers

- 2.3.1 Single blade damper: Galvanized steel minimum 18 gauge, provide with quadrants and lock screw.
- 2.3.2 Multi-blade damper: Galvanized steel minimum 16 gauge, provide with quadrants or adjustment rods and lock screw.
- 2.3.3 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration. Size on basis of straight air volume proportioning.
- 2.3.4 Fabricate single blade dampers for duct sizes to a maximum of 300mm (12") tall and a maximum of 1200mm (48") wide.
- 2.3.5 Fabricate multi-blade dampers of opposed blade pattern with maximum blade sizes 300mm (12") to 1.8m (6'). Assemble centre and edge crimped blades in prime coated or galvanized channel frame with approved type hardware.
- 2.3.6 Include for the supply and installation of four (4) extra balance dampers in installed ductwork pending balance results and comments.

2.4 Turning Vanes

- 2.4.1 Factory or shop fabricated double thickness to SMACNA standards.
- 2.4.2 Turning vanes shall be of steel construction with prime coat finish and complete with supports and fastenings.

2.4.3 Turning vanes shall be double wall with correct airfoil pattern.

2.4.4 Standard of Acceptance:

- .1 Duro Dyne,
- .2 Ductmate.

2.5 Duct Access Doors

2.5.1 Provide access doors in ductwork of adequate size in the following locations:

- .1 at each fire damper,
- .2 in plenum and equipment casings to facilitate maintenance and cleaning of all components.

2.5.2 Construct access doors from double thickness 22 gauge galvanized steel sheets or aluminium in equal strength where required, 25mm apart, with necessary reinforcing inside for rigidity. Fill the 25mm space with glass fibre insulation.

2.5.3 Access doors to be ultra-low leakage with positive seal polyethylene gasket.

2.5.4 Access doors shall be square, rectangular or flat oval. Square and rectangular access doors shall be equal to Nailor 085CL. Flat oval access doors shall be equal to Nailor 0800.

2.5.5 Access Doors shall have minimum two plated steel camlock fasteners for sizes up to 350mm (14"), and four camlock compression latches for sizes over 350mm (14").

2.5.6 Sizes

- .1 Fire dampers and reheat coils:
 - .1 Square/rectangle: minimum 16x16" or 2" less duct size.
 - .2 Flat Oval: minimum 18x10" or 2" less duct size.
- .2 Duct Risers:
 - .1 Square/rectangle: minimum 24x24" or 2" less duct size.

2.5.7 Standard of Acceptance:

- .1 Nailor,
- .2 Price,
- .3 Ruskin.

2.6 Flexible Connections

2.6.1 Flexible Connections shall be Duro Dyne heavy glass, ULC listed, non-combustible, waterproof fabric, double coated with neoprene and shall be 150 mm minimum width,

0.81mm thick, density of 1.3 kg/m². Temperature rating shall be -40C (-40F) to +90C (+194F).

2.6.2 Flexible connectors shall be attached to 24 gauge metal strips minimum 75mm (3") wide.

2.6.3 Standard of Acceptance:

.1 Duro Dyne,

.2 Mercer Rubber Co.

3 Execution

3.1 Installation

3.1.1 Provide access doors of adequate size to service, maintain, or inspect within duct stream where required. Locations include but are not limited to automatic dampers, fire dampers, and filters. Coordinate installation with General Contractor.

3.1.2 Install flexible connections where rigid duct connects to equipment that is susceptible to vibration and as indicated on drawings.

3.1.3 Install instrument test ports to allow Pitot tube insertion with cam-action handle.

3.2 Fire Dampers

3.2.1 Confirm rating of devices with ratings of surfaces or separations.

3.2.2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction.

3.2.3 Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

3.2.4 For curtain-type fire dampers in vertical ducts, the preferred access location is from the floor above the damper. Where access door is located below horizontal fire damper, damper shall be equipped with pull tab release.

3.2.5 Provide duct access doors to service fire dampers for those air transfer openings mounted with ducts.

3.2.6 Provide fire stop flaps on air outlets penetrating fire rated membranes or surfaces.

3.3 Balancing Dampers

3.3.1 Provide balancing dampers, whether shown or required, at points on supply, return and exhaust systems, where branches are taken from larger ducts, for proper air balancing.

3.3.2 Review balance damper locations with the Balancing Contractor prior to installation. Additional costs to add balance dampers for proper balancing after installation will not be accepted.

- 3.3.3 Include for the supply and installation of four (4) extra balance dampers in the already installed ductwork pending balance results and comments.

3.4 Turning Vanes

- 3.4.1 Install in conformance with SMACNA standards.
- 3.4.2 Install in all square elbows and short radius elbows for supply and return air ductwork.

3.5 Access Doors

- 3.5.1 Provide access doors as required for access, adjustment, operation, service, and maintenance.
- 3.5.2 Provide access doors in ductwork of adequate size in the following locations:
- .1 at each fire damper,
 - .2 before and after each reheat coil,
 - .3 bottom of all duct risers – part of, or next to, outside air intakes and outlets,
 - .4 in plenum and equipment casings to facilitate maintenance and cleaning of all components.
- 3.5.3 Sizes
- .1 Fire dampers:
 - .1 Square/rectangle: minimum 16x16" or 2" less duct size.
 - .2 Flat Oval: minimum 18x10" or 2" less duct size.
 - .2 Duct Risers:
 - .1 Square/rectangle: minimum 24x24" or 2" less duct size.

3.6 Flexible Connections

- 3.6.1 Provide flexible connections on inlet and outlet duct connections of air handling units or other equipment likely to be affected by, or to cause vibration or noise to be transmitted through ductwork.
- 3.6.2 Install in accordance with SMACNA.

END OF SECTION

1 General

1.1 Summary

1.1.1 This Section covers fans and accessories for exhaust systems.

1.2 Related Sections

1.2.1 Section 23 05 00 - Common Work Results for HVAC

1.2.2 Section 23 05 29 – Hangers and Supports for HVAC

1.2.3 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

1.2.4 Section 23 09 33 – Controls

1.3 Reference Standards

1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code.
- .2 AMCA Publications 99, Standards Handbook.
- .3 ANSI/AMCA Standard 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .4 AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
- .5 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .6 ANSI/ASHRAE 51, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .7 BS-848, Fans for General Purposes. Performance Testing Using Standardized Airways.
- .8 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .9 ISO-5801, Industrial Fans - Performance Testing Using Standardized Airways.

1.4 Design/Performance Requirements

1.4.1 Capacity:

- .1 Flow rate, external static pressure, brake power, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

1.4.2 Balancing:

- .1 Statically and dynamically balanced to 2 mm/s peak or less, except where noted otherwise.

1.4.3 Sound ratings:

- .1 To ANSI/AMCA (Air Moving and Conditioning Association) Standard 301, tested to AMCA Standard 300. Bear AMCA certified sound rating seal.

1.4.4 Design/Performance ratings:

- .1 Fans: Based on tests performed to ANSI/AMCA Standard 210 and ANSI/ASHRAE 51. Bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.5 Submittals

1.5.1 Shop Drawings

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Submit shop drawings indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and troubleshooting protocol.
 - .2 Elevations, sections, details and operating components, dimensions, gauges, finishes and relationship of operating components to adjacent construction.
 - .3 Complete electrical wiring diagrams including electrical schematics and sequence of operation.
 - .4 Provide fan curves and sound rating data, showing point of operation, brake power and efficiency.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings plus operation and maintenance data shall be included in the maintenance manual.

1.5.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.

.3 Warranty information.

2 Products

2.1 General

- 2.1.1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.
- 2.1.2 Provide balanced variable sheaves.
- 2.1.3 Fans shall be capable of accommodating static pressure variations of +10% with no objectionable operating characteristics.
- 2.1.4 Unless otherwise noted, include all motors and drive combinations with electrical characteristics as detailed elsewhere.
- 2.1.5 Fan hubs and sheaves shall be keyed to shafts for fans over $\frac{3}{4}$ hp. Use of flat ground surface and set screws are not approved.
- 2.1.6 Select variable and adjustable pitch sheaves unless otherwise specified, so that required rpm is obtained with sheaves set at mid-position, and approximate speed adjustment of 25%.
- 2.1.7 Rate drive as recommended by manufacturer, but minimum 1.5 times power rating of the motor. Submit calculations and technical data with shop drawings, to support drive selection.
- 2.1.8 Fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- 2.1.9 All required accessories shall conform to ASHRAE and SMACNA standards and recommendations.

2.2 Cabinet Fans

- 2.2.1 Fans shall be of the centrifugal belt driven in-line type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
- 2.2.2 Cabinet shall be heavy gauge metal with galvanized or baked enamel finish.
- 2.2.3 Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
- 2.2.4 The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.
- 2.2.5 Motors shall be variable speed heavy duty ball bearing type. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.
- 2.2.6 Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum catalogued operating speed.

2.2.7 Accessories:

- .1 NEMA 1 pre-wired disconnect switch.
- .2 Multi-blade, rattle free, backdraft damper with felt lined blade edges.
- .3 Time delay off switch where indicated.
- .4 Controls as indicated on drawing schedule.

2.2.8 Spare Parts

- .1 Supply one (1) complete set of spare belts for all belt driven fans.

2.2.9 Standard of Acceptance:

- .1 Greenheck,
- .2 Cook,
- .3 Twin City.

2.3 Ceiling Mounted Fans

2.3.1 Ceiling mounted fans shall be low sone type equal to manufacturer and model as per schedule and shall not exceed sone value as indicated.

2.3.2 Standard of Acceptance:

- .1 Big Ass Fans,
- .2 Macroair.

3 Execution

3.1 General

3.1.1 Install as per manufacturer's instructions.

3.1.2 Install fans as shown, with resilient or spring mountings and fan restraining snubbers and flexible electrical leads.

3.1.3 Align shafts, belt drive and motor, adjust belt tension, ensure all set screws are tight, and check motor rotation before start-up.

3.1.4 Protect motors and fans during construction and rotate fans, by hand, every month between delivery and acceptance of building.

3.1.5 Locate exhaust fan discharge at least 3 m away from building openings and fresh air intakes.

3.1.6 Coordinate wiring and lockable disconnect with Division 26

- 3.1.7 Adjust variable pitch fan/motor sheaves during balancing to achieve specified air quantities.

3.2 Cabinet Fans

- 3.2.1 Install in conformance with manufacturer's requirements and recommendations.
- 3.2.2 Provide U-Channel, 3/8" rod and vibration isolation for mounting.
- 3.2.3 Provide guard on any exposed fan inlet or outlet.
- 3.2.4 Provide belt guards on belt driven fans.
- 3.2.5 Supply and install sheaves as necessary for final air balancing for belt driven fans.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 Provide Labour, Products, equipment and services necessary for grille, register, and diffuser Work in accordance with the Contract Documents.

1.2 Related Sections

- 1.2.1 Section 23 05 01 - Common Work Results for HVAC
- 1.2.2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:
- .1 ASHRAE, Handbooks.
 - .2 ASHRAE Standard 70, Method of Testing for Rating the Performance of Air Outlets and Inlets.
 - .3 CSA, Canadian Standards Association.
 - .4 OBC, Ontario Building Code, Part 6.
 - .5 ULC, Underwriter's Laboratory of Canada.

1.4 Submittals

1.4.1 Shop Drawings

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Manufacturers shall certify performance and application.
- .4 Submit shop drawings indicating:
 - .1 Performance criteria, compliance with appropriate reference standards, characteristics, limitations and troubleshooting protocol.
 - .2 Capacity.
 - .3 Throw and terminal velocity.
 - .4 Noise criteria.
 - .5 Pressure drop.
 - .6 Neck velocity.

- .7 Dimensions.
- .8 Specified options
- .5 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .6 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.4.2 Closeout Submittals

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Warranty information.

2 Products

2.1 General

- 2.1.1 Air flow tests and sound levels shall be made in accordance with ASHRAE standards.
- 2.1.2 Manufacturers shall certify performance and application.
- 2.1.3 Products to meet size, capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated in manufacturer's Product data for the design performance criteria specified.

2.2 Grilles and Diffusers

- 2.2.1 Provide grilles, registers and diffusers of the types as shown on the drawings.
- 2.2.2 Grille mounted aluminum opposed blade damper with concealed operator.
- 2.2.3 Model Series, dimensions and finish in accordance with Contract Documents.
- 2.2.4 Supply Grilles
 - .1 Provide vertical throw type as noted based on ceiling heights.
 - .2 Construction shall be heavy duty, with 14 gauge steel blades and heavy duty steel support bars and frame unless otherwise noted.

- .3 Grilles shall be complete with steel volume damper of the opposed blade type for balancing purposes as noted.

2.2.5 Return/Exhaust Grilles/Registers:

- .1 Egg crate return grille.
- .2 13 x 13 x 13 aluminum grid core.
- .3 Extruded aluminum construction.
- .4 32 mm border for flat surface mount applications and suspended ceiling grid.

2.2.6 Single deflection exhaust register.

- .1 High capacity, high free area, low sound and pressure drop.
- .2 Extruded aluminum construction.
- .3 32 mm border for flat surface/duct mount applications.
- .4 Duct collar for duct mounting.

2.2.7 Frames:

- .1 Full perimeter gaskets.
- .2 To suit mounting application and in accordance with Contract Drawings.
- .3 Oversized grilles, registers and diffusers to be suitably reinforced and provided with mullions to provide rigidity without compromising performance or operation.

2.2.8 Finish:

- .1 Aluminum and Steel Products:
 - .1 Brushed finish with clear coat epoxy.
 - .2 Powder coat paint finish, 50-75 micron (2.0 - 3.0 mils).

2.2.9 Colour:

- .1 As specified on the Contract Documents and coordinated with architectural finishes

2.2.10 Standard of Acceptance:

- .1 EH Price.
- .2 Nailor,
- .3 Titus,
- .4 Metal Aire,

.5 Kreuger.

2.3 Louvers (supplied by Mechanical)

- 2.3.1 Louvers supplied by mechanical shall be licensed to bear the AMCA seal and certified by the manufacturer for outdoor use.
- 2.3.2 Louvers shall be sized as noted on drawings and model selected to prevent moisture carry-over (896 fpm for base specified Ventex 2435).
- 2.3.3 Frame shall be 0.081" (2.06 mm) extruded aluminium, alloy 6063-T5.
- 2.3.4 Blades shall be 0.081" (2.06 mm) extruded aluminium, alloy 6063-T5, at an angle of 35° on 3.5" (89mm) centres. Louver assembly shall have blades contained within a single frame.
- 2.3.5 Louver components including heads, jambs, sills and mullions shall be factory assembled.
- 2.3.6 All materials shall be factory finished after assembly with Polyester Powder Coat, standard mill finish unless otherwise indicated.
- 2.3.7 Louvers shall be complete with 19 gauge galvanized birdscreen with ½" x ½" openings.
- 2.3.8 Submit all performance data with shop drawings for free area, pressure drop and water carry over.
- 2.3.9 Standard of Acceptance:
 - .1 Tamco,
 - .2 EH Price,
 - .3 Ruskin,
 - .4 Nailor.

3 Execution

3.1 General

- 3.1.1 Confirm location, type of mounting and size of all outlets with site conditions prior to ordering and installing.
- 3.1.2 In accordance with manufacturer's recommendations.
- 3.1.3 Bolt grilles, registers and diffusers in place in all areas except finished office areas.
- 3.1.4 Coordinate installation with Architectural finishes and details.
- 3.1.5 Coordinate installation with fire dampers where grilles, registers and diffusers are installed in fire-rated door or assembly.

- 3.1.6 Set all adjustable blades at 45 deg. and all balancing dampers in fully open position in preparation of TAB.
- 3.1.7 Coordinate manufacture and delivery of custom fabrications, finishes and oversized product requirements to meet construction schedules in accordance with Contract Drawings and Specifications.
- 3.1.8 Provide flanged connection off ductwork for mounting of grilles.
- 3.1.9 Paint inside of ductwork flat black behind supply and return wall grilles.
- 3.1.10 Position vertical throw diffusers and deflection of grilles to achieve best air flow in area. Adjust to suit Balancing Contractor and Engineer's requirements.

3.2 Grilles and Diffusers

- 3.2.1 Confirm location, type of mounting and size of all outlets with site conditions prior to ordering and installing.
- 3.2.2 Provide flanged connection off ductwork for mounting of grilles.
- 3.2.3 Paint inside of ductwork flat black behind supply and return wall grilles.
- 3.2.4 Position vertical throw diffusers and deflection of grilles to achieve best air flow in area. Adjust to suit Balancing Contractor and Engineer's requirements.
- 3.2.5 Provide birdscreen on all open-ended return air ducts unless otherwise noted.

3.3 Louvers

- 3.3.1 Confirm location and size of all louvers with General Contractor prior to ordering and installing.
- 3.3.2 Provide 16 gauge galvanized sheet metal sleeve through wall opening where required.
- 3.3.3 All louvers shall be equipped with birdscreen.
- 3.3.4 Provide caulking at all louvers using non-shrink Mono caulking to match building colour.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of gas fired furnaces.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- 1.2.3 Section 23 09 33 – Controls
- 1.2.4 Section 23 11 23 - Gas Piping
- 1.2.5 Section 23 23 00 - Refrigerant Piping

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:
- .1 Ontario Building Code.
 - .2 ASHRAE.
 - .3 CSA B149.1, Natural Gas and Propane Installation Code.
 - .4 CSA B149.2, Propane Storage and Handling Code.
 - .5 CSA/ANSI Z21.47/CSA 2.3, Gas Fired Central Furnaces.
 - .6 NFPA 90A, Standard for Installation of Air Conditioning and Ventilating Systems.

1.4 Submittals

1.4.1 Shop Drawings

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Submit shop drawings indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and troubleshooting protocol.
 - .2 Elevations, sections, details and operating components, dimensions, gauges, finishes and relationship of operating components to adjacent construction.

- .3 Complete electrical wiring diagrams including electrical schematics and sequence of operation.
- .4 Provide sound rating data, and efficiency.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings plus operation and maintenance data shall be included in the maintenance manual.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Warranty information.

2 Products

2.1 Gas Fired Furnace

- 2.1.1 Provide certified packaged factory-assembled unit consisting of cabinet, fan, fan motor, intake/exhaust assembly, heat exchanger, combustion chamber, burner, controls, air filter, and condensate drainage piping.
- 2.1.2 Unit to be high efficiency, two stage, variable speed, gas fired, condensing furnace with factory authorized conversion kit required for propane.
- 2.1.3 Unit to be complete with direct vent / sealed combustion.
- 2.1.4 Unit to be complete with integral condensate filter/neutralizer kit.
- 2.1.5 Performance Data as indicated in Contract Documents.
- 2.1.6 Unit Cabinet:
 - .1 Fully insulated steel casing, including the blower section.
 - .2 Vertical unit discharge.
 - .3 Removable access panels.

2.1.7 Blower Wheel and Motor:

- .1 Centrifugal type, galvanized blower wheel.
- .2 ECM blower motor permanently lubricated with sealed ball bearings.
- .3 Direct drive.
- .4 Single-speed PSC (Permanent Split Capacitor) draft inducer motor.

2.1.8 Filters:

- .1 Re-usable type.

2.1.9 Heat Exchangers:

- .1 Primary heat exchanger shall be 3-pass corrosion resistant aluminized steel.
 - .1 Fold and crimp sectional design and applied operating under negative pressure.
- .2 Secondary heat exchanger shall be stainless steel flow through.
 - .1 Fin and tube design and applied operating under negative pressure.

2.1.10 Controls:

- .1 Micro-processor based integrated electronic control board with minimum 16 service troubleshooting codes displayed via diagnostic flashing LED light on the control.
- .2 A self test feature that checks all major functions of the furnace.
- .3 A replaceable automotive type circuit protection fuse.

2.1.11 Electrical:

- .1 115V, Single phase, 60Hz.
- .2 Single point connection.
- .3 Control box with 24VAC motor inputs.

2.1.12 Standard of Acceptance:

- .1 Carrier,
- .2 Lennox,
- .3 Trane,
- .4 Daikin,
- .5 York.

3 Execution

3.1 General

- 3.1.1 Install as per manufacturer's instructions.
- 3.1.2 Locate furnace allowing accessibility for service and filter changes.
- 3.1.3 Check for free rotation of fan.
- 3.1.4 Ensure alignment of fan and motor pulleys.
- 3.1.5 Ensure proper belt tension, where occurring.
- 3.1.6 Make connections to line thermostat in accordance with manufacturer's instructions.
- 3.1.7 Make connections to gas service and drainage in accordance with manufacturer's instructions.
- 3.1.8 Coordinate wiring with Division 26.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of energy recovery units.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- 1.2.3 Section 23 09 33 – Controls
- 1.2.4 Section 23 31 13 - Ductwork
- 1.2.5 Section 23 33 00 - Duct Accessories

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:
- .1 Ontario Building Code.
 - .2 ASHRAE:
 - .1 ANSI/ASHRAE 84, Method of Testing Air-to-Air Heat/Energy Exchangers.
 - .3 NFPA 90A, Standard for Installation of Air Conditioning and Ventilating Systems.

1.4 Submittals

- 1.4.1 Shop Drawings
- .1 Submit shop drawings and product data sheets for all products specified in this section.
 - .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .3 Submit shop drawings indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and troubleshooting protocol.
 - .2 Elevations, sections, details and operating components, dimensions, gauges, finishes and relationship of operating components to adjacent construction.
 - .3 Complete electrical wiring diagrams including electrical schematics and sequence of operation.
 - .4 Provide sound rating data, and efficiency.

- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings plus operation and maintenance data shall be included in the maintenance manual.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Warranty information.

2 Products

2.1 Energy Recovery Ventilator

- 2.1.1 Provide certified packaged factory-assembled unit consisting of cabinet, fans, fan motors, ERV core, and membranes.
- 2.1.2 Unit to be high efficiency, crossflow ERV core with latent and sensible energy recovery utilizing enthalpic membranes. Enthalpic core membrane recover both heat and moisture.
- 2.1.3 Adaptive frost management system for cold climate installations.
- 2.1.4 Performance Data as indicated in Contract Documents.
- 2.1.5 Unit Cabinet:
 - .1 0.03 inch thick painted aluminum cabinet, white enamel finish.
 - .2 Insulated with 1-inch closed cell polyisocyanurate foam.
 - .3 Crossflow core.
 - .4 Horizontal flow unit.
 - .5 Two door construction.
 - .6 Adjustable hanging straps.
- 2.1.6 Fans:

- .1 Two backward curve impellers, PSC (Permanent Split Capacitor) motors.
 - .2 Permanently sealed bearings.
- 2.1.7 Filters:
 - .1 MERV 8 filters.
- 2.1.8 Controls:
 - .1 12 VDC remote control.
 - .1 Low speed, high speed, intermittent, 20/40 standby, 20-40-60 minute timer, filter service alert.
 - .2 Furnace interlock.
- 2.1.9 Electrical:
 - .1 115V, Single phase, 60Hz.
 - .2 Single point connection.
 - .3 24V circuit protection with self resetting fuse.
- 2.1.10 Standard of Acceptance:
 - .1 Nu-Air,
 - .2 Venmar,
 - .3 Lifebreath.

3 Execution

3.1 General

- 3.1.1 Install as per manufacturer's instructions.
- 3.1.2 Locate ERV allowing accessibility for service and filter changes.
- 3.1.3 Coordinate wiring with Division 26.

END OF SECTION

1 General

1.1 Summary

- 1.1.1 This section covers the design, supply, complete installation, verification, and testing of air source heat pumps.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- 1.2.3 Section 23 09 33 – Controls
- 1.2.4 Section 23 23 00 - Refrigerant Piping

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 Ontario Building Code.
- .2 ASHRAE
 - .1 ANSI/AHRI 210/240, Unitary Air Conditioning and Air-Source Heat Pump Equipment.
 - .2 ANSI/AHRI 340/360, Standard for Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
 - .3 ANSI/ASHRAE Standard 15, Safety Standard for Refrigeration Systems.
- .3 CSA C656, Performance Standard for Split-System and Single Package Air Conditioners and Heat Pumps.
- .4 Environmental Code of Practice for the Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
- .5 Environment Canada, Ozone-Depleting Substances and Halocarbon Alternatives Regulations.
- .6 NFPA 90A, Standard for Installation of Air Conditioning and Ventilating Systems.

1.4 Submittals

1.4.1 Shop Drawings

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.

- .3 Submit shop drawings indicating:
 - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and troubleshooting protocol.
 - .2 Elevations, sections, details and operating components, dimensions, gauges, finishes and relationship of operating components to adjacent construction.
 - .3 Complete electrical wiring diagrams including electrical schematics and sequence of operation.
 - .4 Provide sound rating data, and efficiency.
- .4 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
- .5 One copy of all stamped reviewed shop drawings plus operation and maintenance data shall be included in the maintenance manual.

1.4.2 Closeout Submittals:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.
- .3 Submit the following for incorporation into Operation and Maintenance Manuals:
 - .1 Copy of full set of reviewed Shop Drawings.
 - .2 Operating instructions and Safety precautions.
 - .3 Warranty information.

2 Products

2.1 Air-to-Air Outdoor Heat Pump

- 2.1.1 Factory assembled, single piece, air cooled outdoor unit with factory wiring, controls and compressor.
- 2.1.2 Unit suitable for wall hung mounting on manufacturer provided wall mounting brackets.
- 2.1.3 Performance Data as indicated in Contract Documents.
- 2.1.4 Unit Cabinet:
 - .1 Galvanized steel, bonderized and coated cabinet with baked enamel finish on the inside and outside of the cabinet.
 - .2 Removable access panels.

- .3 Acoustically lined outdoor compartment.

2.1.5 Fans:

- .1 Direct drive, propeller type, horizontal discharge.
- .2 Totally enclosed, single phase motor with E class insulation.
- .3 Permanently lubricated ball bearings.
- .4 Internal thermal overload protection.

2.1.6 Compressor:

- .1 Fully hermetic rotary type.
- .2 Crankcase heater.
- .3 Motor having thermal and current sensitive overload devices.
- .4 Equipped with an oil system, operating oil change and motor.
- .5 Assembly installed on rubber vibration isolators.

2.1.7 Outdoor Coil:

- .1 Aluminum pre-coated fins mechanically bonded to seamless copper tubes.

2.1.8 Refrigeration Components:

- .1 Brass service valves with refrigerant line fittings, terminating at exterior of casing.
- .2 Schrader type fittings with brass caps.
- .3 Reversing valve, suction line accumulator
- .4 Refrigerant line tubing, fittings and service ports.

2.1.9 Electrical:

- .1 208/230V, Single phase, 60Hz.
- .2 Single point connection.
- .3 Control box with 24V and RS-485 communication.

2.1.10 Standard of Acceptance:

- .1 Carrier,
- .2 Lennox,
- .3 Trane,

.4 Daikin,

.5 York.

2.2 Indoor Coil:

2.2.1 Factory assembled, vertical upflow design.

2.2.2 To be mounted in gas fired furnace.

2.2.3 Must meet or exceed burst pressure test of 2100 psi.

2.2.4 Performance Data as indicated in Contract Documents.

2.2.5 Unit to be complete with the following:

.1 Condensate pan with brass insert connections.

.2 Refrigerant connections.

.3 Thermostatic expansion valve.

.4 Standard of Acceptance:

.1 Carrier,

.2 Lennox,

.3 Trane,

.4 Daikin,

.5 York.

2.2.6 Refrigeration Piping:

.1 Between outdoor unit compressor section and indoor coil, complete with refrigerant metering devices and valves.

2.2.7 Accessories:

.1 Indoor heat/cool programmable thermostat.

.2 Thermostat: ENERGY STAR certified.

3 Execution

3.1 General

3.1.1 Install as per manufacturer's instructions.

3.1.2 Install outdoor heat pump on manufacturer provided wall mounting brackets or stand to maintain acceptable above grade level for drainage.

- 3.1.3 Protect motors, fans and coils during construction.
- 3.1.4 Coordinate wiring and lockable disconnect with Division 26

END OF SECTION

1 GENERAL

1.1 Summary

- 1.1.1 Provide and install electric heaters, gas fired heaters and all associated controls.

1.2 Related Sections

- 1.2.1 Section 23 05 00 - Common Work Results for HVAC
- 1.2.2 Division 26 - Electrical

1.3 Reference Standards

- 1.3.1 Provide work in accordance with requirements of Regulatory Agencies and conform to:

- .1 CSA (Canadian Standards Association).
- .2 ULC (Underwriters Laboratories of Canada).

1.4 Submittals

1.4.1 Shop Drawings

- .1 Submit shop drawings and product data sheets for all products specified in this section.
- .2 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .3 Submit shop drawings indicating:
 - .1 Product Data: Provide manufacturers literature and data indicating electrical characteristics.
 - .2 Performance criteria, compliance with appropriate reference standards, characteristics, limitations, troubleshooting protocol.
 - .3 Information sufficient and clearly marked to demonstrate that the system, including all specified arrangements, options and accessories will be supplied, including but not limited to:
 - .1 Unit model, size capacity, and efficiency.
 - .2 Electrical characteristics.
 - .3 Thermostat and other control devices.
- .4 Fittings, control equipment and accessories shipped loose, showing final location in assembly.
- .5 Wiring diagrams including complete internal panel wiring, external panel wiring and field wiring.

.6 Dimensions, internal and external construction details, recommended method of installation. Manufacturer's special installation requirements including procedures required for mounting and making service connections.

.7 Performance data.

1.4.2 Closeout Submittals

.1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

.2 Operation and maintenance data shall be included in the maintenance manual.

.3 Submit the following for incorporation into Operation and Maintenance Manuals:

.1 Manufacturing name, type, year, serial number, number of units, capacity and identification of related systems.

.2 Functional description detailing operation of components.

.3 Performance criteria and maintenance data.

.4 Operating instructions and precautions.

.5 Safety precautions

.6 Maintenance and troubleshooting guidelines

.7 Copy of full set of reviewed Shop Drawings and, if applicable, Marked-up Shop Drawings.

.8 Warranty information.

2 PRODUCTS

2.1 Electric Unit Heater:

2.1.1 1.2mm thick (18 ga) steel casing, phosphate undercoated for corrosion resistance and finished in polyester powder coat; threaded connections for hanger rods.

2.1.2 Tubular heating elements; stainless steel (2 to 10kW); finned steel (15 to 60kW). Concentric disposition of heating elements.

2.1.3 Propeller type fan, dynamically and statically balanced, with fan guard.

2.1.4 Continuous duty motor, totally enclosed, built-in overload protection, and resilient motor supports, permanently lubricated ball bearings.

2.1.5 Individually adjustable air outlet louvres.

2.1.6 Controls:

.1 Thermostat in location as indicated on the Contract Drawings.

- .2 120 V control circuit with magnetic contactor and transformer.
- .3 Built-in disconnect switch.
- .4 Mounting bracket.

2.1.7 Standard of Acceptance:

- .1 Stelpro,
- .2 Ouellet,
- .3 Chromalox.

2.2 Wall Fan Heater

- 2.2.1 Fan forced, wall mounted heater. Refer to Contract Documents for mounting requirements.
- 2.2.2 1.3mm (18 ga) galvanized steel casing, phosphate undercoated for corrosion resistance and finished in polyester powder coat.
- 2.2.3 Surface-mounting frame for Grille / Front Cover:
 - .1 Ribbed steel, minimum 1.6 mm (16-gauge) to 20-gauge, finished in manufacturer's standard baked powdercoat or epoxy-polyester finish.
 - .2 Discharge louvers shall direct airflow downward and be securely fastened with concealed screws.
- 2.2.4 Tubular heating elements; stainless steel.
- 2.2.5 Propeller type fan, dynamically and statically balanced, with fan guard.
- 2.2.6 Automatic reset thermal cutout switch.
- 2.2.7 Built-in controls.
- 2.2.8 Standard of Acceptance:
 - .1 Stelpro,
 - .2 Ouellet,
 - .3 Chromalox.

2.3 Baseboard Heater

- 2.3.1 Sloped top, 1.2mm thick steel (18 ga) cabinet, low temperature convection.
- 2.3.2 Standard white finish.
- 2.3.3 Copper tubular heating element with aluminum fins with chrome coating.
- 2.3.4 Pedestal for floor mounting.

2.3.5 Built-in controls.

2.3.6 Standard of Acceptance:

- .1 Stelpro,
- .2 Ouellet,
- .3 Chromalox.

2.4 Controls:

2.4.1 Refer to Contract Documents for thermostat locations. Provide as indicated.

3 EXECUTION

3.1 Examination

3.1.1 Review proposed locations on-site and co-ordinate installation requirements with general trades, architectural finishes, and power requirements.

3.2 Installation

3.2.1 Install in accordance with manufacturer's instructions.

3.2.2 Check final location with Engineer if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Engineer's direction.

3.2.3 Provide supplementary suspension steel as required.

3.2.4 Install thermostats in locations indicated.

3.2.5 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.2.6 Coordinate location of wall mount thermostat with furniture layout. Install thermostats in locations shown on drawings.

3.2.7 Make control connections.

3.2.8 Coordinate location for power feed with Division 16, remove knock outs and insert insulating bushing.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- 1.1.1 The requirements of this section shall apply to all sections in Division 26 – Electrical.
- 1.1.2 All material, labour, equipment, and services required under this section shall be the full responsibility of the Contractor including any material, labour, equipment, and services provided by their sub-contractors.
- 1.1.3 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.2 DEFINITIONS

- 1.2.1 “Supply” shall mean supply only.
- 1.2.2 “Install” shall mean install and connect.
- 1.2.3 “Provide” shall mean supply, install, connect and test.
- 1.2.4 “Drawings and Specifications” shall mean Contract Documents.
- 1.2.5 “Authorities” or Authorities having jurisdiction” shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.
- 1.2.6 “Work” shall mean all equipment, materials, labour, and permits to provide a complete and operational electrical system as detailed in the drawings and specifications.
- 1.2.7 “Owner” or “GRCA” shall mean Ganaraska Region Conservation Authority.

1.3 RELATED WORK

- 1.3.1 Division 1 – General
- 1.3.2 Division 22 and 23 – Mechanical
- 1.3.3 Division 26 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions. The Instructions to Bidders, General Conditions, General Requirements, Supplementary General Conditions and Amendments and Supplements thereto form a part of this Division and contain items related to the electrical work.

1.4 INTENT

- 1.4.1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.
- 1.4.2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.

- 1.4.3 Supply all labour, equipment, and materials necessary to install a complete and operational electrical system described herein and shown on the drawings.
- 1.4.4 It is the intent of these drawings and specifications to provide for an electrical installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.
- 1.4.5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.
- 1.4.6 All work must be done by qualified and certified persons in such line of work. Trade certificates must be available on demand.
- 1.4.7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.
- 1.4.8 The Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.
- 1.4.9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation, and finish.
- 1.4.10 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.5 CODES, BYLAWS, STANDARDS, AND REGULATIONS

- 1.5.1 The electrical system shall comply with the latest editions and revisions of applicable codes, bylaws, bulletins, standards, and regulations including but not limited to:
 - .1 Ontario Building Code
 - .2 Ontario Electrical Safety Code
 - .3 Canadian Standards Association
 - .4 Local Municipal Codes
 - .5 Local Building Bylaws
 - .6 Ontario Occupational Health and Safety Act
 - .7 IEEE
- 1.5.2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.

1.5.3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.

1.5.4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

1.6 PERMITS AND FEES

1.6.1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes including HST.

1.6.2 Coordinate all required inspections and give necessary notice to all authorities.

1.6.3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction.

1.7 CONTRACT BREAKDOWN

1.7.1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.

1.7.2 Breakdown shall include but not be limited to:

- .1 Mobilization and shop drawing submission (minimum \$2,000)
- .2 Permits and Fees
- .3 Panelboards and other miscellaneous distribution equipment
- .4 Starters, contactors and control devices
- .5 Feeder conduits
- .6 Branch conduits
- .7 Feeder cables
- .8 Branch wiring
- .9 Wiring for mechanical equipment
- .10 Luminaires (interior)
- .11 Luminaires (exterior)
- .12 Emergency Luminaires
- .13 Voice & Data system rough-in
- .14 Close-out Submittals – Manuals & As-builts (minimum \$5,000)

- 1.7.3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.

1.8 SHOP DRAWINGS

- 1.8.1 Within thirty (30) days of award, the Contractor shall submit shop drawings of all equipment for the project.
- 1.8.2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in PDF format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5x11. 11x17 will be acceptable where appropriate for content and scale.
- 1.8.3 Submittals shall contain but not be limited to details, dimensions, construction, size, arrangement, operating clearances, performance characteristics and capacities of products and parts of the work. Include wiring drawings and schematics showing interconnection with work of other Divisions.
- 1.8.4 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non applicable material. Note on the submittal specified features such as special tank linings, pump seals, materials or painting.
- 1.8.5 Prior to submission to the Consultant, the Contractor shall review all shop drawings. By this review the Contractor represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that he has checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents.
- 1.8.6 The Contractor's review of each shop drawing shall be indicated by his approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Contractor.
- 1.8.7 Review comments from consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval.
- 1.8.8 Review of the shop drawings by the Consultant does not relieve the contractor or his supplier of the responsibility to provide the correct and complete equipment, material or installation.
- 1.8.9 Keep one complete set of shop drawings at job site during construction.
- 1.8.10 Include stamped reviewed shop drawings in the Maintenance Manuals.

1.9 PRODUCT DELIVERY SCHEDULE

- 1.9.1 Within two (2) weeks from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.

1.10 CONSTRUCTION MEETINGS

- 1.10.1 The Electrical Contractor shall attend all site meetings unless otherwise pre-approved.
- 1.10.2 Sub-trades shall attend site meetings as requested or as required.

1.11 AS-BUILT DRAWINGS

- 1.11.1 Refer to Section 26-05-02.
- 1.11.2 Maintain accurate, neat, and clean As-built Drawings on an on-going basis during construction to be reviewed periodically by the Consultant during construction.
- 1.11.3 As-built drawing mark-ups shall be made available at every site meeting or inspection.
- 1.11.4 As-built drawings shall include but not be limited to final location of all component locations and conduit runs.
- 1.11.5 Prior to Substantial Performance submit a complete set of As-built drawings in PDF format. The Contractor is responsible for providing red-line drawings indicating all As-built conditions.

1.12 ESA CERTIFICATES

- 1.12.1 Furnish an unconditional Certificate of Acceptance from Electrical Safety Authority on completion of work. Arrange for interim and rough-in inspections. Arrange and pay for Occupancy Inspections if required for partial occupancies.
- 1.12.2 Incorporate a copy of the final ESA Certificate in the operating and maintenance manual.

1.13 MAINTENANCE MANUALS

- 1.13.1 Refer to Section 26 05 02.
- 1.13.2 Provide the Owner with two (2) indexed, hard cover maintenance manuals plus one (1) electronic copy on labeled on memory stick. Manuals shall contain and be tabbed in the following order:
 - .1 Table of Contents
 - .2 Contractor's, Manufacturer's and Supplier's Contact Information
 - .3 Warranty Letter
 - .4 Colour coding charts for access areas
 - .5 Final ESA Certificate
 - .6 Emergency Lighting Test Report
 - .7 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
 - .8 Maintenance instructions, requirements, and schedule

.9 As-built drawings

- 1.13.3 Submit one (1) complete copy to the Consultant for review and approval. Revise based on any comments and resubmit all copies and electronic copy to Consultant.

1.14 TESTING

- 1.14.1 The installation shall be free of open circuits and grounds.
- 1.14.2 On completion, measure insulation resistances and comply with Table 24 of Ontario Electrical Safety Code.
- 1.14.3 Test all wiring and connections for continuity and grounds before equipment is energized.
- 1.14.4 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.
- 1.14.5 Carry out all tests and furnish all equipment required to demonstrate safe and proper completion of the work, without cost to the Owner.
- 1.14.6 Check load balance on all feeders and make necessary adjustments to provide a "balanced" load.
- 1.14.7 Check voltage drop on all feeders/branch circuits and make necessary adjustments to provide a 2% voltage drop in all feeders and branch circuits and a 4% drop from supply side to point of utilization .
- 1.14.8 Fully coordinate all testing and commissioning with all trades, the Consultant, and authorities having jurisdiction.
- 1.14.9 Provide a minimum of forty-eight (48) hours written notice to all parties.

1.15 DEMONSTRATION AND TRAINING

- 1.15.1 Demonstrate and train the Owner on proper operation of the Electrical and Auxiliary systems.
- 1.15.2 Work with and assist Division 21, 22, 23 and 28 during training as required. Allow a minimum of four (4) separate two-hour sessions.
- 1.15.3 The Contractor shall arrange for all necessary personnel and equipment specialists to be in attendance for purposes of demonstration and training.
- 1.15.4 Provide instruction by a manufacturer's representatives as required too fully demonstrate the systems.
- 1.15.5 Demonstration and Training shall include but not be limited to:
- .1 Training in the normal, abnormal and emergency operating condition of all systems provided under this Division.
 - .2 Review of all necessary maintenance procedures of all systems provided under this Division.

- .3 Provision of a documented maintenance program covering all systems provided or modified under this contract.
- .4 Review of all close-out documentation including complete maintenance manuals and As-built drawings.
- .5 Prepare a Training Agenda and Log for signature by all Participants. Submit to Consultant and include in Manuals.

1.16 SUBSTANTIAL COMPLETION AND PERFORMANCE

- 1.16.1 Substantial completion and performance shall be determined and awarded by the Consultant.
- 1.16.2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:
 - .1 Submit Electrical Safety Authority Certificate
 - .2 Submit reports as specified herein – fire alarm, emergency lighting
 - .3 Fire stopping
 - .4 As-built drawings
 - .5 Demonstration and Training

1.17 WARRANTY

- 1.17.1 Provide a one (1) year full parts and labour warranty for the new system from date of substantial completion.
- 1.17.2 Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

2 PRODUCTS

2.1 GENERAL

- 2.1.1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.
- 2.1.2 Major components shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.
- 2.1.3 The same manufacturer shall be used for types of components used in similar applications.
- 2.1.4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.
- 2.1.5 Materials must be stored in original containers.

- 2.1.6 Remove and dispose of all redundant materials and garbage from site.

2.2 SELECTED PRODUCTS AND EQUIVALENTS

- 2.2.1 Sections within Division 26 list "Acceptable Manufacturers" which must meet characteristics of the specified equipment and products for each section.
- 2.2.2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.
- 2.2.3 Any alternate manufacturers from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified and/or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions.
- 2.2.4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.
- 2.2.5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 QUALITY OF PRODUCT

- 2.3.1 All products provided shall be CSA approved, approved by other relevant authorities.
- 2.3.2 If supplied products are not CSA approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- 2.3.3 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.4 VOLTAGE RATINGS

- 2.4.1 Operating Voltages: to CAN3-C235.
- 2.4.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

2.5 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- 2.5.1 Refer to Drawings for Contractor's equipment wiring responsibility.
- 2.5.2 Control wiring and conduit shall be covered under this Division except connections below 50V which are related to control systems specified under Division 23.

2.6 PRODUCT FINISHES

- 2.6.1 Shop drawings shall include finishes.

- 2.6.2 All cabinets, panelboards, switchboards, cable trays, etc. shall be finished in ANSI 61 grey enamel unless otherwise specified.
- 2.6.3 Apply primer on all items which are to be finished on the job.
- 2.6.4 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

2.7 ACCESS DOORS

- 2.7.1 Provide access doors/panels as required for access, adjustment, operation, service, and maintenance.
- 2.7.2 Access doors shall be flush mounted 600mmx600mm (24"x24") for body entry and 300mmx300mm (12"x12") for hand entry. Doors to open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

2.7.3 ACCESS DOORS/COVERS - FLUSH ACCESS DOOR – DRYWALL AREA

- .1 Acudor #DW-5040 Series flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.

2.7.4 ACCESS DOORS/COVERS - FLUSH ACCESS DOOR - UNIVERSAL

- .1 Acudor #UF-5000 Universal Access Doors, 14 GA. (1.7mm) steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.

2.7.5 Acceptable Manufacturers:

- .1 Acudor
- .2 Zurn
- .3 Nailor Industries
- .4 Le Hage

2.8 SLEEVES

- 2.8.1 Provide sleeves for all cables passing through masonry, concrete or fire rated assemblies unless run in conduit.
- 2.8.2 Sleeves shall be EMT conduit complete with bushing.

2.9 FIRE STOPPING

- 2.9.1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.

- 2.9.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- 2.9.3 Do not use cementitious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.
- 2.9.4 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- 2.9.5 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- 2.9.6 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
- 2.9.7 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- 2.9.8 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- 2.9.9 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
- 2.9.10 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.
- 2.9.11 Install material and components in accordance with ULC certification, manufacturer's instructions and local authority.
- 2.9.12 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.
- 2.9.13 Acceptable Manufacturers:
 - .1 Fryesleeve Industries Inc.
 - .2 General Electric Pensil Firestop Systems
 - .3 International Protective Coatings Corp.
 - .4 Rectorseal Corporation (Metacaulk)
 - .5 Proset Systems
 - .6 3M
 - .7 AD Systems
 - .8 Hilti

3 EXECUTION

3.1 SITE EXAMINATION

- 3.1.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.
- 3.1.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.
- 3.1.3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.2 INTERFERENCE AND COORDINATION DRAWINGS

- 3.2.1 Examine the drawings and all divisions of the specifications.
- 3.2.2 Prepare interference and equipment layout drawings to ensure all components will be properly accommodated within the spaces provided.
- 3.2.3 Lay out the work and equipment with due regard to architectural, structural and mechanical features, and service requirements.
- 3.2.4 Submit interference drawings to the Consultant.
- 3.2.5 Before commencing any work, obtain a ruling from the Consultant if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

3.3 SEPARATION OF SERVICES

- 3.3.1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.
- 3.3.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- 3.3.3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from ceiling installer, and approved clips or hangers are used.

3.4 WORKPLACE SAFETY

- 3.4.1 The workplace must be kept safe at all times.
- 3.4.2 Conform to all ministries of labour, and health and safety regulations at all times.
- 3.4.3 Use ladders and proper techniques as approved by the ministry of labour to perform all work.
- 3.4.4 Cover all holes/openings and provide barriers around hazards, etc. to ensure occupants and workers are not at risk.

3.4.5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner's representative or Consultant or rectify the situation immediately.

3.4.6 Report any hazards or concerns to the Owner's representative immediately.

3.4.7 Conform to the Owner's safety requirements and construction regulations.

3.5 TEMPORARY REQUIREMENTS

3.5.1 Provide grounded extension cords and temporary lights required for work.

3.5.2 Any specific task lighting required on site is the responsibility of this Division.

3.6 LOCATION OF LUMINAIRES

3.6.1 Locations may have to be revised to suit construction and equipment arrangements and it is expected that such changes will not result in additional cost to the Owner, provided that no additional labour or material is required and installation has not been completed.

3.7 MOUNTING HEIGHTS

3.7.1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

3.7.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.7.3 Install electrical equipment at following heights unless indicated otherwise (measurement to the centre of device unless specified):

3.7.4 Local switches: 900mm (36") - 1100mm (43")

3.7.5 Wall receptacles:

3.7.6 General: 400mm (16")

.1 Above top of continuous baseboard heater: 200mm (8")

.2 Above top of counters or counter splash backs: 100 mm (4")

.3 In mechanical rooms: 1200mm (48")

3.7.7 Panelboards: as required by Code or 1400mm (56")

3.7.8 Voice/Data outlets: At height of adjacent outlet or at 400mm (16")

3.7.9 Voice outlet for phone: 900mm (36") - 1100mm (43")

3.7.10 Thermostat: 1200mm (47")

3.8 REPAIRS, CUTTING AND RESTORATION

- 3.8.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match finishes of same materials.
- 3.8.2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- 3.8.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- 3.8.4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.9 PAINTING

- 3.9.1 Refer to other Divisions for Painting unless otherwise specified herein.
- 3.9.2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- 3.9.3 Prime and touch up marred finished paintwork to match original.
- 3.9.4 Restore to new condition, or replace equipment at discretion of Consultant, finishes which have been damaged too extensively to be merely primed, painted and touched up.

3.10 CONCEALMENT

- 3.10.1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls where possible unless otherwise noted on the drawings or approved by the Owner or Consultant.
- 3.10.2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit tight to roof deck and down columns.

3.11 CLEARANCES AND ACCESSIBILITY

- 3.11.1 Install all work for easy access for adjustment, operation, and maintenance.
- 3.11.2 Maintain clearances for all components as per code and manufacturer's instructions.
- 3.11.3 Provide access panels of adequate size as required to access components in concealed areas. Do not install access doors in specialty walls or ceilings.
- 3.11.4 Provide fire rated access doors shall be installed in fire separations and match rating of separation.

3.12 EQUIPMENT AND SYSTEM PROTECTION

- 3.12.1 Protect components and materials from damage in storage and on site before, during, and after installation until final acceptance.
- 3.12.2 Protect inside and outside of components from dust and debris with appropriate covers that will withstand through the construction.
- 3.12.3 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant at the expense of this Contractor.

3.13 SUPPORTS

- 3.13.1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all components.
- 3.13.2 All supports must be securely mounted to structures.

3.14 LOCATION OF OUTLETS

- 3.14.1 Do not install outlets back-to-back in wall. Allow minimum 150mm (6") horizontal clearance between boxes.
- 3.14.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3m (10') and information is given before installation.
- 3.14.3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.15 FIRE STOPPING

- 3.15.1 Refer to Part 2 herein.

3.16 CLEANING

- 3.16.1 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

3.17 OWNER SUPPLIED EQUIPMENT

- 3.17.1 Connect to equipment supplied by the Owner and make operable.

3.18 EQUIPMENT IDENTIFICATION

- 3.18.1 Identify electrical equipment with nameplates as follows:
- 3.18.2 Nameplates:
 - .1 Lamacoid 3mm (1/8") thick plastic engraving sheet, black face, white core, mechanically attached with self-tapping screws.

Nameplate Sizes			
Size 1	9mm x 50mm (3/8" x 2")	1 line	3mm (1/8") high letters
Size 2	12mm x 70mm (1/2" x 2-1/2")	1 line	5mm (3/16") high letters
Size 3	12mm x 70mm (1/2" x 2-1/2")	2 lines	3mm (1/8") high letters
Size 4	20mm x 90mm (3/4" x 3-1/2")	1 line	9mm (3/8") high letters
Size 5	20mm x 90mm (3/4" x 3-1/2")	2 lines	5mm (3/16") high letters
Size 6	25mm x 100mm (1" x 4")	1 line	12mm (1/2") high letters
Size 7	25mm x 100mm (1" x 4")	2 lines	6mm (1/4") high letters

- .2 Wording on nameplates labels to be approved by Consultant prior to manufacture.
- .3 Allow for average of twenty-five (25) letters per nameplate.
- .4 Identification to be English.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Nameplates for disconnects, starters and contactors must indicate equipment being controlled and voltage.
- .7 Nameplates for transformers must indicate transformer label as indicated and capacity, primary, and secondary voltages.

3.19 WIRING IDENTIFICATION

- 3.19.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- 3.19.2 Maintain phase sequence and colour coding throughout.
- 3.19.3 Colour code: to CSA C22.1.
- 3.19.4 Use colour coded wires in communication cables, matched throughout system.

3.20 CONDUIT AND CABLE IDENTIFICATION

- 3.20.1 Colour code conduits, boxes and metallic sheathed cables.
- 3.20.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m (45') intervals.
- 3.20.3 Colour bands must be 25mm (1") wide.

System	Colour
Up to 208V	yellow
Voice system	green
Data system	orange
Security	brown
Public address	black
Fire alarm	red

- 3.20.4 This Contractor must paint all system junction boxes and covers in conformance with the above schedule.

3.21 WIRING TERMINATIONS

- 3.21.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

3.22 WARNING SIGNS

- 3.22.1 Meet requirements of Electrical Safety Authority and Consultant.
- 3.22.2 Provide porcelain enamel signs, with a minimum size of 175mm x 250mm (7" x 10").

3.23 LOAD BALANCE

- 3.23.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- 3.23.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage equipment.
- 3.23.3 Submit at completion of work, report listing phase and neutral currents on panelboards, dry-core 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.

3.24 FIELD QUALITY CONTROL

- 3.24.1 Conduct and pay for following tests:
- .1 Power distribution system including phasing, voltage, grounding, and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.

- .4 Motors, heaters and associated control equipment including sequenced operating systems where applicable.
- .5 Systems: fire alarm system.
- 3.24.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- 3.24.3 Insulation resistance testing.
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- 3.24.4 Carry out tests in presence of Consultant.
- 3.24.5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- 3.24.6 Submit test results for Consultant's review.
- 3.25 COORDINATION OF PROTECTIVE DEVICES**
- 3.25.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated on drawings or as determined from coordination study.
- 3.26 FIELD REVIEW AND DEFICIENCIES**
- 3.26.1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.
- 3.26.2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.
- 3.26.3 The Contractor shall correct all deficiencies within the work period prior to the next review.
- 3.26.4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.
- 3.26.5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

END OF SECTION

1 GENERAL

1.1 WORK INCLUDED

- 1.1.1 Operating and Maintenance Manuals
- 1.1.2 Assembly of certificates and tests report
- 1.1.3 Assembly of shop drawings
- 1.1.4 Assembly of equipment and systems operating and maintenance instructions
- 1.1.5 Assembly of identification schedule
- 1.1.6 As Built Drawings

1.2 RELATED WORK

- 1.2.1 Division 1
- 1.2.2 General Electrical Requirements – Section 26 05 01

2 PRODUCTS

2.1 OPERATION AND MAINTENANCE MATERIALS

- 2.1.1 Provide two (2) 8½" x 11", 3 ring type catalogue binders, labeled front and spine, with plastic tab dividers and Table of Contents. Also provide one (1) complete manual in electronic PDF format on labeled memory stick.
- 2.1.2 Manufacturer's data section is to be indexed and ordered to exactly match the sections of the specifications. Each section of the manufacturer's data section is to include an up to date copy of the equipment schedule for that section. The schedule is to be revised to suit all addenda, change orders and field changes, as well as manufacturers and model numbers matching the equipment supplied.
- 2.1.3 Assemble or develop complete and correct documentation for the operation and preventative maintenance of equipment and systems provided.
- 2.1.4 Assemble or develop copies of all certified shop drawings and material required to complete the documentation. This generally includes but is not limited to the following:
 - .1 Table of Contents
 - .2 Contractor's, Manufacturer's and Supplier's Contact Information
 - .3 Warranty Letter
 - .4 Colour coding charts for access areas
 - .5 Final ESA Certificate

- .6 Emergency Lighting Test Report
- .7 ALL stamped approved shop drawings – Include a tab and blank section for any Owner supplied equipment
- .8 Maintenance instructions, requirements, and schedule
- .9 As Built drawings

2.2 AS BUILT DRAWINGS

- 2.2.1 As Built drawings shall be kept up to date on an ongoing basis during construction for periodic review by the Consultant. As Built drawings shall always be kept in the same location on site known to the Consultant.
- 2.2.2 Contractors shall certify that final reproducible As Built drawings to be correct by notation and signature on the drawings.
- 2.2.3 As Built drawings shall precisely identify the configuration, size and location of all systems and equipment installed under this Division.
- 2.2.4 As Built drawings must be submitted in AutoCAD as specified herein.

2.3 TEST REPORTS

- 2.3.1 Include a copy of all test reports for inclusion in Operating and Maintenance Manuals.

2.4 DEMONSTRATION AND TRAINING REPORTS

- 2.4.1 Refer to Section 26 05 01 – General Electrical Requirements
- 2.4.2 Include a copy of all Training literature in the Operating and Maintenance Manuals.
- 2.4.3 Include a copy of the signed and dated Training Log.

3 EXECUTION

3.1 GENERAL

- 3.1.1 Substantial Performance will not be granted until the hard copies and electronic copy of the complete manual have been submitted by the Contractor and reviewed and accepted by the Consultant.
- 3.1.2 Submit a draft copy of the manual to the Consultant for review prior to final submission of all copies.
- 3.1.3 Provide two (2) final hard copies and one (1) electronic copy in PDF format to the Consultant for final acceptance.

3.2 AS BUILT DRAWINGS

- 3.2.1 Prior to Substantial Performance submit a complete set of As Built drawings in PDF format. The Contractor is responsible for providing red-line drawings indicating all As Built conditions. Make any changes as requested by the Consultant after review.
- 3.2.2 Substantial performance will not be granted until the As Built drawings have been submitted to the Consultant.

END OF SECTION

1 GENERAL

1.1 GENERAL

- 1.1.1 The following specification represents the minimum standard required for installation of basic electrical components.

1.2 WORK INCLUDED

- 1.2.1 Refer to Section 26 05 01.
- 1.2.2 Work to be done under this Section includes labour, materials, and equipment required to install, test and operate Electrical and Communication Systems.
- 1.2.3 Removal of all redundant wiring and conduit including where specifically requested by the Owner.

1.3 CODES AND STANDARDS

- 1.3.1 Ontario Electrical Safety Code – Current Edition.
- 1.3.2 CSA
- 1.3.3 ULC
- 1.3.4 American Electronic/Telecommunication Industry Association
- 1.3.5 Commercial Building for Telecommunications Pathways and Spaces
- 1.3.6 Local Telephone Company requirements
- 1.3.7 Local Codes and Requirements

1.4 SUBMITTALS

- 1.4.1 Shop Drawings:
- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
 - .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.
 - .3 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.
 - .4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.
- 1.4.2 Operation and Maintenance Data:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

1.5 STANDARD OF MATERIALS

- 1.5.1 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.
- 1.5.2 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.
- 1.5.3 Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture.
- 1.5.4 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.
- 1.5.5 Materials shall bear approval labels as required by Code and/or Inspection Authorities.
- 1.5.6 Install materials in strict accordance with manufacturer's recommendations.
- 1.5.7 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.
- 1.5.8 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.
- 1.5.9 Where a specific manufacturer is noted herein, other manufacturers may be considered where approved by the owner.

2 PRODUCTS

2.1 GENERAL

- 2.1.1 Provide all equipment as per the following description to complete the entire works as shown on drawings and as indicated in the specifications to provide a complete and operational system.
- 2.1.2 Coordinate with other trades to provide the components required to make all systems operational – see mechanical schedules for details of equipment provided to make sure the works are complete.

2.2 OUTLET BOXES

- 2.2.1 Outlet boxes shall conform to C.S.A. Standard C22.2 No. 18-1972.
- 2.2.2 Ceiling boxes shall be 103 mm octagon or square, complete with fittings, where required to support fixtures.

2.2.3 Switch and receptacle boxes shall be:

- .1 103 mm square with plaster ring, where flush mounted in plaster walls.
- .2 No. 1104, where flush mounted in wood or drywall, with stud fasteners as required.
- .3 Masonry boxes in masonry walls.

2.2.4 Where boxes are surface mounted in unfinished areas they shall be FS conduits.

2.2.5 Standard outlet boxes shall be manufactured from code gauge galvanized steel.

2.2.6 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.

2.2.7 Boxes shall be of a size suitable for the number and size of conductors and the space requirements for the wiring device.

2.3 CONDUIT ACCESSORIES, CONDULETS AND FITTINGS

2.3.1 Conduit accessories, condulets and fittings shall conform to C.S.A. Standard C22.2 No. 18-1972.

2.3.2 Rigid conduit bushings shall be as manufactured by:

- .1 Thomas & Betts Ltd. – Series 5031
- .2 Efcor of Canada Ltd. – Series 720B
- .3 Commander / Iberville

2.3.3 EMT Connectors shall be steel set screw type as manufactured by:

- .1 Thomas & Betts Ltd. – Steel City TC 121E Series
- .2 Efcor of Canada Ltd. – Series 720B
- .3 Commander / Iberville

2.3.4 Ground Bushing shall be as manufactured by:

- .1 Thomas & Betts – Blackjack or 1220 Series
- .2 Efcor of Canada Ltd.
- .3 Commander / Iberville

2.3.5 Flexible conduit connectors shall be as manufactured by:

- .1 Thomas & Betts Ltd. – Series 3110
- .2 Efcor of Canada Ltd. – Series 1001B

- .3 Commander / Iberville
- 2.3.6 Conduit fittings shall be as manufactured by:
 - .1 Crouse-Hinds of Canada Ltd.
 - .2 Kondu Mfg. Co. Limited
 - .3 Thomas & Betts Ltd.
 - .4 Killark of Canada
 - .5 Efcor of Canada Ltd.
 - .6 Commander / Iberville
- 2.3.7 Steel conduit shall be as manufactured by:
 - .1 Conduits National Co. Ltd.
 - .2 MBF Industries
- 2.3.8 Aluminum conduits shall be as manufactured by:
 - .1 Alcan Canada Products Ltd.
- 2.3.9 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
 - .1 Thomas & Betts – 8125 Series
- 2.3.10 Terminate EMT entering boxes or enclosures with nylon insulated steel threaded bushings.
- 2.3.11 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
 - .1 Thomas & Betts – 5332 Series
- 2.3.12 Install wall entrance seals where conduits pass through exterior walls below grade.
- 2.3.13 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.
- 2.3.14 All cabling shall be run in EMT conduit unless otherwise approved.
- 2.3.15 BX cable is acceptable for short drops to light fixtures to a **MAXIMUM LENGTH OF 1500 mm**. Any installations exceeding 1500 mm **WILL BE REMOVED AND REPLACED AT THE CONTRACTORS EXPENSE**. All installations of BX cable shall be complete with anti-short bushings at all stripped ends as per OEC #12-608(1)(a). Connectors for BX cable shall be Crouse Hinds #L16ST.
- 2.3.16 Rigid PVC (unplasticized) conduit shall be CSA approved according to CSA Standard C22.2 No. 136.

2.3.17 Pull Cords/Strings

- .1 Nylon twine

2.4 CONDUCTORS, WIRES AND CABLES

2.4.1 Wiring installed in conduit, unless otherwise noted, shall be copper 600 volt RW75XLPE, RWU75XLPE or T-75 nylon jacket as per the requirements on the plans. It is the responsibility of the contractor to verify all equipment termination temperature and adjust wire size/rating to suit.

2.4.2 Lighting and power wiring shall be copper, **minimum** No. 12 gauge. Size wires for 2% maximum voltage drop to farthest outlet on a maximum 80% loaded circuit.

2.4.3 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.

- .1 Colour Coding shall be as follows:

- .1 Phase "A" – Red
- .2 Phase "B" – Black
- .3 Phase "C" – Blue
- .4 Control – Orange
- .5 Ground – Green
- .6 Neutral – White

- .2 Wire shall be as manufactured by:

- .1 Nexans
- .2 Industrial Wire and Cable (1970) Ltd.
- .3 Southwire Canada
- .4 Prysmian Cables & Systems Ltd (formerly Pirelli Cables Ltd.)

.3 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

.4 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.

- .1 Thomas & Betts – Marr Max Series

.5 Splice large conductors using compression type connections insulated with heat shrink sleeves.

- .1 Thomas & Betts – 5400 Series lugs and heat shrink type #s series

.6 Where colour coding tape is utilized, it shall be applied for a minimum of 2" at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition. Colour coding shall also apply to bussing in panels and, switchgear, disconnects, and metering cabinets.

2.5 SPLITTERS

- 2.5.1 Splitters must conform to CSA C22.2 No. 76 (latest edition).
- 2.5.2 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- 2.5.3 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- 2.5.4 At least three spare terminals on each set of lugs in splitters less than 400A.
- 2.5.5 Splitter length must match arrangement of equipment unless indicated otherwise.
- 2.5.6 JUNCTION BOXES AND PULL BOXES
- 2.5.7 Junction and pull boxes must conform to CSA C22.2 No. 40 (latest edition).
- 2.5.8 Welded steel construction with screw-on flat covers for surface mounting.
- 2.5.9 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

2.6 SWITCHES

- 2.6.1 Local switches shall be 20A, single pole, double pole, three-way, four-way, keyed, or motor rated complete with pilot light. Switches to be silent, A.C. type and C.S.A. listed, specification grade. Provide switches rated to suit system voltage.
- 2.6.2 Manually operated general purpose with the following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts
 - .3 Urea or melamine molding for parts subject to carbon tracking
 - .4 Suitable for back and side wiring
 - .5 Toggle style
- 2.6.3 Toggle operated fully rated for tungsten filament and LED lamps
- 2.6.4 Up to 80% of rated capacity of motor loads.
- 2.6.5 Switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.
- 2.6.6 Provide white colour (to be confirmed at shop drawing review).
- 2.6.7 Catalogue numbers listed below have been used to indicate quality standards.
 - .1 Single Pole Hubbell 1221/18221 Series

- .2 Double Pole Hubbell 1222/18222 Series
- .3 Three-Way Hubbell 1223/18223 Series
- .4 Four-Way Hubbell 1224/18224 Series
- .5 Motor rated Hubbell HBL1221PL c/w pilot light (min 20A)

2.6.8 Acceptable Manufacturers:

- .1 Hubbell of Canada Ltd.
- .2 Leviton
- .3 Legrand
- .4 Lutron

2.7 Occupancy Sensors

- 2.7.1 Ceiling mounted sensors shall be Dual Technology capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
- 2.7.2 Wall mounted sensors shall be Single Technology capable of detecting presence in the control area by detecting passive infrared heat changes
- 2.7.3 Ceiling sensors shall use patent pending ultrasonic diffusion technology that spreads coverage to a wider area.
- 2.7.4 Ceiling sensors shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
- 2.7.5 Ceiling sensors shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
- 2.7.6 Ceiling sensors shall be ceiling mounted with a flat, unobtrusive appearance and provide 360° coverage.
- 2.7.7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout controlled space.
- 2.7.8 To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
- 2.7.9 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those

emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.

- 2.7.10 Sensors shall have a time delay that is adjusted automatically (with the SmartSet setting) or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch.
- 2.7.11 Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
- 2.7.12 Ceiling sensors shall have a built-in light level sensor that works from 10 to 300 foot candles.
- 2.7.13 Sensors shall have a manual on function that is facilitated by installing a momentary switch.
- 2.7.14 Sensors shall have eight occupancy logic options that give the ability to customize control to meet application needs.
- 2.7.15 The sensors shall feature terminal style wiring, which makes installation easier.
- 2.7.16 Sensors shall have an additional single-pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options.
- 2.7.17 Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.
- 2.7.18 To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
- 2.7.19 Sensors shall have standard 5 year warranty and shall be UL and CUL listed.
- 2.7.20 Leviton is an acceptable alternate for occupancy sensor lighting control.

2.8 RECEPTACLES

- 2.8.1 Receptacles shall conform to CSA 22.2 No. 42 (latest edition).
- 2.8.2 Receptacles shall be specification grade of amperage and voltage indicated on the drawings.
- 2.8.3 Manually operated general purpose with the following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Break-off links for use as split receptacles
 - .3 Urea or melamine molding for parts subject to carbon tracking
 - .4 Suitable for back and side wiring (eight back wired entrances, four side wiring screws)
 - .5 Triple wipe contacts and riveted grounding contacts

.6 Tamper resistant

2.8.4 Switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

2.8.5 Provide white colour (to be confirmed at shop drawing review).

2.8.6 Receptacles shall be as listed below:

.1 15 ampere, 120V, single phase grounded duplex tamper resistant receptacle shall be NEMA-U-ground type CSA Configuration 5-15R.

.2 20 ampere, 120V, single phase grounded duplex tamper resistant receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA.

.3 15 ampere, 120V, weatherproof receptacles shall be equal to those above but complete with gasketed cast plate and hinged covers.

2.8.7 Other types of receptacles shall be provided as shown on Drawings.

2.8.8 Catalogue numbers listed below have been used to indicate quality standards.

.1 T-Slot Hubbell BR20WHITR

.2 Controlled T-Slot Hubbell BR20C2GNTR

.3 GFI T-Slot Hubbell GFTRST20W

.4 Twist Lock Hubbell HBL23XX

.5 Range Hubbell HBL9450A

2.8.9 Acceptable Manufacturers:

.1 Hubbell

.2 Legrand

.3 Leviton

.4 Cooper

2.9 COVER PLATES

2.9.1 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.

2.9.2 Cover plates shall be of the same manufacturer throughout.

2.9.3 Cover plates shall be as manufactured by:

.1 Leviton

.2 Hubbell

.3 Legrand

2.10 DISCONNECT SWITCHES

2.10.1 Fused or Un-fused disconnect or safety switches shall be Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.

2.10.2 Switches throughout job shall be of same manufacture.

2.10.3 Fused switches shall have fuse clips designed for Class "J" fuses and designed to reject standard N.E.C. fuses.

2.10.4 Switches shall be as manufactured by:

.1 Eaton

.2 Siemens

.3 Schneider Electric

2.10.5 Provide fused or un-fused safety or disconnect switches as shown and as required by Code.

2.10.6 Disconnects feeding elevator controllers must be equipped with two auxiliary contacts approved by the elevator supplier.

2.11 MOTOR STARTERS

2.11.1 Starts shall conform to CSA C22.2 No. 14 (latest edition) and EEMAC E14-1.

2.11.2 Manual motor starters shall be/have:

.1 Used for motors ½ hp or less

.2 Equal to Allen Bradley type 600 and 609

.3 Toggle operated

.4 Locking

.5 Plug-in heaters sized to suit the full load current of the motors installed

.6 Red neon pilot light

2.11.3 Magnetic motor starters shall be/have:

.1 Used for motors over ½ hp

.2 Equal to Allen Bradley IEC type

.3 Contactor solenoid operated, rapid action type

- .4 Motor overload protective device in each phase, manually reset from outside enclosure
 - .5 Hand/off/auto push button selector switches
 - .6 Indicating lights: standard duty, 1 red pilot light for “stop” or “off” and 1 green light for “start” or “on”.
 - .7 1-N/O and 1-N/C spare auxiliary contacts
 - .8 24V auxiliary contacts
 - .9 Wiring and schematic diagram inside starter enclosure in visible location
- 2.11.4 Combination starters shall be/have:
- .1 Used where fused switch and magnetic starter are in same location
 - .2 Equal to Allen Bradley IEC
 - .3 Include fused disconnect switch with operating lever on outside of enclosure to control disconnect
 - .4 Locking in “OFF” position
 - .5 Independent locking of enclosure door
 - .6 Provision for preventing switching to “ON” position while enclosure door is opened.
 - .7 Magnetic starter features as per above.
- 2.11.5 Provide control transformers and auxiliary contacts as required for control connections.
- 2.11.6 Provide push to test lights throughout.
- 2.11.7 Half size and IEC starters will not be accepted.
- 2.11.8 Acceptable Manufacturers:
- .1 Allen Bradley
 - .2 Eaton
 - .3 Siemens
 - .4 Schneider Electric

2.12 CONTACTORS

- 2.12.1 Contactors shall conform to CSA C22.2 No. 14 (latest edition).
- 2.12.2 Electrically held and controlled by pilot devices as indicated and rated for type of load controlled. (Mechanically held style for exterior lighting control).

- 2.12.3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- 2.12.4 Mount in CSA Enclosure 1 unless otherwise indicated.
- 2.12.5 Include following options in cover:
 - .1 Red indicating lamp.
 - .2 Hand – Off – Auto selector switch.
- 2.12.6 24V Control transformer: mounted in contactor enclosure.
- 2.12.7 Acceptable Manufacturers:
 - .1 Allen-Bradley
 - .2 Eaton
 - .3 Siemens
 - .4 Schneider Electric

2.13 CONTROL RELAYS

- 2.13.1 Control relays shall be equal to Allen Bradley type P, electrically held. Confirm coil voltages for relays controlling mechanical equipment with controls contractor.

2.14 HANGERS AND SUPPORTS

- 2.14.1 Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract.
- 2.14.2 Hangers for electrical conduit shall be galvanized after fabrication.
- 2.14.3 Conduit hangers shall be as manufactured by:
 - .1 Burndy Canada Ltd.
 - .2 Canadian Strut Products Ltd.
 - .3 E. Myatt & Co. Ltd.
 - .4 Steel City Electric Co.
 - .5 Pilgrim
 - .6 Thomas & Betts
 - .7 B-line
- 2.14.4 Do not use perforated strapping (grappler bars).

2.15 Hand Dryers

2.15.1 Hands dryers are to be supplied and installed by this Division with the following features:

- .1 ULC certified
- .2 Low velocity
- .3 Surface mounting
- .4 Fixed nozzle with automatic activation
- .5 White finish
- .6 Rating of 2300 W (20 A) at 120V
- .7 World Dryer Smartdri Plus Series

2.16 FINISHES AND PAINTING

2.16.1 All factory supplied equipment shall have finish coating factory applied whether finish be painted, galvanized or other, as required and as specified.

2.16.2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

3 EXECUTION

3.1 GENERAL

3.1.1 All wiring to meet Ontario Electrical Safety Code and local authorities.

3.1.2 All power, interlock and control wiring over 50V, and disconnects shall be supplied and installed by the Electrical Contractor. Coordinate with Division 22 and 23.

3.1.3 Division 22 and 23 shall install all control and low voltage interlock wiring less 50V or less for mechanical equipment unless specified.

3.1.4 All outdoor wiring to be run in liquidtight. All indoor wiring to be run in conduit. Last 1.5m (5') at final connection to equipment shall be run in flexible conduit only (not liquidtight).

3.1.5 Where wire size is not indicated, ampacity must match or exceed rating of protective device.

3.1.6 Panels are specified as sequence bussed and all branch circuit wiring from these panels shall be such that where a common neutral is used for two or three circuits, these circuits shall be fed from adjacent breakers, so that single-pole breakers may be replaced with 2 or 3 pole breakers should this be required in the future. All circuits shall be balanced. All neutrals shall be sized to meet the requirements of Section 4-018 of the Ontario Electrical Safety code and in no case smaller than 12 AWG.

- 3.1.7 Feeders, sub-feeders, circuit wiring and ancillary items shall be colour coded for phase identification. Neutral conductors shall be full capacity with white covering and be continuous throughout the system without fuses, switches or breakers of any kind.
- 3.1.8 Install wiring continuously within raceways, splices will be permitted only at outlets and junction boxes. Sufficient slack wire shall be left at these points to permit proper connection of fixtures, devices, equipment, etc.
- 3.1.9 Any exposed conduits or cables shall be run parallel to or at right angles to building lines and in a neat manner. Conduits shall be thoroughly reamed and each threaded termination shall be provided with two lock nuts. Running threads for rigid conduit will not be accepted.
- 3.1.10 Internal raceways in the building
 - .1 Securely cap or plug all openings in conduit and ducts during the execution of the Work to prevent dust and debris from entering the openings.
 - .2 At completion of the installation, the service entry ducts and the conduit system in the building shall be fished to clear all blocks.
- 3.1.11 Outlet and pull boxes shall be cleaned out and the system left free from water and moisture.
- 3.1.12 Provide all conduit, wire, fittings, disconnect switches, line voltage, starters, disconnects, controls and auxiliary materials as previously defined to wire into service all 3 phase motors, single phase motors and equipment included in other Sections unless specified otherwise.
- 3.1.13 Install pull boxes in conduit run where required to facilitate the pulling in of cable and locate in inconspicuous accessible spaces.
- 3.1.14 Provide flexible connections to mechanical equipment for vibration isolation. Connections to equipment roof mounted or in other damp or wet locations shall be liquid tight.
- 3.1.15 Conduits and cables shall not be attached to mechanical units for support.
- 3.1.16 All devices in General Purpose rooms (Gym), Mechanical and/or Electrical rooms and all exterior mounted devices shall have wire guards for protection from mechanical damage. Provide wire guards elsewhere as noted on drawings.

3.2 WIRING METHODS

- 3.2.1 Install wiring in conduit unless otherwise specified.
- 3.2.2 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 mm for final connection to lighting fixtures. Do not connect from fixture to fixture.
- 3.2.3 Use thin wall conduit (EMT), up to and including 53 mm conduit size, for branch circuit and feeder wiring in ceilings, furred spaces, concrete block walls, hollow walls and partitions. Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 65 mm or larger. Use rigid PVC conduit for wiring in slabs on grade and wiring below grade.

3.2.4 Aluminum conduit may be used, in lieu of rigid steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.

3.2.5 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

3.3 OUTLET BOXES

3.3.1 Where 103 mm square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut under Masonry Division as instructed under this Section. Opening shall be cut to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.

3.3.2 Ceiling boxes shall be 103 mm octagon or square, complete with fittings, where required to support fixtures.

3.3.3 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.

3.3.4 Support outlet boxes independently of conduit and cable.

3.3.5 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.

3.3.6 Offset outlet boxes, shown back to back in partitions, horizontally a min. 150mm to minimize noise transmission between adjacent rooms.

3.3.7 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Each system shall utilize separate boxes.

3.3.8 Use tile wall covers where 103 mm square outlet boxes are installed in exposed concrete or cinder block in finished areas.

3.3.9 Flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, shall be provided with suitable flush trims and doors or covers, unless specifically noted otherwise.

3.3.10 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

3.4 CONDUIT ACCESSORIES, CONDULETS AND FITTINGS

3.4.1 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.

.1 Thomas & Betts – 8125 Series

3.4.2 Terminate EMT entering boxes or enclosures with nylon insulated steel threaded bushings.

3.4.3 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.

.1 Thomas & Betts – 5332 Series

3.4.4 Install wall entrance seals where conduits pass through exterior walls below grade.

3.4.5 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.

3.5 CONDUCTORS, WIRES AND CABLES

3.5.1 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.

3.5.2 Colour Coding shall be as follows:

.1 Phase "A" – Red

.2 Phase "B" – Black

.3 Phase "C" – Blue

.4 Control – Orange

.5 Ground – Green

.6 Neutral – White

3.5.3 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3.5.4 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.

.1 Thomas & Betts – Marr Max Series

3.5.5 Splice large conductors using compression type connections insulated with heat shrink sleeves.

.1 Thomas & Betts – 5400 Series lugs and heat shrink type #s series

3.5.6 Where colour coding tape is utilized, it shall be applied for a minimum of 2" at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition. Colour coding shall also apply to bussing in panels and, switchgear, disconnects, and metering cabinets.

3.6 JUNCTION BOXES AND PULL BOXES

3.6.1 Install pull boxes in inconspicuous but accessible locations. Provide access doors in all drywall areas.

3.6.2 Install junction boxes and pull boxes so as not to exceed 30m (100') of conduit run between pull boxes and in conformance with the Electrical Safety Authority.

3.6.3 Provide equipment identification in conformance with Section 260501.

3.6.4 Label all junction boxes with panel and circuit number.

3.7 SWITCHES

3.7.1 Install single throw switches with handle in the “up” position when switch is closed.

3.7.2 Install switches in gang type outlet box when more than one switch is required in one location.

3.7.3 Confirm colour prior to ordering.

3.7.4 Refer to Section 26 05 01 for mounting heights.

3.8 RECEPTACLE

3.8.1 Mount receptacles so long dimension is in the vertical.

3.8.2 Exact locations shall be verified to suit furniture layout.

3.8.3 Connect receptacle grounding terminal to the outlet box with a copper wire.

3.8.4 Install receptacles in gang type outlet box when more than one switch is required in one location.

3.8.5 Where split receptacle has one portion switched mount vertically and switch upper portion.

3.8.6 Weatherproof receptacles shall be equal to 20A GFI and mounted in weatherproof enclosure complete. Enclosure shall be equivalent to Hubbell RW58300.

3.8.7 Confirm colour prior to ordering.

3.8.8 Refer to Section 26 05 01 for mounting heights.

3.9 COVER PLATES

3.9.1 Do not install plates until final painting of room or area is completed. Remove protective covering.

3.10 Destratification Fans and Controls

3.10.1 Ensure fans and controls are installed in conformance with manufacturer recommendations.

3.10.2 Suspend/free hang ceiling fans from roof structure from eye hook / eyebolt on fan. Use minimum ¼ carabineer. Provide chain for back-up support.

3.10.3 Provide junction box for power connection directly above the fan and run flexible conduit to fan.

3.10.4 Fans shall be mounted level with surrounding structure to ensure air flow is not impeded.

- 3.10.5 Electrical Contractor shall supply and install switch or speed controller to suit fan.
- 3.10.6 Install wire guards to be level. Fasten wireguards to structure NOT roof deck. Provide intermediate unistrut supports to suit.
- 3.10.7 Demonstrate fan operation at the time of final inspection

3.11 HANGERS AND SUPPORTS

- 3.11.1 Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract.
- 3.11.2 Support outlet boxes, junction boxes, conduit and all electrical equipment independently with hangers and fastenings to building structural members.
- 3.11.3 Hangers in general shall be supported from inserts in concrete construction or from building structure using beam clamps for steel structures. Provide all additional angle or channel steel members required between beams for support of conduits, cables, luminaires, etc.
- 3.11.4 Use coach screws, lag screws or wood screws as appropriate in any wood construction.
- 3.11.5 Feeders, conduits and power ducts running vertically in a building shall be supported at each floor and between each floor if necessary.

3.12 MOUNTING HEIGHTS

- 3.12.1 Refer to Section 26 05 01.

3.13 CONDUIT SLEEVES AND CURBS

- 3.13.1 Provide conduit sleeves of galvanized steel for conduit and cable runs passing through concrete walls, beams, slabs and floor. Include for all power, communications and control wiring. All conduit sleeves shall be de-burred and have plastic bushings installed to protect wiring.
- 3.13.2 Extend galvanized conduit sleeves for conduit rising through slabs 4" minimum above finished floors. Provide sleeves, passing through floors having a waterproof membrane, with an integral flashing clamp.

3.14 Hand Dryers

- 3.14.1 Install and connect hand dryers in conformance with manufacturer's recommendations.
- 3.14.2 Provide GFI breaker for circuit feeding hand dryer.
- 3.14.3 Hand dryers are to be mounted at a height to suit age of expected users. Unless otherwise noted confirm height with Architectural drawings prior to rough in.
- 3.14.4 Once installed this Contractor is to caulk the joint between dryer and wall surface with a bead of white silicone. Coordinate installation with General Contractor.

3.15 SUPPORTS AND BASES

- 3.15.1 Mount Switchboards, Motor Control Centres and all other floor mounted electrical equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around.
- 3.15.2 Supply and erect special structural work required for installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.
- 3.15.3 Switches or other electrical equipment shall be complete with suitable bases or mounting brackets.
- 3.15.4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.
- 3.15.5 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.
- 3.15.6 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.
- 3.15.7 Do not use explosive drive pins in any section of work without obtaining prior approval.

3.16 FINISHES AND PAINTING

- 3.16.1 Primary and final painting for work, other than items specified as factory primed or finished, shall be performed by trades specializing in this type of work.
- 3.16.2 Repair and finish factory finished equipment, damaged or scratched during installation, in an approved manner.
- 3.16.3 Leave bare metal surfaces ready for painting by removing dirt, rust, grease or millscale to Consultant's approval.
- 3.16.4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with CGSB-GB-40d and leave ready to receive finish paint.

3.17 ELECTRICAL CONNECTIONS FOR MECHANICAL EQUIPMENT

- 3.17.1 Provide all required electrical connections to apparatus provided and/or supplied by Division 21, 22 and 23, the Owner and as part of the work of other Divisions of the Specifications.
- 3.17.2 All power and control wiring over 50V and disconnects shall be installed by the Electrical Contractor.

3.17.3 All control and low voltage wiring 50V and under shall be installed by the Mechanical Contractor and/or Controls Contractor. Coordinate all low voltage wiring with the Mechanical Contractor.

3.17.4 All connections to roof mounted mechanical equipment shall be installed through a gooseneck style pitch pocket equal to Thaler Metal MEF-2A/2A1/2A2. Pitch pocket supplied and installed by Electrical Contractor. Coordinate installation with General Contractor and/or Roofing Contractor.

3.18 MOTORS AND STARTERS

3.18.1 Division 26 shall supply and install all starters unless otherwise indicated.

3.18.2 Coordinate with Division 22 and 23 as required.

3.18.3 Install line voltage disconnect switches at each motor not within the required distance from its starter to meet code requirements.

3.18.4 All motors shall be wired and connected under this Division. The drawings do not necessarily show the exact location of wiring to motors and it shall be the responsibility of this Division to fully coordinate this work with Division 22 and 23.

3.18.5 Temperature Controls: Be responsible for the "line" side power connections to all control apparatus where detailed or required to make the system operational.

3.19 EQUIPMENT IDENTIFICATION

3.19.1 Refer to Section 26 05 01.

3.20 TESTING

3.20.1 Make tests of equipment and wiring at times requested.

3.20.2 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.

3.20.3 Supply meters, materials and personnel as required to carry out these tests.

3.20.4 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

3.20.5 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.

3.20.6 Connect single phase loads so that there is the least possible unbalance of the supply phases.

3.20.7 Submit all test results in report format.

END OF SECTION

1 GENERAL

1.1 SHOP DRAWINGS

- 1.1.1 Submit shop drawings for each system in Conformance with Section 26 05 01.

1.2 PRODUCT/MAINTENANCE DATA

- 1.2.1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to Section 26 05 01.

1.3 SCOPE

- 1.3.1 The scope of this Section will include the following systems.

- .1 Communications rough-in
- .2 Fire Assembly

2 PRODUCTS

2.1 COMMUNICATIONS ROUGH-IN

- 2.1.1 Concealed empty conduit with pull strings and junction boxes maximum 50' spacing.
- 2.1.2 Outlets where noted shall be single gang flush mounted in wall.
- 2.1.3 Recess empty conduit
- 2.1.4 Outlets if unwired are to be provided with blank cover plates.
- 2.1.5 J-hooks in ceiling space.

2.2 FIRE ASSEMBLY

- 2.2.1 Provide fire rated assembly for communication cables entering any data rooms as noted on drawings.
- 2.2.2 Fire Assembly shall be Specified Technologies Inc. model #EZDP433GK.

3 EXECUTION

3.1 COMMUNICATIONS ROUGH-IN

- 3.1.1 Outlets are to be installed complete with 21 mm ($\frac{3}{4}$ ") conduit to ceiling space or nearest zone conduit (if applicable).
- 3.1.2 Provide insulated bushings on all conduits terminated in ceiling space.

END OF SECTION

1 GENERAL

1.1 General Requirements

- 1.1.1 The studies must be submitted to the Consultant prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Consultant may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device rating and characteristics will be satisfactory.
- 1.1.2 The studies shall include all portions off the electrical distribution system from the normal power source or source down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those, which result in maximum fault conditions, shall be adequately covered in the study.
- 1.1.3 The firm should be currently involved in high- and low- voltage power system evaluation. The study must be performed, stamped and signed by a registered professional engineer in the Province of Ontario. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Consultant for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.
- 1.1.4 The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.2 Data Collection For The Study

- 1.2.1 The Contractor shall provide the required data for preparation of the studies. The Consultant performing the system studies shall furnish the Contractor with a listing of the required data immediately after awards of the contract.
- 1.2.2 The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.

2 PRODUCTS

2.1 Short Circuit And Protective Device Evaluation And Coordination Study

- 2.1.1 The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standard.
- 2.1.2 In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculation, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control centre, distribution panelboard, pertinent branch circuit panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system area, including the associated zero sequence impedance data. Include in tabulations fault

impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

- 2.1.3 In the protective devices coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time, dial, pickup, instantaneous, and time delay settings.
- 2.1.4 Include on the curve sheets power company relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. In addition, include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control centre, and main breaker in branch panelboards.
- 2.1.5 Include all adjustable setting for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical fault currents. Terminate device characteristics curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.
- 2.1.6 Select each primary protective device required for a delta-wye connected transformer so that it's characteristic or operating band is within the transformer characteristic, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Separate transformer primary protective by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristics curves from curves for other devices by least a 0.4- second time margin.
- 2.1.7 Include complete fault calculations as specified herein based on contract documents.
- 2.1.8 Submit qualifications of individuals(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit the study to Consultant for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer.
- 2.1.9 Utilize equipment load data for the study obtained by the Contractors form contract document, including contract addenda issued prior to bid openings.
- 2.1.10 Include fault contribution of all motors in the study. Notify the consultant in writing of circuit protective devices not properly rated for fault conditions.
- 2.1.11 When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristics of the protective devices. Contractor shall obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not typical values for the generator.

- 2.1.12 Evaluate proper operations of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
- 2.1.13 For motor controls circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current and time to ensure protective devices will no trip during major or ground start operation.

2.2 Arc Flash Hazard Analysis

- 2.2.1 The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E- Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D and CSA Z462-2018.
- 2.2.2 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D.
- 2.2.3 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study room. Alternative methods shall be presented in proposal.
- 2.2.4 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboard, busway and splitters) where work could be performed on energized parts.
- 2.2.5 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
- 2.2.6 Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- 2.2.7 The Arc Flash Hazard analysis shall include calculation for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- 2.2.8 Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
- 2.2.9 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped based on IEEE 1584 latest edition.

2.3 Study Report

- 2.3.1 The result of the power system study shall be summarized in a final report. Three (3) bound copies of the copies of the final report must be submitted.
- 2.3.2 The report shall include the following sections:
 - .1 Descriptions, purpose, basis, and scope of the study.

- .2 Tabulation of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
- .3 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
- .4 Fault current calculations including a definition of terms and guide for interpretation of computer printout.
- .5 Incident energy and flash protective boundary calculations
 - .1 Arcing fault magnitude
 - .2 Device clearing time
 - .3 Duration of arc
 - .4 Arc flash boundary
 - .5 Working distance
 - .6 Incident energy
 - .7 Hazard Risk Category
 - .8 Recommendations for flash energy reduction

3 EXECUTION

3.1 Field Settings

- 3.1.1 The Contractor shall perform field adjustment of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, and protective device coordination study.
- 3.1.2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

3.2 Arc Flash Warning Labels

- 3.2.1 The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- 3.2.2 The label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD" and shall include the following information:
 - .1 Location designation
 - .2 Nominal voltage
 - .3 Flash protection boundary
 - .4 Hazard risk category
 - .5 Incident energy
 - .6 Working distance

- .7 Engineering report number, revision number and issue date.
- 3.2.3 Labels shall be machine printed, with no field marking.
- 3.2.4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommend overcurrent device settings.
 - .1 For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
 - .2 For each motor control centre, one arc flash label shall be provided.
 - .3 For each low voltage switchboard, one arc flash label shall be provided.
 - .4 For each switchgear, one flash label shall be provided.
 - .5 For medium voltage switches one arc flash label shall be provided.
- 3.2.5 Labels shall be field installed by the firm providing the Arc Flashing Hazard Analysis

3.3 Acceptable Testing Firms

- 3.3.1 MVA Engineering
- 3.3.2 GT Woods
- 3.3.3 Brosz & Associates
- 3.3.4 K-Tek Electro-services Ltd.
- 3.3.5 Eaton Electrical Service Group
- 3.3.6 Schneider Electrical Service Group
- 3.3.7 Siemens Service Group

END OF SECTION

1 GENERAL

1.1 CODES AND STANDARDS

1.1.1 Ontario Electrical Safety Code-Current Edition

1.1.2 CSA

1.1.3 ULC

1.1.4 Local Codes and Requirements

1.2 SUBMITTALS

1.2.1 Shop Drawings:

- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.
- .3 One copy of all stamped approved shop drawings shall be included in maintenance manual.

1.2.2 Operation and Maintenance Data:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

2 PRODUCTS

2.1 Duct (direct buried underground cable duct)

2.1.1 PVC ducts and fittings: Rigid PVC duct to CSA C22.2 No. 211.1, type DB2 with fittings for direct burial (expanded flange ends).

2.1.2 Rigid PVC bends, reducers, bell end fittings, plugs caps, spacers, adaptors same product material as duct to make complete installation

2.1.3 Cable: CU RWU75 XLPE of size noted on drawings. Cable termination temperature to be adjusted to suit equipment to be installed.

2.2 Lighting and Receptacle Panels

2.2.1 Panel boards shall be as manufactured by Eatons complete with circuit breakers and labeled with a CSA short circuit rating. Panel board and circuit breaker short circuit rating shall be as indicated on panel schedules. Provide copper bus sized in accordance with the contract drawings and CSA standards.

- 2.2.2 Electrical characteristics, main sizes, quantities of breakers and quantity of branch circuits shall be as indicated on the drawings.
- 2.2.3 Where noted on the drawings, panel boards serving isolated ground circuits shall be complete with a separate ground bar isolated from the panel board box by an insulating plate. Connect this ground bar directly to the main building ground using AWG #6 copper minimum or larger as required by table 16 of the Ontario Electrical safety Code (unless otherwise noted).
- 2.2.4 Panel boards shall be supplied with doors, concealed hinges, chromed locks and hardware. All locks shall be keyed alike. Doors shall be fitted with plastic covered panel directory, with circuits and areas served typed in. Doors shall be provided with spring latches and semi flush cylinder locks and catch assemblies. Provide two (2) keys per panel board.
- 2.2.5 All panel boards to have sprinkler proof enclosures.
- 2.2.6 Branch Breakers: Shall be of the heavy duty, bolt-on type, single, two or three pole as shown on the drawings and of the ampere ratings indicated. They shall be thermal magnetic, non interchangeable, moulded, case type with toggle mechanism, and be designed for use as switches. Two and three pole breakers shall be common trip type with single handle. Handle ties will not be permitted. Each breaker to be quick-make, quick break type. Shall be approved for use with CU/AL cables.
- 2.2.7 Breakers 200 Amps and above shall have adjustable long delay pickup/time, adjustable short delay pickup/time and adjustable instantaneous pickup.
- 2.2.8 Provide lock-on devices for fire alarm, stairway, exit and night light circuits.
 - .1 Ground fault circuit interrupters where required shall be C.S.A Class A with 5 mA tripping level and shall have push-to-test button on front.
 - .2 Provide ground bus in each panel.
 - .3 Door and trim finish: grey enamel.
 - .4 Panel board depth is not to exceed 146mm.
 - .5 Cover plates shall be provided for all the blank spaces in the distribution section.
 - .6 Provide a nametag on the exterior of the enclosure. Nametag to indicate interrupting rating, voltage, service description, etc.
 - .7 Provide sequential phase bussing with odd numbered breakers on the left and even numbered on the right complete with each breaker identified by permanent marker identification as to circuit number and place.
 - .8 Main breaker, where required, to be mounted top or bottom of the panel to suit cable entry. When mounted vertically, down position shall trip the breaker.
 - .9 Branch circuit panel boards (250 AMP or smaller) must be equal to Eatons POW-R-Line-3X or approved alternate.

- .10 Branch circuit panel boards shall be complete with transient voltage surge suppression filtering system integral to the panel tub and must be equal to Eatons #CPSBXCH208YSD or approved alternate.
- .11 Power distribution circuit breaker panel boards (400 AMP or larger) must be equal to Eatons POW-R-Line-C PRL-4a with bottom side entry wire way or approved alternate.
- .12 Acceptable Manufacturers:
 - .1 Eaton
 - .2 Schneider
 - .3 Siemens

2.3 CIRCUIT BREAKERS

- 2.3.1 Distribution circuit breakers shall be 2-pole or 3-pole as required, with common trip handles, positive "on" indication, thermal and magnetic trip.
- 2.3.2 Branch circuit breakers shall be 1-pole, 2-pole or 3-pole as required with positive "on" indication, thermal and magnetic trip. Multi-pole breakers shall be complete with common trip handles.
- 2.3.3 Minimum interrupting capacity of circuit breakers shall be to suit the application. In no case shall it be less than 10,000 AIC RMS symmetrical.
- 2.3.4 Integrally fused breakers may be used for applications where the high interrupting capacity is required.
- 2.3.5 Ground fault type circuit breakers shall be class "A", with remote indication as required.
- 2.3.6 Circuit breakers shall be NEMA type and supplied by panelboard manufacturers.

2.4 FUSES

- 2.4.1 Fuses: Shall be RK5 or HRC-I, Class J or L unless otherwise specified. Fuses in combination starters shall be HRC time delay type where specified.
- 2.4.2 Motor fuses shall be sized according to the Drawings for the specified motor and starting cycle.
- 2.4.3 Fuses shall be as manufactured by Buss, Gould, Little Fuse or approved equal.
- 2.4.4 Provide three spare fuses of each type and size installed for maintenance.

3 EXECUTION

3.1 Installation of Service Conduits and Cables

- 3.1.1 Run service entrance conduits as shown on the site plan and the trench section for secondary duct bank.

- 3.1.2 Supply and install CU RWU75 XLPE of size noted on drawings from secondary of pad mount transformer to service entrance switchboard located in the electrical room. Coordinate with Utility (Alectra) for all final terminations.
- 3.1.3 Final termination of primary cable to high voltage service and to transformer to be completed by Utility (Alectra).
- 3.1.4 Coordinate exact locations and installation with general contractor before installation commences
- 3.1.5 Do not pull spliced cable inside the duct.
- 3.1.6 Install multiple conductors in duct simultaneously
- 3.1.7 Use CSA approved lubricants to reduce pulling tension.
- 3.1.8 Perform insulation resistant test using a megger on each phase conductor before terminating installed cable.

3.2 Grounding

- 3.2.1 Provide ground plate or two ground rods and connect to the service with 3/0 copper bare ground wire.
- 3.2.2 Make all required ground connections from water meter and gas piping to main electrical service ground. Ground conductors shall be minimum #2/0 copper wire connected with approved fittings.
- 3.2.3 Conduit systems shall not be used for grounding. Provide separate ground conductors in all raceways. Bond the ground wire to all boxes and luminaries.
- 3.2.4 Install grounding connections to typical equipment included in but not necessarily limited to the following list. Service equipment transformers, switchgear, duct systems, frames of motors, motor control centres, starters control panels, building steel work, distribution panels, outdoor lighting.
- 3.2.5 Test the resistance of the grounding system. Add additional ground wires and ground rods if required as directed by the Engineers and retest. Repeat this process until ground resistance is 2 ohms or less. Conduct all tests using Megger Null Balance or Megger Universal ground resistance test equipment.
- 3.2.6 Test and log all ground connections at panels, switchboards and ground buses prior to and after the computer is put into operation. Trace and isolate all equipment causing current in ground wires to exceed one ampere. Replace such equipment if furnished as part of this contract.
- 3.2.7 Test all receptacles for proper connections with a neon lamp type polarity tester. Check that ground resistance is less than 0.2 ohms with an Edgcombe Peebles Ltd., ground loop impedance tester.
- 3.2.8 All grounding conductors run inside of building except in electrical and lan rooms shall be run in EMT conduit or rigid PVC conduit as the application requires.

- 3.2.9 All conduits installed in or under concrete slabs, underground and in concrete or masonry walls shall have a code size green insulated copper grounding conductor installed
- 3.2.10 All distribution feeders shall be complete with separate code size green insulated copper grounding conductors. Do not use conduit as ground.
- 3.2.11 All non metallic conduit shall be complete with a code sized green insulated copper grounding conductor.
- 3.2.12 Connections shall be made by approved compression connectors or by thermatic Weld process.
- 3.2.13 Ground transformer neutrals to approved grounding electrodes as per inspection authorities requirements.
- 3.2.14 Provide building ground system in accordance with Ontario Electric Safety Code. The system shall consist of a minimum of copper wells ground rods (minimum 4' to 10' (1.2 m to 3 m) long) spaced minimum of 10' (3 meters) apart, interconnected with bare minimum No. 3/0 AWG copper loop. Ground rod shall be driven sufficiently to contact permanent water table. Bond all equipment enclosures inside electrical room in vault to ground grid. Where applicable by code connect the building water service (both street and building sides) to ground system with minimum No. 3/0 AWG copper ground rod conductor in conduit. Perform resistivity test on soil to determine exact quantity of rods.
- 3.2.15 All buried ground connection shall be thermatic wild type.
- 3.2.16 Provide one No. 3/0 AWG insulated green copper ground conductor in conduit from the main building ground to the main telephone/LAN room. Provide a minimum 24" (600mm) long x 2" (50 mm) high x 3/8" (10 mm) thick copper ground bus and install on wall with standoff isolators and connect to the 3/0 conductor. The ground bus shall have 8 drilled taps. Provide one number six AWG green ground conductor in conduit from this ground bus and extent each satellite LAN room and coil for future connection to computer cable termination rack.
- 3.2.17 Where cable trays are used for the data cabling pathways, ensure that they are grounded and bonded in accordance with the Ontario Electrical Safety Code.
- 3.2.18 Ground conductors for VFDs shall be sized as the same size as a feeder conductors to VFD/ motor.

3.3 Electrical Connections for Mechanical Equipment

- 3.3.1 Provide all required electrical connections to apparatus provided and/or supplied by Division 21, 22 and 23, the Owner and as part of the work of other Divisions of the Specifications.
- 3.3.2 All power and control wiring over 50V and disconnects shall be installed by the Electrical Contractor.
- 3.3.3 All control and low voltage wiring 50V and under shall be installed by the Mechanical Contractor or Controls Contractor. Coordinate all low voltage wiring with same.

END OF SECTION

1 GENERAL

1.1 CODES AND STANDARDS

- 1.1.1 Ontario Electrical Safety Code – Current Edition
- 1.1.2 CSA
- 1.1.3 ULC
- 1.1.4 Local Codes and Requirements

1.2 SUBMITTALS

- 1.2.1 Submit shop drawings to the Consultant for review prior to ordering or installation.
- 1.2.2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.

2 PRODUCTS

2.1 LUMINAIRES

- 2.1.1 Luminaires including fixtures and lamps shall conform to the light fixture schedule.
- 2.1.2 Manufacturer:
 - .1 Acceptable Manufacturers:
 - .1 Refer to luminaire schedule on drawings.
 - .2 Alternate manufacturers must provide equal fixtures to the satisfaction of the Engineer. Any alternates that do not satisfy the specifications or the Engineer will be rejected.
 - .3 Alternate manufacturers must be in business for a minimum of 20 years.
 - .4 Alternate luminaires must be on approved DLC list if base specified luminaire is on approved list for applicable energy benefits.
 - .5 Alternate luminaires must have lumen package within 10% of base specified luminaires.
 - .6 Where alternates alter functional or visual design, or change the space requirements or mounting details, all such information shall be clearly presented to the Consultant for consideration and any costs associated with same shall be the responsibility of the Contractor.
 - .7 Once shop drawings are approved, no substitutions will be considered except for special circumstances such as delivery. Delivery reasons shall only be considered if at no fault to the Contractor. Contractor's failure to order fixtures within the schedule will not be acceptable.

- 2.1.3 Similar luminaires shall be products of same manufacturer.
- 2.1.4 Luminaires shall be completely factory assembled and delivered in cartons or in palletized form.
- 2.1.5 All fixtures shall be recessed type in acoustic tile or drywall ceilings unless otherwise indicated. Provide drywall trim frame for recessed drywall applications.
- 2.1.6 Troffers in ceiling shall be equipped with adjustable mounting brackets.
- 2.1.7 All fixtures shall be provided with ballasts suitable for the fixture type and application. All ballasts shall CSA approved and ULC listed and comply with CSA standard C22.2 No. 74. Ballasts shall be suitable for 120 volt application as noted.
- 2.1.8 Protective wire guards shall be provided for all fixtures where indicated on the drawings and where subject to damage.

2.2 LENSES

- 2.2.1 In general, lenses shall be K12 distribution acrylic 0.125" (32mm) thick, shall have a recessed prismatic pattern of 3/16" (5mm) square based female cones running 45 degrees to the parallel and perpendicular axis to the panel. Provide vandal lenses where specified.
- 2.2.2 Panel shall be made of ultraviolet inhibited injection moulded clear virgin acrylic.
- 2.2.3 Panels shall be strain free and uniform in production. There shall be no fade-outs or streaks to detract from job performance.
- 2.2.4 Lenses shall be low brightness, sparkling crystal panel that provides maximum efficiency and good brightness control in the direct glare zone.
 - .1 Acceptable manufacturers are Advance Transformers, Universal Technologies, Lutron and Osram Sylvania.

2.3 SOLID STATE DRIVERS

- 2.3.1 Drivers shall be UL/CSA approved for application required and meet all applicable CEC, NEMA and ANSI Standards.
- 2.3.2 Driver to provide full-range dimming, 0-10V, where indicated.
- 2.3.3 Drivers shall comply with NEMA limits governing electromagnetic and radio frequency interference and shall not interfere with operation of other normal electrical equipment.
- 2.3.4 Driver shall meet ANSI Spec C62.41 and IEEE standards regarding all applicable transient protection.
- 2.3.5 Frequency of operation shall be 20 kHz or greater.
- 2.3.6 Driver shall have an 'A' sound rating
- 2.3.7 Total harmonic distortions shall be less than 10%. Meet ANSI C82.77.

2.3.8 Drivers shall have a power factor of 0.85 minimum.

2.3.9 Driver warranty shall be minimum five (5) years.

2.4 LEDS

2.4.1 Shall conform to ANSI C78.377 (latest edition)

2.4.2 LEDs shall be 4500K unless otherwise noted. Verify colour of LEDs before ordering.

2.4.3 LEDs shall provide a minimum 80 CRI unless otherwise noted.

2.4.4 LED life shall be minimum 50,000 hours. LEDs shall be rated for L70 life span.

2.4.5 Warranty shall be minimum 5 years.

2.5 DOWN LIGHTS

2.5.1 Shallow construction

2.5.2 Damp location rated for exterior mounting where noted

2.5.3 Exterior down lights to come with adjustable trim/lamp

2.5.4 Lamp to be LED

2.5.5 Colour temperature to be 3500k

3 EXECUTION

3.1 GENERAL

3.1.1 Luminaires shall be stored in a dry and protected area. Confirm acceptable storage area prior to luminaire being delivered to site.

3.1.2 Lenses for fixtures shall be stored on site and installed separately from the fixtures at a time to be directed by the Consultant.

3.2 INSTALLATION OF LIGHTING FIXTURES

3.2.1 Provide all lighting fixtures and lamps as shown on the drawings and schedules.

3.2.2 Include for assembly, and mounting of all fixtures, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories which may be required for any fixture to provide a complete, safe, fully operational assembly.

3.2.3 Install fixtures in accordance with applicable reflected ceiling plans and/or as directed by the Consultant.

3.2.4 In Equipment Rooms, shafts and similar secondary areas, install fixtures after the mechanical and other major work is roughed-in and adjust fixture locations as required at no cost to the Owner. Fixtures in these areas shall be installed at the same height unless otherwise directed.

- 3.2.5 At the discretion of the Consultant, site test and demonstrate the operation of special application fixtures and adjust their locations within a reasonable distance to obtain the effects desired. Assist in the aligning and positioning of all adjustable fixtures, and ensure that fixtures with adjustable lamp holders are properly positioned to correspond with the lamps specified.
- 3.2.6 Thoroughly review all ceiling types, construction details and mounting arrangements before placing fixture orders and ensure that all mounting assemblies, frames, rings and similar features are included for and match the required installation.
- 3.2.7 Mount luminaires perfectly level and plumb. Luminaires shall fit tightly to ceiling without showing a space or light leak between frame and ceiling. Re-install improperly installed fixtures at no expense to the Owner.
- 3.2.8 All fixtures and fixture assemblies shall be properly secured and supported. Support fixtures independent of the ceiling construction complete with all fasteners, framing and hangers as required. Do not secure fixtures to mechanical ductwork or other vibration producing apparatus.
- 3.2.9 Where fixtures are suspended from the structure they shall utilize self aligning box covers with an additional ground wire from the outlet through the hanger for continuity of ground.
- 3.2.10 Carefully co-ordinate the fixture installation with the work of other trades ensuring that the necessary depths and mounting spaces are provided. Do not alter fixture locations unless approved by the Consultant.
- 3.2.11 All lamps shall be new and intact when the project is complete, and ready for acceptance. Replace lamps used for testing fixture assemblies at the discretion of the Consultant. Include a full lamp listing in the Operating and Maintenance Instructions.
- 3.2.12 Provide safety chains on all surface mounted, T-bar mounted or suspended light fixtures. Light fixtures shall have two chains, each supporting two corners of the luminaire (all four corners supported). Chain shall be #10 tensile jack chain, bright inc coated, with a strength of 400 lbs (180 kg). Attachments shall be made using a No. 10 "S" hook. Caddy fasteners may be used where applicable. "S" hooks must be closed after installation.
- 3.2.13 Industrial luminaires, where suspended, shall have ½" (12mm) conduit hangers and ARB cylinder ball aligners. Length and location shall clear equipment, ducts and pipes. Metal strut (Flexibar or equal) may be used for mounting of luminaires in mechanical areas or electrical rooms.

END OF SECTION

1 GENERAL

1.1 Codes and Standards

- 1.1.1 Ontario Electrical Safety Code – Current Edition
- 1.1.2 CSA
- 1.1.3 ULC
- 1.1.4 Local Codes and Requirements

1.2 Submittals

1.2.1 Shop Drawings:

- .1 Submit shop drawings to the Consultant for review prior to ordering or installation.
- .2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.
- .3 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

1.2.2 Operation and Maintenance Data:

- .1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.
- .2 Operation and maintenance data shall be included in the maintenance manual.

1.3 Acceptable Manufacturers

- 1.3.1 EmergiLite
- 1.3.2 Lumacell
- 1.3.3 Beghelli
- 1.3.4 AimLite
- 1.3.5 Stanpro

2 PRODUCTS

2.1 Battery Units

- 2.1.1 New batteries shall be 24 volt D.C. and shall be designed to supply all units and all connected remote heads for a period of one half hour to an end voltage of 91%. The fully automatic charger shall regulate the charging current according to battery need and provide full recharge in 12 hours or less after full discharge.

- 2.1.2 Battery units shall be complete with long life lead batteries, 10-year warranty and type integral heads as indicated on the drawings. Capacities shall be as noted on the drawings. Provide white finish.
- 2.1.3 Battery units shall provide the required operating time for all connected lights and signs under emergency conditions in conformance with the OBC.
- 2.1.4 Battery Units shall have line cord kit.
- 2.1.5 Automatically activate upon failure of power supply to normal lighting in area covered by the units.
- 2.1.6 Complete with automated self-diagnostic test circuitry, solid state charger, sealed maintenance free batteries and integral lamp head.

2.2 Remote Emergency Lights

- 2.2.1 Lamp head and stem shall be injection molded, impact resistant, flame retardant thermoplastic, vandal-resistant, adjustable LED strips for multiple beam angles, factory white. IP65 rated.
- 2.2.2 Lamp type to be LED. 24V-6W LED, except corridors and large open areas where they shall be 14W.
- 2.2.3 The lens shall be inverse concave design and fully adjustable for aisle or area distribution during installation without the need to energize the lamp.
- 2.2.4 Visual identification of distribution shall be provided through position of adjustment pins.
- 2.2.5 Fixture shall be supplied with a canopy for installation on any four inch octagon box.
- 2.2.6 Housing shall be so designed to allow for lamp replacement if required.
- 2.2.7 Provide protective cages over lights in gymnasiums and other areas where they would susceptible to damage.

2.3 Pictogram (Exit) Signs

- 2.3.1 Exit signs shall be C.S.A.-22.2 Number 141-10 approved.
- 2.3.2 Exit signs shall have white running man on green background complete with directional arrow where required and noted.
- 2.3.3 Exit signs shall operate with universal A.C. input voltage as per site conditions at less than 1.5 watts and universal two-wire D.C. input voltage from 6 volts D.C. to 24 volts D.C. at less than 1.5 watts for single and double face signs.
- 2.3.4 The exit sign shall be suitable for wall, end or ceiling mount.
- 2.3.5 The faceplates shall be constructed of robust clear poly carbonate panel with multiple legend plates provided for field selectable directional routing.
- 2.3.6 The frame shall be of a one-piece steel construction painted factory white

- 2.3.7 The light source shall be light emitting diodes (L.E.D.). The L.E.D. lamps shall provide illumination in normal and emergency operation and shall be mounted inside the exit housing, no on the face.
- 2.3.8 An L.E.D. sensitive diffuser shall be mounted behind the legend to provide the letters with even illumination.
- 2.3.9 The exit sign in a self-powered configuration shall stay illuminated during emergency operation for at least two hours upon A.C. failure.
- 2.3.10 Provide protective cages over lights in areas where they would be susceptible to damage

3 EXECUTION

3.1 General

- 3.1.1 Installation of system equipment shall be in accordance with Canadian Electrical Code and Ontario Building Code.

3.2 Battery Units

- 3.2.1 Provide 120V receptacle for each battery unit mounted adjacent and at height of battery unit.

3.3 Emergency Lights

- 3.3.1 Provide emergency lighting on battery back-up as indicated on the drawings.
- 3.3.2 Emergency lighting is required to provide an average level of illumination of not less than 10 lux at floor level and a minimum level of 1 lux.
- 3.3.3 Emergency Lights shall be mounted as noted on drawings. Where wall mounting is shown, mount 2.45m (8') above finished floor to the underside of the fixture. Where the ceiling height does not permit this mounting height, the minimum acceptable height is 2.13m (7)'.
- 3.3.4 Provide protective cages over lights in areas where they would susceptible to damage.
- 3.3.5 Provide an additional 10 single head remotes and 5 double head remotes to be installed after light level tests at the discretion of the Consultant and/or Building Inspector. Installation of spare devices shall be based on lowest wattage lamp indicated on drawings and include labour and material based on 5000mm of conduit and wire.

3.4 Pictogram (Exit) Signs

- 3.4.1 Every Exit Sign shall be visible from the exit approach. Provide suitable arrows or chevrons indicating direction of egress as required.
- 3.4.2 Exit signs shall be illuminated continuously.
- 3.4.3 Exit lights shall be mounted 2.45m (8') above finished floor to the underside of the fixture. Where the ceiling height does not permit this mounting height the minimum acceptable height is 2.13m (7)'.

- 3.4.4 Exit lights at doors shall be mounted above the door where space permits otherwise it can be mounted directly adjacent to it but ensuring it is visible from the exit approach
- 3.4.5 Provide protective cages over lights in gymnasiums and other areas where they would susceptible to damage.
- 3.4.6 Provide an additional 5 exit signs to be installed at the discretion of the Consultant and/or Building Inspector. Installation of spare devices shall include remobilization if required and labour and material based on 5000mm of conduit and wire.

3.5 Installation

- 3.5.1 Include all necessary conduits, wiring and lamps for a complete operating system.
- 3.5.2 Panel breakers feeding emergency lighting and exit lights shall be complete with circuit breaker lock-off device.
- 3.5.3 Wiring to remote heads and exit light DC sockets shall be sized for a maximum voltage drop of 5%. In no case shall wiring be less than #10 AWG. Provide separate circuits for all exit lighting using separate raceways from non-emergency wiring.

3.6 Verification

- 3.6.1 Following completion of the exit and emergency lighting installation, conduct tests of each system component and confirm battery operation life under emergency conditions.
- 3.6.2 Conduct light level tests in upgraded areas upon completion of emergency lighting system installation.
- 3.6.3 Upon completion of the tests, issue to the Consultant and Building Inspector a report for each test. Reports shall include:
 - .1 As-built location of each component
 - .2 Confirmation that it will remain operational for minimum required time in conformance with OBC
 - .3 Light level readings
 - .4 Technician's name and signature that performed the tests
 - .5 Owner Representative's name and signature that witnessed the tests.
- 3.6.4 Verify all emergency lighting systems in area of work to the Consultant and Building Inspector as requested by them.

END OF SECTION

1 GENERAL

1.1 Scope

- 1.1.1 This Section covers the requirements for excavating, backfilling, and compacting trenches for the installation of sanitary and storm pipe sewers; pipe culverts and end sections; pipe subdrains; forcemains and associated appurtenances; watermain and associated appurtenances; structures, and other underground Yard Piping.

1.2 Related Sections

- 1.2.1 Section 01 00 00 - General Requirements.

1.3 References

- 1.3.1 OPSS.MUNI 180 – Management of Excess Material
- 1.3.2 OPSS.MUNI 1205 – Clay seal.
- 1.3.3 OPSS.MUNI 1303 – Admixtures for Concrete
- 1.3.4 OPSS.MUNI 1359 – Unshrinkable Backfill
- 1.3.5 OPSS.MUNI 1860 – Geotextiles
- 1.3.6 O. Reg. 406/19: On-Site and Excess Soil Management
- 1.3.7 Rules for Soil Management and Excess Soil Quality Standards
- 1.3.8 O. Reg. 153/04: Records of Site Condition
- 1.3.9 O. Reg. 347: General – Waste Management
- 1.3.10 Geotechnical Investigation Report provided as part of the Bid Documents. Refer to Section 01 00 00 – General Requirements.
- 1.3.11 Local Municipal Standards

1.4 Definitions

- 1.4.1 Common Excavation:

- .1 Common excavation is defined as material, of whatsoever nature, excavated to complete works as specified and indicated and includes but not necessarily limited to: earth, trees, tree stumps, deadheads, pipes, tanks, masonry, asphalt pavement, concrete sidewalks, concrete pavements, concrete curbs and gutters, timber, hard pan, shale fractured shale, logs, quicksand, fill, cinders, snow, ice, frost, any combination of these with normal or abnormal earth conditions, or any other obstacles encountered in the excavation, all of which must be removed.

1.4.2 Select Excavated Material:

- .1 Selected excavated material is defined as excavated material that is free from cinders, ashes, refuse, vegetable or organic matter, boulders, rocks, or stones with nominal dimensions greater than 100 mm, paving material, timbers, unbroken or frozen masses of earth, and other material which in the opinion of the Engineer is unsuitable. Selected excavated material to have properties to meet specified compaction requirements.

1.4.3 Borrow Material:

- .1 Material, imported from other sites, to be in accordance with Part 2 of this section.

1.4.4 Soil:

- .1 Unconsolidated naturally occurring mineral particles and other naturally occurring materials resulting from the natural breakdown of rock or organic matter by physical, chemical or biological processes that are smaller than 2 millimeters in size or that pass the US #10 sieve.

1.4.5 Topsoil:

- .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.4.6 Waste:

- .1 Excavated material unsuitable for use in work or surplus to requirements.

1.4.7 Excess Soil

- .1 Soil, or soil mixed with rock, that has been excavated as part of a project and removed from the project area for the project.

1.4.8 Abbreviations

- .1 SPMDD for Standard Proctor Maximum Dry Density.
- .2 OHSA for Occupational Health and Safety Act.
- .3 OPSS for Ontario Provincial Standard Specification.

1.5 Site Conditions

1.5.1 Subgrade Conditions

- .1 Refer to geotechnical investigation, soil sample chemical analysis and hydrogeological study reports.

1.5.2 Existing Grades

- .1 Contours and spot elevations indicated on the Drawings give approximate site grades at time of tendering.

- .2 Actual grades may vary slightly.
- .3 Notify the Engineer of any significant discrepancy in the existing grades before disturbing the site conditions.

1.5.3 Existing Utilities and Services

- .1 Known underground services and surface utility lines are indicated on Drawings. No guarantee is given of completeness or accuracy.
- .2 Maintain existing utilities which must remain in service in or adjacent to the excavation.
- .3 Record locations of underground utility lines.
- .4 Repair damage to existing utility lines and services resulting from work under this Section at no cost to the Owner.
- .5 Notify utilities prior to excavating.

1.5.4 Any soils encountered that are suspected to be impacted or hazardous will be tested by the Engineer. Any soils found to exceed the criteria under the "Soil, Groundwater and Sediment Standards for the use under Part XV.1 of the Environmental Protection Act" dated July 1, 2011, but determined to be non-hazardous based on the leachate quality criteria under Schedule 4 on O.Reg 347 as performed by the Engineer, will be considered impacted. Payment will be through Contract Contingency. Any further necessary determination of hazardous waste classification will be carried out by the Engineer using the Leachate Quality Criteria as per "Landfill Disposal Option" under O.Reg. 558/00. Payment for removal, transportation and disposal of hazardous soil/materials will be extra to the Contract.

1.5.5 Excess soils generated should be characterized and handled in accordance with the Excess Soil Management O.Reg 406/19 and other related regulatory amendments related to the management, reuse and off-site disposal of excess soil.

1.6 Submittals

- .1 Shop drawings.
 - .1 Submit, for record purposes, shop drawings detailing side slopes for excavations in open cut. Specifically show details of transitions between open cut and excavation shoring systems.
 - .2 Provide shop drawing showing temporary shoring system (if applicable)
 - .3 Shop drawings to bear seal and signature of a professional engineer licensed to practice in Ontario.
- .2 Submit as Constructed Drawings
 - .1 Provide copies of all Utility locate forms provided by the Owners of the various buried utility plant.

- .2 Record locations and elevations of all new utilities installed, and existing utilities encountered.
- .3 Record contours of the final grade.

2 PRODUCTS

2.1 Materials

- 2.1.1 Granular 'A': OPSS 1010.
- 2.1.2 Granular 'B', (Type I): OPSS 1010.
- 2.1.3 Clay Seal: OPSS 1205.
- 2.1.4 20 mm Clear Crushed Stone: OPS 1004 – Crushed Rock composed of hard, uncoated angular fragments produced from rock formations or boulders of uniform quality.
- 2.1.5 Imported Fill Material: Non-organic clean fill compactable to specified density and free from frozen lumps, rubble, debris and rocks or boulders with nominal size larger than 100 mm. Material subject to acceptance by Geotechnical Consultant. Fill material to be analyzed and classified in accordance with MECP Decommissioning Guidelines.
- 2.1.6 Select native site material:
 - .1 Excavated material approved by the Engineer.
 - .2 Material free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders over 150 mm in any dimensions, or other deleterious materials.
- 2.1.7 Unshrinkable Backfill:
 - .1 Unshrinkable backfill to OPSS 1359
 - .2 Admixtures shall conform to OPSS 1303 and the latest MTO designated sources list. Calcium chloride or pozzolanic mineral admixtures shall not be used. Air entraining admixtures may be added if desired by the Contractor.
- 2.1.8 Pea Gravel: Roughly spheroidal in shape, nominal diameter size 5 mm to 10 mm.
- 2.1.9 Natural Sand: CAN/CSA-A23.1.
- 2.1.10 Mudmat and Fill Concrete shall have a minimum 28-day compressive strength of 20 MPa. Refer to Section 03 30 00 – Cast-in-Place Concrete.
- 2.1.11 Water
 - .1 Potable water from municipal potable water source.

3 EXECUTION

3.1 General

- 3.1.1 All excavations and trenches shall be kept stable and dry.

3.2 Protection of Existing Features

3.2.1 Existing buried utilities and structures:

- .1 Size, depth and location of existing utilities and structures as indicated on the drawings are for guidance only. Completeness and accuracy are not guaranteed.
- .2 Prior to commencing any excavation work, notify the Engineer and/or applicable authorities having jurisdiction. Establish the location and state of use of buried utilities and structures on and adjacent to site. The Owner or authorities having jurisdiction are to clearly mark such locations to prevent disturbance during work.
- .3 Confirm exact locations and depth of buried utilities by careful test excavations.
- .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered, and provide temporary supports where required.
- .5 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before relocating.
- .6 Remove obsolete or abandoned buried services within 2 m of foundations: cap cut-offs.
- .7 Verify that existing services are not damaged by the construction procedure
- .8 Record location of maintained, re-routed and abandoned underground lines.
- .9 Protect utilities from frost and freezing.

3.2.2 Existing buildings and surface features:

- .1 Adequately protect benchmarks, layout markers, survey markers and geodetic monuments.
- .2 Conduct, with Engineer condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by work.
- .3 Protect existing buildings and surface features which may be affected by work from damage while work is in progress. In event of damage, immediately make repair to approval of Engineer.

3.2.3 Excavations

- .1 Protect bottoms of excavations from freezing, both during and after construction. Do not disturb or weaken subgrade in any way.

- .2 Direct surface water runoff away from all open excavations. Provide and maintain temporary drainage ditches/swales and other diversions outside of excavation limits.

3.3 Site Preparation

- 3.3.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- 3.3.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.4 Stockpiling

- 3.4.1 Stockpile fill materials in areas designated. Stockpile granular materials in manner to prevent segregation.
- 3.4.2 Protect fill materials from contamination.
- 3.4.3 Do not stockpile material in a manner or location that will interfere with site operation or drainage.
- 3.4.4 Apply water, sodding or other means as required to provide continuous control of dust from drifting or blowing.
- 3.4.5 Crown, shape and tarp stockpiles as required to promote runoff and minimize increase in moisture content.
- 3.4.6 When insufficient space is available to allow placing of excavated material on the right-of-way, the Contractor shall load, haul and stockpile such excavated material at an offsite location arranged for by and at the sole expense of the Contractor. When the underground work has been installed, the Contractor shall, at the Contractor's own expense, bring back as much acceptable material.
- 3.4.7 All surplus materials shall be disposed in accordance with the contract requirements for impacted materials and current regulations.
- 3.4.8 The Contractor shall provide a letter from the temporary offsite disposal site property owner accepting the material, placement, grading and restoration and releasing the Municipality of any responsibility to the satisfaction of the Municipality.

3.5 Cold Weather Requirement

- 3.5.1 Obtain written permission from the Engineer before starting excavation in frozen ground.
- 3.5.2 Do not let subgrade at final foundation excavation level to freeze. Provide insulated blankets, heated enclosures or similar means to suit conditions encountered.

3.6 Construction Procedure

- 3.6.1 Employ construction procedures to suit conditions encountered and prevent undermining existing or installed foundations and weakening of material which supports foundations already in place.
- 3.6.2 Undertake work in a safe manner. Take full responsibility for site safety. Comply with safety requirements of the Occupational Health and Safety Act (OHSA).

- 3.6.3 Employ construction procedures so that foundation at adjacent higher levels are not disturbed or weakened.

3.7 Excavating and Backfilling for Structures

3.7.1 Excavating

- .1 Locate existing buried pipes, conduits, duct banks and utilities prior to commencement of excavation operation.
- .2 Excavate to lines, levels and dimensions required.
- .3 Where rock is encountered, use conventional excavation methods to remove rock. Do not use explosives.
- .4 Excavate to provide adequate space for structure and connections to structures, for formwork, braces and supports, for excavation shoring systems and dewatering.
- .5 Notify the Engineer if bottom of excavation appears to be unsuitable for foundation. Excavate unsuitable material and backfill as directed, in writing, by the Engineer.
- .6 All unauthorized excavation made to elevation below the founding level to be remedied at Contractor's expense. Correct unauthorized over-excavation as follows:
 - .1 Fill under bearing surfaces and footings with unshrinkable fill or Granular A per OPSS 1010 compacted to not less than 100% of Standard Proctor maximum dry density.
 - .2 Fill under other areas with Granular B per OPSS 1010, compacted to not less than 100% of corrected Standard Proctor maximum dry density.
 - .3 Hand trim, make firm, and remove loose material and debris from excavations.
 - .4 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .5 Unless otherwise indicated on the drawings, provide concrete mud-mat to prevent destabilization of the finished subgrade.
 - .6 Obtain Engineer's approval of completed excavation.
- .7 Prevent disturbance and destabilization of final subgrade.
- .8 Make excavation in the dry. Provide levelled dense subgrade. Avoid excavation below groundwater table if quick condition or heave is likely to occur. Prevent piping or bottom heave of excavation by groundwater lowering, sheet pile cut-offs or other means. Verify lowered groundwater level in piezometers prior to excavating.
- .9 Protect open excavations against flooding and damage due to surface run-off.
- .10 Provide side slopes of excavations in open cuts suitable to the conditions encountered and in accordance with requirements of OHSA. Stability of side slopes is time dependent. Slopes generally become increasingly unstable with time.

Remove all slides and cave-ins, without extra compensation, at whatever time and circumstances they may occur.

- .11 Excavate with care adjacent to existing structures around existing utilities and pipelines. Provide temporary supports as required. Prevent damage.

3.7.2 Backfilling

- .1 Before proceeding with backfilling against concrete walls, ensure that the wall concrete has reached the specified 28-day compressive strength and slabs, struts, cross walls, and similar items which frame into the wall, and which provide the lateral stability are in place and have reached their specified compressive strength.
- .2 Before proceeding with backfilling around water retaining structures, verify that leakage tests have been successfully completed.
- .3 Before backfilling on slabs, ensure that the concrete in slabs and supports has reached their specified 28-day compressive strength.
- .4 Before proceeding with backfilling, verify that waterproofing for underground structures where indicated, have been completed.
- .5 At the discretion of the Engineer, the Engineer may permit backfilling around partially completed structures, provided that leakage tests have been successfully completed and concrete in slabs and supports has reached specified strength. Do not proceed with backfilling around partially completed structures unless authorized in writing by the Engineer.
- .6 Backfill around structures evenly in maximum 300 mm lifts compacted to 98 per cent SPMDD at a placement moisture content within 2 per cent of optimum. Place a 600 mm minimum thick layer of free-draining granular material (Granular 'B' or approved equal) against all exterior concrete walls. Backfill the remainder with select excavated material.
- .7 Make up any shortfall of selected excavation material with imported fill material.
- .8 Do not backfill to elevation higher than the finish grades.
- .9 Use equipment for backfilling and compaction that would not impose loads greater than those indicated or will damage the surface finishes.
- .10 Puddling is not permitted.
- .11 Fill in low spots after settlement and re-grade as necessary until settlement ceases.
- .12 Repair waterproofed and damp-proofed surfaces damaged during construction.
- .13 Remove all debris and surplus materials from site on completion of work.

3.8 Haulage

- 3.8.1 Haul off site and dispose of at an approved site surplus excavated material not required or suitable for backfill.

- 3.8.2 The Owner has the right of first refusal for excess material that is to be removed.
- 3.8.3 Haul surplus excavated material from site in tight bodied trucks or other means. Clean truck tires prior to exiting site. Prevent hauled material from spilling on roads. Promptly clean up if such spill occurs and maintain roads free of any tracked soil. Maintain roads free of any tracked soil.

3.9 Disposal Sites

- 3.9.1 Make arrangements for disposal of excavated material off the site.
- 3.9.2 Obtain from property owner of disposal site a written agreement setting out terms, conditions, and ultimate responsibility for materials as placed.
- 3.9.3 On completion of the Works, provide the Owner with a release from the owner of disposal site.

3.10 Dust Control

- 3.10.1 Throughout construction period, provide adequate dust control on the site by watering or use of other accepted dust control materials.
- 3.10.2 Apply water or other material as often as necessary to provide continuous control of dust from drifting or blowing.
- 3.10.3 Eliminate dust and dirt in areas where electrical equipment, metering instruments and similar equipment requiring interior cleanliness are being installed or assembled by providing temporary enclosures, covers for openings, or other means of protection.

3.11 Impacted Soils

- 3.11.1 If impacted soils are encountered during excavation, the site and stockpiled soils will be characterized by the Engineer in accordance with O.Reg 153/04.
- 3.11.2 Refer to soils reports for characteristics of "Impacted Soils."
- 3.11.3 Impacted soil that is determined to be excess soils and require off-site disposal need to be characterized and handled in accordance with the Excess Soil Management Regulation 406/19 and other related regulatory amendments related to the management and reuse of excess soil. Trucks used to dispose of impacted soils shall be covered.
- 3.11.4 Disposal of soil identified as impacted excess soils will be paid as a provisional item.

3.12 Field Quality Control

- 3.12.1 Inspection
 - .1 The Owner will retain an independent Geotechnical Consultant to inspect foundations for its suitability prior to placement of concrete or other materials.
 - .2 Notify the Owner sufficiently in advance of operations, to provide field inspection.
 - .3 On reaching specified excavation level, request an inspection of subgrade by the Geotechnical Consultant.

- .4 Provide all facilities to enable proper inspection.
- .5 Do not excavate below the specified level or place concrete or other materials on subgrade until the inspection has been undertaken and permission granted to proceed in writing by the Engineer.
- .6 Co-operate with the Owner's Representative and testing company by scheduling the placing and compacting of fill and backfill so tests can be progressively taken. Provide assistance, as required, to facilitate compaction and material testing.
- .7 The cost for the initial material and compaction testing shall be borne by the Owner. If the compacting Work does not meet the specified requirements, the Contractor shall perform further compacting Work until the specified requirements are met and pay the cost of further testing to establish proof of compliance with the specified compaction.
- .8 Notify the Engineer if bottom of excavation appears to be unsuitable for foundation. Excavate unsuitable material and backfill as directed by the Engineer.

3.12.2 Soil Compaction Densities

- .1 Where specified, compaction densities are percentages of SPMDD in accordance with ASTM D698.
- .2 Field tests of soil compaction densities will be carried out in accordance with ASTM D6938.

END OF SECTION