

SUMMARY OF WORK

1. GENERAL

- .1 The Work to be performed under the Contract is generally described in Scope of Works in D2 and as shown on the Specifications and Drawings.
- .2 The Contractor shall be deemed to have allowed for any increased costs in his Bid for the staging of the Work required including any additional costs incurred because of scheduling constraints imposed by the City, as identified in the Specification Section and elsewhere in the Contract Document.

2. COORDINATION

- .1 The Contractor shall cooperate and liaise with City of Winnipeg employees or their appointed Representatives in order to make appropriate working arrangements to ensure satisfactory execution and timely completion of the Work.
- .2 The Contractor shall attend coordination meetings, as directed by the Contract Administrator, when the Contract Administrator considers that they are necessary

3. MATERIALS DELIVERY

- .1 Where required, the Contractor will construct a storage facility for his equipment and materials as outlined in **Section 01500 – Temporary Facilities**, of the Specification.

4. ACCESS TO THE SOUTH END WATER POLLUTION CONTROL CENTRE SITE

- .1 Access to the Site will be available from existing highways (via Ed Spencer Drive and then South Services Road). Vehicular access is generally as shown on the Drawings.
- .2 It will be the Contractor's responsibility to check that access to the Site is in suitable condition before any equipment or materials are dispatched to the Site.
- .3 Access on the Site could be restricted by existing buried and surface utilities and structures. The Contractor shall confirm the location of all potential obstructions and review routing of construction vehicles with the Contract Administrator.
- .4 The Contractor is to maintain access at all times for City personnel and the Contract Administrator.

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5. ACCESS TO WORK

- .1 Normal working hours for Work shall be the period between 7:30 a.m. and 3:30 p.m., Monday to Friday.
- .2 No Work shall be done outside Normal Working Hours except when the Work is unavoidable or absolutely necessary for:
 - .1 Preventing injury to any person or saving the life of any person; or
 - .2 Preventing damage to property where the circumstances placing the property in danger could not reasonably have been foreseen, and where the immediate carrying out of such Work is necessary in order to prevent damage to that property; in which case the Contractor shall immediately advise the Contract Administrator in writing that such Work outside the Normal Working Hours is necessary and of the reasons for this. The Contractor shall also state the nature and extent of Work to be carried out.

6. SYSTEM SHUTDOWN

6.1 Foul Air System

- .1 The foul air contains high concentrations of hydrogen sulphide gas. Take all necessary measures to prevent injury of personnel caused by the inhalation of hydrogen sulphide gas.
- .2 Installation of components to the existing foul air ducting is only to be undertaken when the existing foul air fan is turned off. The foul air fan will be turned off by the City only.
- .3 Tie-in to the existing foul air system is limited to a single seven (7) hour period.
- .4 The Contractor shall submit a detailed plan and schedule for the plant shutdown required three (3) days in advance to the Contract Administrator for review and agreement. The plan shall include the estimated duration of the shutdown.

6.2 Other Systems

- .1 If plant shutdown is required, it can only be accommodated for a seven (7) hour period, between 8:30 a.m. and 3:30 p.m. Dates of any proposed plant shutdown shall be subject to the acceptance of the Contract Administrator. This acceptance will be based on the anticipated operational requirements of the wastewater treatment system at the proposed shutdown time. The Contractor shall submit a detailed plan and schedule for each plant shutdown at least three (3) days in advance to the Contract Administrator for review and agreement.

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- .2 All required labour, tools, and equipment shall be On-Site prior to a total plant shutdown.

7. SALVAGE

- .1 The Contractor shall salvage equipment and materials during Construction, as identified by the Contract Administrator. Care shall be taken so as not to damage these items.
- .2 All salvaged items shall be the property of the City. The Contractor shall transport all salvaged items as directed by the Contract Administrator to a location On-Site for eventual disposal by City personnel.

END OF SECTION

REGULATORY REQUIREMENTS

1. PERMITS/INSPECTIONS

- .1 The Contractor shall obtain and pay for all permits (e.g., building permit, plumbing permit, backflow permit, etc.), licenses, certificates, and governmental inspections required for the performance of the Work.
- .2 Give all required notices and comply with all local, provincial, and federal laws, ordinances, rules, regulations, codes, and orders relating to the Work, which are or become in force during the performance of the Work.
- .3 Provide and pay for temporary signs related to the Work. Signs shall be in place and approved by the Contract Administrator prior to performing the Work.

2. APPLICABLE CODES/STANDARDS

- .1 The applicable codes/standards for the performance of Work are generally indicated in this Specification.
- .2 Where specified codes/standards are not dated, conform to latest issue of specified Codes/Standards as amended and revised to the Tender closing date.
- .3 Confine apparatus, the storage of Products, and the operations of workers to limits indicated by laws, ordinances, permits, and by directions of the Contract Administrator. Do not unreasonably encumber the premises with products.
- .4 In the event of discrepancies between Codes, Standards, or other provisions, the most stringent shall apply.

3. SAFETY

3.1 General

- .1 Observe and enforce all construction safety measures required by code, Workers' Compensation Board, Manitoba Workplace Safety and Health, and all applicable statutes. Appoint, on behalf of the Contractor, a suitably qualified employee who has sole responsibility On-Site, for compliance with the requirements and so advise the City in writing with a copy to the Contract Administrator. Establish a first aid station On-Site.
- .2 In the event of discrepancy between such provisions, the most stringent provision shall apply.
- .3 Hard hats and safety boots are mandatory requirements for all workers while On-Site. Make available four (4) "visitor safety helmets" for authorized visitors.
- .4 "NO SMOKING" regulations are in effect in all areas of the Work. Ensure that all workers comply with the regulations.

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- .5 Ensure that all workers comply with the City's safety regulations where such regulations are in effect.
- .6 Do not load or permit to be loaded any part of the Work with a weight, load, or force that will exceed the design load and/or endanger its safety.

3.2 Safety Measures and Services

- .1 The Contractor shall be responsible for the safety of all his employees and other persons entering the Site and shall take all measures necessary to ensure their safety. In particular such measures shall include but shall not be limited to the following:
 - .1 Observation and provision of proper safety and emergency regulations, fire, gas, and electric shock precautions, stretchers and a first aid box generally for each place of working.
 - .2 Safe storage, handling, and use of explosives, gases, fuels, and other dangerous goods.
 - .3 Provision of approved safety helmets for all personnel including authorized visitors to the Site.
 - .4 Lighting provisions to provide adequate illumination of the Work, including spares and standby equipment.
 - .5 Provision and maintenance of safe, sound mechanical cranes, hoists, and conveying facilities for the transport of materials and personnel, each item of plant having an up to date test certificate. All cranes, hoists, and the like shall be fitted with audible overload warning devices.
 - .6 Provision and maintenance of safe, sound ropes, slings, blocks, and other lifting tackle, each appliance having an up to date test certificate.
 - .7 Provision of competent operators for control of all lifting and hoisting equipment.
 - .8 Provision and maintenance of all temporary electrical installations.
 - .9 The Contractor shall provide and securely fix into position temporary timber covers not less than 50 mm thick to all openings in floors and roofs.
 - .10 Provision and maintenance of all welding equipment and concrete cutting/coring equipment.
 - .11 All equipment to be used by qualified, trained personnel.
 - .12 Provision of adequate ventilation and testing of air quality prior to and while working in all indoor or enclosed locations. Equipment for continuous monitoring of gases must be explosion-proof and equipped with a visible and audible alarm. The conditions that must be monitored include oxygen deficiency, explosive and toxic gases. The ventilation equipment must Work continuously.

REGULATORY REQUIREMENTS

- .13 Personal hygiene shall be encouraged as Work will be in close proximity of an existing wastewater treatment facility. The Contractor will provide adequate washroom facilities as no access to the South End Water Pollution Control Centre (SEWPCC) bathroom facilities will be allowed.
- .14 The intent is that the Contractor will not operate in areas where foul air is being discharged, to prevent injury due to inhalation of hydrogen sulphide gas. However, as a precaution, operate a minimum of one (1) portable hydrogen sulphide gas monitor throughout the duration of the Work.

3.3 Noise Control On-Site

- .1 All plant and equipment supplied by the Contractor for use on the Work shall be effectively "sound-reduced" by means of silencers, mufflers, acoustic linings or shields, or acoustic sheds or screens to a level of 85 decibels (dBA) measured outside the nearest occupied property or to the satisfaction of the Contract Administrator.
- .2 Provided that the provisions of this clause shall not be applicable in the case of emergency Work necessary for the saving of life, property, or for the safety of the Work.

4. CLEANING OF STREETS

- .1 Conform to local ordinances and by-laws relating to littering of streets.
- .2 Take precautions to prevent depositing mud or debris on public or private roadways adjacent to the Work. Clean up immediately, otherwise the Contract Administrator will direct necessary cleanup with all costs back charged to the Contractor.

5. WORKING LIMITS

- .1 Confine all operations within the City's property limits.

6. EXISTING UTILITIES

- .1 Conform to Provincial and municipal regulations during construction in proximity to utility structures.
- .2 Notify appropriate utility companies and municipal departments a minimum one (1) week in advance of commencing such Work:
 - .1 For water and sewage Work, the City of Winnipeg Streets and Transportation.

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- .3 Make arrangements with utility companies and municipal department for protection of pipelines, conduits, drainlines, wiring, and other structures, whether underground, on the surface or overhead, and satisfy the company or department that the methods or operations are effective.

END OF SECTION

SUBMITTALS

1. SHOP DRAWINGS AND PRODUCT DATA

- .1 "Shop Drawings" are defined in GC.1.01(18). The Contractor shall submit Shop Drawings in accordance with GC.4.04. Submit six (6) copies of the Shop Drawings and one (1) good quality reproducible (sepia, mylar) shall also be submitted.
- .2 All Shop Drawings shall be in conformance with the City of Winnipeg, Works and Operation "Manual for the Production of Construction Drawings". This document may be reviewed by the Contractor at the office of the Contract Administrator. Shop Drawings will be numbered by the Contractor prior to submission.
- .3 Arrange for the preparation of clearly identified Shop Drawings as specified or as the Contract Administrator may reasonably request. Shop Drawings are to clearly indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of the Work. Where articles or equipment attach or connect to other articles or equipment, clearly indicate that all such attachments and connections have been properly coordinated, regardless of the trade under which the adjacent articles or equipment will be supplied and installed. Shop Drawings are to indicate their relationship to design Drawings and Specifications. Notify the Contract Administrator in writing of any deviations in Shop Drawings from the requirements of the Contract Documents.
- .4 Examine all Shop Drawings prior to submission to the Contract Administrator to ensure that all necessary requirements have been determined and verified and that each Shop Drawing has been checked and coordinated with the requirements of the Work and the Contract Documents. Examination of each Shop Drawing shall be indicated by stamp, date, and signature of a responsible person of the Contractor. Shop Drawings not stamped, signed, and dated will be returned without being reviewed and stamped "Rejected".
- .5 Submit Shop Drawings with reasonable promptness and in an orderly sequence so as to cause no delay in the Work. Failure to submit Shop Drawings in ample time is not to be considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed. Further to GC.8.01(1), submit a schedule, fixing the dates for submission and return of Shop Drawings within ten (10) days after commencement of the Work.
- .6 The Contract Administrator will review and return Shop Drawings in accordance with the schedule agreed upon or otherwise with reasonable promptness so as to cause no delay in the Work.
- .7 Shop Drawing review by the Contract Administrator is solely to ascertain conformance with the general design concept. Responsibility for approval of detail design inherent in Shop Drawings rests with the Contractor and review by the Contract Administrator shall not imply such approval.
- .8 Review by the Contract Administrator shall not relieve the Contractor of his responsibility for errors or omissions in Shop Drawings or for proper completion of the Work in accordance with the Contract Documents.

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- .9 Responsibility for verification and correlation of field dimensions, fabrication processes, techniques of construction, installation, and coordination of all parts of the Work rests with the Contractor.
- .10 Shop Drawings will be returned to the Contractor with one (1) of the following notations:
 - .1 When stamped "REVIEWED ONLY", distribute additional copies as required for execution of the Work.
 - .2 When stamped "REVIEWED AS MODIFIED", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED ONLY". Resubmit for final records.
 - .3 When stamped "REVISE & RESUBMIT", make the necessary revisions, as indicated, consistent with the Contract Documents and submit again for review.
 - .4 When stamped "NOT REVIEWED", submit other Drawings, brochures, etc., for review consistent with the Contract Documents.
 - .5 Only Shop Drawings bearing "REVIEWED ONLY" or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.
- .11 After submittals are stamped "REVIEWED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.
- .12 Make changes in Shop Drawings which the Contract Administrator may require consistent with Contract Documents. When re-submitting, notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.
- .13 Shop Drawings indicating design requirements not included in the Contract Documents require the seal of a qualified Professional Engineer registered or licensed in the Province of Manitoba. Engineering calculations shall be submitted for review, if requested, and sealed by a qualified Professional Engineer.

2. SAMPLES

- .1 Submit samples for the Contract Administrator's review as specified or as the Contract Administrator may reasonably request. Clearly label samples as to origin and intended use in the Work. May request reference samples to Drawings and Specifications.
- .2 Submit samples within three (3) working days and in orderly sequence so as to cause no delay in the Work. Failure to submit samples in ample time is not to be considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .3 Notify the Contract Administrator in writing, at the time of submission, of any deviations in samples from requirements of Contract Documents.

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- .4 The Contract Administrator's review will be for conformity of design concept and general arrangement only. Such review is not to be considered relief of responsibility for errors or omissions in samples or of responsibility for meeting all requirements of the Contract Documents.
- .5 Make changes in samples which the Contract Administrator may require consistent with Contract Documents.

3. AS-CONSTRUCTED DRAWINGS

- .1 After award of Contract the Contract Administrator will provide a complete set of Drawings for the purpose of maintaining Project As-Constructed Drawings. Accurately record significant deviations from Contract Documents caused by site conditions and changes ordered by the Contract Administrator. Update daily.
- .2 Record locations of concealed elements of mechanical and electrical services.
- .3 Identify Drawings as "Project As-Constructed Copy". Maintain in good condition and make available for inspection On-Site by Contract Administrator at all times.
- .4 Upon completion of the Work and prior to final inspection, submit As-Constructed Drawings to Contract Administrator for review.
- .5 The Certificate of Total Performance will not be issued until As-Constructed Drawings, satisfactory to the Contract Administrator, have been submitted.

4. OPERATING/MAINTENANCE MANUALS

- .1 Not less than two (2) weeks prior to the scheduled start-up of the equipment, submit to the Contract Administrator three (3) draft copies of Operating and Maintenance (O&M) Manuals which shall contain information required by the Specifications as well as O&M information on equipment supplied by this contract. All instructions in these manuals shall be in the English language to guide the City in the proper O&M of the equipment. The Contractor shall modify and supplement the manual as required by the Contract Administrator. A maximum of three (3) weeks after the manuals have been accepted, five (5) final copies shall be provided by the Contractor for distribution purposes.
- .2 Bind contents in a three-ring, hard covered, plastic jacketed binder. Organize contents into applicable sections of Work, parallel to Specifications break-down. Provide original copies of equipment brochures or technical information.
- .3 In addition to information called for in the Specifications, include the following:
 - .1 Title sheet, labelled "Operation and Maintenance Instructions", and containing project name and date.
 - .2 List of contents.

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- .3 Reviewed Shop Drawings of all equipment.
 - .4 As-Constructed Drawings of all mechanical and electrical installations.
 - .5 Full description of entire system operation.
 - .6 Detailed Specification and O&M instructions for all items of equipment provided including a preventative maintenance program.
 - .7 List of spare parts and consumables, including names and addresses of Suppliers.
 - .8 Names, addresses, and telephone numbers of all major Subcontractors and Suppliers.
 - .9 A copy of all wiring diagrams complete with wire coding.
 - .10 Copy of all warranty and inspection certificates.
- .4 The Contract shall not be considered complete, for the purposes of issuing a Certificate of Substantial Performance, until the above manuals have been completed to the satisfaction of the Contract Administrator.

5. PHOTOGRAPHS AND PUBLICITY

- .1 No photographs of the Site or of any portion of the Work will be permitted without prior approval of the Contract Administrator.
- .2 No press or publicity releases will be permitted without prior approval of the Contract Administrator.

6. NOTICE OF OPERATIONS

- .1 The Contractor shall, except as otherwise specified in the Contract Documents, give at least twenty four (24) hours notice to the Contract Administrator of his intention to set out lines, levels, and alignments for any part of the Work and his intention to commence demolition, pipe laying, concreting, etc., so that arrangements can be made by the Contract Administrator to carry out any necessary checks.
- .2 The checks will be the subject of a formalized system of written applications for inspection and approval. Work which is carried out without being appropriately sanctioned by the Contract Administrator could be classified as defective Work.

7. PROCEDURES

- .1 The Contractor shall, if required by the Contract Administrator, submit for the review of the Contract Administrator method statements which describe in detail, supplement with Drawings where necessary, the methods to be adopted for executing any portion of Work.

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- .2 These statements shall also include details of constructional plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

END OF SECTION

QUALITY ASSURANCE

1. INSPECTION AND TESTING OF WORK

1.1 General

- .1 The City, the Contract Administrator, and other authorities having jurisdiction shall have access to the Work. If parts of the Work are in preparation at locations other than the Place of the Work, access shall be given to such Work whenever it is in progress.

1.2 Laboratories/Agencies

- .1 Independent Inspection/Testing Agencies may be engaged by the City for the purpose of inspecting and/or testing portions of the Work. All costs of such services will be borne by the City. Any additional tests required due to defective Work shall be paid by the Contractor.
- .2 All equipment required for carrying out inspection and/or testing will be provided by the respective Agencies.
- .3 Employment of Inspection/Testing Agencies in no way relieves the Contractor of responsibility to perform the Work in accordance with the Contract Documents.
- .4 Allow the Inspection/Testing Agencies access to all portions of the Work On-Site and manufacturing or fabrication plants, as may be necessary. Provide facilities for such access.

1.3 Design Standards, Code Requirements

- .1 Inspection and/or testing will be performed in accordance with the following:
 - .1 Concrete to Canadian Standards Association (CSA)-A23.2 and mix designs to CSA-A23.1, Part II.
 - .2 Welding to CSA W59.1 and American Society for Testing and Materials (ASTM) E109.
 - .3 Bolted connections to CSA S16 or S16.1.

1.4 Tests and Mix Design

- .1 Prior to commencement of the Work, submit to the Contract Administrator and the Inspection/Testing Agency, the following:
 - .1 Test results and mix designs of each class of concrete.
 - .2 Test results and mix design of mortar types.
 - .3 Mill test certificates for all structural steel and bolts.

QUALITY ASSURANCE

2. PROCEDURES

- .1 Notify the Contract Administrator well in advance of the requirements for tests in order that necessary arrangements can be made.
- .2 Submit samples and/or materials required for testing with reasonable promptness so as to cause no delay in the Work.
- .3 Provide facilities to allow inspection and/or testing and make available space for storage and curing of the test samples.
- .4 If defects are revealed during inspection and/or testing, then the Contract Administrator may issue instructions for removal or correcting defective Work and irregularities. The Contractor shall notify the Contract Administrator within two (2) working days if such instructions are in error or at variance with the Contract Documents.
- .5 Refer to General Conditions GC 5.04 for "Defective Work".
- .6 Costs for re-inspection and/or testing of rejected Work shall be borne by the Contractor.

3. REFERENCE STANDARDS

- .1 Within the text of the Specifications reference may be made to the following standards:

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CCA	Canadian Construction Association
CEC	Canadian Electrical Code (published by CSA)
CEMA	Canadian Electrical Manufacturers Association
CGSB	Canadian Government Specification Board
CISC	Canadian Institute of Steel Construction
CLA	Canadian Lumberman's Association
CPCA	Canadian Painting Contractors Association
CPCI	Canadian Prestressed Concrete Institute
CRCA	Canadian Roofing Construction Association
CSA	Canadian Standards Association
FM	Factory Mutual Engineering Corporation
IEEE	Institute of Electrical and Electronic Engineers

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IPCEA	Insulated Power Cable Engineers Association
NAAMM	National Association of Architectural Metal Manufacturers
NBC	National Building Code
NEMA	National Electrical Manufacturers Association
TTMAC	Terrazzo, Tile and Marble Association of Canada
ULC	Underwriters Laboratories of Canada

Conform to such standards, in whole or in part, as specified.

- .2 If there is question as to whether any product or system is in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance. The cost for such testing will be borne by the City in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.
- .3 Where specified standards are not dated, conform to latest issue of specified standards as amended and revised to the Tender closing date.

END OF SECTION

TEMPORARY FACILITIES

1. FIELD OFFICES AND SHEDS

1.1 Contractor's Office

- .1 If the Contractor requires a dedicated office:
 - .1 Provide and maintain in clean condition during entire progress of the Work, a suitable office adequately lighted, heated, and ventilated for own use.
 - .2 Locate where directed by Contract Administrator.
- .2 Provide within office space adequate first aid facilities as recommended by the Ministry of Labour and Worker's Compensation regulations.

1.2 Contractor's Site Storage for Equipment and Materials

- .1 The Contractor may use the sludge holding tank room, as long as it does not interfere with plant operations.
- .2 The responsibility for the security of the Site storage and the condition of all the equipment and materials therein shall rest solely with the Contractor.

1.3 Access to Site Office and Storage Facilities

- .1 If dedicated office and/or storage facilities are required by the Contractor, provide vehicular accesses to the Site office and storage facilities from the existing access road. The access shall be suitable for use by heavy trucks and shall be kept in a clean serviceable condition and free of obstructions for as long as these offices and storage facilities are required for use.

2. UTILITIES

2.1 Sanitary Facilities

- .1 The Contractor will supply sanitary facilities and will not use the existing facilities at the SEWPCC. Maintain facilities in clean and tidy condition.

2.2 Water Supply

- .1 The Contractor may use water from the plant, as directed by the City. Maintain facilities in clean and tidy condition.

2.3 Heating and Hoarding

- .1 Heating of the existing buildings will be by the City.
- .2 Any other heating shall be the responsibility of the Contractor.

TEMPORARY FACILITIES

2.4 Power and Light

- .1 Where required, provide temporary power and light for own use. Install in accordance with regulations of governing authorities.
- .2 Power consumed will be paid for by the City.

2.5 Telephone

- .1 The Contractor shall:
 - .1 Provide and pay for temporary telephones necessary for own use.

2.6 Fuelled Welding Machines and Air Compressors

- .1 Fuelled welding machines and air compressors required for performance of the Work are to be the responsibility of the respective users. Locate outside of building.

2.7 Gas Welding Apparatus

- .1 Gas welding apparatus required for performance of the Work is to be the responsibility of the respective user.

2.8 Initial Charges of Oils, Etc.

- .1 Provide the initial charges of oil, grease, and all materials necessary for the operation, Site testing, and commissioning of the Work under this Contract, all to the satisfaction of the equipment Manufacturer.

3. BARRIERS

3.1 Guard Rails and Barricades

- .1 Provide guard railings and barricades around all openings, open shafts, and open stairwells. Construct as recommended by local governing authorities.

4. CONSTRUCTION AIDS

4.1 Scaffolding

- .1 Provide and maintain adequate scaffolding as required. Scaffolding is to be rigid, secure, and constructed to ensure adequate safety for workers. Erect without damage to the building or finishes.

4.2 Ladders, Stairs

- .1 Provide and maintain adequate temporary ladders and stairs required for construction.

TEMPORARY FACILITIES

- .2 Secure to structure.
- .3 Ladders and stairs are to comply with all requirements of safety authority.
- .4 Provide temporary wood treads on steel pan stairs for use prior to placement of permanent treads.

4.3 Explosive Actuated Fastening Tools

- .1 Provide for the use of explosive actuated fastening tools when required. When using, conform to the requirements of Canadian Standards Association (CSA) Z166 - "Explosive Actuated Fastening Tools" and local governing authorities.

5. ROADS

5.1 Access to Site

- .1 Provide and maintain access roads, sidewalk crossings, ramps, and construction runways as required for access to and On-Site. Conform to requirements of local governing authorities when required and when necessary make arrangements with adjacent property owners. Locate these traffic facilities where they are least disruptive to normal street traffic.
- .2 Do not limit access of sludge tankers in and out of the truck bay.

5.2 Temporary Vehicular and Pedestrian Access

- .1 Maintain existing vehicular and pedestrian accesses properly at all times during the construction period.
- .2 The Contractor shall confine their equipment, storage of materials, and operations of their workmen to minimize Site damage. The Contractor shall be responsible to restore all areas damaged or affected by construction to equal or better conditions which existed prior to construction, unless designated otherwise.

6. TRAFFIC CONTROL

6.1 Public Traffic Flow

- .1 Provide and maintain flag persons, traffic signals, barricades, and flares/lights/lanterns as required to direct the flow of equipment used in performance of the Work and to protect public traffic. Make arrangements with local governing authorities when these facilities will disrupt the normal flow of public traffic.

6.2 Parking

- .1 Parking will be permitted On-Site in the area to the south of the sludge holding tank building.

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- .2 Do not disrupt the station operation and access for City's operations and maintenance staff. The Contractor shall note that in any case, only limited parking space is available.

7. PROTECTION OF WORK AND PROPERTY

7.1 Protection for Off-Site and Public Property

- .1 Protect adjacent private and public property from damage during the performance of the Work.
- .2 Be responsible for all damages incurred due to improper protection.

7.2 Fire Protection

- .1 Provide and maintain adequate temporary fire protection equipment during performance of the Work as required by insurance companies having jurisdiction.
- .2 Provide a minimum of one (1) fire extinguisher in each equipment and tool shed, temporary office, and material storage shed workshop.
- .3 Where subjected to low temperatures, extinguishers are to be anti-freeze type. In proximity to gas, oil, grease, or paint storage locations they are to be #10 - carbon dioxide type. Extinguishers for all other locations are to be soda-acid type. All extinguishers are to be minimum 10 litre capacity and be Underwriters Laboratories of Canada (ULC) labelled.
- .4 Handle gasoline and like combustible materials with good, safe practice.
- .5 Remove combustible debris from Site daily.

7.3 Protection of Building Finishes and Equipment

- .1 Provide adequate protection for finished and partially finished building finishes and existing equipment and services during the performance of the Work. Provide necessary screens, covers, hoardings, etc., as required. Be responsible for all damages incurred due to improper or lack of protection.
- .2 In general, no dust-creating activities shall be permitted in the building. When dust-creating activities cannot be avoided, the Contractor shall erect a hoarding and seal the area of Work from the rest of the building and shall install a separate ventilation system to create a negative air pressure in the Work area during construction.
- .3 The Contractor shall use methods of construction on concrete work that will not generate dust.
- .4 The Contractor shall protect existing mechanical and electrical equipment from damage.
- .5 Maintain and protect existing services in operation during the course of the Work. Repair services damaged at no cost to the City.

TEMPORARY FACILITIES

- .6 If service interruptions are necessary, such interruptions shall be made only at times approved by the City.
- .7 Advise the Contract Administrator of any necessary service relocations not identified by the Contract documents.

7.4 Snow Removal

- .1 Snow removal will be by the City.

8. SECURITY

8.1 Security

- .1 Security of tools and equipment stored within the existing buildings are the responsibility of the Contractor. Where necessary, provide security for stored items.

9. ENVIRONMENTAL CONTROLS

9.1 Noise Control

- .1 Abide by all local ordinances. Adjust hours of operation accordingly.

9.2 Dust Control

- .1 Initiate dust control measures to eliminate dust generation inside the building and minimize dust generation outside the building.
- .2 For Work within a building, temporary enclosures shall be provided to cover activities that will generate dusts, e.g., mixing of grout and demolition of existing concrete. All the existing equipment in the plant contains sensitive instrumentation and shall be protected from airborne dusts. If the Contract Administrator considers that the dust control measures are not adequate, they will suspend the Work activity that is being undertaken by the Contractor and the Contractor shall not be allowed to resume until corrective measures, to the satisfaction of the Contract Administrator, have been implemented. Such corrective action may include, for example, provision of filters for existing equipment. All of these costs shall be borne by the Contractor.

9.3 Pollution Control

- .1 Ensure that no materials, oils, rubbish, spoil, or debris of any kind from the Work are allowed to be pushed over, washed down, fall, or be deposited on either land adjacent to the Site or in drains, channels, and culverts. In the event that it happens, such materials shall be removed immediately and the affected land and areas restored to their previous state at Contractor's own cost.
- .2 The Contractor shall make his own arrangements for disposing of these unsuitable materials.

TEMPORARY FACILITIES

9.4 Foul Air

- .1 All foul air is to be discharged through the main stack. Do not discharge foul air anywhere other than into the foul air plenum.

10. PROJECT SIGN BOARD

- .1 A project sign board is not required.

END OF SECTION

PRODUCTS/WORKMANSHIP

1. PRODUCTS

1.1 Quality of Products

- .1 Provide new materials, equipment, and articles incorporated in the Work, not damaged or defective and of the best quality (compatible with Specifications) for the purpose intended. If requested furnish evidence as to type, source, and quality of Products provided.
- .2 Defective materials, equipment, and articles whenever found may be rejected regardless of previous inspection. Inspection by the Contract Administrator or an inspector does not relieve the Contractor of his responsibility but is merely a precaution against oversight or error. Remove and replace defective materials at own expense and be responsible for all delays and expenses caused by rejection.
- .3 Should any dispute arise as to the quality or fitness of materials, equipment, or articles, the decision rests strictly with the Contract Administrator based upon the requirements of the Contract Documents.

1.2 Availability of Products

- .1 No substitution of any item will be permitted unless the item cannot be delivered to the job Site in time to comply with the Schedule.
- .2 To receive approval, proposed substitutes must equal or exceed the quality, finish, and performance of those specified and/or shown and must not exceed the space requirements allotted on the Drawings.
- .3 Provide documentary proof of equality, difference in price (if any), and delivery dates in the form of certified quotations from suppliers of both specified items and proposed substitutions.

1.3 Storage, Handling, and Protection of Products

- .1 Handle and store products in a manner to prevent damage, contamination, deterioration, and soiling and in accordance with Manufacturer's recommendations when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with Manufacturers' seals and labels intact. Do not remove packaging or bundling until required in the Work.
- .3 Products subject to damage from weather are to be stored in weatherproof enclosures.
- .4 Store cementitious materials clear of earth or concrete floors and away from walls.
- .5 When used for grout or mortar materials, keep sand clean and dry. Store on polyethylene and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet material, lumber, etc. on flat, solid supports and keep clear of ground.

PRODUCTS/WORKMANSHIP

- .7 Store and mix paints in a room assigned for this purpose. Keep room under lock and key at all times. Remove oily rags and any other combustible debris from Site daily. Take every precaution necessary to prevent spontaneous combustion.

1.4 Manufacturers' Directions

- .1 Unless otherwise specified, install or erect all products in accordance with the Manufacturers' recommendations. Do not rely on labels or enclosures provided with products. Obtain instructions directly from Manufacturers.
- .2 Notify the Contract Administrator, in writing, of any conflicts between the Specifications and Manufacturers' instructions so that the Contract Administrator may establish the course of action.
- .3 Improper installation or erection of products due to failure in complying with these requirements authorizes the Contract Administrator to require any removal and re-installation that may be considered necessary, at no increase in Contract Price.

1.5 Transportation Costs of Products

- .1 Pay all costs for transportation of products required for the Work.
- .2 Transportation costs for products supplied by the City will be paid by the City. Be responsible for unloading, handling, and storage of such Products unless specified otherwise.

1.6 Delivery of Equipment

- .1 All equipment under this Contract shall be supplied, delivered, and installed by the Contractor and is the responsibility of the Contractor. All of the Contractor's materials and equipment are to be delivered directly to the Construction Site.

2. WORKMANSHIP

2.1 Concealment

- .1 In finished areas conceal all pipes, ducts, and wiring except where indicated otherwise on Drawings or in Specifications.
- .2 Before installation, inform the Contract Administrator if there is a contradictory situation. Install as directed.

2.2 Location of Fixtures

- .1 Consider the location of fixtures, outlets, and other mechanical and electrical items indicated on Drawings as approximate. The actual location of these items is to be as required or directed to Site conditions at the time of installation and as is reasonable.
- .2 Before installation inform the Contract Administrator if there is a contradictory situation. Install as directed.

PRODUCTS/WORKMANSHIP

2.3 Cutting and Remedial Work

- .1 Perform all cutting and remedial Work that may be required to make the several parts of the Work come together properly. Coordinate and schedule the Work to ensure that cutting and remedial Work are kept to a minimum.
- .2 Employ specialists familiar with the materials affected in performing cutting and remedial Work. Perform in a manner which will not damage nor endanger any portion of the Work.
- .3 Do not cut, drill, or sleeve any load-bearing members without written approval of the Contract Administrator.
- .4 The Contractor is to perform Work so that no dust is generated.

2.4 Fastenings

- .1 Provide metal fastenings and accessories in same texture, colour, and finish as adjacent material unless otherwise specified.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Space anchors within their load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood plugs are not acceptable.
- .4 Keep exposed fastenings to a minimum, space evenly and lay out neatly.
- .5 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

2.5 Protection of Work In Progress

- .1 Adequately protect all Work completed and in progress. Repair or replace all damaged Work.
- .2 Prevent overloading of any part of the Work.

END OF SECTION

EQUIPMENT INSTALLATION

1. INTENT

- .1 This Section describes general requirements for all equipment supplied under the Contract relating to the supervision of installation, testing, operation, and performance verification. The Contractor shall be responsible for the installation, testing, operation, and performance verification of the supplied equipment.

2. DEFINITIONS

- .1 **Manufacturer:** The Manufacturer is the person, partnership, or corporation responsible for the manufacture and fabrication of equipment provided to the Contractor for the completion of the Work.
- .2 **Manufacturer's Representative:** A Manufacturer's Representative is a trained serviceman empowered by the Manufacturer to provide installation, testing, and commissioning assistance to the Contractor in his performance of these functions.

3. EXPERTISE AND RESPONSIBILITY

- .1 The Contract Administrator recognizes the expertise of the Manufacturer.
- .2 Should the Contract Administrator issue an Addendum, Field Order (FO), Change Order (CO), or Instruction to change the Work, which would, in the opinion of the Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Contractor to notify in writing the Contract Administrator to this effect within two (2) days.

4. EQUIPMENT DELIVERY

- .1 The equipment shall be delivered to the South End Water Pollution Control Centre (SEWPCC) Construction Site to the Contractor who shall be responsible for taking delivery of the equipment. Written acceptance of receipt, at delivery, by the Contractor shall constitute "Delivery to Site" under this Contract. **Form 100, "Certificate of Equipment Delivery"**, shall be completed.
- .2 The Contractor shall be responsible for receiving, off-loading, and placing into storage all equipment at the Site.
- .3 The Contractor shall ensure that they are fully informed of precautions to be taken in the unloading of equipment and its subsequent storage.

5. INSTALLATION ASSISTANCE

- .1 Before commencing installation of equipment, the Contractor shall arrange for the attendance of the Manufacturer's Representative to provide instructions in the methods,

EQUIPMENT INSTALLATION

techniques, precautions, and any other information relevant to the successful installation of the equipment.

- .2 The Contractor shall inform the Contract Administrator, in writing, of the attendance at the Site of any Manufacturer's Representative for installation training at least three (3) days prior to arrival.
- .3 When the Manufacturer's Representative is satisfied that the Contractor is aware of all installation requirements, they shall so certify by completing **Form 101** attached to this Specification.
- .4 The completed form shall be delivered to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.
- .5 Installation of the equipment shall not commence until the Contract Administrator has advised that they have received the completed **Form 101**.
- .6 Separate copies of **Form 101** shall be used for different equipment.

6. INSTALLATION

- .1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Contractor shall contact the Manufacturer to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.
- .2 If it is found necessary, or if so directed by the Contract Administrator, the Contractor shall arrange for the Manufacturer's Representative to visit the Site to provide assistance during installation, all at no cost to the City.
- .3 Prior to completing installation, the Contractor shall inform the Manufacturer and arrange for the attendance at the Site of the Manufacturer's Representative to verify successful installation.
- .4 The Manufacturer's Representative shall conduct a detailed inspection of the installation including alignment, electrical connections, belt tensions, rotation direction, running clearances, lubrication, workmanship, and all other items as required to ensure successful operation of the equipment.
- .5 The Manufacturer's Representative shall identify any outstanding deficiencies in the installation.
- .6 The deficiencies shall be rectified by the Contractor and the Manufacturer's Representative will be required to re-inspect the installation, at no cost to the City.
- .7 When the Manufacturer's Representative accepts the installation, they shall certify the installation by completing **Form 102**, attached to this Specification.

EQUIPMENT INSTALLATION

- .8 Deliver the completed **Form 102** to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.
- .9 Tag the equipment with a 100 mm by 200 mm card stating "Equipment Checked. Do Not Run." stenciled in large black letters. Sign and date each card.
- .10 Provide separate copies of **Form 102** for different equipment.

7. OPERATION AND PERFORMANCE VERIFICATION

- .1 Equipment will be subjected to a demonstration, running test, and performance tests after the installation has been verified and any identified deficiencies have been remedied.
- .2 Inform the Contract Administrator at least three (3) days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Contract Administrator.
- .3 The Manufacturer's Representative will conduct all necessary checks to equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other Work needed prior to confirming the equipment is ready to run.
- .4 The Contractor shall then operate the equipment for at least one (1) hour to demonstrate to himself the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.
- .5 The Contractor shall then notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend, as expeditiously as possible.
- .6 With the assistance of the Manufacturer's Representative, the Contractor will demonstrate that the equipment is properly installed. Alignment, piping connections, electrical connections, etc., will be checked and if appropriate, code certifications provided.
- .7 The equipment shall then be run for one (1) hour. Local controls shall be satisfactorily verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc., will be checked to ensure that they are within the specified or Manufacturer's recommended limits, whichever is more stringent.
- .8 On satisfactory completion of the one (1) hour demonstration, the equipment will be stopped and critical parameters, such as alignment, will be rechecked.
- .9 The equipment will be restarted and run continuously by the Contractor for two (2) days. During this period, as practicable, conditions will be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed by the Manufacturer's Representative, the Contractor, and Contract

EQUIPMENT INSTALLATION

Administrator on the basis of the information contained in the Technical Specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

- .10 Performance tests will be conducted either concurrent with or subsequent to the running test, as practicable and agreed between the Contract Administrator, the Manufacturer's Representative, and the Contractor.
- .11 Performance tests shall be as dictated in the Technical Specifications for each item of equipment or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Specification.
- .12 The Contractor shall submit the results of the performance tests to the Contract Administrator, documented and summarized in a format acceptable to the Contract Administrator. The Contract Administrator reserves the right to request additional testing. No equipment shall be accepted and handed over to the City prior to the satisfactory completion of the performance test(s) and receipt of the test reports.
- .13 The City will supply all water, natural gas, and power required for the initial demonstration, running test, and performance tests.
- .14 Should the initial demonstration, running test, or performance tests reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and/or performance tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Contractor, the Contract Administrator, or the City, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Contractor.
- .15 On successful completion of the demonstration, running test, and performance tests, **Form 103** attached to this Specification will be signed by the Manufacturer's Representative, the Contractor, and the Contract Administrator.
- .16 Performance tests will be conducted either concurrent with or subsequent to commissioning of the entire system, as practicable and agreed between the Contract Administrator, the Manufacturer's Representative, and the Contractor.

8. OPERATOR TRAINING

- .1 For equipment specified to include training, arrange for the attendance of the Manufacturer's Representative to provide a classroom training session to operation and maintenance (O&M) staff.
- .2 The training session shall last eight (8) hours. The training sessions shall be given during the two (2) week period preceding the start of the two (2) day operating period required for **Form 103**.
- .3 Coordinate the training session with the Contract Administrator.

EQUIPMENT INSTALLATION

- .4 Prepare a draft handout taking the form of the relevant sections of the O&M Manual supplemented with any other information needed to fully explain the equipment operation.
- .5 Prepare a draft agenda outlining the content of the training sessions. Allow half an hour at the beginning of the first period for the Contract Administrator to provide a summary of the design intent relating to that equipment. Following the engineering design overview, provide (as a minimum) information covering major equipment operation, mechanical and instrumentation engineering.
- .6 Submit the draft handout and draft agenda to the Contract Administrator for review. Upon obtaining the Contract Administrator's acceptance, prepare ten (10) copies of the handout and submit to the Contract Administrator.
- .7 Inform the Contract Administrator of any requirements for audio-visual aids five (5) days before the training session.
- .8 The Manufacturers' Representative shall provide five (5) sets of training seminar manuals in similar format to the O&M Manuals prior to the training session. In addition, the Manufacturers' Representative shall be responsible to document each training session with a detailed set of minutes.
- .9 Upon completion of training, the Contractor shall issue **Form T1: Certificate of Satisfactory Training**, complete with all required signatures.

EQUIPMENT INSTALLATION

**CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100**

We certify that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

(Authorized Signing Representative of the Contractor)

Date

(Authorized Signing Representative of the Subcontractor)

Date

(Authorized Signing Representative of the Contract Administrator)

Date

EQUIPMENT INSTALLATION

**CERTIFICATE OF READINESS TO INSTALL
FORM 101**

I have familiarized the installer of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

(Authorized Signing Representative of the Manufacturer) Date

(Authorized Signing Representative of the Subcontractor) Date

I certify that I have received satisfactory installation instructions from the equipment Manufacturer/
Supplier.

(Authorized Signing Representative of the Contractor) Date

EQUIPMENT INSTALLATION

**CERTIFICATE OF SATISFACTORY INSTALLATION
FORM 102**

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

OUTSTANDING DEFECTS: _____

(Authorized Signing Representative of the Manufacturer)

Date

(Authorized Signing Representative of the Contractor)

Date

EQUIPMENT INSTALLATION

**CERTIFICATE OF SATISFACTORY TRAINING
FORM T1**

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

**REFERENCE
SPECIFICATION:** _____

(Trainer)

Date

(Authorized Signing Representative of the Installer)

Date

(Authorized Signing Representative of the Contract Administrator)

Date

END OF SECTION

COMMISSIONING

1. COMMISSIONING

1.1 General

- .1 At the time of the Commissioning, the Contract Administrator shall advise the Contractor of the Commissioning requirements.
- .2 The Contractor shall note that on materials and equipment installed in this Contract, warranty will not begin until issuance of Total Performance.

2. INTENT

- .1 This Section describes the Contractor's responsibilities in the Commissioning and hand over of the process, electrical, and other systems to be installed as part of this Work.

3. DEFINITIONS

- .1 System: For the purpose of this Specification Section, a system shall be defined as the equipment, piping, controls, ancillary devices, electrical power, etc., which together perform a specific function at the facility.
- .2 Commissioning: For the purpose of this Specification Section, Commissioning shall be defined as the successful operation of a system in accordance with its design requirements for a period of nine (9) days; two (2) days by the Contractor and seven (7) days by the City.
- .3 Acceptance: For the purpose of this Specification Section, Acceptance shall be defined as the formal turnover of a system to the City for their O&M. This shall occur after the successful end of Commissioning of each system through a formal agreement between the Contract Administrator, the City, and the Contractor. Success of the Commissioning Period is determined by the Contract Administrator.

4. COMMISSIONING TEAM

- .1 The Work of Commissioning will be conducted by teams comprised of personnel from the Contractor, the City, and the Contract Administrator.
- .2 The City's appointed staff shall represent process personnel and operating staff.
- .3 The Contractor shall provide personnel representing the appropriate trades, including Instrumentation and Controls (I&C) personnel during the Commissioning. These personnel shall be skilled workmen, able to expedite any minor repairs, adjustments, etc., as are required to complete Commissioning with as few delays as possible.

COMMISSIONING

5. COMMISSIONING PLAN

- .1 The Commissioning Team shall develop a detailed methodology for the Commissioning of each system at least ten (10) calendar days prior to planned start of Commissioning. The plan shall be drafted by the Contractor and Contract Administrator and include the following:
 - .1 Detailed Schedule of Events, including but not limited to the schedule for completion of testing of all component parts of the system in accordance with **Section 01650 – Equipment Installation** prior to Commissioning of a system.
 - .2 Method for introducing foul air and disposing of partially treated foul air generated during the Commissioning process. The Contractor will take responsibility for the implementation of these measures.
 - .3 Sampling and analytical program for tests necessary to verify compliance with performance Specifications.
 - .4 Planned attendance schedule for Manufacturer's Representatives.
 - .5 Contingency plans in the event of a process malfunction.
 - .6 Drawings and sketches as required to illustrate the planned sequence of events.
 - .7 List and details for all temporary equipment (pumps, etc.) required to facilitate Commissioning.
 - .8 List of all personnel who the Contractor plans for Commissioning and hand-over with information indicating their qualifications for this Work.
- .2 The Commissioning Plan shall be reviewed and agreed by the Commissioning Team prior to its implementation. The Contract Administrator shall be the final arbiter.

6. EQUIPMENT

- .1 All process, mechanical, electrical, control, and miscellaneous equipment related to a system shall be successfully installed and tested in accordance with **Section 01650 – Equipment Installation** and any specific requirements noted in other divisions. **Form 103** (Contractor-Supplied Equipment) shall be executed for each item.
- .2 As required in **Section 01300 – Submittals**, O&M Manuals will be submitted and reviewed by the Contract Administrator.
- .3 Staff training sessions shall be completed.

COMMISSIONING

7. CONTROLS

- .1 All controls which are the responsibility of this Contractor shall be installed and tested prior to commissioning.
- .2 The Contract Administrator shall arrange for the simulation of the control. Every effort shall be made to ensure that the Commissioning Period provides for the full and comprehensive operation of the equipment under all anticipated normal and adverse operating conditions.

8. PLANT UTILITY SERVICES

- .1 The City shall provide power, chemicals, and other ancillary services as necessary to operate the plant through the Commissioning Period. Provision of these services shall be limited to reasonable levels.

9. MANPOWER

- .1 Supply all staff required during Commissioning as necessary to assist the City's staff in the operation of the system.
- .2 Supply competent staff capable of maintaining, repairing, and adjusting the equipment and controls to achieve the intended design functions during the Commissioning Period.
- .3 Ensure equipment Manufacturer's Representatives are available as necessary to certify adjustments in equipment, to guide in setting correct operating limits, and to generally provide input as required for the appropriate operation of the equipment.

10. OPERATING DESCRIPTIONS

- .1 Operating descriptions have been prepared for the plant systems. To some degree, the intent of these have been included in the Drawings and Technical Specifications. Other information outlining the operating requirements is available from the Contract Administrator. The Contractor will review these descriptions and will make themselves familiar with the requirements in order that they can undertake commissioning in an appropriate manner.

11. DESIGN PARAMETERS

- .1 Design parameters for the systems to be commissioned shall be as defined in the Specifications and/or the operating descriptions; as modified by the Commissioning Team. The Commissioning Team will identify to the Contractor which parameters shall be modified prior to Commissioning and shall be responsible for any subsequent changes during the Commissioning Period.

COMMISSIONING

12. PREPARATION

- .1 Running tests for each item of equipment included in the system to be commissioned shall be completed prior to commissioning. Performance tests will be conducted either concurrent with or subsequent to commissioning of the entire system, as practicable and agreed between the Contract Administrator, the Manufacturer's Representative, and the Contractor.
- .2 Piping, wiring, and other conduit systems shall be finished and tested.
- .3 Electrical connections shall be completed and inspected to the satisfaction of the governing authorities.
- .4 All other regulatory inspections shall be completed to the satisfaction of the governing authorities.
- .5 Control systems shall be completed and the related control software debugged.

13. SEQUENCE

- .1 Systems shall be commissioned in a logical manner. Upstream components shall be commissioned first to the degree possible.
- .2 The following sequence of events shall be followed:
 - .1 O&M Manuals shall be available as per the requirements of **Section 01300 – Submittals** at least two (2) weeks prior to the start of Commissioning.
 - .2 The Contract Administrator will make Operating Descriptions available prior to testing.
 - .3 Initial operator training shall be undertaken prior to Commissioning.
 - .4 Equipment running tests shall be conducted successfully.
 - .5 Start and run system in manual mode.
 - .6 Turn separate items of equipment to automatic in a planned and logical manner. Ensure that the control system is operating the equipment in a manner which precludes damage of the equipment and which is consistent with the process operating requirements.
 - .7 Commence Commissioning Period of nine (9) days. The Contractor shall operate the system continuously for two (2) days upon which the system will be turned over to the City and operated by City personnel for an additional seven (7) days. Minor failures shall not void the Commissioning Period. A minor failure is defined as one which does not present a safety hazard, does not impact overall process functioning and can be temporarily overcome by the use of available standby equipment. The Commissioning Period shall be re-started if a critical failure occurs. A critical failure shall be deemed as one, which prohibits the process from functioning successfully for an eight (8) hour period or one which creates a safety hazard.

COMMISSIONING

- .8 Upon completing the Commissioning Period, the system shall be granted formal acceptance by the Contract Administrator.

14. COMMISSIONING

- .1 Foul air and natural gas will be introduced to the system in a manner, which precludes the damage of any equipment.
- .2 Assist in the operation of the plant to achieve the process objectives.
- .3 All components and systems shall be operated in the automatic/manual and the remote/local modes as required to prove proper operation.
- .4 Ensure all bypasses and backup provisions function satisfactorily.
- .5 All minor and major alarm conditions will be induced to ensure that the process reacts as intended, the applicable alarms are enunciated.

15. ACCEPTANCE

- .1 The Commissioning of a system shall be considered acceptable when the process has operated in a stable manner, satisfying the design criteria for a period of nine (9) days; two(2) days run by the Contractor and the last seven (7) of which shall be run by City personnel.
- .2 On successful completion of Commissioning **Form 104 – Certificate of Satisfactory Process Performance** attached to this Specification will be signed by the representative of the Manufacturer, Contractor, Contract Administrator, and the City.
- .3 Notice of Acceptance for the entire project will be granted when all systems have been commissioned and accepted, and all requirements of the General Conditions have been completed.

COMMISSIONING

**CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE
FORM 104**

We certify that the equipment listed below has been operated and tested as per the Specifications using foul air and that the equipment meets its Performance Testing Criteria. The equipment is therefore classed as “conforming”.

PROJECT: _____

SYSTEM DESCRIPTION: _____

TAG NO (S): _____

**REFERENCE
SPECIFICATION (S):** _____

(Authorized Signing Representative of the Manufacturer) _____ Date

(Authorized Signing Representative of the Contractor) _____ Date

(Authorized Signing Representative of the Contract Administrator) _____ Date

(Authorized Signing Representative of the City of Winnipeg) _____ Date

END OF SECTION

CONTRACT CLOSEOUT

1. RELATED REQUIREMENTS

- .1 Submission of As-Constructed Drawings: **Section 01300 – Submittals.**
- .2 Operation and Maintenance (O&M) Manuals: **Section 01300 – Submittals.**
- .3 General Conditions of the Contract.

2. FINAL CLEANING

- .1 When the Work is Substantially Performed, remove surplus products, tools, construction machinery, and equipment not required for the performance of the remaining Work.
- .2 Remove waste products and debris and leave the Work clean and suitable for occupancy by the City.
- .3 When the Work is Totally Performed, remove surplus products, tools, construction machinery, equipment, waste products, and debris.
- .4 Leave the Work areas broom clean before the final inspection process commences.

3. SITE RESTORATION

- .1 The Contractor shall remove the temporary site office and storage facilities prior to Total Performance being issued.
- .2 The Contractor will be responsible for grounds restoration (seeding or sodding), as determined necessary by the Contract Administrator.
- .3 The Contractor will be responsible for any damage caused by his forces on roadways or accesses.

END OF SECTION

GENERAL PROCESS PROVISIONS

1. GENERAL

1.1 Intent

- .1 Provide complete, fully tested, and operational process systems to meet requirements described herein and in complete accord with applicable Codes and Ordinances.
- .2 Contract Documents of this Division and Process Drawings are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material, and installation quality and are not detailed installation instructions.
- .3 Follow Manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.
- .5 Install equipment to provide access and ease of maintenance.
- .6 Connect to equipment specified in other Sections. Uncrate equipment, move in place, and install complete; start-up and test.

1.2 Regulations

- .1 All Work carried out under this Division shall be in full accordance with all applicable Codes, Regulations, By-laws, and Ordinances and nothing in the plans and Specifications shall remove this responsibility.

1.3 Permits, Fees, and Inspections

- .1 Apply for all permits, supply all test certificates, and pay all fees to authorities having jurisdiction regarding the installation and inspection of the complete process systems, installed under this Contract.

1.4 Existing Conditions and Other Trades

- .1 Visit the Site to determine existing conditions affecting the Work of this Division. Failure to do so shall not remove the responsibility for the effects of such conditions on the Work.
- .2 Examine the Mechanical, Structural, Electrical, and Instrumentation Controls (I&C) Specifications and Drawings and become fully familiar with the Work of other trades under this Contract.

GENERAL PROCESS PROVISIONS

- .3 Maintain the utmost cooperation with all other trades. Particular attention must be paid to the proximity of all electrical cables, control conduits, and utilities to the Work. Maintain maximum clear ceiling heights throughout. Provide connections of sizes as shown on the Drawings for connection by other trades.

1.5 Materials

- .1 Materials and equipment installed shall be new, full weight, and of quality specified. Use same brand or Manufacturer for each specific application.

1.6 Scope of Work

- .1 Refer to **Section 01010 – Summary of Work** and D2 of the Supplemental Conditions for the Scope of Work.
- .2 Consideration will not be granted for any alleged misunderstanding of the extent of the Work to be performed. Tendering a proposal shall convey full agreement to all items and conditions specified, indicated on the Drawings, and/or required by the nature of the Site.

1.7 Discrepancies and Omissions

- .1 These Specifications shall be considered as an integral part of the Drawings, which accompany them, and neither the Drawings nor Specifications shall be used alone. Any items or subject omitted from one, but which is mentioned and/or indicated in the other, shall be considered as properly and sufficiently specified and shall therefore be provided.
- .2 Should the Contractor find discrepancies or omissions in the Contract Documents, or be in doubt as to the intent thereof, he shall immediately obtain clarification from the Contract Administrator.

1.8 Transportation and Hoisting

- .1 Assume responsibility for transportation, hoisting, warehousing, and demurrage for all equipment and materials to be furnished and installed under this Division.

1.9 Definitions and Interpretations

- .1 Where the term “Provide” is used herein, it shall be understood to include labour, materials, and services necessary to supply, install, and make functional the items or Work referenced.
- .2 Where the term “Instructions” or “As Instructed” or “Where Instructed”, etc. is used herein, it shall be understood to mean as instructed in writing by the Contract Administrator.

GENERAL PROCESS PROVISIONS

- .3 Where the term “Listed” is used herein, it shall be understood to mean that the materials or equipment have been tested in accordance with applicable standards and methods, and have been approved and listed for the intended use by a testing authority which itself has been approved by the authorities having jurisdiction.
- .4 Where the term “Approved” or “Approval”, etc., is used herein, it shall be understood to mean approved by Authorities having jurisdiction as conforming to codes, standards, by-laws, etc.
- .5 Where the term “Acceptable” or “Acceptance”, etc., is used herein, it shall be understood to mean acceptable to the Contract Administrator as conforming to the requirements of the Contract Documents.
- .6 Where the term “Submit for Review” is used herein, it shall be understood to mean submit to the Contract Administrator.
- .7 Where the term “Subject to Review” etc., is used herein, it shall be understood to mean Work shall be laid out for review by the Contract Administrator. No Work shall proceed until written instructions have been obtained from the Contract Administrator. Submit further information, Shop Drawings, samples, etc., as specified and/or as may be reasonably requested by the Contract Administrator.
- .8 Where the term “Accessible” is used herein, it shall be understood to mean readily approachable by person or tools as required and where obstacles may be removed and replaced without cutting or breaking out materials.
- .9 Where working pressure or pressure ratings are specified or shown on the Drawings for valves, piping, fittings, equipment, etc., these items shall be suitable for operating at specified pressures and corresponding temperature unless noted otherwise.

1.10 Shop Drawings

- .1 Refer to **Section 01300 – Submittals** for the general requirements for Shop Drawings.
- .2 For specific requirements for Shop Drawings for various pieces of equipment, refer to the relevant specific Sections describing the equipment.
- .3 Shop Drawings shall be complete; capable of illustrating fully that the Product to be supplied is in accordance with the Specifications; including design considerations, materials, and accessories and spare parts. Include wiring diagrams for power supply and control schematics for all electrically powered and/or controlled equipment.

GENERAL PROCESS PROVISIONS

1.11 Coordination

- .1 Coordinate with other Divisions the location of openings, housekeeping pads, and anchor bolts.
- .2 Coordinate the connection of the services of other Divisions to the equipment and material supplied under this Division.

1.12 Minor Changes

- .1 Equipment and materials shall be located and arranged generally as shown on the Drawings. However, minor changes may be required to suit the precise requirements of the actual equipment or materials supplied, or to avoid conflict between services.
- .2 Prior to the installation of the relevant equipment or materials, the Contractor shall advise the Contract Administrator of the requirement for any minor changes (including box-outs and coring) and shall undertake such minor changes as instructed by the Contract Administrator. Such changes shall be undertaken at no extra cost except where the connection or arrangement is modified in length, alignment, or position by more than 1 m; or if the change involves the addition of more than two (2) fittings greater than 50 mm in diameter.

1.13 Housekeeping Pads

- .1 The existing housekeeping pad is to be reused for the thermal oxidizer unless it is not of the appropriate size or is not in a suitable condition.
- .2 Housekeeping pads are required for all pieces of equipment unless otherwise noted. Dimensions shown on the Drawings are for guidance only. Housekeeping pads shall be at least 100 mm larger than the equipment base plate(s) and 100 mm to 200 mm deep, unless greater or lesser depths are required to support the equipment at the proper elevation. The final housekeeping pad dimensions shall be based on the dimensions of the actual equipment to be installed and the Manufacturer's recommendations. In addition, housekeeping pads to include a minimum 20 mm - 45° chamfer to remove sharp edges from the pad.
- .3 The Contractor shall coordinate the location and installation of all the housekeeping pads, to be done by other Divisions.

1.14 Metric Conversion

- .1 All units in this division are expressed in SI units.
- .2 Submit all Shop Drawings and maintenance manuals in SI units.

GENERAL PROCESS PROVISIONS

- .3 On all submittals (Shop Drawings etc.) use the same SI units as stated in the Specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
 - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment, and piping.
 - .2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

EQUIVALENT NOMINAL DIAMETER OF PIPES

mm	Inches	mm	Inches	mm	Inches
3	1/8	65	2-1/2	375	15
6	1/4	75	3	450	18
10	3/8	100	4	500	20
15	1/2	125	5	600	24
20	3/4	150	6	750	30
25	1	200	8	900	36
30	1-1/4	250	10	1050	42
40	1-1/2	300	12	1200	48
50	2				

1.15 Cutting and Patching

- .1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Obtain written approval from the Contract Administrator before cutting or burning structural members.
- .4 Patch building where damaged from equipment installation, improperly located holes, etc. Use matching materials as specified in the respective Section.

1.16 Substantial and Total Performance

- .1 Perform the following items prior to Substantial Performance Inspection.
 - .1 Provide a complete list of items which are deficient.

GENERAL PROCESS PROVISIONS

- .2 Make systems capable of operation with alarm controls functional and automatic controls in operation generally, but not necessarily finally calibrated.
 - .3 Make necessary tests on equipment including those required by authorities. Obtain certificates of approval.
 - .4 Complete valve tagging and identify equipment. Paint equipment, piping and install escutcheons.
 - .5 Lubricate equipment as per Manufacturer's data.
 - .6 Mail warranty forms to Manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one (1) year.
 - .7 Submit O&M Manuals as per **Section 01300 – Submittals**.
- .2 During the Substantial Performance Inspection, compile a complete list of items which are deficient.
 - .3 Prior to the Total Performance Inspection, provide declaration in writing that deficiencies noted at time of Substantial Performance Inspection have been corrected and the following items completed prior to the Total Performance Inspection:
 - .1 Complete final calibration of controls.
 - .4 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until Substantial Performance is declared.

1.17 Equipment Protection and Clean-Up

- .1 Protect equipment and materials in storage On-Site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Thoroughly clean both existing and new piping, ducts, and equipment of dirt, cuttings, and other foreign substances.
- .4 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.18 Temporary Usage

- .1 Usage by the City of any process device, apparatus, machinery, or equipment prior to Total Performance being issued is not to be construed as acceptance.

GENERAL PROCESS PROVISIONS

1.19 Painting and Identification

- .1 Coordinate colour coding of piping and equipment with that of the existing plant. All piping and equipment is to be painted.
- .2 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum 20 mm high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.
- .3 Identify piping with labels, colour bands, and flow arrows. Provide identification at 15 m maximum intervals, before and after pipes pass through walls, at all sides of tees, behind access doors, and in equipment rooms as required.

1.20 Acceptable Products and Acceptable Manufacturers

- .1 The first Product specified in a Product list is considered the “Design Standard” unless noted otherwise. The Design Standard is taken to mean that Product has been used as the basis for design. Dimensions, operating protocol, basic materials, etc. have been incorporated in the design.
- .2 Where one or more Acceptable Products or Acceptable Manufacturers have been listed for an item of equipment, these are accepted as equivalent in concept to the Design Standard, if a Design Standard is listed. Incorporation of equipment options to satisfy the intent of the Specifications such that the process system would function as intended with the Design Standard is the responsibility of the Contractor. Modifications to the equipment services, supports, structure, etc., to suit acceptable Products shall be the responsibility of the Contractor.
- .3 It remains the responsibility of the Contractor to ensure the Products supplied are equal to the specified Products in every respect, operate as intended, and meet the performance Specifications and physical dimensions of the specified Product.
- .4 The Contractor shall be fully responsible for any additional Work or materials required to accommodate the use of equipment from the acceptable Manufacturers and Suppliers list.
- .5 Submit within fourteen (14) days of Contract award a copy of the list underlining the name of the Manufacturer whose price was carried in the tender. If no Manufacturer’s names are submitted, it will be assumed that the price carried in the tender was that of the specified Manufacturer or where the specified Product is generic, the first acceptable Manufacturer listed for each item and equipment.

GENERAL PROCESS PROVISIONS

1.21 Delivery Schedule

- .1 The Contractor is to coordinate the equipment and material delivery schedule with the Suppliers of the equipment and materials supplied under this Contract to suit the construction schedule. The dates for delivery shall be identified within twenty (20) working days of Contract award. These delivery dates may be altered by mutual agreement between the Contractor and the Contract Administrator.

1.22 Delivery

- .1 The Contractor shall be responsible for unloading the equipment and materials supplied under this Contract and shall examine all packages on delivery, compare with the shipping list, and inform the supplier, the Contract Administrator, and the carrier of any visible damages or defects. The Contractor shall arrange with the supplier to have the supplier replace any damaged or defective items.

1.23 Storage

- .1 Refer to **Section 01500 – Temporary Facilities** for storage details.
- .2 Pipe and any other materials shall be stored in a manner which prevents rust, deformation, weathering, or any other physical deterioration. Covered space shall be provided by the City if necessary to provide for this protection.
- .3 The Contractor shall adhere to the Manufacturers' storage recommendations.
- .4 Heated covered storage space shall be provided for sensitive items of equipment such as motors, pumps, as well as other equipment or supplies specified in this Division or other Divisions.

1.24 Spare Parts and Special Tools

- .1 If spare parts or special tools are to be provided with any equipment specified, the specific parts or tools will be listed in the relevant Specification Section and are to be supplied with the equipment.
- .2 Where the operation of the equipment for a period of two (2) years following total performance would require that some specific spare parts are likely to be required, but are not listed in the Specification, the Contractor shall so inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified spare parts shall be identified.
- .3 Where some specific special tools are required for the maintenance and/or operation of a specific item of equipment, but are not listed, the Contractor shall so inform the

GENERAL PROCESS PROVISIONS

Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified special tools shall be provided.

- .4 This clause does not relieve the Contractor of the responsibility to provide, at no cost, any spare parts required during the warranty period to repair malfunctioning or failed equipment. At the end of the maintenance period, the spare parts inventory shall be replenished to allow for the above.

1.25 Abbreviations

- .1 The following abbreviations are found in the Process Specifications:

ABFMA	American Bearing Fabrication and Manufacturer Association
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BS	British Standard
CGSB	Canadian Government Standards Board
CSA	Canadian Standards Association.
DIN	Deutsche Industry Norm
MSS	Manufacturer's Standardization Society of the Valve and Fittings Industry

END OF SECTION

PROCESS EQUIPMENT INSTALLATION

1. GENERAL

1.1 Work Included

- .1 Installation, including the supply of anchor bolts, and start-up and witness testing of equipment supplied under **Division 11**.
- .2 Removal, relocation, reinstallation, modification, supply of anchor bolts and lubricants, and start up and witness testing of existing equipment as detailed on the Drawings.

1.2 Definitions

- .1 Testing: In **Division 11**, testing shall be defined as the operation of a specific item of equipment under actual and/or simulated conditions for the purpose of ensuring the equipment satisfies its basic design criteria. Testing shall be conducted by the Contractor. All materials, labour, and equipment required to conduct the tests shall be the Contractor's responsibility. Refer to **Section 01650 – Equipment Installation**, for testing requirements.
- .2 Commissioning: Refer to **Section 01670 – Commissioning**.

1.3 Submissions

- .1 The Contractor shall check all the Shop Drawings relative to the equipment and materials, dimensions, measurements, size of members, type of materials, controls, list of equipment being supplied, names of Manufacturers, and other details to satisfy himself that they are correct and conform to the requirements and intent of the Contract.

2. PRODUCTS

2.1 Equipment

- .1 All equipment detailed on the equipment Specification Sheets, or shown on the Drawings shall be supplied and installed by the Contractor unless indicated otherwise.
- .2 Determine the extent of equipment to be supplied from the Specifications, list of equipment and materials, and Manufacturer's Drawings covering the equipment. All additional materials necessary to complete the installation shall be furnished and installed by the Contractor.

2.2 Anchor Bolts

- .1 All anchor bolts and fasteners shall be 316 stainless steel, unless otherwise specified.
- .2 All other types of anchor bolts and fasteners, e.g. galvanized or cadmium-plated, shall only be used with the Contract Administrator's approval.
- .3 Anchor bolts shall be sized to suit the equipment Manufacturer's requirements.

PROCESS EQUIPMENT INSTALLATION

- .4 For rotating equipment of 37 kW or above and where specified or shown on the Drawings, anchor bolts shall be supplied with washers and sleeves as shown in the Standard Details to permit minor adjustments during installation.
- .5 The use of drilled expansion anchors for any equipment will not be allowed unless by prior agreement between the Contract Administrator and the Contractor.

2.3 Equipment Base Templates

- .1 For all rotating equipment of 37 kW or above and where specified or shown in the Drawings, an equipment base template will be provided.
- .2 The template will be manufactured of structural steel with stops or holes for the anchor bolts.
- .3 The templates shall be shop finished as specified in **Section 11900 – Field Applied Protective and Maintenance Coatings** for items to be buried in concrete.
- .4 Access holes for the placement of grout or concrete as applicable will be provided.

3. EXECUTION

3.1 Coordination

- .1 Coordinate the Work specified under this Section with the Work of other Sections to produce a complete and workmanlike job.

3.2 Preparation

- .1 Before commencing installation of the Work, inspect and take field measurements and ensure that Work carried out previously in the area is not prejudicial to the proper installation of the Works.
- .2 Schedule the visits to the Site of the Manufacturer's Representative for the times and periods specified in other Sections. Cooperate with the Manufacturer's Representative in their supervision of the installation and start-up and follow all reasonable instructions of the Manufacturer's Representative. Should the Contractor require the Manufacturer's Representative to attend for longer or more frequent periods they shall arrange this, at their own expense, with the Manufacturer.

3.3 Installation of Equipment

- .1 All equipment specified in other Sections, detailed on the equipment Specification Sheets, or shown on the Drawings is to be installed by the Contractor according to the Manufacturers' installation instructions, if applicable.
- .2 Dimensions shown on the Contract Documents for equipment bases, piping connections, etc., are approximate and must be corrected by the Contractor to suit the dimensions of the exact equipment selected for each application. Any necessary modifications to piping

PROCESS EQUIPMENT INSTALLATION

- connections or to pipework shall be arranged by the Contractor at his own expense and must be acceptable to the Contract Administrator.
- .3 Supply all necessary shims, gaskets, etc., and all necessary lifting and loading equipment and tools, etc., required to complete the installation.
 - .4 For rotating equipment of 37 kW or above and for equipment requiring structural anchoring, set anchor bolts in advance using machine base templates. Set anchor bolts in sleeves to permit minor adjustment during installation.
 - .5 Where equipment is supplied with a plate steel base, provide access holes in the top of the plate and use a pour grade, non-shrink, non-metallic grout to fill the entire void under the base.
 - .6 Prepare grout as specified on drawings and provide full contact with the equipment bases unless otherwise recommended by the equipment Manufacturer and agreed by the Contract Administrator. Shims shall be left in place and the grout neatly bevelled, formed, or trimmed as shown or required.
 - .7 The sequence of installation shall be as follows:
 - .1 Level machine base on anchor bolts, use non-ferrous shims, not more than three (3) pieces.
 - .2 Eliminate soft foot.
 - .3 Carry out preliminary alignment.
 - .4 Attach piping, etc.
 - .5 Carry out final alignment.
 - .6 Grout base.
 - .7 Demonstrate to the City, Contract Administrator, and Manufacturer's Representative the final alignment (hot or cold as applicable), no soft foot, no pipe strain.
 - .8 Extend any inaccessible lubrication points and lubricant drains to convenient locations. Remove storage lubricant and provide the initial fill of new lubricants for the equipment. Lubricant grade to be as recommended by the equipment Manufacturer.

3.4 Alignment

- .1 All rotating equipment is to be set and aligned in accordance with the more stringent requirements of either the Manufacturer's requirements or the following:
 - .1 Level base, use machinists level on all machined bases.
 - .2 Align couplings to ± 0.05 mm.

PROCESS EQUIPMENT INSTALLATION

- .3 Check for rocking of footing. Maximum permissible 0.002 mm.
- .4 Where equipment undergoes a substantial differential temperature rise (30°C between driver and driven), provide precision benchmarks in foundation and on equipment and perform alignment at operating temperatures.

3.5 Vibration Survey

- .1 A vibration survey shall be carried out under normal operating conditions for all equipment with a motor size exceeding 37 kW and for smaller units where specified.
- .2 Vibration shall be monitored in all three (3) dimensions at the head and tail end of both the driver and driven units and at other critical locations which may be specified by the Contract Administrator.
- .3 Unless specified otherwise, unfiltered velocities will be used as the vibration criteria. Unfiltered velocities less than 5 mm/sec shall be considered acceptable. Values in excess of 5 mm/sec shall require corrective action be undertaken.

3.6 Noise Requirements

- .1 The general requirement for any item of equipment shall be that it operates at a noise level less than 85 dBA, when measured in free field. Noise requirements may be more stringent in areas where more than one item of process equipment is intended to operate concurrently.
- .2 In any process area, the Contractor shall take whatever measures necessary to maintain a composite noise level below 90 dBA.

3.7 Quality Assurance Forms

- .1 All process equipment will be tested to ensure it operates in accordance with the basic design criteria in the Specifications. The Contractor will be required to have forms completed which attest to the proper installation and functioning of the equipment. Copies of these forms are included in **Section 01650 – Equipment Installation**.

3.8 Certificate of Satisfactory Installation

- .1 **Form 102 - Certificate of Satisfactory Installation** - shall be prepared by the Contractor and witnessed by the equipment Manufacturer's Representative when they are satisfied the equipment has been installed in accordance with the Manufacturer's instructions. Installation will be complete, including attached pipework and valves, wiring and motor starters, and controls and instrumentation. Vibration requirements shall be satisfied. A copy of this form is included in **Section 01650 – Equipment Installation**.

3.9 Certificate of Equipment Satisfactory Performance

- .1 **Form 103 - Certificate of Equipment Satisfactory Performance** - shall be prepared by the Contractor and witnessed by the equipment Manufacturer's Representative and the Contract Administrator. In order to fulfill the requirements of this running test, the equipment will be started and run under simulated process conditions for a minimum of two (2) days. The

PROCESS EQUIPMENT INSTALLATION

simulated process conditions shall cover the entire range of operating conditions to ensure that the equipment reacts as intended during alarms, warnings, low load, high load and overload situations. A copy of this form is included in **Section 01650 – Equipment Installation**.

3.10 Process Commissioning

- .1 The separate process systems will be commissioned as specified in **Section 01670 - Commissioning** and **Section 11025 - Commissioning**.

END OF SECTION

PROCESS VALVES

1. GENERAL

1.1 Description

- .1 Supply, installation, and testing of process valves and actuators.

1.2 Definitions

- .1 Process valves are identified in the Drawings by an alphanumeric code.
- .2 Detailed Valve Specification Sheets are provided in **Section 11115 – Detailed Valve Specification Sheets**.

1.3 Submittals for Review

- .1 Shop Drawings: Shop Drawings for valves identified by valve Specification number, shall be furnished prior to delivery.
- .2 Conform to **Section 01300 – Submittals**.
- .3 Submit the following information in accordance with **Section 01300 – Submittals**:
 - .1 Catalog cuts and/or Shop Drawings for each type of valve indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.
 - .2 An amended Detailed Valve Specification Sheet for all valves. Indicate with check marks where the valve supplied meets the requirements specified and with written amendments where the Product differs from the Specification.
- .4 Operating and Maintenance (O&M) data for incorporation in O&M manual. Include complete description of operation together with detailed Drawings, a complete list of replacement and repair parts, and parts Manufacturer's identifying numbers.

1.4 Shipment, Protection and Storage

- .1 Deliver valves to Site using unloading methods which do not damage casings or coatings.
- .2 Clearly tag valves stating size, type, coatings, and mating parts.
- .3 Store On-Site until ready for incorporation in the Work using methods recommended by the Manufacturer to prevent damage, undue stresses, or weathering.

2. PRODUCTS

2.1 General

- .1 Provide valves of the same type, size range, and service from a single Manufacturer.

PROCESS VALVES

- .2 Provide new, unused valves for the Work.
- .3 Valve materials shall be free from defects or flaws, with true alignment and bores.
- .4 Unless otherwise indicated on the Process and Instrumentation Drawings (P&IDs), valves shall be the same size as the pipe run in which they are to be installed.
- .5 Valve bodies shall be clearly marked in raised lettering to indicate the valve type, rating, and where applicable, the direction of flow.
- .6 Specific requirements for the materials, ratings, and service conditions for each valve are listed in the detailed Valve Specification Sheets, **Section 11115 – Detailed Valve Specification Sheets**.
- .7 Valves to open counter-clockwise.

2.2 Drawings

- .1 The P&IDs indicate all valves which are critical to proper process operation.
- .2 The detailed process Drawings and process standard Drawings indicate additional valves required for isolation, draining, flushing, pressure reduction, etc.
- .3 In pipe runs less than 100 mm diameter, in addition to the valves indicated on the P&IDs, detailed Drawings, and standard Drawings, provide isolation valves in straight pipe runs at intervals no greater than 60 m and at takeoffs to individual services. Provide ball isolation valves in pipe of 65 mm diameter and less, or in pipe of less than 100 mm diameter and carrying solids. Provide butterfly isolation valves in pipe of 75 mm diameter and greater and not carrying solids.
- .4 In pipe runs carrying sludge or scum tap bottom of pipe at low point of runs and install short nipple and isolation valve.
- .5 Provide valves and taps on top of pipe at high point in all liquid pipe runs greater than 60 m length where the change in slope exceeds 4%.
- .6 Provide flushing connections and valves as shown in standard details, at 30 m intervals on any primary sludge, primary and thickener scum and thickened secondary sludge lines.
- .7 Unless otherwise specified, provide gate valves 400 mm and larger with a bypass valve sized in accordance with American Water Works Association (AWWA) C500.
- .8 Where a valve may be required for the process to function correctly or is required to satisfy fire and safety codes but it is not shown in the Drawings, inform the Contract Administrator and provide details and suggestions for remedial action. Do not commence piping in the related pipe run until obtaining the Contract Administrator's approval.

PROCESS VALVES

2.3 Valve Ends

- .1 In pipe runs less than 75 mm diameter provide valves with female threaded ends, unless indicated otherwise. Threads to conform to American National Standards Institute (ANSI) B1.20.1.
- .2 Valves in pipe runs equal to or greater than 75 mm diameter to be flanged unless indicated otherwise. Provide flange adapters at all valves to facilitate easy removal/installation of the valves.
- .3 For cast iron body valves, drill flanges to Class 125 pattern conforming to ANSI B16.1. For steel body valves, flanges to be Class 150 pattern or Class 300 pattern conforming to ANSI B16.5 or as noted in **Section 11115 – Detailed Valve Specification Sheets**.
- .4 Do not use grooved joint valve ends.
- .5 Use flanged joints for buried and exterior valves. The flanges are to be compatible with the pipe and jointing technique used.
- .6 Use flanged joints for buried butterfly valves.
- .7 Lug style wafer body valves shall have tapped holes, suitable for the bolt spacing of the pipe flanges placed on either side.
- .8 Wafer body valves shall have positioning holes, suitable for the bolt spacing of the pipe flanges placed on either side.
- .9 For gate valves, end flanges shall be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1, Class 125 flanges.

2.4 Manual Operators

- .1 Provide valves with manual operators unless specifically indicated otherwise on the P&IDs and in **Section 11115 – Detailed Valve Specification Sheets**.
- .2 For hand wheels, clearly show the direction of opening in raised lettering and symbols.

PROCESS VALVES

- .3 Hand wheel diameter to conform to the following:

Nominal Valve Diameter (mm)	Minimum Hand Wheel Diameter (mm)
12	50
20	50
25	60
38	75
50	85
65	105
75	200
100	250
150	300
200	350
250	400
300	450
350	450
400	550
450	600
500	600
600	600

- .4 The maximum rim pull on a hand wheel not to exceed 300 N when one side of the valve is at test pressure and the other side is at atmospheric pressure. Where a shaft mounted hand wheel would require greater than this force to operate, provide a gear operator. Unless different operators are scheduled or shown in the Drawings, conform to the following minimum requirements:
- .1 Gate Valves: less than 300 mm, hand wheel; equal to or greater than 300 mm, gear operator.
 - .2 Knife Gate Valves: less than 300 mm, hand wheel; equal to or greater than 300 mm, gear operator.
 - .3 Globe and Needle Valves: less than 200 mm, hand wheel; equal to or greater than 200 mm, gear operator.
- .5 Match existing operating nuts. Provide two (2) eight-point operating wrenches.
- .6 Supply stem extensions and valve boxes for buried valves specified in the Drawings, **Sections 11115 – Detailed Valve Specification Sheets**, and in Clause 2.5 of this Section. Provide two (2) operating tees.

PROCESS VALVES

- .7 Lever operators to conform to the following dimensions:

Nominal Valve Diameter (mm)	Minimum Length of Lever (mm)
6	80
12	80
20	100
38	150
50	150
65	150
75	175
100	225
150	250
200	300
250	450
300	450

- .8 Quarter turn lever operators to be perpendicular to the pipe run when the valve is closed.
- .9 Lever operators on ball valves to be two (2) positions. Provide butterfly valves with ten (10) position latching levers except where used to balance air flows. Where used to balance air flows provide infinite position, screw down levers.
- .10 The maximum pull at the end of the lever arm not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. Where greater than this force would be required to operate the valve with a lever, provide a gear operator. Unless different operators are scheduled or shown in the Drawings, conform to the following minimum requirements:
- .1 Plug Valves and Ball Valves: less than 150 mm, lever operator; greater than or equal to 150 mm, gear operator, unless otherwise specified.
 - .2 Butterfly Valves: less than 250 mm, lever operator; greater than or equal to 250 mm, gear operator, unless otherwise specified.
- .11 Gear operator to be worm gear type, equipped with a hand wheel and a visual indicator of the valve position. Equip operators with adjustable mechanical stop-limiting devices to prevent over travel of the disc/ball in the open and closed positions and which are self-locking and designed to hold the valve in any intermediate position between full open and full closed. Gear operators shall be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.
- .12 Manual operators for butterfly and gate valves for buried service to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures to 700 kPa. Operators for exposed service shall be gasketed for weatherproof service. Place gear boxes above ground and liquid surfaces.
- .13 Gear and manual operators for submerged service to be permanently lubricated and sealed for operation at water pressures to 700 kPa.

PROCESS VALVES

- .14 For manual valves on lines 75 mm and greater, mounted over 2.0 m above the operating floor, provide chain wheel gear operators. Design the operator so that a force of 150 N is sufficient to open the valve when one side of the valve is at test pressure and the other side is at atmospheric pressure. The chain pulley to mesh positively with the chain. Extend the chain from the valve operator to operating height 1.2 m above the floor or as directed by the Contract Administrator. The exact dimensions shall be field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

2.5 Valve Stem Extensions

- .1 Provide valve stem extensions where additional clearance is required for pipe insulation, where valve operation without the extension is difficult, and in manholes.
- .2 Where angle valve stem extensions are employed, they shall be angle geared. Universal joint types are not permitted.

2.6 Valve Floor Stands

- .1 Floor stands shall be provided where operating valve is installed below floor level.
- .2 Valve stands shall be capable of withstanding all dead loads and operating loads imposed by the electric actuator or a manual handwheel, as specified in Contract Documents herein.

2.7 Insulation

- .1 In insulated pipe runs, insulate valves in accordance with **Section 15200 – Piping Insulation**.
- .2 Preform insulation in a shape suitable for the valve, of the same material specified in **Section 15200 – Piping Insulation**.
- .3 Recovering to be as specified in **Section 15200 – Piping Insulation**, with transition sections for the joints between the valve insulation and the pipe insulation.
- .4 Insulation to be removable and reusable without destroying insulation or recovering.

2.8 Protective Coatings

- .1 Unless otherwise specified, provide valves coated in accordance with **Section 11901 – Factory Applied Corrosion Protective and Maintenance Coatings**.

2.9 Spare Parts

- .1 Provide all spare parts which normally would be required for two (2) year's operation following Total Performance.
- .2 Provide a list of all spare parts which would be expected to be required under normal conditions for a period of five (5) years. At the Contract Administrator's request, provide a price for these parts.

PROCESS VALVES

3. EXECUTION

3.1 Preparation

- .1 The valve and piping arrangement indicated in the Drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in the piping to allow for discrepancies between the valve dimensions shown and those supplied for the Work.
- .2 Prior to the installation of the valves, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that the valve location and orientation provides suitable access to manual operators and that sufficient space and accessibility is available for pneumatic and electric actuators.
- .3 Where conflicts are identified, inform the Contract Administrator, and initiate the necessary piping modifications at no cost to the City.

3.2 Valve Installation

- .1 In horizontal pipe runs other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.
- .2 Mount butterfly valves and trunnion ball valves with the shaft in a horizontal orientation.
- .3 When joining valves to pipe or fittings, do not over torque bolts to correct for misalignment.
- .4 Support valves in position using temporary supports until valves are fixed in place.
- .5 Permanently support valves to prevent transmission of loads to adjacent pipework and/or equipment.
- .6 Where valves are installed in polyvinyl chloride (PVC) pipework greater than 100 mm diameter, support valves independently and brace against operating loads and torque to prevent transmission of stresses to the adjacent pipework.
- .7 Generally pipe supports and hangers are not shown unless for indication purposes only.
- .8 Install gate valves in the closed position.
- .9 Install valves which are bubble tight in one direction to seal in a direction opposite to normal flow unless otherwise noted or directed by the Contract Administrator.
- .10 Unless otherwise specified, install single seated ball valves and knife gate valves with the seat downstream. Install at tank connections with seat away from tank. Install on pump discharge and suction lines with seat adjacent to the pump.
- .11 Install all valves in accordance with the Manufacturer's recommendations.
- .12 Protect valves installed below grade with a shrink sleeve or polyethylene sheath attached to the pipe with tape wrap.

PROCESS VALVES

- .13 All bolted connections on PVC pipes to include back-up washers.

3.3 Valve Extensions

- .1 Install valve stem extensions where necessary to provide clearance from insulation, or where the valve is in an inaccessible location.

3.4 Insulation

- .1 Install insulation and covering as specified in **Section 15200 – Piping Insulation.**

3.5 Valve Testing

- .1 Operate valves under simulated and/or real process conditions to ensure they operate as intended.

END OF SECTION

DETAILED VALVE SPECIFICATION SHEETS

1. GENERAL

1.1 Description

- .1 The Valve Specification Sheets on the following pages detail the process valves which are to be supplied, installed, and tested as part of the Work and should be read in conjunction with **Section 11110 – Process Valves**. Furnish all valves in accordance with the requirements of this Section and those requirements of **Section 11110 – Process Valves**. Where there is a conflict, conform to the most stringent requirements.
- .2 Process valves are identified on the Drawings.
- .3 Named Acceptable Products are shown to define basic materials and performance criteria required for each valve type. Modify valves as specified to meet the service requirements of the system and detailed Specifications.

2. PRODUCTS

- .1 Detailed Valve Specification Sheets follow.

DETAILED VALVE SPECIFICATION SHEETS

GENERAL:						
TYPE OF VALVE	SYMBOL	TYPE OF COMMODITY	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE Setting (Pag)	TEMP. (°C)	PRESSURE (Pag)	TEMP. (°C)
Pressure and Vacuum Relief Valve	SV693	Foul Air	500	(-)40-40	215-7000	(-)50-80
TYPICAL SERVICE:						
Low pressure make up air supply						
VALVE MATERIALS			VALVE DESCRIPTION			
ITEM	MATERIAL	REFERENCE DOCUMENT				
Body	Aluminum	SIZE RANGE	200 mm			
Trim	Aluminum	RATING	Class 125			
Protective Screen	High Density Polyethylene	VALVE ENDS	125# Flat Faced Flanges			
Valve Seats and Guilds	Teflon Coated	Pressure and Vacuum S eat Rings	Replaceable			
Seat Insert	Flexible Teflon					
NOTES:						
1. Valves to be factory tested for leakage and correct setting.						
ACCEPTABLE PRODUCTS						
Varec Model 2011B	Or Approved Equal					

END OF SECTION

THERMAL OXIDIZER

1. GENERAL

1.1 Work Included

- .1 This Section specifies the work (including design, fabrication of pre-assembled package, factory testing, supply, installation, On-Site testing/commissioning/training, and a coordinated design responsibility).
- .2 The scope of Work includes:
 - .1 Disassemble and remove the existing microturbine which is currently situated in the area designated for the Thermal Oxidizer and transport it to a location selected by the City.
 - .2 Supply and install one (1) Thermal Oxidizer (Tag # S693-TO) to effectively remove odour from the foul air supply from the head space of the sludge storage tanks and the truck loading area.
 - .3 Provide appurtenant fittings or materials not herein or elsewhere specifically mentioned or included, but necessary for the complete operation of the equipment. This includes all works associated with natural gas supply, combustion air supply, exhaust gas systems, and all associated controls, control valves, blowers, and safety interlocks recommended by the Thermal Oxidizer supplier and to comply with Natural Gas Installation Code B149.1.
 - .4 Provide On-Site testing and commissioning services required to place the Thermal Oxidizer system in operation.
 - .5 Provided On-Site training for the Owner's operation and maintenance (O&M) staff.
 - .6 Provide a complete set of documentation including as-constructed drawings and O&M manuals.

1.2 Reference codes, Standards, and Specifications

- .1 Natural Gas Installation Code CSA B149.1.
- .2 Comply with the applicable reference codes, standards, and specifications as applicable in the Province of Manitoba.
- .3 Materials - conform to American Society for Testing and Materials (ASTM) and Canadian Standards Association (CSA) unless specified otherwise.
- .4 Equipment - conform to American Society of Mechanical Engineers (ASME) unless specified otherwise.
- .5 Welding - conform to CSA W59 M (metal arc welding) and W47.1 (welding certification).
- .6 Screw Fastenings - conform to ANSI.

THERMAL OXIDIZER

- .7 Painting - conform to Steel Structures Painting Council (SSPC) unless specified otherwise.
- .8 Structural design - conform to CSA Standard S16.1 for steel and the Manitoba Building Code.
- .9 Stainless steel pipe used for structural members shall conform to the requirements of ASTM A312.
- .10 Ontario Building Code (OBC), National Building Code (NBC), Occupational Safety and Health Administration (OSHA), National Fire Protection Agency (NFPA), Institute of Electrical and Electronic Engineers (IEEE), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories of Canada (ULC) Canadian Electrical Codes, Instrumentation, Systems, and Automation Society (ISA) etc. and others as may be applicable and as part of good engineering, design, fabrication practice.
- .11 Natural gas fuel train compliant with CSA 149.3.

1.3 Submittals

- .1 Shop Drawings: Submit six (6) copies of Shop Drawings, include the following:
 - .1 Catalogue cuts or equipment data sheets showing Manufacturer's complete descriptive information which shall include, but not limited to, product literature, equipment make and model, material of construction, weight of product, mechanical components.
 - .2 Process Mechanical Drawing with general arrangement showing principal dimensions and weights of the thermal oxidizer, piping connections sizes for foul air and natural gas, anchor bolt location, and other information required for the installation of the equipment and accessories as a complete system.
 - .3 Design Brief with the Shop Drawings outlining the adequacy of the proposed design. To include technical data for air/gas flow rates, velocities, chamber sizing, exhaust temperature, anchor bolt sizing, noise conditions, weight etc.
 - .4 Sample print-out copies (single pages) of the temperature data logging in graph and numerical forms. Each form is to record the date and time for each temperature reading. The City and/or the Contract Administrator reserve the right to request temperature programming changes at any time.
 - .5 Product data sheets and dimension Drawings for all accessories.
 - .6 Electrical single line diagram showing all power requirements.
 - .7 Drawings of control panel including door layout, interior layout, electrical ladder diagram, and interconnects to all components outside of panel.
 - .8 Operating description for the equipment and control panel covering all logic and sequence of operation.
 - .9 Sample equipment nameplates.

THERMAL OXIDIZER

- .2 O&M Data: Two (2) draft copies of the O&M Manuals, covering each item of equipment, a minimum of two (2) weeks prior to the scheduled start-up of the equipment. A maximum of three (3) weeks after review, five (5) copies of the final manuals shall be supplied. Include the following in the O&M Manual:
 - .1 Submit certified shop performance test results for materials requiring testing, quote standard.
 - .2 Submit certified field performance test results, quote method standard.
 - .3 Submit a certificate, which confirms that the thermal oxidizer received the specified insulation, finishings, etc.
 - .4 Submit a Commissioning certificate regarding installation and performance requirements.

1.4 Service Conditions

- .1 The thermal oxidizer is to be located indoors near the open surface wastewater clarifier area on an existing concrete pad.
- .2 The thermal oxidizer is to be used for foul air treatment. Foul air will be utilized as combustion air for the thermal oxidizer. Provisions are available to add ambient air as well. The high temperature in the thermal oxidizer shall oxidize odorous compounds in the foul air.
- .3 The fuel for the thermal oxidizer is natural gas and the natural gas supply is at approximately 3 to 4 psi.
- .4 Operating Temperature Range: 600 °C to 800 °C
- .5 Minimum Retention Time: 1 second
- .6 Maximum Outside skin Temperature: 50 °C
- .7 Expected foul air conditions are as follows:
 - .1 Air flowrate up to 10 m³/min (350 SCFM)
 - .2 High concentration of hydrogen sulphide (maximum of 1000 ppm).
 - .3 Total reduced sulphur of up to 5000 ppm.
 - .4 Volatile organic carbon <10% LEL.
 - .5 Temperature of incoming air: Minimum 10 °C
Maximum 30 °C
 - .6 Fine particulate matter.

THERMAL OXIDIZER

- .7 Relative humidity of 100%.
- .8 Trace quantities of grease and oil.
- .9 Trace quantities of siloxane.

1.5 Coordination

- .1 Coordinate with the City to ensure there are no conflicts in the Work.

1.6 Performance Data and Factory Test

- .1 Provide non-witnessed certified shop tests on the thermal oxidizer. Ensure satisfactory performance to the Manufacturer's or various recognized standards.
- .2 State if the thermal oxidizer is expected to create SO₂ in the exhaust.

1.7 Shipment, Protection, and Storage

- .1 Ship pre-assembled to the degree possible. Site assembly as per Manufacturer's recommendations.
- .2 Identify special storage requirements. Store On-Site, until ready for incorporation in the Work, using methods recommended by the Manufacturer to prevent damage, undue stress, or weathering.

2. PRODUCTS

2.1 Combustion Chamber

- .1 Chamber shall be of vertical orientation. Length and diameter of the chamber to be designed such that it will fit in the allotted space and will provide a residence time of one (1) second.
- .2 Fabricate the combustion chamber with 316 stainless steel. The external plate shall be braced with structural angles adequate for the temperatures and pressures.
- .3 The combustion chamber shall be lined with Ceramic Fibre lining. The lining shall be a soft, flexible fibre blanket module with integral stainless steel reinforcement and mounting components. It shall be capable of operation up to 800°C and designed to provide a skin temperature less than 54°C during normal operation.
- .4 The combustion chamber shall be provided with one (1) 316 stainless steel access door, lined with ceramic fibre insulation. The insulation shall be tapered to form a tight seal on closure without restricting access door operation. The door shall be hinged with quick opening, tight sealing hold-downs. A limit switch shall be provided on the door to prevent operation of the oxidizer while the door is open.

THERMAL OXIDIZER

2.2 Forced Draft Burner Assembly Burner/Ignition Control Panel

- .1 The burner assembly shall come complete with a high efficiency, total enclosed fan cooled motor (TEFC), 120 V/1 phase/60 Hz, and a dynamically balanced reversed incline centrifugal blower wheel to provide combustion air.
- .2 The burner assembly to be equipped with a factory assembled natural gas train complete with required safeties. Gas train to be FM and Industrial Risk Insurers (IRI) approved as well as CSA B149.3 compliant. Equip the pilot natural gas supply line with a valve and regulator system. Provide an explosion-proof solenoid valve to fail close during system power failures to prevent the release of natural gas.
- .3 Burner to be equipped with modulating controls to provide a variable heat input for higher efficiency. A Honeywell UDC 1000 series digital indicating temperature controller (or approved alternate) shall be provided to maintain and control the combustion chamber temperature. A thermocouple shall measure the mix gas temperature and provide the temperature signal to the temperature controller. If the temperature exceeds a preset value, the oxidizer shall shut down.
- .4 Provide a control panel that shall include a burner safety system and local on/off push buttons with supervised safe burner operation at all times. The control panel shall be housed in a NEMA 4X control cabinet and shall be mounted to the structural steel base grid. The panel shall be completely pre-wired to terminal strips within the cabinet and ready for connection of main power supply and remote monitoring and control signals. The main power supply will be 120 VAC single phase. Control signals shall include remote burner start, burner stop, dry contact for burner on status, and dry contact for thermal oxidizer fault.
- .5 Power Failure - Upon loss of utility power to the Thermal Oxidizer, the burner shall shut down and the main gas supply valve shall close automatically. When the utility power is restored, the flame control system shall automatically purge the combustion chamber and return to a ready state without manual intervention. In the event that the "remote start" contact is calling for the burner to run, the burner shall start automatically following the combustion chamber purge cycle.

2.3 Supports and Connection

- .1 Provide suitable 316 Stainless Steel adapter piece for the connection from the existing filters to the inlet chamber and for the connection from the exhaust to the existing system (refer to drawing P04 for detail).
- .2 Provide independently driven 316 stainless steel process isolation and fresh air valves to provide positive isolation from the process and a source of fresh air during the oxidizer's purge and start-up cycle. The valves shall automatically switch when the "oxidizer run" permissive has been satisfied. The fresh air damper shall modulate to control the combustion chamber temperature during high Volatile Organic Compound (VOC) load, and to provide a source of oxygen for combustion. Ball valves to be utilized for sizes smaller or equal to 51 mm. Valves larger than 51 mm to be butterfly valves.

THERMAL OXIDIZER

- .3 The combustion chamber shall be supported by a base grid, fabricated from 316 Stainless Steel in accordance with American Institute of Steel Construction (AISC) specifications.
- .4 Fabricate the flare tip of 316 stainless steel
- .5 Provide a flame rod for continuous flame supervision. A burner peep sight will allow for the viewing of the oxidized flame during operation.

2.4 General

- .1 All wiring shall be identified at both ends with designations corresponding to the diagrammatic wiring Drawings.
- .2 Unless otherwise noted, all equipment and control devices must be CSA or ULC approved and of corrosion-resistant construction.
- .3 Electrical equipment to comply with Canadian Electrical codes and Manitoba Electrical code.

2.5 Spare Parts

- .1 Furnish the following minimum spare parts, plus any additional parts required during the two (2) year period of operation following Total Performance. Where specific special tools are required for the maintenance and/or operation of a specific item of equipment, but are not listed, the Contractor shall supply. Suitably mark and pack all parts in a single, hinged-covered box.
 - .1 Gas regulator repair kit
 - .2 Thermocouple
 - .3 UV flame sensor
 - .4 Vent valve repair kit
 - .5 Gas shut off valve repair kit
 - .6 Burner replacement parts
- .2 Provide spare parts that are identical and interchangeable with the original parts.
- .3 Finish clearly identifiable and labelled containers.

2.6 Acceptable Manufacturers

- .1 Inpro-heat. – Telephone #604 808 1974
- .2 Bigelow-Liptak – Telephone #905 825 1800
- .3 Wisconsin Oven. – Telephone #262 642 3938

THERMAL OXIDIZER

3. EXECUTION

3.1 Manufacturer's Representative

- .1 The Manufacturer's Representative shall be required to attend to train installation personnel; to train operating personnel; and to witness installation and testing to ensure the equipment is installed and operates as intended as per **Section 01650 – Equipment Installation** and **Section 01670 – Commissioning**.

3.2 Installation

- .1 Refer to **Section 01650 – Equipment Installation**.
- .2 Equipment to be installed as required to provide satisfactory service.
- .3 The Manufacturer's Representative to instruct the Contractor in the methods and precautions to be followed in the installation of the equipment. The Contractor's installation understanding to be certified by the completion of **Form 101**.
- .4 Fulfill the requirements for a successful installation as documented by **Form 102**.
- .5 Contractor shall be certified to work on Gas Fired Equipment.

3.3 Testing

- .1 Ensure the equipment, including all component parts, operates as intended.
- .2 Fulfill the requirements for successful testing of the equipment as documents by **Form 103**. Refer to **Section 01650 – Equipment Installation**.

3.4 Commissioning

- .1 Attend during commissioning of the process system, which includes the equipment specified in this section to ensure the equipment functions as intended in the process system. Refer to **Section 01670 – Commissioning**.

END OF SECTION

**FIELD APPLIED CORROSION
PROTECTIVE AND MAINTENANCE COATINGS**

1. GENERAL

1.1 Work Included

- .1 Provide, apply and maintain the specified field applied protective and maintenance coating systems. Coatings are required on all process and mechanical equipment, vessels and pipes unless specifically accepted.
- .2 Refer to Drawings and Schedules for the type, location, and extent of coatings required and included for all field coating necessary to complete all the Work shown, specified or scheduled.

1.2 Delivery and Storage

- .1 Deliver all coating materials to the Site in sealed containers properly labelled to indicate the Manufacturer's name, type and colour of contents, date of manufacture, batch number, and storage requirements.
- .2 Provide adequately heated and ventilated storage for all materials and ensure compliance with fire prevention regulations.

2. PRODUCTS

2.1 Manufacturers

- .1 All constituents of each coating system are to be provided by the same Manufacturer.
- .2 Acceptable Manufacturers: Valspar, Sherwin Williams, Benjamin Moore

2.2 Schedule of Surface Treatments

- .1 The Schedule of Surface Treatments defines the components of the protective coating system.

**FIELD APPLIED CORROSION
 PROTECTIVE AND MAINTENANCE COATINGS**

Schedule of Surface Treatments

Ref.	Description	Surface Treatments
A	Solvent Cleaning	As SSPC-SP1
B	Hand Tool Cleaning	As SSPC-SP2
C	Power Tool Cleaning	As SSPC-SP3
D	Brush Blast	As SSPC-SP7
E	Near White Metal Blast	As SSPC-SP10
F	White Metal Blast	As SSPC-SP5 (NACE #1)
G	Abrasion	Lightly abrade surface using steel wool or abrasive cloth to provide a key for the next coat, to remove runs or excessive brush marks.
H	Vinyl Wash Primer	DFT 13 microns. Over-coat within 24 hours
I	Zinc Chromate Primer	Nominal DFT 40 microns
J	Inorganic Zinc Primer	Zinc in ethyl silicate vehicle. Minimum DFT 40 microns
K	Industrial Enamel (to 100°C)	To 1-GP-61M Alkyd Enamel. Minimum DFT 30 microns
L	High Built Epoxy	To AWWA C210 and certified by an appropriate testing agency (NSF Std. 61, CSA, etc.) for use on wastewater applications. Minimum DFT 200 microns
M	Bituminous Paint	To AWWA C230, MIL-P-151470
N	Silicone Alkyd (100°C to 150°C)	Min. 60% solids by weight. Nominal DFT 40 microns
O	Silicone Enamel (150°C to 400°C)	To 1-GP-143M, DFT 40 microns
P	Fast Drying Aluminum Sealer	To 1-GP-69M, Nominal DFT 25 microns
Q	Canvas Insulation Sealer	Acrylic or PVA latex
R	Epoxy Gloss Enamel	To 1-GP-146, nominal DFT 50 microns

SSPC: Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213
 Surface Preparation Specifications, March 1985.

2.3 Schedule of Protective Systems

- .1 The schedule of protective systems defines the combination of surface treatments required in each system and the sections of the plant to which it is to be applied. The systems have been grouped into three (3) categories as follows:
 - .1 Category A: Immersed Service, equipment or material fully, partially or intermittently immersed in water during routine plant operation.
 - .2 Category B: Exposed Service, equipment or material exposed to the normal range of atmospheric conditions and conditions common to wastewater treatment facilities (high humidity, etc.)
 - .3 Category C: Indoor Service, equipment or materials inside buildings or other ventilated spaces.

**FIELD APPLIED CORROSION
 PROTECTIVE AND MAINTENANCE COATINGS**

2.4 Category A

- .1 All Category A systems will be tested by the Contract Administrator using a wet sponge holiday detector set at 67.5 volts. Touch up will be required at points where the detector is grounded.
- .2 Schedule:

Schedule of Systems

System	Surface Treatments	Typical Applications
A1	A, D, L, L	Equipment or piping delivered with inorganic zinc primer, e.g. clarifier mechanics, mixers, etc.
A2	A, F, J, L, L	Equipment or piping delivered uncoated or with coatings not compatible with epoxy, e.g. ductile iron, cast iron or steel pipe and pipe sleeves inside treatment units. External Surfaces at valves, fabricated pipe supports, brackets, etc.
A3	A, G, M	Aluminum surfaces in contact with concrete, e.g. access cover frames
A4	A, E	Ferrous metal surface cast into concrete, e.g. penstocks, pipe sleeves
A5	A	Stainless steels, plastics, and fibreglass products

2.5 Category B

- .1 Schedule:

Schedule of Systems

System	Surface Treatments	Typical Applications
B1	A, B, R, R	Equipment or piping delivered with inorganic zinc primer, e.g. motors, flocculator gearbox & motor, valve headstocks, piping above ground & outside treatment units, hydrants, etc.
B2	A, B, J, R, R	Equipment or piping delivered but not applied with an inorganic zinc prime coat or with a prime coat not compatible with an inorganic zinc overcoat.
B3	A, B, H, R, R	Galvanized or cadmium plated goods, e.g. pipe supports or brackets, mountings for electrical or control equipment (Unistrut, etc.)
B4	A	Stainless steel or aluminum products, e.g. insulation recovering

**FIELD APPLIED CORROSION
PROTECTIVE AND MAINTENANCE COATINGS**

2.6 Category C

.1 Schedule

Schedule of Systems

System	Surface Treatments	Typical Applications
C1	A, B, K, K	Equipment or piping delivered c/w factory finished coatings. Coated for system identification and maintenance. Surface temperature during operation not exceeding 100°C, e.g. pumps, air handling units, valves, etc.
C2	A, G, K, K	Equipment or accessories fully primed. Surface temperatures not exceeding 100°C, e.g. pumps, steel piping
C3	A, C, I, N, N	Equipment or accessories as C1 or C2 but with operating surface temperatures between 100°C and 150°C, e.g. air compressors, blowers
C4	E, J, O	Equipment or accessories as C1 or C2 but with operating surface temperatures between 150°C and 400°C, e.g. boiler fittings
C5	B, P, K, K	Piping or valves with bituminous or tar coatings. Surface temperatures not exceeding 100°C, e.g. cast iron & ductile iron pipe, valves.
C6	A, K, K	PVC pipe, fittings or accessories coated for identification only.
C7	A, H, K, K	Aluminum insulation recovering coated for identification only.
C8	A, Q, G, N, N	Canvas insulation recovering.

NOTE: (1) Surface preparation G-abrasion has not been fully scheduled but is to be carried out between all coatings.
(2) No bare ferrous metal surfaces are permitted. Pipe hanger rods etc., unless zinc or cadmium plated, are to be at least prime coated. Cut ends of plated surfaces (Uni-strut, etc.) are to be spot primed.

2.7 Colour Coding

.1 Not Used

3. EXECUTION

3.1 Quality Assurance

- .1 Apply all paints and coatings strictly in accordance with the Manufacturer's directions.
- .2 Pay particular attention to ensure the compatibility of each surface treatment with the preceding and subsequent surface treatments and coatings. Ensure the compatibility of all surface treatments and coatings.
- .3 Coatings exhibiting visible defects such as drips and runs will not be accepted.

3.2 Environmental Conditions

- .1 Do not apply a coating when the ambient or surface temperature is below 10°C or less than 3°C above the dew point.

**FIELD APPLIED CORROSION
PROTECTIVE AND MAINTENANCE COATINGS**

- .2 Provide adequate ventilation and sufficient heating to maintain temperatures above 7°C for twenty-four (24) hours before coatings are applied. Continue heating to maintain 10°C during application and for forty-eight (48) hours after application.
- .3 Provide a minimum of 300 lux illumination on surface to be treated.
- .4 Do not apply coatings where dust is being generated.

3.3 Protection

- .1 Provide sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Make good any damage resulting from inadequate or unsuitable protection.
- .2 Maintain all coated surfaces until completion of the Works. Damage to coatings, occurring at any time, shall be made good within seven (7) days.
- .3 Place cotton waste, cloths and material which may constitute a fire hazard in closed metal containers and remove from the Site at suitable intervals.
- .4 Remove and, after painting, replace or adequately mask all grease nipples, bright metal surfaces, identification plates and other items not to be painted. Do not use solvent that may remove permanent lacquer finishes.

3.4 Condition of Surfaces

- .1 Thoroughly examine all surfaces to be treated or coated prior to commencement of Work. Report, in writing, to the Contract Administrator any condition or defect that may affect the integrity or quality of the finished coating. Do not commence Work on any Section until all such defects in that Section have been corrected.
- .2 On all factory primed or coated equipment, touch up defects prior to the application of subsequent coatings.
- .3 Be responsible for the condition of surfaces and for correcting defects and deficiencies in the surface.

END OF SECTION

IDENTIFICATION

1. GENERAL

1.1 Work Included

- .1 Identification of equipment, motors, vessels, valves, ferrous, non-ferrous, and insulated piping.

1.2 Related Work

- .1 Field Applied Protective and Maintenance Coatings: **Section 11900 – Field Applied Protective and Maintenance Coatings.**

2. PRODUCTS

2.1 Equipment Manufacturer's Nameplates

- .1 Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.
- .2 Provide Underwriters' Laboratories (UL) and/or Canadian Standards Association (CSA) registration plates, as required by respective agency.
- .3 Manufacturer's nameplates to indicate size, equipment model, Manufacturer's name, serial number, voltage, cycle, phase, and power of motors.

2.2 Equipment - Project Identification

- .1 Supply and install black lamacoid identification plates for all equipment installed under this Contract. The identification shall consist of the unit name and equipment number in 12 mm high lettering and electrical characteristics, if applicable, in 6 mm high lettering.
- .2 Example:
Thermal Oxidizer 12 mm lettering
S693-TO 12 mm lettering
120 V/60 Hz 6 mm lettering
Circuits A##, A##, A## 6 mm lettering
- .3 Submit list of plates for review prior to engraving.

2.3 Valves

- .1 Provide all valves with a 32 mm diameter brass tag with 12 mm black engraved names and numbers complete with non-ferrous chains.
- .2 Number valves as directed by the Contract Administrator or as shown on the Drawings.

IDENTIFICATION

2.4 Piping

- .1 All piping installed under this Contract shall be identified with pipe markers designating the pipe service and the direction of flow.
- .2 Pipe markers may be self-adhesive, plastic coated cloth labels provided that each marker is secured, in addition to its adhesive, with a full tape band at each end of the label.
- .3 Direction arrows are to be 150 mm long by 50 mm wide for piping with an outer diameter 75 mm or larger, including insulation. Use 100 mm long by 20 mm wide for smaller diameters. Provide double headed arrows where appropriate.
- .4 Block capital letters are to be used for names, 50 mm high for piping with an outer diameter 75 mm or larger, including insulation. Use 20 mm high for smaller diameters. Pipe fluid codes shall be used as detailed on the Drawings.
- .5 Use brass tags for pipes and tubing with an outer diameter 20 mm and smaller.

2.5 Colour Coding

- .1 Colour coded system identification shall be carried out on the following items:
 - .1 All piping and valves.
 - .2 All pumps - pumps shall be coated the colour identifying the material being pumped.
 - .3 All motors - all motors shall be painted grey.
- .2 Identification shall consist of the following:
 - .1 Full coating of pipes and valves to the colour of the medium being conveyed.
 - .2 Non-submerged process equipment shall be coated to match the colour requirement of the material being processed.
 - .3 Valve handles, chain wheels, and similar appurtenances shall be black.
- .3 Identification colours shall be in accordance with the existing facilities in the Wastewater Treatment Plant as indicated in the following table, or as directed by the Contract Administrator. For factory finished equipment, the identification colours shall be identified by the Contract Administrator during the Shop Drawing submission stage.

STANDARD SEWPCC COLOUR CODING

Item	Colour	S.W. Code # ⁽¹⁾
Natural Gas	Safety Yellow	SW 3064
Ductwork	Warm Grey	SW 3070
Steel Pipe Supports	ANSI Light Grey	SW 3071
Handrails (Painted)	Aluminum	B59S2

IDENTIFICATION

Item	Colour	S.W. Code # ⁽¹⁾
Valves/Pumps	Match Conduit	
Valve Hand/Chainwheels	Red	SW 3065
Floor Paint	Warm Grey	3183
Concrete/Blockwork ⁽²⁾	Platinum Grey	SW 4012

Note (1) SW is Sherwin Williams

(2) The City has requested that the concrete and blockwork be painted white.

3. EXECUTION

3.1 Equipment Manufacturer's Nameplates

- .1 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

3.2 Equipment Project Identification

- .1 Plates shall be attached to the equipment with sheet metal screws or nuts and bolts (adhesive will not be accepted).
- .2 Fasten plates in conspicuous locations. Where plates cannot be mounted on hot or cold surfaces, provide standoffs.

3.3 Valves

- .1 Attach brass tags to all valves with supplied chains. Ensure tags are easily accessible and do not conflict with valve operation.

3.4 Piping

- .1 On completion of protective coatings or finish painting, neatly stencil direction flow arrows and the pipe service.
- .2 Attach pipe markers in readily visible locations. Piping shall be identified:
 - .1 At each valve
 - .2 On both sides of wall penetrations
 - .3 At floor and roof penetrations
 - .4 On each leg of branches
 - .5 Every 15 m along continuous runs.

END OF SECTION

GENERAL MECHANICAL PROVISIONS

1. GENERAL

1.1 Scope of Work

- .1 The general intent of the Work involves the installation of a Thermal Oxidizer at the City of Winnipeg South End Water Pollution Control Centre (SEWPCC) to provide treatment of foul air generated by the process in the sludge storage area. The Thermal Oxidizer will be installed to operate on natural gas and utilize the foul air as the combustion air.
- .2 Pipe the existing gas line to the Thermal Oxidizer located at the south end of the clarifier near the fan room.
- .3 The supply, delivery, installation, testing, and commissioning of a 165 L/s (350 CFM) air supply blower.
- .4 The decommissioning and removal of the existing air supply blower
- .5 Supply and install new 316 stainless steel exhaust duct transition from the Thermal Oxidizer outlet to the existing 150 mm stainless steel exhaust duct.
- .6 Supply and install suitable 316 Stainless Steel adapter piece for the connection from the existing filters to the inlet chamber of the Thermal Oxidizer.
- .7 Provide all necessary supports, hangers, anchors, and ancillary devices which are necessary for a complete and functional installation, in accordance with these Specifications and the associated Drawings.
- .8 Supply and install all isolation valves as indicated in the Drawings.
- .9 Modify piping from the truck fill exhaust fan to the Thermal Oxidizer as indicated in the Drawings.
- .10 Supply and install check valves on the Thermal Oxidizer inlet lines.
- .11 Modify the ductwork and rebalance the existing distribution system to provide positive pressure within the truckfill control room.

1.2 Intent

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .2 Contract Documents and Drawings in this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material, and installation quality and are not detailed installation instructions.
- .3 Follow Manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

GENERAL MECHANICAL PROVISIONS

- .4 Install equipment generally in locations and routes shown. Run piping and ductwork close to building structure, parallel to building lines to maximize head room and with minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.
- .5 Install equipment to provide access and ease of maintenance.
- .6 Connect to equipment specified in **Sections 11005 – General Process Provisions to 16990 – Electrical Equipment and Systems Demonstration and Instruction** and to existing equipment. Uncrate equipment, move in place and install complete; start-up and test.
- .7 Install control valves, control dampers, thermal wells, and other devices on piping and ducts, as specified.

1.3 Coordination of Work

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make reference to electrical, mechanical, and process Drawings when setting out Work. Consult with respective trades in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts On-Site before fabricating or installing any materials or equipment.
- .3 Where dimensional details are required, work with the applicable Drawings from the other Divisions.
- .4 Full size and detailed Drawings shall take precedence over scale measurements from Drawings. Drawings shall take precedence over Specifications.
- .5 Any areas indicated as space for future materials or equipment shall be left clear.

1.4 Quality of Work

- .1 All Work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Contract Administrator.
- .2 Work which does not conform to standards accepted by the Contract Administrator will be rejected by the Contract Administrator. The Contractor shall redo rejected Work to the accepted standard at no cost to the City.

1.5 Metric Conversion

- .1 All units in this Section are expressed in SI units.
- .2 Submit all Shop Drawings and maintenance manuals in SI units.
- .3 On all submittals (Shop Drawings etc.) use the same SI units as stated in the Specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:

GENERAL MECHANICAL PROVISIONS

- .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
- .2 When Canadian Standards Association (CSA) approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

<i>mm Inches (NPS)</i>	<i>Mm Inches (NPS)</i>	<i>Mm Inches (NPS)</i>
<i>3 1/8</i>	<i>65 2-1/2</i>	<i>375 15</i>
<i>6 1/4</i>	<i>75 3</i>	<i>450 18</i>
<i>10 3/8</i>	<i>100 4</i>	<i>500 20</i>
<i>15 1/2</i>	<i>125 5</i>	<i>600 24</i>
<i>20 3/4</i>	<i>150 6</i>	<i>750 30</i>
<i>25 1</i>	<i>200 8</i>	
<i>30 1-1/4</i>	<i>250 10</i>	
<i>40 1-1/2</i>	<i>300 12</i>	
<i>50 2</i>		

- .5 Metric Duct Sizes:

- .1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.6 Alternate Materials and Equipment

- .1 Requests for approval for tendering purposes of equivalent materials or equipment shall be in accordance with B6 Substitutes - Bidding Procedures.

1.7 Drawings and Specifications

- .1 Drawings and Specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.
- .2 Should any discrepancy appear between Drawings and Specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and Specifications, obtain a ruling from the Contract Administrator, before submitting a Tender. If this is not done, it will be assumed that the most expensive alternate had been included.
- .3 Examine all Contract Documents, including all Drawings and Specifications, and Work of other trades to ensure that Work is satisfactorily carried out without changes to building.

1.8 Shop Drawings

- .1 Submit Shop Drawings in accordance with **Section 01300 - Submittals**.

GENERAL MECHANICAL PROVISIONS

1.9 Cutting, Patching, and Coring

- .1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Obtain written approval from the Contract Administrator before cutting or burning structural members.
- .4 Provide openings and holes required in precast members for mechanical Work. Cast holes 100 mm or larger in diameter. Field-cut smaller than 100 mm.
- .5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.10 Installation of Equipment

- .1 Pipe all equipment drains to building drains.
- .2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.
- .3 Maintain permanent access to equipment for maintenance.

1.11 Fire-Stopping

- .1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The Contractor is required to coordinate with the architectural Drawings to contractual rated wall types and installation details.
- .2 Fire-stopping materials to meet Underwriters Laboratories of Canada (ULC) CAN 2S115. Acceptable Materials: by "Tremco" or "National Firestopping".
- .3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per Manufacturer's instructions.

1.12 Connections to Existing Services

- .1 Maintain liaison with the City and provide a schedule to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.
- .2 Major services shall not be interrupted before all preparatory Work is completed and all required materials are On-Site. Provide a minimum of fourteen (14) days notice for all service shutdown.
- .3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

GENERAL MECHANICAL PROVISIONS

1.13 Equipment and Materials

- .1 Materials and equipment installed shall be new, full weight, and of quality specified.
- .2 Each major component of equipment shall bear Manufacturer's name, address, catalogue, and serial number in a conspicuous place.
- .3 Where two (2) or more Products of the same type are required, Products shall be of the same Manufacturer.

1.14 Equipment Protection and Clean-Up

- .1 Protect equipment and materials in storage On-Site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain, and flush out unsealed bearings and refill with new change of oil, before final acceptance.
- .4 Thoroughly clean piping, ducts, and equipment of dirt, cuttings, and other foreign substances.
- .5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.15 Miscellaneous Metals

- .1 Provide all necessary miscellaneous metals to hang or support materials, equipment and provide access for Work under this Contract.
- .2 All miscellaneous metals shall be finished in accordance with **Division 11**.
- .3 Miscellaneous metals shall include but not limited to:
 - .1 Hangers for equipment, piping, and ductwork.
 - .2 Supports for new foul air fan EF S692 and other miscellaneous components.

1.16 Painting and Identification

- .1 Painting and identification shall be in accordance with **Sections 11900 - Field applied Corrosion Protective and Maintenance Coatings** and **11910 – Identification**.

GENERAL MECHANICAL PROVISIONS

1.17 Acceptable Manufacturers

- .1 The following listed Manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified Product. The list does not endorse the acceptability of all Products available from the listed Manufacturers/Suppliers.
- .2 It remains the responsibility of the Contractor to ensure the Products supplied are equal to the specified Products in every respect, operate as intended, and meet the performance Specifications and physical dimensions of the specified Product.
- .3 The Contractor shall be fully responsible for any additional Work or materials, to accommodate the use of equipment from the acceptable Manufacturers and Suppliers list.
- .4 Submit within fourteen (14) days of Contract award a copy of the list underlining the name of the Manufacturer whose price was carried in the Tender. If no Manufacturers names are submitted, it will be assumed that the price carried in the Tender was that of the specified Manufacturer or where the specified Product is generic, the first acceptable Manufacturer listed for each item and equipment.
- .5 List of acceptable Manufacturers:
 - .1 Balancing Agents Air Movement Systems Ltd., Airdronics Inc., AHS Testing and Balancing Ltd., DFC Mechanical Testing & Balancing Ltd.
 - .2 Piping Hangers and Saddles Mueller/Grinnell, Myatt
 - .3 Dampers – FRP Backdraft Belco
 - .4 Valves – PVC Butterfly Hayward

1.18 Installation

- .1 Make all mechanical connections to equipment supplied by others under this Contract. This shall include all water, drain, gas, exhaust, traps, ductwork, and similar connections required. Provide isolation valves, unions, flanges, and traps as required for a complete installation.
- .2 Change to rough-in of services or final equipment connections due to a change in the make of equipment from that specified shall be made at no extra cost to the City, provided that proper Shop Drawings are available for rough in. Prior to commencing installation of rough in for the equipment, coordinate with the final reviewed equipment Shop Drawings and with the Manufacturer.
- .3 Arrange piping connections to allow for equipment removal.

1.19 Electrical Motors

- .1 Supply mechanical equipment complete with electrical motors.

GENERAL MECHANICAL PROVISIONS

- .2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: National Electrical Manufacturers Association (NEMA), Electrical & Electronic Manufacturer's Association of Canada (EEMAC), CSA, Canadian Electrical Code (CEC) Part 1, Institute of Electrical and Electronic Engineer (IEEE) and American National Standards Institute (ANSI). All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch. All motors intended for use with a variable speed drill (variance frequency drill) shall be inverter only rated.
- .3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.
- .5 Motors less than ½ hp shall be 120 V, 60 Hz, 1 phase. Motors ½ hp and larger shall be 3 phase at the indicated voltage.
- .6 All motors shall be 1800 rpm where indicated.
- .7 Provide motors with complete except where indicated.
- .8 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .9 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.
- .10 Refer to electrical specifications, **Division 16**, for voltage, frequency, and phase data. This shall take precedence over any reference in **Division 15**.
- .11 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.
- .12 Minimum certified motor efficiency shall be as outlined in Manitoba Hydro's latest high efficiency motor incentives program, or the following table, whichever indicates the higher minimum efficiency.

GENERAL MECHANICAL PROVISIONS

MINIMUM EFFICIENCY (%) *				
HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1	75.5	82.5	80.0	74.0
1.5	82.5	84.0	85.5	77.0
2	84.0	84.0	86.5	82.5
3	85.5	87.5	87.5	84.0
5	87.5	87.5	87.5	85.5
7.5	88.5	89.5	89.5	85.5
10	89.5	89.5	89.5	88.5
15	90.2	91.0	90.2	88.5
20	90.2	91.0	90.2	89.5
25	90.5	91.7	91.3	89.6
30	90.8	91.9	91.4	90.7
40	91.4	92.5	92.3	90.6
50	91.9	92.7	92.3	91.3
60	92.4	93.2	92.9	91.6
75	92.5	93.5	93.1	92.8
100	93.0	93.7	93.5	92.7
125	93.6	93.9	93.6	93.4
150	93.8	94.3	94.2	93.4
200	94.3	94.5	94.6	93.9
250	95.0	95.0	95.0	95.0
300	95.0	95.0	95.0	95.0
400	95.0	95.0	95.0	95.0
500	95.0	95.0	95.0	95.0

(*) As defined in CSA C390 or IEEE 112B Nominal Standards

2. PRODUCTS

.1 Not Applicable.

3. EXECUTION

.1 Not Applicable.

END OF SECTION

BALANCING

1. GENERAL

1.1 Scope

- .1 Balance, adjust, and test the new foul air fan S692-EF to deliver 165 litres/second (**350 cfm**) when the thermal oxidizer is operational and Drawing air through a clean vacuum breaker located on the roof.
- .2 Balance, supply, and transfer air systems associated with Sludge Truck Bay Control Room.
- .3 Contractor shall prepare the facility for balancing.
- .4 Provide additional sheaves and belts to balance the system accordingly.

1.2 Quality Assurance

- .1 Work specified in this Section shall be performed by an Independent Agency specializing in this type of Work, and paid by the Contractor.
- .2 Balancing procedures shall be in accordance with the latest, current requirements Associated Air Balance Council (AABC), Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) and American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) Standards.

1.3 Approved Agencies

- .1 Air Movement Services Ltd., Airdronics Inc., AHS Testing and Balancing Limited, DFC Mechanical Testing and Balancing Ltd.

1.4 Balance Report

- .1 Submit two (2) copies of balancing reports to the Contract Administrator prior to final acceptance of project.
- .2 Provide a final report for each Operation and Maintenance (O&M) Manual as indicated in **Section 01300 – Submittals**.
- .3 Include types, serial number, and dates of calibration of instruments in the reports.

1.5 Air Systems

- .1 Testing, adjusting and balancing standards to be the most stringent of TAB standards of AABC, ASHRAE or SMACNA.
- .2 Test, adjust, and balance existing foul air fan S692-EF.
- .3 Qualifications: Personnel performing testing, adjusting and balancing to be a current member in good standing of AABC.

BALANCING

- .3 Install at each piece of mechanical equipment a "Data Register" showing significant operating temperatures, pressures, amperes, voltage, brake horsepower. "Data Register" to be enclosed in a plastic holder securely attached to the equipment or to a wall in the adjacent area.
- .4 Submit with report, fan curves with operating conditions plotted.
- .5 Report shall be indexed as follows:
 - .1 Air
 - .2 Summary
 - .3 Procedure
 - .4 Instrumentation
 - .5 Drawings
 - .6 Equipment Summary
 - .7 Fan Sheets
 - .8 Fan Curves
 - .9 Fan Profile Data
 - .10 Static Data

END OF SECTION

SUPPORTS, ANCHORS, AND SEALS

1. GENERAL

1.1 Scope

- .1 Pipe hangers and supports
- .2 Duct hangers and supports
- .3 Sleeving for mechanical equipment

1.2 Reference Standards

- .1 Pipe supports shall meet the requirements of current edition of American National Standards Institute (ANSI) B31.1, Power piping.

1.3 General Requirements

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction and to accommodate insulation; provide insulation protection saddles.
- .2 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.
- .3 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.
- .4 Fasten hangers and supports to building steel or concrete clevis plate for concrete construction.
- .5 Provide and set sleeves required for equipment, including openings required for placing equipment. Provide sleeves for all pipe and duct penetrations through walls, ceilings, floors and footings.
- .6 Dielectrically isolate dissimilar metals.
- .7 Obtain approval from the Contract Administrator prior to drilling for inserts and supports for piping systems.
- .8 Obtain approval from the Contract Administrator prior to using percussion type fastenings.
- .9 Use of piping or equipment for hanger supports is not permitted.
- .10 Use of perforated band iron, wire or chain as hangers is not permitted.
- .11 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Contract Administrator and Professional Engineer.

SUPPORTS, ANCHORS, AND SEALS

- .12 Where deemed necessary by the Contract Administrator the Contractor shall, at his own cost, employ a Professional Engineer to design equipment supports and/or pipe anchors.

2. PRODUCTS

2.1 General

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and Manufacturer's Standardization Society (MSS) SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 Pipe Hangers

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture
 - .2 Use electro-plating galvanizing process
- .2 Upper attachment structural: Suspension from lower flange of I-Beam
 - .1 Cold piping normal pipe size (NPS) 2 maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 13 mm Factory Mutual (FM) approved.
 - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, Underwriters Laboratories of Canada (ULC) listed, FM approved to MSS-SP-58 and MSS-SP-69.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam
 - .1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved to MSS-SP-69.
 - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved.
- .4 Upper attachment to concrete
 - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
- .5 Hanger rods: threaded rod material to MSS SP-58
 - .1 Ensure that hanger rods are subject to tensile loading only

SUPPORTS, ANCHORS, AND SEALS

- .2 Provide linkages where lateral or axial movement of pipework is anticipated
- .3 Do not use 22 mm or 28 mm rod
- .6 Pipe attachments: material to MSS SP-58
 - .1 Attachments for steel piping: carbon steel galvanized
 - .2 Attachments for copper piping: copper plated black steel
 - .3 Oversize pipe hangers and supports
- .7 Gas Piping:
 - .1 Adjustable clevis: material to MSS SP-69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
- .8 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A 563
 - .1 Finishes for steel pipework: galvanized

2.3 Riser Clamps

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS-SP-58, type 42, UL listed FM approved
- .2 Bolts: to ASTM A 307
- .3 Nuts: to ASTM A 563

3. EXECUTION

3.1 Pipe Hangers and Supports

- .1 Support horizontal steel and copper piping as follows or as indicated on drawings:

Nominal Pipe Size	Distance Between Supports		Hanger Rod Diameter
	Steel	Copper	
15 mm	1.8 m	1.5 m	10 mm
20 mm to 40 mm	2.1 m	1.8 m	10 mm
50 mm & 65 mm	3.0 m	2.4 m	10 mm
80 mm & 100 mm	3.6 m	3.0 m	16 mm
150 mm to 300 mm	4.2 m	4.0 m	22 mm
350 mm to 450 mm	6.0 m	--	25 mm

SUPPORTS, ANCHORS, AND SEALS

- .2 Install hangers to provide minimum 12 mm clear space between finished covering and adjacent Work.
- .3 Place a hanger within 300 mm of each horizontal elbow.
- .4 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.
- .5 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .6 Where practical, support riser piping independently of connected horizontal piping.

END OF SECTION

PIPE AND PIPE FITTINGS

1. GENERAL

1.1 Quality Assurance

- .1 Welding materials, fabrication standards and labour qualifications must conform to American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) B31.1, ANSI B16.25, ASME Section IX, and the Provincial Board of Labour Regulations latest current editions.
- .2 Use welders fully qualified and licensed by Provincial Authorities.
- .3 Gas Piping: National Standard of Canada CAN1-B149.1 (latest edition), installation Code for Natural Gas Burning Appliances and Equipment.
- .4 All below grade steel piping shall be yellow jacketed with taped and sealed joints.
- .5 Non specified pipe joining and pipe fitting methods such as T-drill and press fit are not permitted in any piping system covered under **Section 15**.

2. PRODUCTS

2.1 Pipe

	Service	Material
.1	Natural gas, propane Grade B	Steel, Sch.40, ASTM A53
.2	Thermal Oxidizer exhaust	316 Stainless Steel, Sch.40, ASTM A778

2.2 Fittings and Joints

	Service	Material	Joint
.1	Natural gas, propane	Banded malleable iron, 1033 kPa, for sizes 40 mm and under	Screwed
		Steel, same schedule as pipe, for sizes 50 mm and larger: and for high pressure(over 860 kPa)- all sizes; and for piping installed outdoors - all sizes	Welded
.2	Thermal Oxidizer exhaust	316L stainless steel, same schedule as pipe, all sizes	Welded
.3	Use factory fabricated butt welded fittings for welded steel pipes.		
.4	Use long radius elbows.		

PIPE AND PIPE FITTINGS

2.3 Unions, Flanges and Couplings

- .1 Size 50 mm and under: 1033 kPa malleable iron, bronze to iron ground joint unions for threaded ferrous piping, air tested for gas service, all bronze for copper piping.
- .2 Sizes 65 mm and over: 1033 kPa forged steel welding neck flanges for ferrous piping, 1033 kPa bronze slip-on flanges for copper piping. Gaskets shall be 1.5 mm thick performed synthetic rubber bonded asbestos. Gaskets for gas service shall be synthetic rubber.
- .3 Flange bolting: For systems up to 120°C, use carbon steel stud bolts, semi-flushed and heavy hex nuts, American Society for Testing and Materials (ASTM) A307-GrB. For systems up to 215°C, use alloy steel bolts ASTM A193-GrB7, and semi-finished heavy hex nuts ASTM A194-Gr2H.

2.4 Flexible Couplings to Sludge Trucks

- .1 325 mm length 200 mm ID on one end reducing to 150 mm ID. Coupling shall be flexible and H₂S resistant.
- .2 Acceptable Manufacturer – Fernco Inc.

3. EXECUTION

3.1 Preparation

- .1 Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
- .2 Protect all steel pipes when stored on site from external conditions and ensure protective coating remains intact. If in the opinion of the Contract Administrator, deterioration of the protective coating has instigated corrosion, all rust must be removed down to bare metal and prime coated with red oxide paint.

3.2 Connection

- .1 Screw joint steel piping up to and including 40 mm. Weld piping 50 mm and larger, including branch connections.
- .2 Make screwed joints with full cut standard taper pipe threads with approved non-toxic joint compound applied to male threads only.
- .3 Make joints for plain end pipe with gasket and clamp type mechanical fastener.
- .4 Make connections to equipment, specialty components, and branch mains with unions or flanges.
- .5 Provide dielectric type connections wherever joining dissimilar metals in open systems. Brass adapters and valves are acceptable.

PIPE AND PIPE FITTINGS

3.3 Route and Grades

- .1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furring to a minimum.

3.4 Installation

- .1 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.
- .2 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.

END OF SECTION

VALVES AND STRAINERS

1. GENERAL

1.1 Scope

- .1 Natural gas valves

1.2 Manufacturer

- .1 Provide valves of the same type by the same Manufacturer throughout.
- .2 Provide valves with Manufacturer's name and pressure rating clearly marked on outside of body.

1.3 Submittals

- .1 Submit Shop Drawings in accordance with **Section 01300 – Submittals**.
- .2 Submit detailed Shop Drawings clearly indicating make, model, size, pressure rating, materials of construction and intended service.

2. PRODUCTS

2.1 Natural Gas Systems

- .1 Plug Cocks: Class 125 non-lubricated parallel-plug valve, cast iron body and plug, short pattern, regular port, full bore, threaded or flanged ends, CGA approved.
- .2 Ball valves up to 50 mm: Class 125 non-lubricated ball valves suitable for outdoor use, brass body, CGA approved Section 3.16 threaded ends. Standard of Acceptance: Kitz Fig. #68 (AKTAF).

2.2 Valve Operators

- .1 Provide one (1) plug cock wrench for every ten (10) plug cocks sized 50 mm and smaller, minimum of one (1). Provide each plug cock sized 65 mm and larger with a wrench, with set screw.

3. EXECUTION

3.1 Installation and Application

- .1 Install valves with stem upright or horizontal, not inverted.

END OF SECTION

PIPING INSULATION

1. GENERAL

1.1 Scope

- .1 Thermal Oxidizer exhaust pipe insulation
- .2 Adhesives, tie wires, tapes
- .3 Recovering

1.2 Quality Assurance

- .1 Insulation shall be installed by skilled workmen regularly engaged in this type of Work.
- .2 Materials shall meet or exceed fire and smoke hazard ratings as stated in this Section and defined in applicable building codes.

1.3 Submittals

- .1 Submit Shop Drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

1.4 Job Conditions

- .1 Deliver material to job Site in original non-broken factory packaging, labelled with Manufacturer's density and thickness.
- .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.

1.5 Alternatives

- .1 Alternative insulations are subject to review and acceptance by the Contract Administrator. Alternatives shall provide the same or better thermal resistance at normal conditions as material specified.

2. PRODUCTS

2.1 General

- .1 Insulation Materials, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives: Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed.
- .2 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labelled.

PIPING INSULATION

- .3 Insulate fittings and valve bodies with preformed removable insulated fittings.

2.2 Materials

- .1 Thermal Oxidizer Exhaust: Formed rigid hydrous calcium silicate insulation, moulded to conform to piping, "K" value maximum 0.059W/m.°C at 93°C. Service temperature up to 750°C.
- .2 Recovery Jackets: Recovery Jackets: Aluminum: 0.9 mm embossed aluminum sheet to American Society for Testing and Materials (ASTM) B 209. Longitudinal and circumferential slip joints with 50 mm laps. 0.9 mm thick die shaped fitting covers with factory attached protective liner. Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

3. EXECUTION

3.1 Preparation

- .1 Do not install covering before piping and equipment has been tested and approved.
- .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

- .1 Insulate complete system including fittings, valves, unions, flanges, strainers. Do not insulate flexible connections and expansion joints.
- .2 Finish insulation neatly on hangers, supports and other protrusions.
- .3 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.
- .4 Provide recovering jackets on insulation throughout. Make smooth uneven insulated surfaces before recovering.
- .5 Thermal Oxidizer Exhaust: Tightly butt insulation with staggered joints secured with metal bands or wire. Cover fittings with equivalent thickness of insulation.

3.3 Insulation Installation Thickness Schedule

Piping or Equipment	Pipe Sizes <i>mm</i>	Insulation Thickness <i>mm</i>	Recovery Jacket
.1 Thermal Oxidizer Exhaust	All sizes	100	Aluminum

END OF SECTION

FRP FANS

1. GENERAL

1.1 Scope

- .1 Fibreglass reinforced plastic centrifugal fans

1.2 Quality Assurance

- .1 Fans shall be constructed in accordance with Air Movement and Control Association (AMCA) Standards 99. Fans shall bear the AMCA certified rating seal.
- .2 Motors to be high efficiency as specified in **Section 15010 – General Mechanical Provisions.**

1.3 Submittals

- .1 Submit with Shop Drawings fan curves showing fan performance with fan and system operating point plotted on curves, including equipment weights, bearing calculations and centre of gravity diagrams for suspended fans.

1.4 Job Conditions

- .1 Do not operate fans for any purpose, temporary or permanent until filters are in place, bearings are lubricated, and fan has been run under close supervision of unit Manufacturer.

1.5 Alternates

- .1 Equivalent fan selections shall not increase motor kilowatts, increase rpm, increase noise level, increase tip speed by more than 10%, or increase inlet air velocity by more than 20%, from that of the specified fan.

2. PRODUCTS

2.1 General

- .1 Balancing:
 - .1 Balancing of the impeller shall be achieved only with the use of the identical material used to fabricate the impeller. Balancing shall be in accordance with ASTM D-4167.
 - .2 The fan shall be test run at operating speed and not shipped until vibration readings are within acceptable limits.
- .2 Fans are to be capable of accommodating static pressure variations of $\pm 10\%$ with no objectionable operating characteristics.
- .3 Fan suppliers to provide replacement sheaves for balancing purposes.

FRP FANS

- .4 Provide belt guards with tachometre holes.
- .5 External static pressure means external to the fan cabinet and all accessories such as backdraft dampers, mixing boxes, filters and coils, etc. These accessories if supplied as part of the unit are considered as internal losses for the fan.

2.2 Construction

- .1 Impeller:
 - .1 Heavy duty radial blade, self cleaning design.
 - .2 Material: Vinyl ester resin, premium quality Hetron FR992 and reinforcing glass throughout. The method of construction is to be hand lay-up only. The entire surface of the impeller exposed to the gas stream will be complete with a resin-rich corrosion barrier consisting of C-veil and a smooth finish minimum 90 mils thickness. Constructed with clear resin to detect imperfections and ensure quality control. Pigmented impellers are not expectable.
 - .3 The shaft is to be attached to the back-plate of the impeller by way of a taper lock bushing and a one-piece sprocket hub. The entire shaft attachment assembly is to be completely covered with a minimum 0.25"(6 mm) of FRP clear lay-up.
 - .4 An FRP sleeve shall cover the shaft through the housing extending outside the fan housing.
 - .5 Spark resistant construction: Constructed incorporating an electrically conductive layer of graphite within the gas contact corrosion barrier, pigmented black.
- .2 Housing:
 - .1 Fan housing shall be scroll design.
 - .2 The method of construction is to be hand lay-up only.
 - .3 The entire surface of the inlet cone and housing exposed to the gas stream will be complete with a resin-rich corrosion barrier consisting of C-veil and a smooth finish minimum 90 mils thickness. All flanges are to have factory flat finishes.
 - .4 Spark resistant construction: Constructed incorporating an electrically conductive layer of graphite within the gas contact corrosion barrier, pigmented black.
 - .5 Fan housing shall be structurally designed to handle specified static pressure.
 - .6 The housing shall include a machined PTFE shaft seal to limit gas leakage.
- .3 Fan Base:

FRP FANS

- .1 The fan base is to be of a heavy-duty industrial quality design to minimise vibration and to ensure long life. The bearing/shaft pedestal is to be constructed of heavy gauge steel. The fabrication method is to be all welded.
- .2 After welding is complete, prior to the fan assembly, the fan base is to be cleaned or sand blasted and coated with 4-5 mils of epoxy paint. Standard of acceptance: Intergard 345 two part epoxy – color to be grey.
- .3 Adjustable motor mount shall be structural channel painted as listed above. Threaded rod to be 316 stainless steel.
- .4 Bearings:
 - .1 The type and mountings of bearings shall be designed for a minimum of L10 – 200,000 hours. Bearings shall be ball or spherical roller type. Mountings shall be solid pillow block or split pillow block.
- .5 Shaft:
 - .1 316 stainless steel complete with the correct keyways to accept V-belt drive selections.
 - .2 The diameter of the shaft shall be sized to ensure that the critical speed of the fan is at least 25% above the fan operating speed.
 - .3 The impeller side of the shaft shall be complete with an FRP shaft sleeve, which is bonded to the back-plate of the impeller and protrudes through the housing. The outside diameter of the sleeve is machined to provide a minimum clearance gap with the PTFE shaft seal.
- .6 Motor:
 - .1 In accordance with **15010 – General Mechanical Provisions**.
 - .2 Explosion proof construction.
- .7 Belt Drive:
 - .1 V-belt drive shall be sized with a safety factor of 1.5 times the motor horsepower.
 - .2 An adjustable base will be provided under the motor to permit setting the belt tension.
- .8 Guards:
 - .1 Weatherproof guards complying with OSHA standards will protect the shaft/bearings and v-belt drive.
- .9 Grounding Lugs:

FRP FANS

- .1 Grounding lugs and wire are to be used to provide a common grounding point for static electricity to safely purge.

3. EXECUTION

3.1 Installation

- .1 Supply and install sheaves as necessary for final air balancing.
- .2 Install in accordance with Manufacturer's recommendations.

3.2 Performance

- .1 Fan performance based on 233 m conditions.
- .2 Refer to **Section 15999 – List of Schedules.**

END OF SECTION

DUCTWORK

1. GENERAL

1.1 Scope

- .1 Modification to existing stainless steel inlet/access plenum and duct connection to Thermal Oxidizer.
- .2 Ventilation upgrades for Sludge Truck Bay Control Room.

1.2 Definitions

- .1 Medium Pressure: Static pressure in duct less than 1500 Pa and velocities greater than 10 m/s.
- .2 Duct sizes shown on plans are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.3 Quality Assurance

- .1 Fabricate in accordance with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) duct manuals and American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) handbooks.

1.4 Alternatives

- .1 Obtain written permission from the Contract Administrator prior to making variations in duct configuration or sizes. Size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

2. PRODUCTS

2.1 Materials – Thermal Oxidizer - Ductwork

- .1 Ducts: 316 stainless steel lock forming quality.
- .2 Fasteners: Weld ducts.

2.2 Materials – Control Room Ductwork

- .1 Ducts: Galvanised steel lock forming quality, having galvanized coating of 380 g/m² (1.25 oz/ft²) for both sides.
- .2 Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low-pressure ducts.
- .3 Sealant: Water resistant, fire resistant, compatible with mating materials.

DUCTWORK

3. EXECUTION

3.1 Installation

- .1 Fabricate ductwork from field measurements and not from plans and Shop Drawings exclusively. Failure to do so will not constitute an extra to the Contract.
- .2 Weld all stainless steel ductwork and ensure a smooth finish on all interiors.

3.2 Plenum Gauges

- .1 Fabricate Thermal Oxidizer intake plenums of 1.6 mm thick material.

3.3 Installation

- .1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.
- .2 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.

END OF SECTION

DUCT ACCESSORIES

1. GENERAL

1.1 Scope

- .1 Balancing dampers
- .2 Backdraft dampers

1.2 Quality Assurance

- .1 Accessories shall meet the requirements of National Fire Protection Association (NFPA) 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) Handbooks and Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Duct Manuals.

2. PRODUCTS

2.1 Balancing Dampers

- .1 Fabricate of 316 stainless steel, minimum 1.6 mm (16 gauge)
- .2 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to 400 mm (16 inch) deep and on accessible round ducts.
- .3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425 mm (17 inch) and over in depth and on all inaccessible rectangular and round ducts.
- .4 On round ducts construct of single blade (butterfly) type. On 500 Pa (2 in wg) class and on all dampers over 300 mm (12 inch) diameter fabricate with full blade-length shaft.
- .5 Provide over-ride limiting stops on all operating mechanisms.
- .6 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.
- .7 On round ductwork install operating mechanism on a stainless steel mounted base firmly secured to the ductwork.

2.2 Backdraft Dampers

- .1 Construct of minimum 1.3 mm (18 gauge) aluminum channel frame.
- .2 Construct of minimum 0.6 mm (24 gauge) aluminum blades, complete with stiffeners along trailing edge. Fabricate single blade dampers for duct sizes to 240 mm (9.5 inch), multiblade dampers for ducts greater than 240 mm (9.5 inch).

DUCT ACCESSORIES

- .3 Provide full blade-length shafts complete with brass or nylon bearings.
- .4 Provide neoprene anti-clatter blade strips on pivot side of blades.
- .5 Construct blade connecting linkage of minimum 2.0 mm (12 gauge) aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.
- .6 Maximum blade length of 750 mm (30 inch).
- .7 Backdraft damper suitable for 10 m/s (2000 fpm) face velocity.

3. EXECUTION

3.1 Application

- .1 Provide balancing dampers at points on supply and exhaust systems where branches are taken from larger ducts as required for proper air balancing.

END OF SECTION

POLYVINYL CHLORIDE DUCTWORK

1. GENERAL

1.1 Scope

- .1 Polyvinyl Chloride (PVC) ductwork and fittings.
- .2 Supports and hangers.
- .3 PVC butterfly valves.

1.2 References

- .1 American National Standards Institute/American Society for Testing and Materials (ANSI/ASTM) D1784, Specification for Rigid PVC compounds and Chlorinated PVC Compounds.
- .2 ASTM D 1927, Specification for Rigid PVC Plastic Sheet.
- .3 CAN/CSA B137.3, Rigid PVC Pipe for Pressure Applications.

1.3 Quality Assurance

- .1 Fabricate in accordance with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) duct manuals and American Society for Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) handbooks.

1.4 Submittals

- .1 Submit Shop Drawings and samples of duct fittings for approval, including particulars such as material thicknesses, welds, and configurations prior to start of Work.

2. PRODUCTS

2.1 Materials

- .1 PVC: to ASTM D 1784.

2.2 Ductwork

- .1 Fabricate from unplasticized rigid PVC sheets, to ASTM D 1927 and to the following thicknesses:

Largest Dimension (Round or Rectangular)	Wall Thickness
Up to 450 mm	3.2 mm
475 to 750 mm	5.0 mm
775 mm and up	6.4 mm

- .2 Construction Standard:

POLYVINYL CHLORIDE DUCTWORK

- .1 Construction to be to SMACNA “Standards of Construction for PVC Duct Systems”.
- .2 Maximum operating static pressure: 2500 Pa positive pressure, 1000 Pa negative pressure.
- .3 Welding: hot gas, filler rod welding only throughout.
- .4 Straight ductwork heat formed with butt-welded longitudinal seams.
- .5 Rectangular ductwork: corners to be heat-formed.
- .6 Round ductwork: moulded to form perfect round shape within tolerances specified in standard.
- .7 All ductwork exceeding 750 mm in the largest dimension shall be reinforced by means of 50 mm x 6.4 mm flat PVC bars welded to duct with 6.4 mm side around the perimeter and spaced a minimum of 1200 mm on centres.
- .8 Sections and fittings: connected by sleeves welded to ducts or by belled ends.
- .9 Fittings:
 - .1 Round elbows: centreline radius at least $1\frac{1}{2}$ times diameter, 5 piece mitred construction.
 - .2 Branches, connections to main ducts: at 45° to main duct, unless noted otherwise.
 - .3 Reducers, round to rectangular transformations: minimum taper 3 units in length to each unit of change in diameter/size.
 - .4 Offsets: 45° to centreline of straight duct.
- .10 Flanges:
 - .1 Welded to ducts where indicated and elsewhere as required for cleaning, connections to equipment or access to interior of ducting.
 - .2 Fabricated from 6.4 mm thick PVC at least 50 mm wide.
 - .3 Gaskets: full face type, 3.2 mm thick of plasticized PVC.
 - .4 Flange bolts, nuts and washers: 7.2 mm diameter type 316 stainless steel.
- .11 Flexible Connections:
 - .1 Material: 3.2 mm thick plasticized PVC.
 - .2 Length: 75 mm between both parts to be connected when system in operation.
 - .3 Clamping: 316 stainless steel strap with gear drives.

POLYVINYL CHLORIDE DUCTWORK

.12 Supports and Hangers:

- .1 As detailed on Drawings.
- .2 Hangers spacing: maximum 1500 mm.

2.3 PVC Butterfly Valves

- .1 Lug body design PVC butterfly valve complete with chain operator.
- .2 Valve tag: S692-BFV.
- .3 Rating: 1035 kPa at 21 C.
- .4 Materials:
 - .1 Shaft: 316 stainless steel.
 - .2 Body: PVC.
 - .3 Liner: To suit commodity.
- .5 Standard of Acceptance: Hayward.

2.4 FRP Check Valve

- .1 Flanged body design FRP horizontal check valve.
- .2 Valve tags: S694-CHK-1A, S694-CHK-B
- .3 Rating: 7.5 kPa at 93°C.
- .4 Materials:
 - .1 Shaft and adjustable counterweight: 316 stainless steel.
 - .2 Frame and blade: Fibreglass, vinyl ester resin.
- .5 Standard of Acceptance: Belco.

3. EXECUTION

3.1 Installation

- .1 In accordance with SMACNA and ASHRAE.
- .2 Hangers complete with locking nuts and washers.

POLYVINYL CHLORIDE DUCTWORK

- .3 Heat weld seams of flexible connections to form seamless sleeve. Install with sufficient slack to prevent vibration transmission when fan in operation.
- .4 Spark-test all welded joints during fabrication, all field-joints to be checked for leaks when system is sealed and pressurized.
- .5 Fabricate ductwork from field measurements and not from plans and Shop Drawings exclusively. Failure to do so will not constitute an extra to the Contract.

3.2 Installation

- .1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.
- .2 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.
- .3 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment.

END OF SECTION

AIR OUTLETS

1. GENERAL

1.1 Scope

- .1 Diffusers
- .2 Grilles and registers

1.2 Quality Assurance

- .1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.
- .2 Unit rating shall be approved by ADC and AMCA.
- .3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

1.3 Project Conditions

- .1 Review requirements of outlets as to size, finish and type of mounting prior to submitting Shop Drawings and schedules of outlets.
- .2 Positions indicated are approximate only. Check locations of outlets and make necessary adjustments in position to conform with Architectural features, symmetry and lighting arrangement.

1.4 Submittals

- .1 Submit Shop Drawings with complete catalogue information, materials of construction, dimensions and accessories for all air outlets and components in this specification section, and as scheduled.
- .2 Submit colour selection charts of finishes for approval prior to fabrication.

2. PRODUCTS

2.1 General

- .1 Provide supply outlets with sponge rubber seal around the edge.
- .2 Provide plaster frame for diffusers located in plaster surfaces.
- .3 Refer to Air Outlet Schedule for Specifications of air outlets.

AIR OUTLETS

3. EXECUTION

3.1 Priming

- .1 Paint ductwork visible behind air outlets matte black.

3.2 Sizing

- .1 Size air outlets as indicated on Drawings.

3.3 Air Outlets Schedule

- .1 Refer to Equipment Schedules.

END OF SECTION

LIST OF SCHEDULES

1. LIST OF SCHEDULES

- .1 Fan Schedule
- .2 Grilles, Registers and Diffusers

Fan Schedule

Tag	S692-EF
Manufacturer	Plasticair
Model	Mini 1050-R
Function	Foul Air Fan
Location	Sludge Tank Room
Volume - l/s (cfm)	165 (350)
E.S.P. - Pa (in.wg.)	1000 (4)
RPM	2,461
Outlet Velocity – m/s (fpm)	5.39 (1061)
Tip Speed – m/s (fpm)	40.9 (8054)
Motor Power - kW (HP)	0.56 (3/4)
Power Supply (V/Ph/Hz)	600/3/60
Type	SWSI
Arrangement	#10
Accessories & Remarks	1,3,9

- Accessories: (Select Appropriate)
- 1. AMCA Type “B” spark resistant construction
 - 2. Gasketed bolted access door
 - 3. Housing drain with plug
 - 4. Totally enclosed belt guard
 - 5. Shaft and bearing guard
 - 6. Extended grease fittings
 - 7. Fan base and vibration isolators
 - 8. Explosion Proof motor
 - 9. Drive cover
 - 10. Shaft seal

LIST OF SCHEDULES

ELECTRICAL GENERAL REQUIREMENTS

1. GENERAL

1.1 Work Included

- .1 Complete and operational electrical system as required by the Drawings and as herein specified.

1.2 Drawings and Specifications

- .1 The General Conditions and **Sections 01010 – Summary of Work to 01700 – Contract Closeout** are a part of this Specification and shall apply to **Sections 16010 – Electrical General Requirements to 16990 – Electrical Equipment and Systems Demonstration and Instruction**.
- .2 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested, and ready for operation.
- .3 Symbols used to represent various electrical devices often occupy more space on the Drawing than the actual device does when installed. In such instances, do not scale locations of devices from electrical symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices.
- .4 These Specifications and the Drawings and Specifications of all other Sections shall be considered as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications or the Drawings but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.
- .5 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.
- .6 If discrepancies or omissions in the Drawings or Specifications are found, or if the intent or meaning is not clear, advise the Contract Administrator for clarification before submitting tender.
- .7 Responsibility to determine which Section provides various products and Work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of Specifications.

1.3 Quality Assurances

- .1 Codes, Rules, Permits, and Fees
 - .1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this Work.

ELECTRICAL GENERAL REQUIREMENTS

- .2 Comply with all rules of the Canadian Electrical Code, Canadian Standards Association (CSA) Standard C22.1 and the applicable building codes. Do Underground Systems in accordance with CAN/CSA-C22.3 No. 7 except where specified otherwise.
 - .3 Quality of Work specified and/or shown on the Drawings shall not be reduced by the foregoing requirements.
 - .4 Immediately after award of contract and prior to installation, verify location, arrangement and point of attachment for service and service entrance equipment with supply authority and inspection departments. Failure to do so will render **Sections 16010 – Electrical General Requirements to 16990 – Electrical Equipment and Systems Demonstration and Instruction** responsible for any corrections necessary without additional compensation.
 - .5 Give all required notices, submit Drawings, obtain all permits, licenses, and certificates and pay all fees required for this Work.
 - .6 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.
- .2 Standards of Workmanship
- .1 Execute all Work in a competent manner and to present an acceptable appearance when completed.
 - .2 Employ a competent supervisor and a sufficient number of licensed tradesmen to complete the Work in the required time.
 - .3 Arrange and install products to fit properly into designated building spaces.
 - .4 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of Manufacturers.

1.4 Submittals

- .1 Submit for review, Shop Drawings of all items specified in this Section in accordance with Shop Drawings in **Section 01300 – Submittals**.

1.5 Product Handling

- .1 Use all means necessary to protect the products of **Sections 16010 – Electrical General Requirements to 16990 – Electrical Equipment and Systems Demonstration and Instruction** before, during, and after installation and to protect products and installed Work of all other trades.
- .2 Immediately make good any damage by repair or replacement at no additional cost to the City and to the approval of the Contract Administrator.

ELECTRICAL GENERAL REQUIREMENTS

- .3 Remove advertising labels from all electrical equipment. Do not remove identification of certification labels.
- .4 Remove dirt, rubbish, grease, etc. resulting from this Work from all surfaces, including the inside of all cabinets, equipment enclosures, panelboard tubs, etc.

2. PRODUCTS

2.1 Selected Products and Equivalents

- .1 Products and materials provided shall be new and free from all defects. Defective products or materials will be rejected, regardless of previous inspections. The Contractor shall be responsible to remove and replace defective products at their expense, and shall be responsible for any resulting delays and associated expenses which result from defective products being rejected. Related materials shall be of the same Manufacturer throughout the project.
- .2 Products and materials referred to in the Specifications by trade names, Manufacturer's name and catalogue reference are those which shall be used as the basis for the Tender.
- .3 The design has been based on the use of the specified product.

2.2 Alternative Products

- .1 All product substitutions must be approved by the Contract Administrator. Failure to obtain approval from the Contract Administrator will result in the alternative product being rejected, in which case the Contractor shall provide an approved product at no additional cost to the City.
- .2 The Contractor shall assume full responsibility for ensuring that when providing alternative products or materials, all space, weight, connections, power and wiring requirements etc. are considered. Any costs incurred for additional components, changes to services, structural or space requirements, layouts and plans, etc. that may be necessary will be borne by the contractor.
- .3 Suppliers to submit all requests for alternative product approval to the Contract Administrator. Submissions must be received by the Contract Administrator not less than seven (7) working days prior to the close of tenders. Submissions received after the "Cut-Off" date will not be reviewed.
 - .1 All submissions which are approved by the Contract Administrator shall be identified as "Approved Alternatives" in an Addendum. Alternative products not listed in the Addendum will be rejected.
- .4 Approval of an alternate is not intended to change the original Specifications unless specifically stated in the Addenda. The submitter is responsible for all costs incurred by

ELECTRICAL GENERAL REQUIREMENTS

other trades as well as his own, to install the product/system in accordance with the Contract Documents.

- .5 All submissions to be provided with technical data and whatever pertinent information that may be required by the Contract Administrator to evaluate equivalency to the specified product. The responsibility to provide sufficient technical data with respect to submissions will remain solely with those making the submission.

2.3 Quality of Products

- .1 All products provided shall be CSA Approved, Underwriters Laboratories of Canada (ULC) approved where applicable, and new, unless otherwise specified.
- .2 If products specified are not CSA approved, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Contract Administrator.

2.4 Uniformity of Manufacture

- .1 Unless otherwise specifically called for in the Specifications, uniformity of manufacture shall be maintained for similar products throughout the Work.

2.5 Product Finishes

- .1 Finish all cabinets, panelboards, switchboards, equipment cabinets, cable trays, etc. in American National Standards Institute (ANSI) 61 grey enamel unless otherwise specified.
- .2 Apply primer on all items which are to be finished on the job.
- .3 Touch up all damaged painted finishes with matching lacquer, or, if required by the Contract Administrator, completely repaint damaged surface.

2.6 Use of Products during Construction

- .1 Any equipment used for temporary or construction purposes shall be approved by the Contract Administrator and in accordance with the General Conditions, "Use of Premises". Clean and restore to "as new" condition all equipment prior to the time of substantial completion.
- .2 The warranty period shall not begin until the date of Total Performance of the Work.

ELECTRICAL GENERAL REQUIREMENTS

3. EXECUTION

3.1 Site Examination

- .1 Examine the Site of Work and become familiar with all features and characteristics affecting this Work before submitting tender.
- .2 No additional compensation will be given for extra Work due to existing conditions which such examination should have disclosed.
- .3 Report to the Contract Administrator any unsatisfactory conditions which may adversely affect the proper completion of this Work.

3.2 Coordination with Other Sections

- .1 Examine the Drawings and Specifications of all Sections and become fully familiar with their Work. Before commencing Work, obtain a ruling from the Contract Administrator if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.
- .2 Lay out the Work and equipment with due regard to architectural, structural, and mechanical features. Architectural and structural Drawings take precedence over electrical Drawings regarding locations of walls, doors, and equipment.
- .3 Do not cut structural members without approval of the Contract Administrator.
- .4 Coordinate with all Section installing equipment and services, and ensure that there are no conflicts.
- .5 Install anchors, bolts, pipe sleeves, hanger inserts, etc. in ample time to prevent delays.
- .6 Examine previously constructed Work and notify the Contract Administrator of any conditions which prejudice the proper completion of this Work. Commencement of this Work without such notification shall constitute acceptance of other Work.

3.3 Location of Equipment

- .1 Electrical Drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, examine the Work Site directly.
- .2 Outlet and equipment locations shown on the Drawings are approximate. Locations may be revised up to 3 m to suit construction and equipment arrangements without additional cost to the City prior to the installation of the outlets, or equipment. Relocation by the City or Contract Administrator within this distance tolerance will be allowed without additional cost.

ELECTRICAL GENERAL REQUIREMENTS

- .3 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of Manufacturers.

3.4 Separation of Services

- .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.
- .2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- .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 the Contract Administrator and the ceiling installer, and approved clips or hangers are used.

3.5 Equipment Identification

- .1 Plastic lamicoid name plates 3 mm thick, black face, white core, mechanically attached with self tapping screws, 6 mm high lettering, to be attached to the front face of the following equipment:
 - .1 Starters, Circuit breakers, and Disconnects (designation, voltage, load controlled).
 - .2 Terminal cabinets and pull boxes (system, voltage).
 - .3 Transformers (designation, capacity, primary and secondary voltage).
- .2 All conductors shall be identifiable by coloured insulation and permanent markers at every terminal and accessible points throughout its entire run.
 - .1 Conductors:

Equipment Grounding - Green
Neutral Conductor - White

120/208 Volt System

Phase 1 - Red
Phase 2 - Black
Phase 3 - Blue

3.6 Testing - Refer to Section 16980 - Testing, Adjusting and Balancing of Electrical Equipment and Systems.

3.7 Instructions to City's Personnel

- .1 Refer to **Section 16990 - Electrical Equipment and Systems Demonstration and Instruction.**

ELECTRICAL GENERAL REQUIREMENTS

3.8 Access Panels

- .1 Where electrical equipment, junction boxes, remote ballasts or the like are concealed, access panels shall be supplied. Panels shall be of adequate size for servicing of the Electrical Work and complete with necessary frames and hinged doors held closed with captive fasteners. Coordinate type and size of panels with the Contract Administrator.

3.9 Mounting Heights

- .1 Unless a conflict exists, use the following as mounting heights from finished floors to centre of device.

Control Devices	1400 mm
Disconnect Switches	1400 mm

3.10 Sealing of Wall and Floor Openings

- .1 All conduit and cable entries through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade shall be sealed to prevent passage of moisture, dust, gasses, flame, or to maintain pressurization.
- .2 Openings shall be sealed when all wiring entries shown on the Drawings have been completed.
- .3 Sealing material shall be fire resistant and shall not contain any compounds which will chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations to be sealed.

3.11 Sleeves

- .1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.
- .2 For wall, partitions and ceilings the ends shall be flush with the finish on both sides but for floors they shall extend 4" above finished floor level.
- .3 The space between the sleeve and the conduit shall be filled with Dow Corning silicone RTV foam for fire stop and caulked around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound and ensure that the seal is compatible with the floor and ceiling finishes.
- .4 Locate and position sleeves exactly prior to construction of walls, floors.
- .5 Failure to comply with the above requirements shall be remedied at the expense of **Sections 16010 – Electrical General Requirements to 16990 – Electrical Equipment and Systems Demonstration and Instruction.**

ELECTRICAL GENERAL REQUIREMENTS

3.12 Insulation Resistance Testing

- .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
- .2 Megger 350 to 600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing.
- .4 Carryout tests in presence of Contract Administrator.
- .5 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for the Contract Administrator's review.

3.13 Load Balance

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 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.

END OF SECTION

ELECTRICAL SCOPE OF WORK

1. GENERAL

- .1 Supply and installation of all equipment and wiring necessary for the removal of a Microturbine and installation of a Thermal Oxidizer at the South End Water Pollution Control Centre (SEWPCC) all in accordance with the requirements specified herein and as shown on the associated Drawings. Perform all Works in accordance with the latest edition of the Canadian Electrical Code and the City of Winnipeg Electrical By-laws. In particular, pay special attention to the requirements of Section 84 of the Canadian Electrical Code.
- .2 Provide all minor items not shown or specified but which are necessary for a complete and functional installation, in accordance with these Specifications and the associated Drawings.

2. WORK INCLUDED

2.1 General Requirements

- .1 General clean-up.
- .2 All inspections, permits, and licenses required by all applicable inspections agencies.
- .3 Special testing or inspections additional to that specified above.
- .4 Scaffolding.
- .5 Shop Drawings.
- .6 Project record Drawings.
- .7 Operation and Maintenance (O&M) manuals.

2.2 Scope of Work

- .1 The general intent of the work involves the removal of a microturbine and the installation of a Thermal Oxidizer at the SEWPCC to provide removal of the foul air generated by the process in the sludge storage and truck filling areas. To that end the Thermal Oxidizer will be installed to operate on natural gas for treatment of the foul air. Connect 120 V supply to the non essential panel to provide the power to the Thermal Oxidizer.
- .2 Disconnect and remove completely all power and control wiring from the existing microturbine to facilitate microturbine removal.
- .3 Supply and Install additional power and control wiring as required to facilitate connection of the Thermal Oxidizer to the City's distributed control system (DCS) as shown on the instrument loop diagrams. Reuse existing conduit and wiring where possible.
- .4 Install a new resistive temperature device (RTD) sensor, wiring, and temperature transmitter as indicated on the instrument Loop Diagrams. Calibrate the temperature transmitter and submit a calibration report. See Drawing 6238000-I01 for details.

ELECTRICAL SCOPE OF WORK

- .5 Assist equipment Manufacturer and City forces to test functionality of new control wiring and temperature sensor.
- .6 Upgrade existing motor starter and feeder for exhaust fan S692-EF as required to accommodate the new upgraded foul air exhaust fan. Supply and Install new starter overload devices based on the actual size of motor Installed.

3. UNITS OF MEASUREMENT

3.1 General

- .1 The Contract Documents have been prepared using the modified International System (SI) units of metric measurement. Whenever appropriate, available metric products shall be used unless otherwise specified herein.
- .2 Only metres (m) and millimetres (mm) are used. Generally, metres are used for measurements of 10 m or more, and millimetres for measurements below 10 m.
- .3 All measurements on Drawings are in millimetres unless otherwise indicated.

3.2 Conversions

- .1 The following three (3) conversion methods were used in product and location dimensions:
 - .1 Hard Conversion: Industry available products which are manufactured in metric measurements.
 - .2 Soft Conversion: Products which are still manufactured in Imperial units and are converted in specifications using arithmetic conversion factors.
 - .3 Rationalized Conversion: Dimensions which are soft converted and rounded off for ease of measurements.
- .2 In cases where measurements may be open for interpretation, dual dimensions have been incorporated until hard conversions can be used exclusively.

4. DEFINITIONS

4.1 General

- .1 All terminologies, abbreviations, and acronyms used in this document are as listed in the various Standards, Codes, Rules and Bulletins used herein.

5. FORMAT

5.1 Sections

- .1 The Sections are written in a three (3) part format: General, Products, and Execution.

ELECTRICAL SCOPE OF WORK

5.2 Reference

- .1 Imperative tense has been used throughout this Document for Work intended for the successful Contractor. There shall be no Work exclusions unless they have been clearly identified as such herein.
- .2 Any reference to "Design Authority" shall mean Earth Tech (Canada) Inc., Consulting Engineers.
- .3 The word "provide" shall mean "supply and install" unless otherwise indicated.

6. CODES

6.1 General

- .1 All Codes, Standards, Rules, Regulations, Bulletins, By-laws etc., shall be those that are currently enforced in the locality of job site, unless otherwise specified herein.

END OF SECTION

WIRES AND CABLES 0 – 1000 V

1. GENERAL

1.1 Work Included

- .1 Provide a complete system of wiring, making all connections necessary for the installation shown on Drawings.

1.2 References, Codes, and Standards

- .1 Canadian Standards Association (CSA) C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.
- .2 Install and rate power cables in accordance with the Canadian Electrical Code requirements, or in accordance with Insulated Cable Engineers Association (ICEA) requirements where permissible.

1.3 Product Data

- .1 Submit product data in accordance with **Section 16010 – Electrical General Requirements**.

2. PRODUCTS

2.1 Teck Cable

- .1 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .2 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V for power cables, and 600 V for control cables.
- .3 Inner jacket: polyvinyl chloride (PVC) material.
- .4 Armour: aluminum interlocking armour.
- .5 Overall covering: thermoplastic PVC material.

WIRES AND CABLES 0 – 1000 V

.6 Fastenings:

- .1 One hole malleable iron straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables at 600 mm centers.
- .3 6 mm dia. threaded rods to support suspended channels.

.7 Connectors:

- .1 Watertight, approved for Teck cable.

2.2 Control Cables

- .1 Cable for power and control shall be based on Teck 90 armoured cable, with stranded copper conductors, 90°C insulation, rated at 600 V AC, manufactured to CSA Specification C22.2, No. 131, integral copper ground wire, PVC inner jacket, aluminum interlocking armour, and PVC outer jacket having heat, flame, and moisture retardant properties. Flame retardancy of outer jacket to be rated in accordance with CSA Standard C22.2, No. 0.3.

3. EXECUTION

3.1 Installation of Teck Cable 0 - 1000 V

- .1 Install cables.
- .2 Group cables wherever possible on channels.
- .3 Terminate cables in accordance with **Section 16151 - Wire and Box Connectors – 0 - 1000 V**.

3.2 Installation of Control Cables

- .1 Ground control cable shield at one end only.

3.3 Workmanship

- .1 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the Canadian Electrical Code. Submit data sheet with values measured.
- .2 Provide sizes of conductors as shown on Drawings. Advise Contract Administrator if problem is foreseen.
- .3 Exercise care in stripping insulation from wire. Do not nick conductors.

WIRES AND CABLES 0 – 1000 V

3.4 Identification, Coding and Balancing

- .1 For branch circuit wiring, follow identification system shown on the Drawings and as specified in **Section 16010 – Electrical General Requirements**.
- .2 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two wraps of 3M #471 plastic film tape 48 mm wide.
- .3 Conductors sized No. 10 and smaller are required to be factory coloured, not taped On-Site.

3.5 Testing

- .1 All power and control wiring shall be tested for insulation resistance value with a 1000 V megger. Resistance values shall be as recommended by the cable Manufacturer.
- .2 All wire test results shall be properly tabulated, signed, dated, and submitted to the Contract Administrator.

END OF SECTION

**SPLITTERS, JUNCTION
BOXES, PULL BOXES, AND CABINETS**

1. GENERAL

1.1 Work Included

- .1 Provide a complete system of pull boxes and junction boxes for the installation of wiring and equipment.

1.2 Shop Drawings and Product Data

- .1 Submit Shop Drawings and Product Data for cabinets in accordance with **Section 16010 – Electrical General Requirements**.

2. PRODUCTS

2.1 Junction Boxes and Pull Boxes, Indoor Dry Locations

- .1 Materials:
 - .1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish, National Electrical Manufacturer's Association (NEMA) 4 rated.
- .2 Components:
 - .1 Use rolled edges for surface boxes.
- .3 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

3. EXECUTION

3.1 Installation

- .1 Junction Boxes and Pull Boxes:
 - .1 Supply all pull boxes and junction boxes shown on the drawings or required for the installation.
 - .2 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.
 - .3 Identify with system name and circuit designation as applicable.
 - .4 Size in accordance with the Canadian Electrical Code, as a minimum.

**SPLITTERS, JUNCTION
BOXES, PULL BOXES, AND CABINETS**

.2 Identification

- .1 Provide equipment identification in accordance with **Section 16010 – Electrical General Requirements.**

END OF SECTION

WIRE AND BOX CONNECTORS
0 – 1000 V

1. GENERAL

1.1 Work Included

- .1 Provide a complete system of wiring, making all connections necessary for the installation shown on Drawings.

1.2 Special Codes

- .1 Install and rate power cables in accordance with the Canadian Electrical Code requirements.

1.3 References

- .1 Canadian Standards Association (CSA) C22.2 No. 65 Wire Connectors.

2. PRODUCTS

2.1 Materials

- .1 Pressure type wire connectors: with current carrying parts same material as conductors sized to fit the conductors as required.
- .2 Fixture type splicing connectors: with current carrying parts same material as conductors sized to fit the conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, flexible conduit, as required.

2.2 Wire Connectors

- .1 Use Weidmuller terminal blocks as detailed on Drawings for all small power, and control wiring.
- .2 Use Thomas & Betts non-insulated ring type compression lugs for terminating #10 AWG and smaller motor connections. Tape with rubber and scotch tape. Lugs to accept ten – 32 x 3/8” machine bolts.
- .3 Terminate conductors #8 AWG and larger with Thomas & Betts Colour-Keyed compression connectors Series 54000, or on lugs provided with equipment.
- .4 Thomas & Betts “KOPR-SHIELD” compound Series CP8 on all terminations for compression connectors.

WIRE AND BOX CONNECTORS
0 – 1000 V

3. EXECUTION

3.1 Installation

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by the Manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.

3.2 Wire Connectors

- .1 Brush “KOPR-SHIELD” compound on terminations for compression connectors as recommended by the Manufacturer.
- .2 Install compression connectors using methods and tools recommended by the Manufacturer.
- .3 Do not install stranded conductors under screw terminals unless compression lugs are installed.

END OF SECTION

GROUNDING

1. GENERAL

1.1 Description

- .1 Supply and install a complete grounding system. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest version of the electrical codes and any applicable local amendments.
- .2 The system to consist of cables, supports, and all necessary materials and inter-connections to provide a complete system.

2. PRODUCTS

- .1 Cables 3/0 and smaller to be connected to ground bars via Burndy Quiklug Type QA-2B connectors. Connections for cables larger than 3/0 shall be brazed.
- .2 All ground wires to be stranded copper TWH complete with a green jacket unless otherwise shown.

3. EXECUTION

3.1 Grounding – General

- .1 All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded through the conduit system or via a ground wire.
- .2 All transformers, switchgear, motor control centres, and fused switches fed from the main distribution centre shall be grounded by grounding conductors sized in accordance with the Canadian Electrical Code. The ground wire shall be terminated at each end with an appropriate grounding lug which shall be connected to the equipment ground bus. Ground wire to be green TWH.
- .3 All main distribution centres, motor control centres, switchgear, and all panels requiring equipment grounds shall contain a ground bus of adequate size, and tapped for lugs for the ground wire required.
- .4 All bolted connections must be accessible.
- .5 All motors and generators shall be grounded by means of an adequately sized green ground wire contained within the feeder.
- .6 Expansion joints and telescoping sections of raceways shall be bonded using jumper cables as per the Canadian Electrical Code.

GROUNDING

- .7 Use Burndy compression connectors or approved equal for all grounding splices and terminations unless otherwise shown on the Drawings. For bolted ground connections use Burndy Engineering Company's "Durium" or approved equal hardware.
- .8 Connect all transformer neutrals to the main AC safety ground system using accessible bolted connections and/or compression connections.
- .9 Install rigid conduit sleeves where ground wires pass through concrete slabs.

END OF SECTION

FASTENINGS AND SUPPORTS

1. GENERAL

1.1 Work Included

- .1 Supply and install all hangers, supports and inserts for the installation shown on the Drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

2. PRODUCT

2.1 Framing and Support System

- .1 Materials:
 - .1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the Manufactures connecting components and fasteners for a complete system.
 - .2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.
- .2 Finishes:
 - .1 Indoors, dry locations: Galvanized when available, prime painted if not available.
 - .2 Nuts, bolts, machine screws: Cadmium plated.
- .3 Unistrut:
 - .1 Section P1000 or as required for load and span, with mounting screws, or approved. P1000 or equal is a minimum standard for supporting conduits 50 mm and larger.

2.2 Concrete and Masonry Anchors

- .1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.
- .2 Components: Non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.
- .3 Manufacturer: Hilti (Canada) Limited or approved equal.

2.3 Non-Metallic Anchors

- .1 Material: Plastic anchors for sheet metal screws.
- .2 Manufacturer: Fischer.

FASTENINGS AND SUPPORTS

2.4 Cable Supports

- .1 General: Malleable iron one-hole straps.
- .2 Structural Steel: Crouse-Hinds “Wedgetite” supports or equivalent manufactured by Appleton.
- .3 Masonry, concrete, stone, etc.: Anchors.
- .4 Title: Toggle bolts.
- .5 Metal studs, ceiling hangers, etc.: “Caddy-Clips”.
- .6 Unistrut: Unistrut conduit clamps.

3. EXECUTION

3.1 General

- .1 Do not cut or drill beams, joists or structural steel unless written permission of the Contract Administrator is obtained.
- .2 Distance between conduit or cable supports not to exceed code requirements.
- .3 Supports to be suitable for the real loads imposed by equipment.
- .4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 m span and 8 mm over a 2 m span.
- .5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with Manufacturer’s installation recommendations.
- .6 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 Installation

- .1 Secure equipment to poured concrete with expandable inserts.
- .2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.

FASTENINGS AND SUPPORTS

- .3 Beam clamps to secure conduit to exposed steel work.
- .5 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support two (2) or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .6 Use plastic anchors for light loads only. Use metal anchors for all other loads.
- .7 Shot driven pins may only be used with written approval of the structural engineer.
- .8 Use round or pan head screws for fastening straps, boxes, etc.
- .9 Do not support heavy loads from the bottom chord of open web steel joists.
- .10 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four (4) 6 mm fasteners.
- .11 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .13 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .14 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Contract Administrator.

END OF SECTION

MOULDED CASE CIRCUIT BREAKERS

1. GENERAL

1.1 Product Data

- .1 Submit Product Data in accordance with **Section 16010 - Electrical General Requirements.**

2. PRODUCTS

2.1 Breakers General

- .1 Bolt-On Moulded Case Circuit Breaker: Quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .2 Common-Trip Breakers: With single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from three (3) to eight (8) times current rating.

2.2 Thermal Magnetic Breakers

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

3. EXECUTION

3.1 Installation

- .1 Install circuit breakers as indicated.

END OF SECTION

**TESTING, ADJUSTING AND BALANCING OF
ELECTRICAL EQUIPMENT AND SYSTEMS**

1. GENERAL

1.1 Intent

- .1 Except where otherwise specified, arrange, and pay for testing, adjusting, balancing, and related requirements specified herein.
- .2 If test results do not conform with applicable requirements, repair, replace, adjust, or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.
- .3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.
- .4 All tests shall be witnessed by persons designated by the Contract Administrator, who shall also sign the test documentation.
- .5 Submit procedures proposed in writing for approval two (2) weeks prior to test.

1.2 Manufacturer's Production Test Records

- .1 If requested, submit copies of production test records for production tests required by the Electrical and Electronic Manufacturer's Association of Canada (EEMAC) and Canadian Standards Association (CSA) standards for manufactured electrical equipment.

1.3 Site Testing Reports

- .1 Log and tabulate test results on appropriate test report forms.
- .2 Submit forms to Contract Administrator for approval prior to use.
- .3 Submit completed test report forms as specified, immediately after tests are performed.

1.4 Reference Documents

- .1 Perform tests in accordance with:
 - .1 The Contract Documents.
 - .2 Requirements of authorities having jurisdiction.
 - .3 Manufacturer's published instructions.
 - .4 Applicable CSA, Institute of Electrical and Electronic Engineer (IEEE), Insulated Power Cable Engineers Association (IPCEA), EEMAC and American Society for Testing and Materials (ASTM) standards.
- .2 If requirements of any of the foregoing conflict, notify Contract Administrator before proceeding with test and obtain clarification.

**TESTING, ADJUSTING AND BALANCING OF
ELECTRICAL EQUIPMENT AND SYSTEMS**

1.5 Manufacturer's Site Services

- .1 Arrange and pay for the Site services of approximately qualified Manufacturer's Representatives where Site testing, adjusting, or balancing of electrical equipment or systems' performed by Manufacturer's Representatives is:
 - .1 Specified, or
 - .2 Otherwise required to ensure that electrical equipment and systems are operational in full compliance with the Contract Documents

1.6 Sequencing and Scheduling

- .1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Interim Acceptance of the Work.
- .2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

2. PRODUCTS

2.1 Test Equipment

- .1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

3. EXECUTION

3.1 Testing of Wiring and Wiring Devices

- .1 All power and control wiring shall be insulation resistance tested as per the requirements of **Section 16010 – Electrical General Requirements, Part 3.12**. Resistance values shall be as recommended by cable Manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.
- .2 Test service grounding conductors for ground resistance.
- .3 Test all wiring devices for correct operation.
- .4 Test all receptacles for proper polarity and circuitry.

3.2 Ground Resistance Testing

- .1 Measure ground resistance with earth test meter to verify compliance with CSA C22.2 No. 0.4 and Canadian Electrical Code.

**TESTING, ADJUSTING AND BALANCING OF
ELECTRICAL EQUIPMENT AND SYSTEMS**

3.3 Submittals

- .1 Submit for review, Shop Drawings of all items specified in this Section in accordance with "Shop Drawings" in the **Section 01300 – Submittals**.
- .2 At completion of Work the prior to final acceptance, provide maintenance manuals for all items specified in this Section.

END OF SECTION

**ELECTRICAL EQUIPMENT AND SYSTEMS
DEMONSTRATION AND INSTRUCTION**

1. GENERAL

1.1 Intent

- .1 Provide demonstration and instruction sessions to familiarize the City's operation and maintenance (O&M) personnel with electrical systems and their O&M.
- .2 Submit system sign off sheets for each system listed prior to substantial completion.
- .3 All sign off and survey sheets shall be typewritten.

2. PRODUCTS – NOT APPLICABLE

3. EXECUTION

3.1 Systems Demonstration

- .1 Demonstrate operation of following systems:
 - .1 Motor starters and related controls.
 - .2 Control system as detailed in the applicable sections herein.

**ELECTRICAL EQUIPMENT AND SYSTEMS
DEMONSTRATION AND INSTRUCTION**

SYSTEM COMPLETION AND COMMISSIONING

SYSTEM: _____

The above system is installed as per the Drawings and Specifications, is complete and has been commissioned.

Electrical Contractor

Signed by: _____ Dated: _____

General Contractor

Signed by: _____ Dated: _____

Deficiencies Attached

This system has been reviewed by:

The Consultant

Signed by: _____ Dated _____

The City's personnel have been instructed in the operation and maintenance of the above system:

The City of Winnipeg

Signed by: _____ Dated _____

The above does not constitute a waiver of any of the requirements of the Contract Documents.

ELECTRICAL
CONTRACTOR

GENERAL
CONTRACTOR

Address:

_____	_____
_____	_____
_____	_____
_____	_____

Phone:

_____	_____
-------	-------

END OF SECTION

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

1. GENERAL

1.1 Requirements of Work

- .1 Supply, install, commission, provide warranty, and fully document a complete instrumentation and control (I&C) system as shown on the Drawings and as specified herein. The I&C system contains vendor component subsystems specified in this and other Sections of the Specification.
- .2 Component subsystems of the I&C system will include, but are not limited to, the following:
 - .1 Primary elements and transmitters
 - .2 Final control elements
 - .3 I&C field devices
 - .4 I&C junction boxes and marshalling panels
 - .5 Instrumentation cabling
 - .6 Instrumentation power supplies
 - .7 Conduit and cable tray
- .3 The Contractor's responsibility also includes receiving, uncrating, examining for shortages or damage, assembling, field fitting, installing, mounting, wiring and testing of vendor supplied component subsystems.
- .4 Where packaged, stand-alone control systems are supplied under other Divisions of this Specification, provide cabling to connect to the required remote monitoring and/or control functions. Provide end-to-end Commissioning of all required remote monitoring and/or control functions. Ensure the correct functionality of any equipment supplied under other Divisions of this Specification.
- .5 Documentation referred to in 1.1.1 to include as a minimum:
 - .1 Equipment descriptive data
 - .2 Equipment installation, service manuals, operation and maintenance (O&M) manuals and recommended spare parts lists
 - .3 Schematics and interconnecting wiring diagrams
 - .4 Records of conductor identification, field terminals, changes, etc.
 - .5 I&C panel Shop Drawings, face layouts, schematics and point-to-point wiring diagrams

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .6 Records of as-built information for the complete instrumentation system.
- .6 Documentation provided is formatted as follows:
 - .1 *Process & Instrumentation Diagrams (P&IDs)* – depict the general intent of the control systems and are to be used as the governing document for the scope of Work.
 - .2 *Instrument Index* – Not Used, Refer to the Instrumentation Loop Diagrams.
 - .3 *Input/Output (I/O) Index* – Not Used, Refer to the Instrumentation Loop Diagrams.
 - .4 *Instrument Specification Sheets* - detail the relevant data for the supply of devices.
 - .5 *Instrument Loop Diagrams (ILDs)* – show typical interconnections and hook-up of devices. The Contractor is to reproduce an ILD for each device and record all relevant as-built information on each sheet for submission at the completion of the Work. Fill in all terminal and wiring numbers etc. from the Shop Drawings as they become available. A set of ‘B’ size (11 x 17) ACAD Drawings and associated files will be made available to the successful tenderer. Where an ILD is not shown for wiring of simple devices provide a legible sketch for as-built information.
 - .6 *Location Drawings* - indicate in plan and/or elevation views where the instrument elements are physically located. These Drawings are provided to assist the Contractor in estimating the amount of cable and ducting required.
 - .7 *Standard Details* – Not Used, Refer to the Instrumentation Loop Diagrams.
 - .8 *Detailed Specification* – lists qualifications, quality of materials and workmanship, and supplementary information.
- .7 Definitions
 - .1 Interpret specialized terms not explicitly defined herein in accordance with The Instrumentation, Systems, and Automation Society (ISA) S51.1, National Electrical Manufacturers Association (NEMA) ICS 1, American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Std 100, and The Communications Standard Dictionary, by Martin H. Weik.
- .8 References
 - .1 This Specification contains references to the following Documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed Documents, the requirements of this Section prevail.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

<u>Reference</u>	<u>Title</u>
API RP550-86	Manual on Installation of Refinery Instruments and Control Systems, Part I--Process Instrumentation and Control Sections 1 Through 13
ASME Section VII-89	Rules for Construction of Pressure Vessels
ASTM B68-86	Seamless Copper Tube
ASTM D883-89	Terms Relating to Plastics
IEEE 100-88	Dictionary of Electrical and Electronic Terms
ISA RP7.1-56	Pneumatic Control Circuit Pressure Test
ISA RP12.6-87	Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations
ISA S5.4-76	Instrument Loop Diagrams
ISA S18.1-79	Annunciator Sequences and Specifications
ISA S51.1-79	Process Instrumentation Terminology
NEMA 250-85	Enclosures for Industrial Controls and System
NEMA ICS 1-88	General Standards for Industrial Control and Systems
NEMA ICS 2-88	Industrial Control Devices, Controllers, and Assemblies
NFPA 70-90	National Electrical Code (NEC)
SAMA PMC 17-10-63	Bushings and Wells for Temperature Sensing Elements
UBC-88	Uniform Building Code
UL 1012-89	Power Supplies
UL 94-80	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
Weik, Martin H.	Communications Standard Dictionary, Van Nostrand Reinhold Co., 1983

.9 Related Work:

- | | |
|-----------------------|--------------------|
| .1 Process: | Division 11 |
| .2 Mechanical: | Division 15 |
| .3 Electrical: | Division 16 |

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

.10 Qualifications:

- .1 The instrumentation Subcontractor must be experienced in the process and instrument requirements of this Contract.
- .2 The instrumentation Subcontractor must show that it maintains a fully equipped and qualified organization, capable of performing the present Work and of providing warranty service to the system after installation.
- .3 Perform all instrument hook-ups, calibrations and checkouts with qualified journeyman instrument mechanics that are licenced and have CET registration. Instrument mechanics must be familiar with the devices being installed.
- .4 Perform all control wiring installation and connections with qualified journeyman electricians.
- .5 Programming of the plant distributed control system (DCS) controllers and operator interface shall be performed by ABB automation.

.11 Codes, Rules, Permits, and Fees

- .1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this Work.
- .2 Comply with all rules of the Electrical Safety Act of the Province, Canadian Standards Association (CSA) Standards, Underwriters' Laboratories of Canada (ULC) and the applicable building codes, whether specifically shown on Drawings or not.
- .3 Give all required notices, submit Drawings, obtain all permits, licenses and certificates and pay all fees required for this Work.
- .4 Furnish a certificate of final inspection and approvals from an inspection authority to the Contract Administrator.

.12 Standards of Workmanship

- .1 Execute all Work in a manner, which will result in the completed installation presenting an acceptable appearance, to a level of quality defined in the general conditions of this Specification.
- .2 Employ a competent supervisor and all necessary licensed tradesmen to complete the Work in the required time.
- .3 Arrange and install Products to fit properly into designated building spaces.

.13 Unless otherwise specified or shown, install Products in accordance with the recommendations and ratings of the Product Manufacturers.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .1 Supply and execute installation of all instrumentation control tubing in accordance with **Division 17**.
- .14 Contract Drawings and Specifications
 - .1 Refer to **Division 1**.
 - .2 Supply and install all items and accessories specified by the Drawings or the Specification in the quality and quantity required. Perform all operations as designated by the Specification according to the methods prescribed, complete with all necessary labour and incidentals.
 - .3 Treat any item or subject omitted from this Division's Specifications or Drawings, but which is mentioned or reasonably specified in other Divisions' Specifications or Drawings and pertains to the instrumentation and control system, as being integral to the overall system. Provide such specified items or subjects.
 - .4 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.
 - .5 If discrepancies or omissions in the Drawings or Specifications are found, or if intent or meaning is not clear, consult the Contract Administrator for clarification before submitting tender.
 - .6 The 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.

1.2 Equipment

- .1 Tender Submittals
 - .1 Submit with the Tender an equipment list indicating the type and make of all equipment and materials proposed for this project.
- .2 Receiving, Storing, and Protection of Components During Construction
 - .1 Examine each component upon delivery to Site. Report all damage noted to the Contract Administrator prior to accepting or rejecting delivery. All instrumentation primary elements, control components, panels, etc. shall be placed in a secure, dry, heated storage building. Maintain the space temperature above 10°C and the space relative humidity below 50%.
 - .2 Perform a preliminary examination upon delivery to ensure that:
 - .1 All I&C components supplied for this project under this Section of the Specification comply with the requirements stated in the instrument Specification sheets.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .2 All I&C components supplied under other Sections of this Specification, to be connected to I&C components supplied under this Section of the Specification, comply with the requirements stated in the Contract Documents.
- .3 Itemize all non-conformities noted above and forward them to the Contract Administrator. Any delays in construction resulting from the delivery to Site of non-conforming I&C components to be borne by the Contractor.
- .4 Do not install primary elements or other sensitive equipment until construction is sufficiently completed to provide an "operating condition" environment. Notify the Contract Administrator prior to installing any equipment of this type.
- .5 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage.
- .6 Return all damaged equipment to the factory for total corrective repairs. If deemed necessary by the Contract Administrator, the damaged equipment shall be replaced with new Product. The Contractor shall bear any costs due to construction delays resulting from the delay in delivery of acceptable equipment.

1.3 Site

- .1 Classification of Plant Areas
 - .1 Refer to **Division 16**

1.4 Documentation

- .1 Tender Submittals
 - .1 Submit a schedule within thirty (30) days of award of Contract to the Contract Administrator showing projected ordering and delivery dates of all Products to meet the required construction schedule. Provide all necessary information regarding ordering and delivery dates for whose delivery affects the construction schedule.
 - .2 Submit Shop Drawings for all Products supplied by this Division. Submit Shop Drawings for review prior to delivery of any Products or equipment to job Site and sufficiently in advance to allow ample time for checking.
 - .3 Contractor to review, modify, and approve the Shop Drawings prior to submitting Shop Drawings to the Contract Administrator for review. Contractor approval of a Drawing indicates the following:
 - .1 The Drawing has been checked by the person making the approval.
 - .2 The equipment or material complies in all respects with the requirements of the Specifications and Drawings.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .3 The quantities, if indicated on the Drawing, are correct.
- .4 The physical dimensions of the components are such that they can be installed without interference with the building structure or other equipment, and that, after installation, there are sufficient clearances on all sides for maintenance, servicing and operation of the equipment.
- .5 The points of attachment are clearly indicated, i.e. TOP, BOTTOM, SIDE, etc.
- .6 The arrangement and location are properly oriented.
- .7 The Product is suitable for its intended use.
- .4 Stamp and sign the Shop Drawing to show approval, indicating the above has been complied with. If Contractor revisions are too extensive, return the submission to the supplier for revision, then repeat the Shop Drawing approval process before submitting them to the Contract Administrator.
- .5 Manufacture of Products shall conform to Shop Drawings marked as reviewed by the Contract Administrator and returned to the Contractor.
- .6 Keep one (1) complete, maintained set of Shop Drawings at the job Site during the construction period, record Site modifications.
- .7 Refer to **Division 1** for further information on Shop Drawing submittals.
- .2 Operations and Maintenance Manuals
 - .1 Refer to **Division 1** for general O&M manual submittal information.
 - .2 In addition to the requirements specified in **Division 1**, provide the following information:
 - .1 Table of Contents - Arrange contents sequentially by systems under Section numbers.
 - .2 Systems Descriptions - A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
 - .3 O&M instructions for all equipment and controls - These operating instructions need not be Manufacturer's data but may be typewritten instructions in simple language to guide the City in the proper O&M of his installation.
 - .4 A copy of all wiring diagrams complete with wire coding.
 - .5 Set of final reviewed Shop Drawings.
- .3 Record Drawings

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .1 Maintain On-Site a complete set of as-built Drawings as listed in **Division 1** of this Specification.
- .2 In addition to the requirements as stated in Division 1, record on the Drawings the following information:
 - .1 Mark all change orders, alterations or additions
 - .2 Show all instrumentation cable and control tubing
 - .3 Show all changes to the numbers and location of outlets, motors, panels and end devices that may occur during the course of the Work.
- .3 Before requesting the final completion certificate make any necessary final corrections to the Drawings, sign each print as a certification of accuracy and deliver all sets to the Contract Administrator for approval.

2. PRODUCTS

2.1 General

- .1 Refer to the requirements of **Division 1**
- .2 Selected Products and Equivalent
 - .1 Provide Products and materials that are new and free from all defects.
 - .2 Products and materials called for on the Drawings or in the Specifications by trade names, Manufacturer's name and catalogue reference are those, which are to be used as the basis for the Bid.
 - .3 The design has been based on the use of the first named Product, where applicable equivalent Products are listed.
 - .4 Provide the Products specified unless a proposal for an alternative or substitute Product has been accepted by the Contract Administrator.
- .3 Alternate Products
 - .1 Refer to **Division 1** for consideration of alternate Products.
 - .2 Alternate Products and materials to those specified will only be considered by the Contract Administrator if they are shown in the Bid as a material variation, and if they are submitted with an appropriate price adjustment. The Contract Administrator will reserve the right to accept or reject any alternative without explanation.
 - .3 The alternate submission shall provide sufficient information to enable the Contract Administrator to determine whether the alternate is acceptable or unacceptable.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .4 Provide complete information on required revisions to other Work and Products to accommodate each alternate Product.
 - .5 The Contractor assumes full responsibility when providing alternative Products or materials that all space, weight, connections, power and wiring requirements etc. are considered and compensated for. Any costs incurred for additional components, changes to other services, structural or space requirements, layouts and plans, etc. that may arise from the use of the alternate to be borne by the Contractor.
 - .6 Materials or equipment rejected by the Contract Administrator to be immediately removed from the project.
- .4 Review of Products
- .1 Immediately after notification of award of Contract, review with the Contract Administrator the list of Products to be provided by this Division
 - .2 After agreement on Product list has been reached, no subsequent changes will be permitted except as specified hereafter.
- .5 Substitution of Products after Contract Award
- .1 After acceptance of the list of Products, no substitution of any item will be permitted unless the approved item cannot be delivered in time to comply with the Work schedule.
 - .2 To receive acceptance, proposed substitute Products are to equal or exceed the quality, finish and performance of those specified and/or shown, and not to exceed the physical space requirements allotted, as shown on the Drawings.
 - .3 Provide to the Contract Administrator documentary proof of equality, difference in price (if any) and delivery dates, in the form of certified quotations from Suppliers of both specified items and proposed substitutions.
 - .4 Include costs for any required revisions to other structures and Products to accommodate such substitutions.
 - .5 Refer to **Division 1** for additional information on substitutions.
- .6 Quality of Products
- .1 All Products provided to be CSA Approved, and ULC approved where applicable.
 - .2 If Products specified are not CSA approved, obtain approval of the relevant provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
 - .3 Refer to **Division 1** of this Specification for further information.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

.7 Uniformity of Manufacture

- .1 Unless otherwise specifically called for in the Specification, uniformity of manufacture to be maintained for similar Products throughout the Work.

.8 Product Finishes

- .1 Products to be Manufacturers' standard finish. Where special finishes are specified refer to **Division 9** for details on quality and workmanship of the finishes.

.9 Use of Products During Construction

- .1 Any equipment used for temporary or construction purposes to be approved by the Contract Administrator and in accordance with Division 1 of this Specification. Clean and restore to "as new" condition all equipment prior to the time of substantial completion.
- .2 The Warranty Period does not begin until the date of Total Completion of the Work.

2.2 Instrumentation

.1 General

- .1 Instruments to be suitable for the environmental conditions in which they are to be installed.
- .2 Determine where injurious conditions may be expected to occur and make proper provision to protect the instruments to ensure their proper and reliable operation.
- .3 Provide power surge protectors, heating cables and devices to protect instruments, equipment and lines from being functionally impaired or damaged by power surges or environmental conditions such as moisture or freezing.

2.3 Identification

- .1 Refer to **Division 16** for general identification requirements. Provide lamacoid nameplates with 5 mm white lettering on black background. Identify the loop tag number (where applicable) and the device name, function, and instrument range or setpoint value on the nameplate.
- .2 Where it is not possible to attach a lamacoid nameplate to a field instrument component, provide the component with a stainless steel metal tag firmly wired to the device and identified with the loop tag number.
- .3 Identify all wires where they terminate at the marshalling panels, junction boxes, and field devices with a heat shrink sleeve with machine printed labeling.
- .4 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .5 Provide neatly typed circuit directories for panel power distribution systems to indicate loops or devices powered by the circuit and the fuse size.
- .6 Identify all exposed control conduits at all pull box locations, where the conduits enter or leave a room, and 13 m on centre throughout the room. This shall apply to conduits above removable ceilings. Use Thomas & Betts TY-RAP 5532-M labels conduit identification.
- .7 For direct current wiring use black for positive and white for negative.
- .8 For thermistor wiring to motors use red and blue coloured, insulated wire.

3. EXECUTION

3.1 Site Examination

- .1 Refer to the requirements of **Division 1**.
- .2 No additional compensation will be given for extra Work due to existing conditions that a Site examination prior to Bid should have disclosed.

3.2 Coordination With Other Divisions

- .1 Examine the Drawings and Specifications of all Divisions and become fully familiar the Work. Before commencing Work, obtain a ruling from the Contract Administrator on any conflicting issues between Divisions. No compensation will be made for any costs arising from conflict not identified before Work has commenced.
- .2 Coordinate the Work to be performed under this Section of the Specification with all Divisions installing equipment to ensure that there are no conflicts.
- .3 Install anchors, bolts, pipe sleeves, hanger inserts, etc. required in ample time to prevent delays to other Division's installation Work.
- .4 Lay out the Work and equipment with due regard to architectural, structural, and mechanical features. Architectural and structural Drawings take precedence over electrical Drawings regarding locations of walls, doors and equipment.
- .5 Structural members shall not be cut without prior approval of the Contract Administrator.
- .6 Examine previously constructed Work and notify the Contract Administrator of any conditions, which prejudice the proper completion of this Work.

3.3 Product Handling

- .1 Use all means necessary to protect the Products included in this Division before, during and after installation, and to protect Products and installed Work of all other trades.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .2 Any damage to the Products and/or installed Work shall be repaired or replaced by the Contractor at no additional cost to the City, and to the approval of the Contract Administrator.
- .3 Remove advertising labels from all Products installed that have such labels attached. Identification or CSA labels are not to be removed.
- .4 Remove dirt, rubbish, grease, etc. resulting from Work performed under this Section of the Contract from all surfaces.

3.4 Separation of Services

- .1 Maintain separation between the electrical wiring system, building piping, ductwork, and the instrumentation cables so that each system is isolated (except at approved connections to such systems) to prevent galvanic corrosion. In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is unacceptable.
- .2 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings are not to be used for the support of wiring.

3.5 Wire And Cable

- .1 Refer to **Section 17124 – Instrumentation Cable**.

3.6 Equipment Connections

- .1 Prior to the connection of signal wiring to process control and instrumentation devices check the device voltage rating and polarity for compatibility with the corresponding loop and/or schematic diagram. Where device and circuit characteristics are found to be incompatible, the connections are not to be made. Report the condition immediately to the Contract Administrator.
- .2 All control-wiring diagrams illustrate typical control circuits applicable to the type of equipment specified. Control circuits may vary with different Manufacturer's equipment. Verify all control circuits with the suppliers of the equipment and make any corrections to the control wiring diagrams that may be required.
- .3 Provide power disconnect terminals in the marshalling panels for all devices or PLC/DCS input/outputs sourced from the panel. Provide local power disconnect switches for all 120 VAC power instruments. Mount adjacent to the instrument.
- .4 Provide a disconnecting means in the cable connecting each ultrasonic transponder to the transmitter. This disconnect shall consist of a terminal strip in a local WP junction box within approximately 3 m of cable from the transponder.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

3.7 Wiring To Equipment Supplied By Others

- .1 Equipment supplied by the City or by other Divisions, that have external or field mounted control devices, are to be installed, wired and commissioned by this Division.

3.8 Access Panels

- .1 Provide access panels where instrumentation and control system junction boxes are concealed. Panels to be of adequate size for servicing of the concealed junction box and complete with necessary frames and hinged doors held closed with captive fasteners. The type and size of panels are to be coordinated with the Contract Administrator.
- .2 In removable ceiling areas provide markers on ceiling tile to locate equipment requiring access. Use a 25 mm diameter blue circle painted on the access panel to indicate that it is for instrumentation and control system access.

3.9 Instrument Mounting Stands

- .1 Supply and install instrumentation mounting stands as required. Stands are to be either floor or wall mounted. The mounting stands are to be fabricated from aluminum or galvanized steel.
- .2 Supply and install protective drip shields for any exterior stand-mounted instrumentation equipment. Drip shields are to extend 50 mm past the front and side faces of the equipment. Drip shields are to be fabricated from aluminum.

3.10 Sealing Of Wall And Floor Openings

- .1 Seal all conduit and cable entries passing through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade.
- .2 Seal openings after all wiring entries have been completed.
- .3 Sealing material shall be fire resistant and shall not contain any compounds that could chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations, if required, are to be sealed. Acceptable methods are Canstrut "Fire Stop", Electrovert "Multi-Cable Transit" or Dow Corning RTV Silicone Foam.

3.11 Sleeves

- .1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.
- .2 For walls, partitions and ceilings the ends shall be flush with the finish on both sides. For floors the ends shall extend 100 mm above finished floor level.
- .3 Fill the space between the sleeve and the conduit with fire stop material. Caulked around the top and bottom with approved permanently resilient, non-flammable and weatherproof

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

silicone base compound. Ensure that the seal is compatible with the floor and ceiling finishes.

- .4 Locate the sleeves and position exactly prior to construction of the walls and floors.
- .5 Failure to comply with the above requirements shall be remedied at the Contractor's expense.

3.12 Connections to Mechanical, Electrical and Existing Systems

- .1 Refer to **Division 16** for the required tie-in procedures.

3.13 Testing of Instrumentation Loops

- .1 After all devices within a loop have been connected, check the loop for correct functioning and interaction with other loops, where applicable. Provide written notice to the Contract Administrator when the loops are going to be tested so that the tests may be witnessed at the Contract Administrator's discretion.
- .2 Check the operation of final control elements such as solenoid valves, actuators, etc. by manual control before checking with automatic control.
- .3 Test all tubing for leaks in compliance with ISA RP7.1. Isolate all instruments when tubing is being tested to protect against over pressure.
- .4 Perform tests and record results on test data forms, which are included in this Section. Develop additional and/or more detailed test forms as necessary to suit more complex instrumentation.
- .5 Sign and date all test reports. Submit the test reports to the Contract Administrator within five (5) working days of testing.
- .6 Coordinate and cooperate with City staff and equipment vendors to test Control system I/O points during loop testing.

3.14 Calibration

- .1 Instruments to be factory pre-calibrated and the calibration verified in-place after installation. Provide a printed record of the factory calibration parameters for "smart" devices.
- .2 Prior to calibration completely program all "smart" transmitters including entries of the appropriate range and tag number. Provide a printed record of smart device parameters, configuration, serial numbers, and assigned tag number.
- .3 Instruments to be set up and calibrated by an accredited instrument technician working under the approval of the instrument Manufacturer.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .4 Calibrate all instruments to an accuracy of a half (1/2) of 1% of full range, or to the Manufacturer's stated accuracy of the instrument whenever an accuracy of a half (1/2) of 1% is not achievable.
- .5 Prior to instrument installation perform the following applicable calibration for each instrument and its associated signal conditioning equipment:
 - .1 Calibrate all inline flowmeters by a draw-down test
 - .2 Calibrate all density meters by lab samples
 - .3 Calibrate all vacuum and pressure instruments by manometer or accurate test instrument and hand test pump
 - .4 Calibrate gas detectors using standard gas sample
 - .5 Calibrate temperature instruments against a standard lab thermometer.

3.15 Commissioning

- .1 Refer to the requirements of **Division 1** for additional Commissioning requirements.
- .2 Inspections
 - .1 Provide two (2) weeks' written notice to the Contract Administrator prior to energizing any system to allow for inspection by the Contract Administrator of the following:
 - .1 Proper mounting.
 - .2 Proper connections.
 - .2 During Commissioning demonstrate to the Contract Administrator proper calibration and correct operation of instruments and gauges
- .3 Commissioning of the instrumentation and control system to include but not be limited to the following.
 - .1 Installation of components, wiring connections and piping connections.
 - .2 Wiring continuity and pipe leak tests.
 - .3 Verify instrument calibration and provide written report.
 - .4 Function check and adjust under operational conditions the instruments and control equipment.
 - .5 Coordinate instruments and control equipment supplier's service personnel as required for complete system testing.

INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

- .6 Instruct plant personnel in correct method of operation of instruments and control equipment.
- .7 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant.
- .8 Ensure that the instrumentation and control equipment Suppliers cooperate to complete the Work of this Section.
- .9 Verify signal levels and wiring connections to all I&C equipment.
- .10 Coordinate and cooperate with City staff and the equipment suppliers to commission Control system I/O points during equipment Commissioning.

3.16 Training

- .1 Provide training, described in detail in **Division 1**, as required by the plants personnel to become fully competent in the proper O&M of all control devices, control valves, and ancillary instrumentation described under this Section of the Specification.

3.17 Test Forms

<u>Form No.</u>	<u>Title</u>
.1 LCR	Loop Check Report
.2 ITR	Instrument Test Report

**INSTRUMENTATION AND CONTROL
 GENERAL REQUIREMENTS**

LOOP CHECK REPORT

- CHECKED OUT OK
- NOT APPLICABLE
- FURTHER ACTION REQUIRED

	INSTRUMENT TAG NO.									
LOOP NO. _____ SHEET NO. _____ P & I DWG. NO. _____										
INSTALLATION COMPLETE										
Primary Element										
Impulse Lines										
Block and Drain Valves										
Air Supply/Filter/Reg.										
Wiring										
Tracing/Insulation/Housing										
Mounting and Location										
PLC/SCADA I/O & Status										
CALIBRATED										
Impulse Lines Press. Tested										
LOOP CHECKED										
Element To Receiver										
X Mtr. to Receiver										
X Mtr./Trans. to Receiver										
X Mtr./Trans. to Switches										
Switches to Annunciator										
Interlocking Circuit										
Controller to Valve										
Controller Action D or R										

REMARKS:

READY FOR START-UP

DATE: _____

Installed by: _____

Checked by _____

**INSTRUMENTATION AND CONTROL
 GENERAL REQUIREMENTS**

INSTRUMENT TEST REPORT

SYSTEM: _____

SERVICE: _____ TAG NO. _____

LOCATION: _____

MAKE: _____ MODEL: _____

SERIAL NO.: _____ CSA: _____

ELEMENT: _____ RANGE: _____

DESIGN SETTING/RANGE: _____ CONTACT TO: _____ ON: _____

SIGNAL IN: _____ OUT: _____ ASSOCIATED INSTRUMENT: _____

INSTRUMENT CONDITION: _____ CONFORM TO SPEC: _____

PROJECT NO.: _____ DATA SHEET: _____

TEST METHOD	TEST 1				TEST 2			
	INPUT		OUTPUT		INPUT		OUTPUT	
PROCESS	INC.	DEC.	INC.	DEC.	INC.	DEC.	INC.	DEC.
TEST POINT 1								
TEST POINT 2								
TEST POINT 3								
TEST POINT 4								
TEST POINT 5								
COMMENTS								
GRAPHS								

TESTED BY: _____ CHECKED BY: _____

DATE: _____ DATE: _____

END OF SECTION

ENCLOSURES

1. GENERAL

1.1 References - General

- .1 Suppliers, equipment, products, and execution must meet all requirements detailed in **Section 17010 – Instrumentation and Control General Requirements.**

2. PRODUCTS

2.1 General

- .1 Unless otherwise specified, provide outside finishes on all enclosures in American National Standards Institute (ANSI) 61 Grey.
- .2 The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.

2.2 Enclosures

- .1 Provide Electrical & Electronic Manufacturer's Association of Canada (EEMAC) Type 1A gasketed enclosures in Motor Control Centre (MCC) rooms and control rooms.
- .2 All enclosures for mounting outside of MCC rooms and control rooms to be EEMAC Type 4, watertight except where otherwise specified.
- .3 Provide EEMAC 7/3R enclosures for equipment in and around classified areas such as sumps.
- .4 Enclosures for certain equipment in corrosive atmospheres to be EEMAC 4X approved for the classification (e.g. chemical cleaning).
- .5 Enclosures for mounting field control indicator lamps and switches in unclassified areas to be Allen Bradley model 800T-xTZ die cast enclosures.
- .6 Enclosures for mounting field control indicator lamps and switches in Class 1 areas to be Allen Bradley model 800H-xHHX7 cast aluminum enclosures.

2.3 Panel Enclosures

- .1 Fabricate panel enclosures from 11 gauge steel panels complete with necessary stiffening to form a rigid free-standing lineup. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide removable top and bottom cable entry plates.
- .2 Provide panels with front access only. Doors shall be key lockable and fitted with 3-point heavy duty latching assemblies. Provide a continuous piano hinge and a pneumatic hold open device on each door.

ENCLOSURES

- .3 Finish the interior of the enclosure with white paint. Provide a switched fluorescent light fixture and 120 VAC duplex convenience receptacle inside the enclosure.

2.4 Marshaling and Control Panels

- .1 Supply, fabricate, checkout, layout, document and deliver to Site fully equipped and functional panels.
- .2 Supply all components contained on or within the panels fully wired under this Section of the Specification.
- .3 The Selection of all accessories, materials and methods for fabrication not covered by this Specification, but which are necessary to complete the fabrication of the control panels, is the responsibility of the panel fabricator.
- .4 Marshaling and control panels shall be adequately sized to facilitate a professional, uncluttered arrangement. Provide adequate internal and external space to accommodate a 20% increase in each type of component used. Allow space for future installation of at least one (1) additional programmable logic controller (PLC) or distributed control system (DCS) rack as appropriate.

2.5 Wiring and Accessories

- .1 Provide wiring inside the panels according to the following Specifications:
 - .1 Control wiring to be a minimum of #16 AWG tinned stranded copper; insulation rated at 600 V.
 - .2 Wiring for power distribution shall be a minimum of #14 AWG tinned stranded copper; insulation rated at 600 V.
 - .3 Refer to **Division 16** for cable routing requirements.
- .2 Tag each wire at both ends with a heat shrink sleeve that is machine printed.
- .3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.
- .4 Run all wiring in enclosed plastic wireways such as Panduit. Size all wireways so that the total cross sectional area of the insulated wire and cable does not exceed 40% of the cross sectional area of the wireway.
- .5 Provide a minimum clearance of 40 mm between wireways and any point of wire termination.
- .6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, defined as follows:

ENCLOSURES

- .1 Wire identification to use the connected field device tag name with the wire's corresponding terminal number appended to it.
- .2 Identify every joint and/or terminal of the above wire run with the same identifier until the wire meets another tagged device, at which point the wire identifier will change to use the new device name and terminal number.
- .3 For example, pressure transmitter K4-PT-100A located in the field has a 2CTPSH cable connected to it. The cable runs through a junction box to a marshaling panel. The wire identifiers for the pair of wires would be K4-PT-100A all the way to the marshaling panel.
- .4 Identify spare wires by using the destination identifier, i.e. the location and terminal identifier of the opposite end of the wire are combined to form the wire tag.
- .7 Provide a 120 VAC panel power distribution system and a 24 VDC power distribution system in each panel. Provide a thermal magnetic circuit breaker on each main power circuit and a fused terminal block for each branched circuit off the main.
- .8 Provide disconnect type terminal blocks Wieland WK4TSK/U type to isolate field wiring that is powered sourced from the panel.
- .9 Provide sufficient terminals so that not more than two (2) wires are connected under the same terminal. Provide 20% spare terminal capacity at each terminal block assembly.
- .10 Terminals shall be Wieland Type WK4/U color coded as follows:

Red	=	positive 24 VDC
Black	=	0 VDC common and analog signal plus
White	=	analog signal common and VAC neutral
Grey	=	120 VAC
Green	=	ground
- .11 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be black lamicoïd with white lettering, a minimum of 25 mm x 75 mm in size with up to three lines of 3 mm lettering. Securely fasten nameplates in and situate them in a visible location.

2.6 Panel Grounding

- .1 Provide a ground system for the instrumentation circuits, isolated from the main power system ground to each marshaling panel.
- .2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.
- .3 Provide in each marshaling panel an isolated grounding bus bar 6 x 25 x 600 mm, equipped with necessary lugs for accepting two (2) #2 AWG grounding conductors.

ENCLOSURES

- .4 Firmly bond all panel-mounted devices on or within the panels to ground. Provide supplementary bonding conductors for backpanels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

3. EXECUTION

3.1. References - General

- .1 Refer To **Section 17010 – Instrumentation and Control General Requirements**, Part 3.

3.2 Mounting Heights

- .1 Unless otherwise specified or a conflict exists, mount all panels, starters and disconnects 2,000 mm to top of cover.

END OF SECTION

INSTRUMENTATION CABLE

1. GENERAL

1.1 Product Data

- .1 Submit Product data in accordance with **Division 1** and **Division 16**.

1.2 Related Work

- .1 Refer to **Division 16**.

1.3 Inspection

- .1 Provide adequate notice to the Contract Administrator so that all cable installations can be inspected prior to connecting equipment.

1.4 Standards

- .1 All wire and cable shall be Canadian Standards Association (CSA) approved.

2. PRODUCTS

2.1 Twisted Pair Shielded Cables (TPSH)

- .1 TPSH shall be constructed as follows:
 - .1 Two (2) copper conductors, stranded, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm.
 - .2 Insulated for 600 V, 90° C.
 - .3 100% coverage aluminum foil or tape shield.
 - .4 Separate bare stranded copper drain wire, minimum #18 AWG.
 - .5 Overall flame retardant polyvinyl chloride (PVC) jacket to CSA-C22.2.
 - .6 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.
 - .7 Shaw Type 1751-CSA or Beldon equivalent.
- .2 Where multiconductor TPSH cables are called for, each pair shall be individually shielded, continuous number coded, and the cable assembly shall have an overall shield and overall flame retardant PVC jacket.

INSTRUMENTATION CABLE

2.2 Resistance Temperature Detector and Multi Conductor Shielded Cable

.1 Resistance Temperature Detector (RTD) cables shall be CSA approved and shall be constructed as follows:

- .1 Three (3) or more copper conductors, stranded, minimum #18 AWG.
- .2 PVC insulated for 600 V.
- .3 100% coverage aluminum foil or tape shield.
- .4 Separate bare stranded copper drain wire.
- .5 Overall flame retardant PVC jacket to CAS-C22.2

2.3 Teck Cables

.1 As per **Division 16**.

2.4 Wire

.1 As per **Division 16**.

2.5 Fibre Optic Cables

- .1 Provide fibre optic cable assemblies where indicated in the Specification and Drawings.
- .2 Fibre optic cables shall be constructed with specified quantity of 62.5/125 μm multi-mode glass fibres with individual and overall PVC jacket, spiral interlocked armour, and outer PVC jacket FT4 rated.
- .3 Provide terminations for fibre optic cables including; buffer tube fan out kits, connectors, termination panels, and wall mount enclosure.
- .4 Provide fibre optic jumpers 62.5/125 μm multi-mode for inter-cabinet connections.

3. EXECUTION

3.1 Analog Signals

- .1 Use TPSH cable for all low level analog signals such as 4-20 mA, 1-5 VDC, 0-10 VDC, pulse type circuits 24 VDC and under, and other signals of a similar nature.
- .2 Use RTD cable for connections between RTDs and transmitters or control system RTD inputs.

INSTRUMENTATION CABLE

3.2 Digital Signals

- .1 Use TPSH cable for all low level input (24 V and below) and output signals to the control system.
- .2 Use Teck cable or wire and conduit for power to instruments, for 120 V signals other than those mentioned above and as otherwise indicated on the Drawings. Use stranded wire and cable to supply power to instruments.

3.3 Installation

- .1 Install instrumentation cables in conduit systems or in cable trays. Use a minimum of 300 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.
- .2 Where non-armoured instrumentation cables are installed in cable trays, provide barriers in the tray to separate instrumentation cables from power cables.
- .3 At each end of the run leave sufficient cable length for termination.
- .4 Do not make splices in any of the instrumentation cable runs. Where splices are required, obtain approval from the Contract Administrator prior to installing the cable.
- .5 Where splices are necessary in instrumentation cables other than coaxial cables, perform such splices on terminal blocks in terminal boxes. Keep splices in instrumentation cable to a minimum and separated physically from power circuits. Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.
- .6 Where splices are made to coaxial cables, use standard coaxial cable connectors
- .7 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the marshalling panel.
- .8 Protect all conductors against moisture during and after installation.

3.4 Conductor Terminations

- .1 All equipment supplied shall be equipped with terminal blocks to accept conductor connections.
- .2 Instrumentation conductors, where terminated at equipment terminals other than clamping type terminal blocks, shall be equipped with Burndy-YAE-2 or STA-KON, self-insulated, locking type terminators, sized as required to fit conductors and screw terminals.
- .3 Terminations of fibre optic cables shall be performed by factory trained technicians with appropriate tools and testing equipment.

INSTRUMENTATION CABLE

3.5 Testing

- .1 Test all conductors for opens, shorts, or grounds. Resistance values shall not be less than those recommended by the cable Manufacturer.
- .2 Test all fibre optic cables and terminations for signal integrity and Manufacturer's Specifications.

3.6 Identification

- .1 Identify all instrumentation cables.
- .2 Identify each conductor with wire numbers using a machine printed heat shrink wire marker, similar to Raychem TMS or equivalent.

END OF SECTION

POWER SUPPLIES

1. 1. GENERAL

1.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements.**

2. PRODUCTS

2.1 Power Supply and Conditioning Equipment

.1 General

- .1 Provide all DC power supplies as required for all instrument circuits. All circuits to be powered from the marshalling panels. Power supplies to be equal to Hammond or G.F.C., complete with an overvoltage protection module.
- .2 Provide redundant configurations for power supply equipment serving more than one (1) instrument loop, so that failure of a single unit will not disable all or any shared part of the instrumentation and communication system. Provide diode isolation for redundant direct current supply units, and ground the negative terminal of the power supply.
- .3 Power supplies and transmitters feeding circuits that run in non-armoured cable in cable tray shall meet the requirements for Class 2 circuits as defined under Section 16 of the Canadian Electrical Code (CEC) Part I.
- .4 Unless otherwise required, all DC power supplies to be rated 28 VDC, adjustable plus or minus 5%, and set to provide 26.4 V on the panel direct current bus. Size the power supply for two (2) times the connected load, minimum size is 2 amps.

2.2 Noise Suppression

- .1 Provide power conditioners in each panel to power AC instrumentation and control loads. Power conditioners are Oneac Series CX.

3. EXECUTION

3.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements, Part 3.**

END OF SECTION

SWITCHES AND RELAYS

1. GENERAL

1.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements.**

2. PRODUCTS

2.1 General

- .1 Use normally closed contacts for alarm actuation which open to initiate the alarm.
- .2 Use normally open contacts to control equipment. The contacts close to start the equipment.
- .3 Contacts monitored by solid state equipment to be hermetically sealed and adequately rated for the connected load.
- .4 Contacts monitored by electro-magnetic devices such as mechanical relays to be rated National Electrical Manufacturers Association (NEMA) ICS 2, designation B300.
- .5 Provide double barriers between switch elements and process fluids such that failure of one (1) barrier will not permit process fluids into electrical enclosures.
- .6 Switch electrical enclosures to be rated Electrical & Electronic Manufacturer's Association of Canada (EEMAC) 4, minimum.

2.2 Indicators, Pushbuttons and Selector Switches

- .1 All control indicator lamps, pushbutton switches and selector switches in unclassified or non-corrosive areas to be Allen Bradley 800T or 800E series items.
- .2 All control indicator lamps, pushbutton switches and selector switches in classified or corrosive (includes outdoors) areas to be Allen Bradley 800H series items.
- .3 Enclosures to be as specified under **Section 17110 – Enclosures.**

2.3 Relays

- .1 The Quality and type of relays shall be based on Omron types.
- .2 120 VAC relays to be Model LY 4PDT, plug-in, complete with test button and operation indicator, and surge suppressor.
- .3 24 VDC relays to be Model MY 2PDT plug-in, complete with test button and operation indicator, and surge suppressor diode.

SWITCHES AND RELAYS

- .4 Time delay relays for behind panel mounting to be Model H3BA, 2PDT, plug-in, and programmable for sixteen (16) time ranges and four (4) operation modes.
- .5 Time delay relays for flush panel mounting and operator accessible timing range modifications to be Model H5BR, SPDT, screw terminals, programmable for five (5) timing ranges and eight (8) operation modes, complete with digital display, module for time settings and flexible protective cover.
- .6 Where the contact ratings of the relays listed are insufficient for the application select an appropriate type from an approved Manufacturer with the same quantity of contacts as was originally specified.
- .7 Provide relay plug-in sockets for DIN mounting complete with stacked screw clamp terminals.

3. EXECUTION

3.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements.**

END OF SECTION

SIGNAL CONDITIONING MODULES

1. GENERAL

1.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements.**

2. PRODUCTS

2.1 Signal Conditioning Modules

- .1 Where required, provide signal conditioning modules which comply with the following requirements, unless otherwise specified:
 - .1 Analog signal inputs: 4 to 20 mA DC into 500 ohms
 - .2 Analog signal outputs: 4 to 20 mA DC into 500 ohms
 - .3 Discrete output contacts: SPDT rated 5A
 - .4 Arrange electronic trips so that output contact opens in case of loss of signal or loss of power supply.
 - .5 Modules to be rated for continuous operation in an ambient temperature of 0 to 80°C. Ambient temperature effect not to exceed plus or minus 0.01% per °C within that range.
 - .6 Span and zero adjustments to be made by front accessible multi-turn potentiometers or keypad.
 - .7 Provide electronic trip modules with LED indicators for relay status.
 - .8 Modules to withstand 30 V per m radio frequency radiation between 200 and 500 MHz with not more than 0.25% calibration effect. Provide modules with traps on the terminals to shunt conducted radio frequency interference to ground.
 - .9 Galvanically isolate signal and power supply terminals from the case.
- .2 All modules specified in this Section to be the Product of a single Manufacturer.

2.3 Current to Pneumatic (I/P) Converters

- .1 Not used.

SIGNAL CONDITIONING MODULES

3. EXECUTION

3.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements, Part 3.**

END OF SECTION

PANEL INSTRUMENTS

1. GENERAL

1.1 References - General

- .1 Equipment, products and execution must meet all requirements detailed in **Section 17010 – Instrumentation and Controls General Requirements.**

2. PRODUCTS

2.1 Electronic Panel Instruments

- .1 Provide panel instruments with the following requirements, unless otherwise specified:
 - .1 Analog instruments to be miniature-case drawout type nominally 150 mm high by 75 mm wide by not more than 350 mm deep.
 - .2 Make the operator, tuning and configuration adjustments accessible without disconnecting the instrument from the process.
 - .3 Analog signal indicators to be solid-state, LED or gas-discharge type, including bar-graph displays with not less than 200 segments. Backlit LCD indication is also acceptable.
 - .4 Analog signal inputs to be 4 to 20 mA VDC.
 - .5 Analog signal outputs to be 4 to 20 mA VDC into 500 ohms.
 - .6 Galvanically isolate the signal and power supply from the instrument case.
- .2 Panel instruments specified in this Section are to be the Product of a single Manufacturer, and to match and line up to form an integrated appearance and operator interface strategy.

3. EXECUTION

3.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements.**

END OF SECTION

MISCELLANEOUS PANEL DEVICES

1. GENERAL

1.1 References - General

- .1 Equipment, Products and Execution must meet all requirements detailed in **Section 17010 – Instrumentation and Controls General Requirements**.

2. PRODUCTS

2.1 Miscellaneous Panel Devices

- .1 Pilot Lights
 - .1 Provide pilot lights of the LED transformer type for extended lamp life, oil tight, push to test, complete with appropriate colour lenses. Normal colours used are run=red, stop=green unless otherwise depicted elsewhere. Refer to **Division 16** for additional information
 - .2 Terminals
 - .1 Provide strap screw type terminal blocks rated for 600 V.
 - .2 Identify each terminal block within an enclosure with a unique machine printed terminal block number. Cabinet chassis grounding terminal blocks to be identified by the electrical ground symbol.
 - .3 Connections to screw terminals to be locking fork tongue insulated crimp type wire connectors.
 - .4 Terminals to be Weidmuller or approved equal.
 - .5 Provide a group of terminals for each of 120 VAC hot and neutral and 24 VDC positive and negative power. Distribution wiring to have a thermal magnetic circuit breaker upstream of all major blocks of loads, adequately sized to protect the connected load while not causing nuisance tripping.
 - .6 Provide Weidmuller disconnect type terminal blocks for each load or loop powered from the marshalling panels.
 - .3 Nameplates
 - .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements** for nameplate Specification.

MISCELLANEOUS PANEL DEVICES

2.2 Signal Current Isolator

- .1 Isolator to provide galvanic isolation of milliampere transmission signals from transmitters with inadequately isolated output circuits.
- .2 Isolator to be housed in a National Electrical Manufacturers Association (NEMA) 250, Type 4/7 conduit body and derive its operating power from the signal input circuit.
- .3 Input and output signals to be 4 to 20 mA, with an error not exceeding 0.1% of span. Input resistance will not exceed 550 ohms with an output load of 250 ohms.
- .4 Isolator to be Moore Industries.

3. EXECUTION

3.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements, Part 3.**

END OF SECTION

CONTROL AND OPERATOR INTERFACE REQUIREMENTS

1. GENERAL

1.1 General Requirements

- .1 Design and implement new distributed control system (DCS) control logic and operator interface screens that will control and monitor the Thermal Oxidizer System in accordance with the requirements defined by the Contract Documents.
- .2 Cooperate with the equipment vendors and City staff to interface and test the new system together with the existing DCS.
- .3 Participate in the testing, start-up, and commissioning of the complete control system and associated field devices and wiring.

2. PRODUCTS

2.1 System Integration Requirements

- .1 Cooperate and coordinate activities with other Contractors, City staff, and consultants to facilitate installation, testing, and commissioning of the Thermal Oxidizer System.
- .2 Control logic and operator interface screens shall be developed by ABB in accordance with established City of Winnipeg standards.
- .3 Provide Shop Drawings for all proposed new logic and interface screens in accordance with **Section 01300 – Submittals** – for review.
- .4 Develop a new operator interface screen for the Thermal Oxidizer System together with control logic to facilitate the following features:
 - .1 Graphic Representation of the Thermal Oxidizer System as depicted on the P&ID's.
 - .2 Full animation of equipment, process data, and piping symbols in accordance with noted standards.
 - .3 Provide run time totalizers for the thermal oxidizer and exhaust fans.
 - .4 Provide manual start/stop control for the Thermal Oxidizer System including automatic restart after power failure.
 - .5 Provide automatic control of exhaust fans S692-EF and S694-EF including automatic restart after power failure. Normally, fan S692-EF shall be on at all times. When the sludge hauler truck fill is in progress, S692-EF shall stop and truck exhaust fan S694-EF shall run. When the Truck filling is complete and following a one minute time delay, S692-EF shall restart and S694-EF shall stop.

CONTROL AND OPERATOR INTERFACE REQUIREMENTS

- .6 Provide system alarms for thermal oxidizer failure, thermal oxidizer fail to start/run, fan S692-EF fail to start/run, and fan S694-EF fail to start/run. As indicated on the instrument loop drawings, all DCS wiring is to be routed through and terminated in Field Device Panel FDP-S.
- .7 Provide an operator adjustable alarm setpoint for the foul air plenum. When plenum temperature exceeds setpoint, initiate a high temperature alarm and stop the thermal oxidizer. (Fans continue to run as normal)
- .5 All equipment testing and commissioning responsibilities must be carried out while at the same time maintaining the plant DCS. Any equipment outage requirements are to be kept to a minimum and are to be scheduled with the Contract Administrator prior to implementation.

3. EXECUTION

3.1 Performance – General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements, Part 3**

3.2 Installation

- .1 Provide hardware in accordance with the foregoing requirements in sufficient quantity to satisfy the performance requirements defined in this and other Divisions of the Specification.
- .2 Provide all necessary documentation to define the control system including details for all hardware.
- .3 Commission and start up the system as defined herein.
- .4 Provide all documentation and training as defined herein.
- .5 Maintain existing plant operation during entire Construction Period. Refer to the requirements of Division 1.

END OF SECTION

INSTRUMENT SPECIFICATION SHEETS

1. GENERAL

1.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Controls General Requirements.**

1.2 Instrument Specification Sheets

- .1 The following data sheets provide information for instruments included as part of this Work.
- .2 All instruments described in each instrument Specification sheet are to be from a single source. Design has been based on the first named Supplier.

2. PRODUCTS

- .1 Not used in this Section.

3. EXECUTION

- .1 Not used in this Section.

END OF SECTION

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION NUMBER:	I101
DEVICE:	Air Temperature Transmitter
TAG:	S693-TE/TT
TYPE:	100 OHM Platinum RTD Sensor with Transmitter
RANGE:	0 to 100°C
INACCURACY:	±0.5% of span or better
OUTPUT:	4 to 20 mA DC
POWER SUPPLY:	Loop powered
ENCLOSURE:	Sensor: 3 mm Ø Stainless steel temperature probe with weatherproof termination box. Transmitter: General Purpose, DIN rail mount.
ACCESSORIES:	Transmitter: Surface mount bracket for the RTD sensor. DIN rail mount option for the transmitter.

END OF SECTION

INSTRUMENT LOOP DRAWINGS

1. GENERAL

1.1 References - General

- .1 Refer to **Section 17010 – Instrumentation and Control General Requirements.**

1.2 Instrument Loop Drawings

- .1 One (1) Drawing per loop will be completed and submitted for approval after award of Contract. The following three (3) Drawings are an integral part of this Specification Section:

6238000-I01	Instrument Loop Diagram – Thermal Oxidizer
6238000-I02	Instrument Loop Diagram – Truck Exhaust Fan S694-EF
6238000-I03	Instrument Loop Diagram – Foul Air Exhaust Fan S692-EF

2. PRODUCTS

- .1 Not used in this Section.

3. EXECUTION

- .1 Not used in this Section.

END OF SECTION