



Chorley+Bisset
CONSULTING ENGINEERS

**BOILER REPLACEMENT
URSULINE COLLEGE CHATHAM CATHOLIC SECONDARY SCHOOL
CHATHAM ONTARIO
ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD**

**CHORLEY + BISSET LTD
CONSULTING ENGINEERS
LONDON ONTARIO**

**FILE NO. 6774
MARCH 2011**

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 CHATHAM ONTARIO
 ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD**

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NAME OF BIDDER _____

**BID FORM
BOILER REPLACEMENT
URSULINE COLLEGE CHATHAM CATHOLIC SECONDARY SCHOOL
CHATHAM ONTARIO
ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD**

ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD
420 CREEK STREET
WALLACEBURG ON N8A 4C4

Attention: Mr. Paul Lernout - Coordinator of Facility Services

1. GENERAL TERMS

1. In submitting this Bid, we recognize and acknowledge the right of the Owner to accept the Bid which is deemed to be most advantageous, or to reject any or all bids.
2. We recognize that this Bid will be declared invalid if it has been improperly completed or not completed in full.

2. BASE BID

We have examined the Specifications and other Contract Documents for this project. We hereby offer to supply all labour, materials, plant and tools for the execution of this work including all prime costs, allowances and all applicable taxes (**excluding** HST), in accordance with the Contract documents for the sum of:

_____ DOLLARS

(\$ _____) in lawful money of Canada.

3. TAXES WAIVED OR REFUNDED

Where taxes or duties are waived or refunded, we will return the savings in full to the Owner.

4. DOCUMENTS

This Bid is based on the following documents:

- 1. Bid Form
- 2. Instructions to Bidders
- 3. Specifications
- 4. Drawings: ME1.1, M2.1, M2.2, M2.3, M2.4, M2.5, M3.1, M3.2, E1.1, E2.1 and E2.2.
- 5. Addendum No. _____ Dated _____
- 6. Addendum No. _____ Dated _____
- 7. Addendum No. _____ Dated _____

5. EXECUTION OF CONTRACT

If notified of acceptance of this offer within 90 days of the time set for closing of Bids, we will:

- 1. Accept a Purchase Order from the Owner.
- 2. Provide a complete Contract Price breakdown by construction element within seven working days from receipt of either Letter of Intent or the Purchase Order, whichever occurs first. This breakdown will be representative of the full Contract Price.

6. INSURANCE

We carry Policy # _____ with the _____

in the following amounts:

- 1. Comprehensive General Insurance \$ _____
- 2. Automobile Liability Insurance \$ _____

7. SUBCONTRACTORS AND SUPPLIERS

We submit herewith a list of Subcontractors and Suppliers we propose to use on this Contract.

Title	Name of Subcontractor or Supplier
Electrical Contractor	_____

Insulation Contractor _____

Roofing Contractor _____

Boilers _____

Motor Control Equipment _____

Panelboards _____

Variable Frequency Drives _____

8. SCHEDULE

If awarded this Contract by April 1, 2011, we will complete the Contract by

_____.

Signature _____

Print Name _____

Title _____

Company _____

Address _____

Telephone No. _____

FAX No. _____

Date _____

INSTRUCTIONS TO BIDDERS

1. Bids will be accepted only from preselected Mechanical Contractors. The successful Mechanical Contractor will be the Prime Contractor
2. Complete all parts of the Bid Forms. Failure to do so will render the Bids invalid.
3. Submit your Bid using the enclosed Bid Form. Sign the Bids and have them duly witnessed. If an incorporated company, have the duly authorized officers sign the Bids and affix the company seal. Acknowledge all addenda in the proper place on Bid Forms.
4. Deliver Bids **by hand** not later than 1500 hours local time, **Thursday, 24 March, 2011**, to:

**ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD
420 CREEK STREET
WALLACEBURG ON N8A 4C4**

Attention: Paul Lernout - Coordinator of Facility Services

Submit Bids in a sealed opaque envelope marked:

“BOILER REPLACEMENT - URSULINE COLLEGE CHATHAM CATHOLIC SECONDARY SCHOOL, CHATHAM, ONTARIO”.

5. Bids which are qualified, or improperly completed, executed or delivered, will not be considered.
6. Show any alternatives, substitutions or qualifications of the Bids, which are not requested in the Bid Forms, separately from the Bids. These may be in the form of an accompanying letter so that they may be considered separately from the Bids.
7. **Pre-Bid Site Meeting**
 1. All Mechanical Contractors wishing to submit Bids on this project must attend a Pre-Bid Site Meeting. Any Bids received from a Contractor who was not represented at this meeting may be declared invalid and the Bid may not be opened.
 2. The Pre-Bid Meeting will be held at **11:00 a.m., Tuesday, 15 March, 2011** at the school.
8. Examine the Drawings and Specifications thoroughly. Report to the Consultant all ambiguities, discrepancies, omissions, errors and departures from building bylaws or good practice, discovered during examination. In submitting your Bids, do not take into account any instructions given by the Consultant unless they are in writing. It will be assumed that the Contractor thoroughly understands the Drawings and Specifications, including those particular items about which questions have been asked and instructions given.
9. **Letter of Intent:** A Letter of Intent will be issued to initiate the Contract. At a later date, a Purchase Order will be prepared by the Board.
10. The Owner is:

ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD
420 CREEK STREET
WALLACEBURG ON N8A 4C4
Telephone: (519) 339-7274
Fax: (519) 627-8230

11. The Consultant is:

CHORLEY + BISSET LTD.
369 YORK STREET, SUITE 2B
LONDON ON N6B 3R4
Telephone (519) 679-8660
FAX (519) 679-2145
email@chorley.com

LIST OF ACCEPTABLE MECHANICAL CONTRACTORS

Black & McDonald
Comstock Canada Ltd.
Culliton Brothers Limited
Curney Mechanical Ltd.
J.M.R. Electric
Linde Plumbing & Heating
Poleair Technical Inc.
Postma Heating and Cooling Inc.
QPS Mechanical
Sarnia Plumbing & Mechanical Ltd.
Soan Mechanical
TSM Limited

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- 1 General
- 1.1 **SECTION INCLUDES**
1. GENERAL
 2. THE WORK
 3. PROJECT COORDINATION
 4. SCHEDULING
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 8. TEMPORARY FACILITIES
 9. CLEANING
 10. PROJECT CLOSEOUT
 11. SCHEDULE
 12. IDENTIFICATION AND TRAINING
 13. WELDING PROCEDURES
 14. SITE INSPECTION
- 1.2 **RELATED SECTIONS**
1. Tender/Bid Form
 2. Instructions to Bidders
- 2 The Work
- 2.1 **WORK COVERED BY CONTRACT DOCUMENTS**
- 2.1.1 Work of this Contract is the renovation of some areas of the existing school as indicated on the Drawings including but not necessarily limited to:
1. Removal of existing heating boilers and accessories.
 2. Installation of new heating boilers and associated pumps and piping system.
 3. Rebalance of existing water heating systems.
 4. Associated electrical work where noted.
- 2.1.2 The work is to be carried out at location as shown in Bid Form.
- 2.2 **CONTRACT METHOD**
- 2.2.1 Construct the Work under a single Purchase Order.
- 2.3 **WORK BY OTHERS**
- 2.3.1 The following work, related to this project, will be done by the Owner:
- 2.3.1.1 Removal of loose furnishings, equipment and supplies from boiler room areas where interferes with boiler installation.
- 2.4 **TIMING OF WORK**
- 2.4.1 Preparatory work shall commence immediately after Award of the Contract. Preparatory work includes:
1. Obtaining of all necessary permits

2. Shop Drawings
3. Ordering of material and equipment

2.4.2 Work at the site shall commence not earlier than 1 July 2011 and the work shall be Substantially Performed by 15 August 2011.

2.5 **CONTRACTOR USE OF PREMISES**

2.5.1 The Contractor shall limit his use of the premises to the following areas:

2.5.1.1 The areas of the School that are to be renovated as indicated on the Drawings.

2.5.1.2 For access: existing entrances and corridors. At no time shall corridors or exits be blocked.

2.5.1.3 Exterior space for parking, deliveries, storage facilities and the like: suitable space as designated by the Owner.

2.6 **OWNER OCCUPANCY**

2.6.1 Owner will occupy premises during construction period for normal summer cleaning and maintenance activities.

2.6.2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

3 Project Coordination

3.1 **PRE-CONSTRUCTION MEETING**

3.1.1 The Contractor shall arrange and administer a pre-construction meeting to be held at the site before on site work begins.

3.1.1.1 Participants in the pre-construction meeting shall include:

1. Representatives of the Contractor including their on site superintendent.
2. Principal Subcontractors including Mechanical, Electrical and Roofing.
3. Representatives of the School Administration and custodial staff.
4. Representatives of the Owner.
5. The Consultant.

3.1.2 Arrange with the School's Administration for suitable meeting space and make arrangements for meeting.

3.1.3 The Contractor will record minutes of the meeting and distribute copies to meeting participants, the Owner's representative and a representative of the school staff.

3.1.4 Topics of discussion at the meeting shall include:

1. Contract Administration procedures and responsibilities.
2. Billing procedures
3. Project Schedule
4. Suitable storage space within the school acceptable to all parties.
5. Parking arrangements.
6. Contractor's Site Office.

7. Coordination of the Contractor's proposed construction schedule with the Owner's scheduled activities.
8. Safety and administrative issues.

3.2 **PROGRESS MEETINGS**

3.2.1 The Contractor shall arrange and administer biweekly progress meetings to be held at the site.

3.2.1.1 Participants in progress meetings shall include:

1. Representatives of the Contractor including their on site superintendent.
2. Representatives of subcontractors currently working on the project.
3. Representatives of the School Administration and custodial staff.
4. Representatives of the Owner.
5. The Consultant.

3.2.2 Arrange with the School's Administration for suitable meeting space and make arrangements for meeting.

3.2.3 The Contractor will record minutes of the meetings and distribute copies to meeting participants, the Owner's representative and a representative of the school staff.

3.2.4 Topics of discussion at the meeting shall include:

1. Progress of the work as it relates to the Contractor's Schedule for the Work.
2. The work scheduled for the following weeks.
3. Coordination of the Contractor's proposed construction schedule with the Owner's scheduled activities.
4. Safety and administrative issues.

3.3 **DAILY COORDINATION**

3.3.1 Each work day the Contractor's site superintendent shall meet informally with the school staff to discuss the work proposed for the day, to coordinate that work with school activities and to arrange access to storage and work areas.

3.4 **DIMENSIONING AND LAYOUT**

3.4.1 Dimensions on the Drawings have been taken from the Drawings for the original construction and shall be verified in the field by the Contractor.

3.4.2 Before fabrication of any component whose dimensions are dependent on existing conditions, the Contractor shall take field dimensions so as to ensure a proper fit of new components with existing work.

4 Scheduling

4.1 **SCHEDULE INFORMATION REQUIRED**

4.1.1 The following scheduling information shall be provided:

1. Overall Schedule for the Work including the activities of all trades required to complete the Work in each area of the project.
2. Submittal Schedule for Shop Drawings, Product Data and Samples.

3. Product Delivery Schedule.

4.2 **FORMAT**

4.2.1 Prepare schedule in the form of a horizontal bar chart with a time scale of weeks subdivided into days. Indicate weekends, holidays and any other non-working days by shading or hatching.

4.2.2 Provide a separate set of bars for each trade or major operation.

4.2.3 Preferred format is one schedule incorporating all required schedule information on one sheet. Maximum size 22" by 16".

4.3 **SUBMISSION**

4.3.1 Submit initial schedules before the Pre-Construction Meeting.

4.3.2 Submit three copies for review by the Consultant and the Owner.

4.3.3 Consultant will review schedule and return reviewed copy within three working days.

4.3.4 Submit finalized schedule within three working days of return of review copy.

4.3.5 Distribute copies of the revised schedule to:

1. The school office.
2. Subcontractors.
3. Consultant, Owner and other concerned parties.

4.3.6 Instruct recipients to report to the Contractor within five working days, any problems anticipated by the timetable shown in the schedule.

5 Submittals

5.1 **ADMINISTRATIVE**

5.1.1 Submit to Consultant submittals listed for review in the various Specification Sections. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work.

5.1.2 Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

5.1.3 Work affected by the submittal shall not proceed until review is complete. Allow five working days for Consultant's review.

5.1.4 The Contractor shall review submittals before submission to the Consultant. Contractor review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project will be returned without being reviewed.

5.1.5 Before submitting documents for review, verify field measurements.

-
- 5.1.6 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- 5.1.7 Contractor's responsibility for compliance with the requirements of Contract Documents is not relieved by Consultant review.
- 5.1.8 Keep one reviewed copy of each submission on site.
- 5.2 **SHOP DRAWINGS AND PRODUCT DATA**
- 5.2.1 "Shop Drawings" means Drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.
- 5.2.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- 5.2.3 Adjustments made on Shop Drawings by the Consultant are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to the Consultant prior to proceeding with the Work.
- 5.2.4 Make changes in Shop Drawings as the Consultant may require, consistent with Contract Documents. When resubmitting, notify the Consultant in writing of any revisions other than those requested.
- 5.2.5 One copy of reviewed Shop Drawings, data sheets and brochures will be retained by the Architect and, one by the Owner. Submit the number of copies required for the work plus the two to be retained by the Consultant and Owner.
- 5.2.6 If upon review by the Consultant, no errors or omissions are discovered or if only minor corrections are made, the copies will be returned marked "Reviewed" or "Reviewed as noted" and fabrication and installation of Work may proceed. If Shop Drawings are returned marked "Revise and Resubmit" noted copy will be returned and re-submission of corrected Shop Drawings, through the same procedure indicated above, shall be performed before fabrication and installation of Work may proceed.
- 5.3 **CERTIFICATES AND TRANSCRIPTS**
- 5.3.1 Immediately after award of Contract, submit Workers' Compensation Board status, insurance certificates and a proposed billing breakdown of the Contract Price.
- 6 Products and Workmanship
- 6.1 **REFERENCE STANDARDS**
- 6.1.1 Within the text of the Product Specifications, reference standards are identified. Conform to these standards, in whole or part, as requested in the specifications.
- 6.1.2 Conform to latest date of issue of referenced standards in effect on date of submission of bids.

6.2 QUALITY

6.2.1 Except where it is specified to reuse salvaged materials, products, materials and equipment incorporated in the Work shall be new, 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.

6.2.2 Should any dispute arise as to the quality or fitness of Products, the decision rests strictly with the Consultant based upon the requirements of the Contract Documents.

6.3 PRODUCT AVAILABILITY

6.3.1 Immediately on Award of the Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items.

6.3.2 In the event of failure to notify the Consultant at commencement of Work the Consultant reserves the right to substitute more readily available products of similar character, at no increase in Contract Price.

6.4 STORAGE, HANDLING AND PROTECTION

6.4.1 Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

6.4.2 As soon as products arrive at the Contractor or Subcontractor's warehouse facility or at the site, whichever occurs first, examine the complete shipment. Verify that the products received are as specified or approved, undamaged and that the correct quantity has been received.

6.4.3 Store packaged or bundled Products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in the Work.

6.4.4 Store products subject to damage from weather in weatherproof enclosures.

6.4.5 Remove and replace damaged Products at own expense and to the satisfaction of the Consultant.

6.5 MANUFACTURER'S INSTRUCTIONS

6.5.1 Unless otherwise indicated in the Specifications, install or erect Products in accordance with manufacturer's instructions.

6.5.2 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes the Consultant to require removal and re-installation at no increase in Contract Price.

6.6 WORKMANSHIP

6.6.1 Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if required Work is such as to make it impractical to produce required results.

6.6.2 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant, whose decision is final.

6.7 **REMEDIAL WORK**

6.7.1 Perform remedial work required to repair or replace the parts or portions of the Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

6.7.2 Perform remedial work by specialists familiar with the materials affected. Perform in a manner to neither damage nor endanger any portion of Work.

6.8 **FASTENINGS**

6.8.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

6.8.2 Prevent electrolytic action between dissimilar metals and materials.

6.8.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected Specification Section.

6.9 **PROTECTION OF EXISTING WORK AND WORK IN PROGRESS**

6.9.1 Adequately protect adjacent existing work and Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Consultant, at no increase in Contract Price.

6.9.2 Erect dust partitions at doorways between areas to be renovated and adjacent rooms to contain dust within the work area. Minimum construction for dust partitions shall be 1/4" plywood or OSB or wafer board over 6 mil polyethylene sheet on lumber framing. Seal perimeter and joints with tape.

6.9.3 The Contractor to provide and maintain adequate fire extinguishers for the protection of the work during the construction period. The locations on site to meet the requirements to the insurance company. All other temporary fire fighting equipment to be provided as required by the Fire Marshal, Insurance Authorities and Building Codes, at no extra cost to the Owner.

6.9.4 Bulk storage of flammable liquids or hazardous materials will not be allowed within the building or site at any time.

6.9.5 if required, the Contractor, at his own expense, is to maintain watchmen as required for security to keep the public out of the building at all times, and for fire at all times.

6.9.6 The Contractor is to maintain water, fire alarm, P.A. and Security Systems, electrical, storm and sanitary connections in the school for the duration of the work.

6.9.7 Protect all floors, walls and ceiling surfaces during the work. Special care is required during the welding of structural and piping work. Submit plan of floor protection to Consultant before starting work. All surfaces damaged in the completion of this work are to be repaired to the satisfaction of the Owners and Consultant.

6.9.8 Protect roof areas from damage due to the work of this contract by laying of minimum

1/2" plywood over entire area being worked on.

6.9.9 All appropriate safety procedures must be maintained including the use of the four hour spark watch, use of fire blankets, etc. to prevent fire or spark damage. Ventilation must be provided to remove smoke and odours. Existing paint may contain lead, so appropriate ventilation must be provided.

6.9.10 Provide complete floor covering protection.

6.9.11 Provide fencing around outdoor work and materials storage/dumping areas, to be fully enclosed.

6.9.12 Hot work permits are required for all open flame work.

6.10 OVERLOADING

6.10.1 Prevent overloading of any part of the building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Consultant.

7 Quality Control

7.1 REVIEW AND INSPECTION

7.1.1 The Owner, School Board representatives and the Consultant shall have access to the Work. If part of the Work is in preparation at locations other than the Place of the Work, access shall be given to such work whenever it is in progress.

7.1.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultant instructions, or the law of the Place of the Work.

7.1.3 If the Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have the inspections or tests satisfactorily completed and make good such Work.

7.1.4 The Consultant may order any part of the Work to be examined if the Work is suspected to be not in accordance with the Contract Documents. If, upon examination such work is found not in accordance with the Contract Documents, correct such work and pay the cost of examination and correction. If such Work is found in accordance with the Contract Documents, the Owner shall pay the cost of examination and replacement.

7.2 REJECTED WORK

7.2.1 Remove defective Work, whether the result of poor workmanship, use of defective products or damage and whether incorporated in the Work or not, which has been rejected by the Consultant as failing to conform to the Contract Documents. Replace or re-execute in accordance with the Contract Documents.

7.2.2 Promptly make good other Contractor's work damaged by such removals or replacements.

7.2.3 If in the opinion of the Consultant it is not expedient to correct defective Work or Work not performed in accordance with the Contract Documents, the Owner may

deduct from the Contract Price the difference in value between the Work performed and that called for by the Contract Documents, the amount of which shall be determined by the Consultant.

8 Temporary Facilities

8.1 **INSTALLATION AND REMOVAL**

8.1.1 Provide temporary utilities and facilities in order to execute the work expeditiously. Refer to Mechanical and Electrical Drawings for additional temporary facilities required of the mechanical and electrical subcontractors.

8.1.2 Remove from site all temporary work after use.

8.2 **SANITARY FACILITIES**

8.2.1 Existing facilities as designated by the Owner may be used by construction workers during the construction period provided they are kept clean and are not damaged.

8.3 **WATER SUPPLY**

8.3.1 The Owner will provide a continuous supply of potable water for construction use.

8.3.2 Water shall be taken from the nearest available existing outlet. Make any necessary modifications for attachment of hoses and restore to original condition on completion of the work.

8.3.3 The Contractor shall provide hoses, valves and other necessary equipment to convey water from the existing outlet to the work area.

8.4 **TEMPORARY POWER AND LIGHT**

8.4.1 The Owner will provide temporary 110 volt electrical power during construction for temporary lighting and the operating of power tools.

8.4.2 Power shall be taken from the nearest existing outlet. Provide extension cords as required.

8.5 **TEMPORARY TELEPHONE**

8.5.1 The Contractor and subcontractors shall equip their on site superintendents with cellular phones which shall be used for all telephone calls.

8.6 **SITE STORAGE AND OVERLOADING**

8.6.1 Confine the Work and the operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with products.

8.6.2 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the Work.

8.7 **CONSTRUCTION PARKING**

8.7.1 Parking will be permitted on site in existing parking areas.

-
- 8.7.2 Parking shall be restricted to areas designated by the Owner.
- 8.8 **EQUIPMENT, TOOL AND MATERIALS STORAGE**
- 8.8.1 Store equipment, tools and materials within the Work Area.
- 8.9 **PROTECTION OF BUILDING FINISHES AND EQUIPMENT**
- 8.9.1 Provide protection for finished and partially finished new and existing building finishes and equipment during performance of Work.
- 8.9.2 Be responsible for damage incurred due to lack of or improper protection.
- 9 Cleaning
- 9.1 **PROGRESSIVE CLEANING**
- 9.1.1 Maintain the Work in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other Contractors.
- 9.1.2 Remove waste material and debris from the site at the end of each working day.
- 9.2 **FINAL CLEANING**
- 9.2.1 Remove waste products and debris other than that caused by the Owner, other contractors or their employees, and leave the Work clean and suitable for the occupancy by Owner.
- 9.2.2 When the Work is Totally Performed, remove surplus products, tools, construction machinery and equipment. Remove waste products and debris other than that caused by the Owner or other Contractors.
- 9.2.3 Remove waste materials and the site at regularly scheduled times or dispose of as directed by the Consultant. Do not burn waste materials on site, unless approved by the Consultant.
- 9.2.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- 9.2.5 Leave the work broom clean before the inspection process commences.
- 9.2.6 Clean and polish glass, mirrors, window framing, hardware and window stools. Replace broken, scratched or disfigured items.
- 9.2.7 Remove stains, spots, marks and dirt from decorative work, Electrical and Mechanical fixtures, furniture fitments, walls, ceilings and floors.
- 10 Project Closeout
- 10.1 **INSPECTION AND DECLARATION PROCEDURES**
- 10.1.1 **Contractor's Inspection:** Contractor and all Subcontractors shall conduct an inspection of the Work, identify deficiencies and defects; repair as required to conform to Contract Documents. Notify Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made. Request

a Consultant's Inspection.

10.1.2 **Consultant's Inspection:** Consultant and Contractor will perform an inspection of the Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

10.1.3 **Final Inspection:** When items noted in 2 above are completed, request a final inspection of the Work by Owner, Consultant, and Contractor. If Work is deemed incomplete by Consultant, complete outstanding items and request a reinspection.

11 **Schedule**

11.1 The project must be completed by 26 August 2011. The occupied areas are to be finished two weeks prior to that date to allow for school access.

11.2 Contractor will be able to access building on a full time basis on 1 May 2011. Access prior to this date will be restricted to after hours or weekends. Any prior work is to be done in such a manner that the School is fully functional when occupied by the Owner for classroom instruction.

12 **Identification and Training**

12.1 All Contractors are to have formal training by the St. Clair Catholic District School Board and possess required identification prior to starting work. All costs associated with the procurement of training and identification is to be borne by the Contractor.

13 **Welding Procedures**

13.1 Structural Steel Contractors to have in place the appropriate welding procedures, including but not limited to joist welding and up-hand welding.

14 **Site Inspection**

14.1 Drawings do not show all existing utilities etc. within ceiling space. The Contractor must satisfy themselves as to the extent of relocations required in order to facilitate reinforcing. No claims for extra costs will be considered for obstruction to work visible through a site visit prior to Bid closing. All Contractors urged to visit the site during the Bid period to satisfy themselves as to the extent of the relocations required. Site visits can be scheduled through the school principal for after 3:30 p.m. classes.

END OF SECTION

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-
- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 This Section and Division 1 - General Requirements applies to and governs the work of all Sections of Division 15.
- 1.2 **VISITING SITE**
- 1.2.1 Visit the site and be familiar with working conditions and work involved before submitting Bids. No extras will be granted due to lack of a thorough preliminary investigation of the site.
- 1.3 **CONTRACT DRAWINGS**
- 1.3.1 Mechanical and Electrical Drawings show Mechanical and Electrical work only and are not intended to show Structural details or Architectural features. Take building dimensions and details from job measurements.
- 1.3.2 Only the general location and route of piping and ductwork is shown. Install all piping and ductwork neatly to conserve headroom. All piping and ductwork to be installed parallel to building lines unless shown otherwise.
- 1.3.3 The Consultant reserves the right to revise the locations of equipment and outlets within any given room without altering the Contract Price provided Notice of Change is given prior to roughing-in.
- 1.3.4 In case of conflict between work of other trades and work of this Division, clarify the location of these items with the Consultant before roughing-in.
- 1.3.5 In the event of any discrepancies or ambiguity of any symbol, note, abbreviation, etc., used in this Specification or on the Contract Drawings, obtain clarification, in writing, from the Consultant prior to submitting Bid. No allowance will be made for additional costs arising from failure to obtain proper clarification of conflicting information before Bid.
- 1.4 **SHOP DRAWINGS**
- 1.4.1 Submit Manufacturers' Shop Drawings, Electrical Wiring Diagrams and Control System Drawings to the Consultant. Provide title sheet for Shop Drawing submitted. Include project name, Shop Drawing item and approval stamps. The Consultant reserves the right to have samples submitted of any specified products.
- 1.4.2 Before submitting shop drawings, provide a complete list of shop drawings to be submitted in Microsoft Excel format. List all shop drawings and approximate date of submission.
- 1.4.3 Submit all shop drawings electronically in Adobe Acrobat PDF format. File attachments to an email must total no more than 5 MB and must be submitted unzipped. If multiple items are submitted in single PDF file, each individual piece of equipment must be "book marked" using equipment labels as per Design Drawings. All shop drawings submitted electronically must be checked and stamped by Contractor as specified below.

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- 1.4.4 Catalogues, manuals or price lists will not be accepted as Shop Drawings. Before submission, check Shop Drawings, make necessary corrections, apply stamp "Checked and Certified Correct", sign and date.
- 1.4.5 Submit one reviewed set of Shop Drawings with each set of Maintenance and Operating Instructions.
- 1.4.6 The review of Shop Drawings by Chorley + Bisset Ltd. is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Chorley + Bisset Ltd. approves the detail design inherent in the Shop Drawings, responsibility for which remains with the Contractor. Such review does not relieve the Contractor of his responsibility for errors or omissions in the Shop Drawings or of his responsibility for meeting all requirements of the Construction and Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all subtrades.
- 1.4.7 Ensure at least one copy of the reviewed Shop Drawings is kept on site at all times for reference.
- 1.4.8 Prepare all Drawings in IP units.
- 1.5 **FIELD DRAWINGS**
- 1.5.1 Submit, to the General Contractor, Drawings accurately showing all openings for ducts, pipes, etc. Drawings must include the size of openings and their locations by dimensions, including the location of the structural members framing these openings. Each trade will be responsible for detail layout of their own work.
- 1.5.2 Assume full responsibility for the detailed coordination of all Division 15 work. Prepare Field Drawings to determine the exact location of each service. On these Drawings, include all mechanical and electrical services, architectural features, and structural details. If a conflict becomes apparent after the installation of services, pay all costs associated with removing and reinstalling these services.
- 1.6 **RECORD DRAWINGS**
- 1.6.1 The Contractor will be provided with the Drawings.
- 1.6.2 Revise and maintain the prints as work progresses. Show all revisions, relocations and changes, to scale. Use colour markings.
- 1.6.3 Submit completed marked up Record Drawings to the Consultant.
- 1.6.4 For the purposes of Contract payments, Record Drawings and Manuals will be assumed to have a value of \$2,000.00. This will not be released until Record Drawings have been accepted as complete and acceptable by the Consultant.
- 1.7 **FIRESTOPPING**
- 1.7.1 Before starting any work on site, submit detailed Shop Drawings to the Consultant for review and comments. Include:
- 1.7.1.1 Manufacturer's technical product data and installation instructions for each specific

type and location of penetration.

- 1.7.1.2 Certification that proposed firestopping materials and assemblies comply with CAN4-115-M.
- 1.7.1.3 For each specific type and location of penetration, provide installation instructions from a recognized independent testing agency.
- 1.7.2 Mark penetration types and locations on set of white prints. At completion of project, transfer this information to Record Drawings.
- 1.7.3 Comply with all requirements of Ontario Building Code Clause 3.1.9, "Building Services in Fire Separations and Fire Rating Assemblies".

1.8 MAINTENANCE AND OPERATING INSTRUCTIONS

- 1.8.1 Assemble three sets of equipment literature (cuts), operating instructions, maintenance instructions, pressure test results, certificate, other pertinent data and Letter of Warranty. Place in three ring binders, complete with index pages, indexing tabs and cover identification at front and side. Submit to Consultant for approval. Make changes or submit additional information as required to obtain approval. Final Certificate of Completion will not be issued until the Consultant possesses three approved sets. Include copies of approved Shop Drawings and name and address of Spare Parts' Suppliers with manuals. Divide the maintenance manuals into the following sections:

Section 1 - General
Section 2 - Piping and Pumps
Section 3 - Heating
Section 4 - Automatic Controls

- 1.8.2 The following information is to be contained within the Sections:
- 1.8.2.1 **Section 1:** A list of names, addresses and telephone numbers of the Consultants, General Contractor and Mechanical Contractor. Written warranty of the Mechanical systems. A copy of the valve directory, giving number, valve location, normal valve position and purpose of valve.
- 1.8.2.2 **Sections 2 and 3:** A copy of all pressure tests and operational tests for pumping systems. A list of names, addresses and telephone numbers of all suppliers. A copy of all approved Shop Drawings.
- 1.8.2.2.1 A complete and comprehensive lubrication, maintenance and operating instructions details D (daily), W (weekly), M (monthly), SA (semi-annually), A (annually) schedule for maintenance and lubrication.
- 1.8.2.2.2 Copies of warranties.
- 1.8.2.3 **Section 4:** Complete control diagrams, wiring diagrams and description of control system and the functioning of the system.
- ## 1.9 REGULATIONS AND PERMITS
- 1.9.1 Carry out the work in accordance with the latest editions of relevant codes, local bylaws, and requirements of local authorities having jurisdiction. Apply for and obtain

any necessary permits. Pay any necessary fees.

1.9.2 Enforce all prevailing Provincial and local safety regulations at all times. Abide by all safety and security policies and procedures and conform to all regulations of the current Occupational Health and Safety Act.

1.9.3 Submit copies of CRN Certificates for all pressure vessels.

1.10 MATERIAL AND EQUIPMENT

1.10.1 Where an item of material or any equipment is specifically identified by a manufacturer's trade name and/or catalogue number, make no substitution except as provided for in paragraphs 3, 4 and 5 below.

1.10.2 In the case of some items of equipment, one or more additional names of acceptable equal manufacturers are listed in the Clause describing an item or a group of items. The design, layout, space allocation, connection details, etc., are based on the products named first in the description of each item. The products named first in the description of each item establish the quality of manufacture and design standards for all other manufacturers of that item. The general approval indicated by listing the names of other manufacturers is subject to final review of Shop Drawings, performance data, test reports, production samples (if required) by Consultant, and equipment shipped to site. Ensure that the products used meet the requirements specified and as shown on the Contract Drawings.

1.10.3 Suppliers wishing to submit other items of equipment for approval as an equal to those specified must apply to the Consultant at least 12 working days before Bid closing date. Requests must be accompanied by complete description and technical data on the items proposed. Approval for substitution of equipment will only be given on the understanding that all details, accessories, features and performance meet the Specifications unless otherwise stated. **Deviations from the Specifications must be stated in writing at time of application for approval.**

1.10.4 Include in the Bid, the equipment named in the Specifications or approved as an equal as in paragraph 3 above. This will form the **Base Bid**. Any number of alternative bids, as defined below, may be included in addition to the **Base Bid**.

1.10.5 Items of equipment by Manufacturers not named in the Specifications may be offered as **alternatives** to the manufacturers named in the Specifications. The alternative proposals must be accompanied by full descriptive and technical data, together with the statement of amount of addition or deduction from the Base Bid, if the alternative is accepted. Prior approval by the Consultant is **not** required on items submitted as alternative bids.

1.10.6 After execution of the Contract, substitution of equipment will be considered only if equipment accepted cannot be delivered in time to complete the work in proper sequence, or if the manufacturer has stopped production of the accepted item. In such cases, requests for substitution must be accompanied by proof of equality and difference in price and delivery, in the form of Certified Quotations from Suppliers of both specified and proposed equipment. Credit any decrease in price involved in substitution to the Owner by reduction of the Contract Price. The Contractor will **not** be reimbursed for any such increase in price.

1.10.7 Where equipment other than the equipment used as a basis for design, layout and space allocation is used, produce and submit revised layouts of equipment, pipes,

ducts, etc., in the areas affected. Submit these Drawings with the Shop Drawings. Failure to produce these Drawings is indication by the Contractor that they are not required and the original space allocations are adequate for the substituted equipment.

1.10.8 Name the Subcontractors and Manufacturers in the Bid as indicated in Clause "List of Mechanical Subcontractors and Manufacturers".

1.11 INTERPRETATION OF CONTRACT DOCUMENTS

1.11.1 The decision as to which trade provides required labour or materials rests solely with the Contractor. Extra payments will not be considered based on a difference in interpretation of the Contract Documents as to which trade involved provides materials or labour for specific items of work. The Consultant will not enter into such discussions.

1.12 WARRANTY

1.12.1 Warranty all workmanship and make good any defects for one year after Owner's takeover except where specifically specified otherwise. Warranty material and equipment supplied by the manufacturers for one year after Owner's takeover. Make good damage caused due to defects and workmanship.

1.12.2 Where equipment specified in Sections of Division 15 to have an extended warranty period, e.g. five years, the first year of the warranty period will be governed by the terms and conditions of the warranty in the Contract Documents, and the remaining years of the warranty will be direct from the manufacturer and/or supplier to the Owner. Submit signed and dated copies of the extended warranties to the Consultant before applying for a Certificate of Substantial Performance of the Work.

2 Products

2.1 MATERIALS

2.1.1 Use materials specified herein or approved equal as defined in Clause "Material and Equipment".

2.2 SLEEVES

2.2.1 Use minimum 22 gauge galvanized steel sleeves.

2.2.2 For rated separation requiring an F firestopping rating, use materials in conformance with manufacturer's recommendations.

2.3 FIRESTOPPING

2.3.1 Use only service penetration firestop components and assemblies tested in accordance with CAN4-S115-M "Standard Method of Fire Tests of Firestop Systems" and listed in most recent ULC "List of Equipment and Materials" or by another recognized independent testing and certification agency acceptable to the Consultant.

2.3.2 All pipe insulation passing through the fire separation to be approved with the listing of the firestop system.

2.3.3 Pipe sleeves through fire separations requiring a rating are to be installed as per firestopping manufacturer's recommendations, as some firestopping manufacturers do not allow pipe sleeves within their approved system. Confirm pipe sleeve compatibility prior to starting work on site.

2.4 ESCUTCHEON PLATES

2.4.1 Use chrome or nickel-plated brass, solid type, with set screws for ceiling or wall mounting.

2.5 ACCESS DOORS

2.5.1 Access doors to be flush to edge of frame, concealed continuous hinge with screwdriver operated cam latch. Non fire-rated door construction to be minimum 14 gauge, with 16 gauge frame. Fire-rated door construction to be a minimum 20 gauge insulated door with 16 gauge frame. Insulation thickness to provide required rating.

2.5.2 Size doors to allow adequate operating/maintenance clearance for devices. Doors to be a minimum 600 mm x 600 mm (24" x 24") for body entry, and 300 mm x 300 mm (12" x 12") for hand entry, unless noted otherwise. Use the following access doors:

2.5.3 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause "Material and Equipment":

Adam
Ancon LeHage
E. H. Price

2.6 ELECTRIC MOTORS

2.6.1 Unless specified otherwise, use CSA approved motors with the following characteristics:

370 watts (1/2 hp) and under - 115 volt, 60 hertz, single phase
560 watts (3/4 hp) and over - 208 volt, 60 hertz, three phase.

2.6.2 Motors 250 watts (1/3 hp) and under: Use continuously rated squirrel cage induction type with capacitor start, CEMA "N" starting characteristics and a minimum of Class "A" insulation, unless specified otherwise.

2.6.3 Motors 370 watts (1/2 hp) and over: Use continuously rated squirrel cage induction type with CEMA "B" starting characteristics and a minimum of Class "B" insulation.

2.6.4 Use drip-proof type motor with a 1.15 service factor, unless specified or required otherwise by the motor location. Totally enclosed motors must be fan cooled and have a 1.0 service factor.

2.6.5 Provide motors of adequate size and type for intended service. Unless stated otherwise, use ambient temperature of 40°C (104°F).

2.6.6 Unless specified otherwise, starters for electric motors will be provided by Division 16.

2.6.7 All motors 0.75 kW (1 hp) and above, use high efficiency type motors in accordance with ASHRAE/IES 90.1-1989 Standard. Submit with Shop Drawings the following information:

- Motor manufacturer's name
- Motor serial number
- Enclosure type
- Speed
- Efficiency nameplate reading

2.7 ELECTRICAL WIRING

2.7.1 Meet all requirements of Division 16 for all wiring included in Division 15 and pre-wired equipment provided by Division 15.

2.7.2 Ensure all pre-wired electrical equipment is CSA approved. Where this is not possible, arrange and pay for special Electrical Safety Authority approval.

2.7.3 All electrical wiring, both line voltage and low voltage, for equipment supplied by Division 15 is the responsibility of Division 15. Line voltage wiring from power panels to starters and from starters to motors will be supplied and installed by Division 16.

2.8 IDENTIFICATION NAME LABELS

2.8.1 Identification name labels, directional arrows and colour bands for piping to be plastic coated pressure sensitive "Brady" or "Westline" selfstick labels, waterproof, colourfast, dirt and grease resistant. For pipes up to and including 65 mm (2-1/2") diameter, use markers 28 mm (1-1/8") high. For pipes 80 mm (3") diameter and over, use markers 57 mm (2-1/4") high. For all exposed piping with a canvas covering, use Smillie McAdams Summerlin Coil - Mark pipe covers.

2.9 VALVE AND CONTROLLER TAGS

2.9.1 Use brass valve and controller tags with 32 mm (1-1/4") stamped code lettering and numbers filled with black paint. Hang a copy of the valve chart in Mechanical Room.

2.10 EQUIPMENT NAMEPLATES

2.10.1 Use minimum size 90 mm x 40 mm x 2.4 mm (3-1/2" x 1-1/2" x 3/32") thick laminated phenolic plastic nameplates with black face and white lettering. Lettering to be minimum 6 mm (1/4") high.

3 Execution

3.1 GENERAL

3.1.1 Instruct and supervise other Sections doing related work.

3.1.2 Supply the measurements of equipment to other Sections to allow for necessary openings to be left in the work of other Sections.

3.1.3 Install pipes, ducts and tubing, which are to be concealed, neatly and close to building structure so that the necessary furring can be kept as small as possible.

3.1.4 Install all ceiling components in direct accordance with reflected ceiling plans.

3.1.5 Mechanical Drawings show approximate locations for wall-mounted devices. Clarify exact location and mounting height with Consultant prior to roughing-in.

3.2 DISSIMILAR METALS

3.2.1 Separate dissimilar metals by means of gaskets or shims of approved material or use dielectric unions or flanges in order to prevent electrolytic action. Where piping of dissimilar metals is connected, use approved dielectric unions or couplings. A brass fitting or brass valve may also be used in making connections between copper and steel piping.

3.3 STORAGE OF MATERIALS

3.3.1 Provide proper weatherproof storage for the protection of materials and equipment on site. Blank off openings in all equipment until required for use.

3.4 SUPPORTS AND BASES

3.4.1 Provide structural work required for installation of equipment provided under this Division.

3.4.2 Where piping and/or equipment is to be supported by steel stud walls, use brackets and supports which attach to steel studs. Support equipment independently of wall sheathing.

3.5 CONCRETE WORK

3.5.1 Arrange for the supply and pouring of all concrete required for the Mechanical work. Include the cost of this in the Lump Sum Contract Price for the Mechanical work of this project.

3.5.2 Set all floor-mounted equipment on 100 mm (4") high concrete bases. Size concrete equipment bases to suit the equipment actually supplied and in accordance with the Shop Drawings of such equipment. Do not start concrete work until anchor bolts and other embedded parts required for the complete installation, as well as Shop Drawings, are available at the site.

3.6 SLEEVES

3.6.1 Provide sleeves for all pipes which pass through walls and floors.

3.6.2 Provide sleeves for insulated pipe large enough to permit free movement of pipe without crushing the insulation.

3.6.3 Provide sheet metal framing around ducts through masonry walls in exposed areas to ensure a clean finish around ducts.

3.7 FIRESTOPPING

3.7.1 Provide a listed firestop system in accordance with the Ontario Building Code to seal around all piping, tubing, ducts, conduits, electrical wires and cables, and other similar mechanical services which penetrate part of a building assembly required to have a fire resistance rating or a fire separation.

3.8 CUTTING AND PATCHING

- 3.8.1 Do not cut or drill holes through floors, roof or structural members before obtaining permission from the Consultant.
- 3.8.2 For penetrations through walls not required to have a fire rating, seal all spaces between pipe or pipe and surrounding wall construction with a fire-rated foam sealant. Use 3M Fire Barrier, Metacaulk, or Dow Fire Stop UL Classified fire rated foam sealants. Do this as the work progresses, to avoid leaving inaccessible holes at completion of the job. For penetrations through parts of the building assembly required to have a fire resistance rating or acting as a fire separation, see Clause "Firestopping" in this Section.
- 3.8.3 All cutting and patching to be done by the trade specializing in the materials to be cut.
- 3.8.4 Where pipes and ducts are shown on the Mechanical Drawings passing through existing walls, floors, and roof, cut and patch the necessary openings. Include the cost of all cutting and patching in the Lump Sum Contract Price for the work of Division 15. Before drilling holes through floors or roof slabs, accurately locate and note sizes for each required hole. Get approval of Consultant before any cutting is started. Electrical conduits with live wiring may be embedded in concrete floor slabs.
- 3.8.5 Remove and replace ceiling where necessary to complete the work of this Division unless this work is specifically included in another Division.
- 3.9 **ELECTRICAL WORK**
- 3.9.1 Perform all electrical work included in the work of this Division in accordance with the requirements of Division 16.
- 3.10 **PAINTING**
- 3.10.1 Touch up minor damage to finish on equipment supplied with factory applied baked enamel finish. Completely refinish items suffering damage which, in the opinion of the Consultant, is too extensive to be remedied by touchup.
- 3.10.2 Paint all steel framework provided by this Division with a chromium oxide primer.
- 3.11 **ACCESS DOORS**
- 3.11.1 Provide access doors wherever equipment, valves, dampers, life safety devices, etc., are concealed behind walls or inaccessible ceilings. All devices installed requiring periodic maintenance to be made accessible.
- 3.12 **IDENTIFICATION**
- 3.12.1 Identify all piping using name labels. Apply labels at 7 m (24') intervals and at all branch connections, valves, and access panel locations.
- 3.12.2 Mark each pipe in a space or area less than 7 m (24') at least once with a name label. Apply flow directional arrows beside each name label.
- 3.12.3 To ensure permanent bond, apply 3M Adhesive EC-1341 to the surface of the insulation or pipe material. Apply the label with its own adhesive on this surface. Remove any labels "lifting" or "peeling". Clean the surface and repeat the procedure specified with a new label. Where labels do not adhere, use pipe banding tape

spirally wrapped for full length of label. Apply label over the banding tape.

3.12.4 Provide nameplate identifying equipment type, identification number, service and area served on each piece of mechanical equipment.

3.12.5 Identify all manual and automatic control valves on all systems using brass tags attached with non-ferrous chains. Prepare a schedule of all tags for each system showing designating number, service and function. Include these schedules in the Operating and Maintenance Manuals and in the Mechanical Room.

3.13 PIPING

3.13.1 General

3.13.1.1 Install all above ground piping parallel to building walls and partitions.

3.13.1.2 In locations where space is provided for future or other equipment requiring connection to systems installed under this Contract, install services with shutoff valves and caps to allow connection to the system without interruption.

3.13.2 **Drain Hose Connections:** Provide drain hose connections at the base of all risers, on the suction side of all pumps and in all locations shown on Drawings.

3.13.3 Supports and Hangers

3.13.3.1 Provide all hangers, supports and sway braces in accordance with A.N.S.I. B31.3.

3.13.3.2 Use Anvil beam clamps.

3.13.3.3 Use line size adjustable wrought steel clevis type hangers for horizontal piping 32 mm and less (1-1/4" and less). For copper pipe, wrap pipe with tape at all hangers or use Anvil Figure CT-99C adjustable tubing ring hangers.

3.13.3.4 For piping 40 mm and over (1-1/2" and over) use adjustable wrought steel clevis type hangers large enough for pipe insulation. See Section 15260 for insulation shields.

3.13.3.5 Unless specified otherwise, support piping at maximum spacing as shown and within 460 mm (18") of each side of all valves and bends.

3.13.3.6 Do **not** support piping from other piping or equipment, or from metal roof decking.

3.13.3.7 Schedule:

Pipe Size in	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4 to 8 incl.	10 & Over
Max. Span ft	6	7	8	8	10	11	12	14	20

3.13.4 **Provision for Expansion:** Make proper allowance for thermal expansion and

contraction whether shown on the Drawings or not.

3.14 INSPECTION AND TESTING

3.14.1 **General:** Inspect and test all piping. Repair any leaks and retest until satisfactory. Do not cover or close in piping until inspection and tests are completed. Thoroughly test all systems before making arrangements for the final demonstration in the presence of the Owner's staff. At the completion of the work, demonstrate operation of **all** systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found and retest.

3.14.2 **Soil, Waste, Vent and Building Drains:** Seal all openings in section under test, then fill with water to a height of 3 m (10') above top of section. Maintain water level for at least two hours. Test in sections as the work progresses. After all fixtures have been placed, apply a smoke test to the satisfaction of the local Plumbing Inspector.

3.14.3 H. W. Heating and Domestic Water

3.14.3.1 Apply a hydrostatic test of 1034 kPa (150 psig) or 1-1/2 times working pressure, whichever is greater, for two hours.

3.15 START-UP SERVICES

3.15.1 Provide the services of a qualified person to be in the building after work of this Contract is taken over by the Owner. Assist Owner's staff to become familiar with the system operation.

3.16 WELDING

3.16.1 Perform welding to CSA W59-M (for steel) or CSA W59.2-M (for aluminum) materials and methods. Have welding performed by tradesmen certified to CSA W47.1 or CSA W47.2-M.

3.17 PLACING IN OPERATION

3.17.1 Upon completion of all work and before turning over the job, test each system for proper operation.

3.17.2 Open and clean all new and existing traps, strainers and scale pockets after two weeks' operation.

3.18 MAINTENANCE OF EXISTING SERVICES

3.18.1 Take every precaution to locate and protect existing services so that no unscheduled interruption occurs. If any existing service is damaged due to the work of this Division, arrange and pay for repair. Bear any costs due to interruption of existing services.

3.18.2 Permission from the Consultant is required before making any connections to or rerouting of existing services. Give one week's prior notice to the Consultant and Owner.

3.19 REMOVAL OF EXISTING MATERIAL AND EQUIPMENT

-
- 3.19.1 Remove existing material and equipment where shown or specified. Unless noted or specified otherwise, all material and equipment which is removed becomes the property of the Contractor and must be immediately removed from the site.
- 3.19.2 The Owner may ask for the hand over of valves, controls, pumps, boiler components, etc. being removed in this project. The Owner will indicate these items before demolition starts.
- 3.20 **TESTING**
- 3.20.1 All systems must be thoroughly tested by the Technical Representative of the system manufacturers before arrangements are made for the final demonstration in the presence of the Owner's staff.
- 3.20.2 At the completion of the work, demonstrate operation of all systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found.
- 3.21 **LIST OF MECHANICAL SUBCONTRACTORS AND MANUFACTURERS**
- 3.21.1 In the Bid documents, name the Subcontractors and Manufacturers for the items listed below. Use only one name for each item. See Clause "Material and Equipment".
- 3.21.2 **Subcontractors**
- Electrical Contractor
Insulation Contractor
Roofing Contractor
- 3.21.3 **Manufacturers**
- Boilers

END OF SECTION

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- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 15001, "Mechanical General Provisions".
- 1.2 **DESCRIPTION OF SYSTEMS**
- 1.2.1 **Heating System:** New boilers will replace existing boilers.
- 2 Products
- 2.1 **GENERAL**
- 2.1.1 Furnish all test equipment. All equipment will remain the property of the testing and balancing company. Use recently calibrated instruments. Provide verification of calibration to the Consultant when requested.
- 2.1.2 Approved testing and balancing companies for this project are:
- Accu-Air Balance
Air Audit
Caltab Air Balance
C. J. Zettler & Associates Ltd.
- 2.2 **MATERIALS**
- 2.2.1 Use materials specified herein or approved equal as defined in Section 15001, "Mechanical General Provisions", Clause "Material and Equipment".
- 3 Execution
- 3.1 **GENERAL**
- 3.1.1 Include all labour, engineering and test equipment required to adjust and balance all heating equipment installed or altered under this Contract.
- 3.1.2 Ensure that all control valves, devices and equipment interlocks are operating in the manner required for the correct performance of the systems.
- 3.2 **JOB CONDITIONS**
- 3.2.1 Schedule this work in cooperation with other trades involved.
- 3.2.2 Do not begin testing and balancing until the systems have been completely installed, tested and put in running order. Correct operation of equipment and system components and cleanliness of piping is the responsibility of the appropriate trade.
- 3.3 **SUBMITTALS**
- 3.3.1 Record all test data and submit four copies of completed reports to the Consultant.
- 3.3.2 Use data sheets which are approved by the Consultant to record measurements. Include schematic diagrams of all systems identifying branches, inlets, outlets and equipment. Submit sample sheets for review using same procedure as for Shop

Drawings.

3.3.3 Provide a Deficiency List to the Contractor for all materials and installation methods which are found not to be complying with the Specifications and, where specified, quantities could not be achieved within the required tolerances. Submit copy of Deficiency List to the Consultant at the same time it is issued to the Contractor.

3.3.4 Submit report.

3.4 HEATING SYSTEM

3.4.1 Prior to testing and balancing of the heating system.

3.4.1.1 Verify that all strainers are clean.

3.4.1.2 Check expansion tank and ensure that the system is not air bound and is completely filled with water as required.

3.4.1.3 Check air vents at coils and high points of the systems to verify that all are installed and operating freely.

3.4.2 Measure and adjust circulating water pump flow capacities to design quantities.

3.4.3 Mark and record flow readings of balancing devices. Where flow measuring devices are not installed, balance using design temperature differences.

3.4.4 Record data as specified in Clause "Balancing Data".

3.5 BALANCING DATA

3.5.1 Include the following information in the test report:

3.5.1.1 **Motors:**

Manufacturer
Model and/or Serial Number
Rated amperage and voltage
Rated kW (hp)
Rated rpm
Corrected full load amperage
Measured amperage and voltage
Calculated kW (hp)
Measured rpm
Sheave size, type and manufacturer

3.5.1.2 **Pumps:**

Manufacturer
Model and/or Serial number
Rated flow rate
Rated Head
Measured discharge pressure (full flow and no flow)
Measured suction pressure (full flow and no flow)
Measured L/s (gpm)
Operating Head

Operating rpm
Performance curve by manufacturer

3.5.1.3 **Testing and Balancing Instruments:**

Types
Serial Numbers
Dates of calibration

3.6 **FINAL INSPECTION AND ACCEPTANCE**

3.6.1 After submission of balancing report, arrange a final inspection with the Consultant.

3.6.2 At final inspection recheck points or areas selected by the Consultant.

END OF SECTION

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- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 15001, "Mechanical General Provisions".
- 1.1.2 Under no circumstances may any insulation product containing asbestos fibre be used on this project.
- 1.1.3 **Submittals:** Provide product description, List of Materials and thickness for each service or equipment schedules, locations and manufacturers's installation instructions.
- 1.1.4 **Environmental Requirements:** Maintain ambient temperature and conditions required by manufacturers of adhesives, mastics and insulation cements.
- 1.1.5 **Quality Assurance:** Insulation materials must be manufactured at facilities certified and registered with an approved Registrar to conform to ISO 9000 Quality Standard.
- 1.1.6 **Delivery and Storage of Materials:** Deliver all materials to the job site and protect the insulation against dirt, water, chemical and mechanical damage before, during or after installation. DO NOT INSTALL damaged insulation and remove it from the Job Site.
- 1.1.7 Deliver insulation, coverings, cements, adhesive coatings, etc., to the site in Fabricated-Factory Containers with the manufacturer's stamp or label affixed showing fire hazard ratings of the products, name of manufacturer and brand.
- 1.1.8 Installed insulation which has not been weatherproofed to be protected from inclement weather by an approved waterproof sheeting installed by the Contractor. The Contractor will remove or replace, at no additional cost, any water damaged insulation.
- 1.2 **DEFINITIONS**
- 1.2.1 In this Specification, "exposed to view" means all services within Equipment Rooms, Service Corridors, plus all other areas of the building where the services are not enclosed within ceilings or shafts.
- 1.2.2 In this Specification, "exposed to weather" means all services located outdoors without an architectural enclosure. It **also** refers to ductwork inside horizontal and vertical architectural enclosures across the roof and down the faces of the building.
- 1.3 **DESCRIPTION OF SYSTEMS**
- 1.3.1 **Piping Systems**
- 1.3.1.1 Completely insulate the following piping systems:
- Hot Water Heating
 - Domestic Cold Water
 - Domestic Hot Water
- 1.3.1.2 Use the following Mean Rating Temperatures when selecting insulation thicknesses:

Hot Water Heating : 60 - 93°C (141 - 200°F)

1.3.1.3 Insulate the combustion air ductwork.

1.3.2 **Existing Services:** Where connections are made to existing systems, or where damage occurs to existing insulation due to the work of this Contract, repair in accordance with this Section.

1.3.3 **Supply, Return, Exhaust and Outside Air Duct Systems**

1.3.3.1 Externally insulate ductwork exposed on the roof.

1.3.3.2 Externally insulate all combustion air intake ductwork.

1.4 **ASBESTOS INSULATION**

1.4.1 The project areas may contain asbestos insulation. The Owner is responsible for removal of insulation prior to the Contractor starting work. Allow a minimum of one week after school is out to allow Owner's forces to remove insulation containing asbestos.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001, "Mechanical General Provisions", Clause "Material and Equipment".

2.2 **AIR DUCTS**

2.2.1 On rectangular ducts exposed to weather, use Johns Manville Spin Glas Type 817 rigid fibreglass insulation board, 96 kg/m³ (6 lb/ft³) density, with FSK facing. Product must meet the requirements of ASTM C 612, and include aluminum foil vapour barrier reinforced with fibreglass scrim and laminated to a fire resistant kraft facing. Maximum thermal conductivity 0.032 W/mEC (0.22 Btu-in/hr²ft²°F) at 24°C (75°F) mean temperature. Use 80 mm (3") thickness.

2.3 **PIPING INSULATION INSERTS**

2.3.1 Make rigid insulation inserts equal in thickness to the adjoining insulation. Use Johns Manville Thermo 12/Gold hydrous calcium rigid pipe insulation. Minimum width should be equal to 50% of pipe circumference. Use the following insert lengths:

Nominal Pipe Size		Insert Length	
mm	(inches)	mm	(inches)
40 - 65	(1-1/2 - 2-1/2)	250	(10)
80 - 150	(3 - 6)	300	(12)
200 - 250	(8 - 10)	400	(16)
300 and over	(12 and over)	560	(22)

2.4 **PIPING INSULATION INSERT SHIELDS**

2.4.1 Use minimum 18 gauge galvanized metal shields. Form shields to fit insulation and extend up to the pipe centre line. Make length 100 mm (4") less than length of

associated insert.

2.4.2 Use steel pipe covering protection saddles when roller hangers and pipe roll supports are specified in Section 15001

2.5 PIPE INSULATION

2.5.1 Piping

2.5.1.1 Use Johns Manville Micro-Lok glass fibre insulation with factory applied AP-T Plus jacket. Insulation must be CAN/ULC S-102-M88 approved.

2.5.1.2 On cold systems, vapour barrier performance is extremely important. All penetrations of outer jacket and exposed ends of insulation to be sealed with vapour barrier tape or mastic. Vapour seals at butt joints and at each fitting to provide isolation of water incursion.

2.5.1.3 In areas exposed to view, finish with Johns-Manville, Zeston 2000 PVC (20 mil) 0.51 mm thickness "Cut and Curled" jacketing. Use Zeston "Perma-Weld" solvent welding adhesive to permanently seal all PVC joints. Use colours as specified.

2.5.2 Valves and Fittings

2.5.2.1 For pipe sizes 50 mm (2") and smaller use mitered sections of insulation equivalent in thickness and composition to installed on straight pipe runs. Seal all fitting joints with approved sealing tape or vapour retarder mastic compound.

2.5.2.2 For pipe 65 mm (2-1/2") and larger insulate with pre-formed fibreglass fittings or fabricated sections of blanket insulation. Thickness to be equal to adjacent pipe insulation. Finish with Johns Manville Zeston 2000 PVC, (20 mil) 0.51 mm thickness fitting covers.

2.5.3 **Pipe Thickness Schedule****Pipe Insulation Schedule - Imperial**

Fluid Design Operating Temperature Range (°F)	Insulation Conductivity		Nominal Diameter (in)				
	Conductivity Range Btu-in/ (hr.ft ² °F)	Mean Rating Temperature (°F)	less than 1	1 and 1-1/4	1-1/2 to 3	4 to 6	8 & up
Heating Systems (Steam, Steam Condensate, Hot Water & Combined Heating/Cooling)							
141 - 200	0.25 - 0.29	125	1.0	1.0	1.5	1.5	1.5
Domestic and Service Hot Water Systems							
105 & greater	0.22 - 0.28	100	1.0	1.0	1.5	1.5	1.5
Domestic Cold Water (Sanitary, Storm and Condensate Drains)							
40 - 75	0.23 - 0.27	75	1.0	1.0	1.0	1.0	1.0

2.6 **LAGGING ADHESIVE**

2.6.1 Use Bacon 120-18 or Childers CP52 adhesive which meets NFPA 90A Code, 25/50 flame spread/smoke developed.

2.7 **EQUIVALENT MANUFACTURERS**

2.7.1 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause "Material and Equipment":

Johns Manville
Knauf
Roxul
Manson
Owens Corning
Kooltherm

3 Execution

3.1 **GENERAL**

3.1.1 Install all insulation in strict accordance with manufacturer's published recommendations.

3.1.2 Install all insulation continuous through walls and sleeves.

3.1.3 Do not apply insulation until piping has been tested and approved.

3.1.4 Do not insulate unions or flanges at connections to equipment. In these locations, and in all other locations where insulation ends, finish with vapour resistant mastic.

3.1.5 Insulate ALL components of insulated systems unless specifically excluded.

-
- 3.1.6 Extend all surface finishes to protect all surfaces, ends and raw edges of insulation.
- 3.1.7 Patch and make good any existing insulation and covering which is damaged during the work of this Contract. Use material of the same quality as existing.
- 3.2 **PIPING SYSTEMS**
- 3.2.1 Insulate the following piping systems in their entirety:
- hot water heating
 - domestic cold water
 - domestic hot water
- 3.2.2 **Insulation Application**
- 3.2.2.1 **Hanger Points:** Provide an insulation insert and shield at each hanger point on all systems. On cold lines, vapour seal butt joints on each side of insert.
- 3.2.2.2 **Pipe:** Apply insulation over clean dry pipe. Butt all joints firmly together. Seal all jackets neatly in place. Wrap butt joints with a minimum 75 mm (3") wide strip of the jacketing material. Use a vapour barrier adhesive on all "cold" lines and dual temperature systems.
- 3.2.2.3 **Fittings and Valves**
- 3.2.2.3.1 For pipe sizes 40 mm (1-1/2") and smaller, insulate with fibreglass blanket wrapped firmly under compression (minimum 2:1) to a thickness matching adjoining insulation. Secure with 20 gauge galvanized annealed steel wire. Finish with a smoothing coat of finishing cement or PVC jackets.
- 3.2.2.3.2 For pipe sizes 50 mm (2") and larger, insulate with segments of moulded insulation. Secure with 20 gauge galvanized annealed steel wire. Finish with a smoothing coat of finishing cement.
- 3.2.2.3.3 On all "cold" systems, vapour seal the insulation covering fittings and valves with a layer of 20/10 open weave glass cloth embedded between two 3.0 mm (1/8") thick coats of mastic. Lap the sealed glass cloth at least 50 mm (2") on each side of the adjoining insulation. This applies to:
- domestic cold water
- On components which require service, fabricate easily removable and reusable insulation sections e.g. suction guides for circulating pumps and pump casings. Test ports on balancing valves to be accessible outside of insulation.
- 3.2.3 **Pipe Insulation Covering:** In all locations where the insulation will be exposed to view, finish with PVC insulation covering. Follow strictly manufacturer's installation procedures for cold and hot systems. Use white covering.
- 3.3 **AIR DUCTS**
- 3.3.1 **General**
- 3.3.1.1 Seal all vapour retardant jacket seams and penetrations with UL Listed tape and adhesive.

3.3.1.2 Externally insulate ductwork exposed on the roof.

3.3.1.3 Externally insulate all combustion air intake ductwork.

3.3.2 **Application**

3.3.2.1 On rectangular ducts, use adhesive and impale insulation over mechanical fasteners. Provide 100% coverage of adhesive on sheet metal, all exposed insulation edges, and all transverse joints. Provide mechanical fasteners per Insulation Manufacturer's published recommendations. Insulate behind duct balancing damper operators.

3.3.3 **Finish**

3.3.3.1 Where insulation is exposed to the weather, finish with aluminum jacket over insulation with 15 mm x 0.38 mm (1/2" x 0.015") stainless steel banding at 1220 mm (4') O/C. Overlap all joints at least 80 mm (3") with longitudinal joint lapped to the weather.

3.4 **COMBUSTION AIR DUCTS**

3.4.1 **General**

3.4.1.1 Use pre-formed insulation with vapour retardant all purpose jacket. Seal all vapour retardant jacket seams and penetrations with UL Listed tape and adhesive.

3.4.2 **Application**

3.4.2.1 Insulate and finish combustion air ducts in same manner as piping. Apply insulation to the first 10' of duct adjacent to the outside wall.

END OF SECTION

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- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 15001, "Mechanical General Provisions".
- 1.2 **DESCRIPTION OF SYSTEMS**
- 1.2.1 **Domestic Water:** Provide a sink and eye wash station in the Mechanical Rooms and water connections as shown and/or as specified.
- 1.2.2 **Sanitary Drainage:** Provide soil and waste drainage system complete with connections to fixtures and equipment as shown and/or as specified.
- 1.3 **SHOP DRAWINGS**
- 1.3.1 Submit Shop Drawings in accordance with Section 15001, "Shop Drawings" for the following equipment and materials:
- Neutralizing Tank
 - Backflow Preventer
- 1.3.2 Provide the manufacturer's name, only, for the following components:
- Valves
- 2 Products
- 2.1 **MATERIALS**
- 2.1.1 Use materials specified herein or approved equal as defined in Section 15001, "Mechanical General Provisions", Clause "Material and Equipment".
- 2.2 **PIPE AND FITTINGS**
- 2.2.1 Select the most economical use of the materials named below. Unless specified or shown otherwise, either material may be used or a combination of materials, whichever provides the greatest economy.
- 2.2.2 **Domestic Water Piping**
- 2.2.2.1 **Pipe Above Grade:** Copper, Type "L" with soldered joints.
- 2.2.3 **Natural Gas Piping:** Schedule 40 wrought iron or steel pipe with malleable iron or steel fittings.
- 2.2.4 **Sanitary Drainage Piping (Including Vent Piping):** Use cast iron Class 4000 with mechanical joints, or copper type DWV with soldered joints. For below grade sanitary piping, use PVC pipe in accordance with ASTM Standard D3034 and CSA B182.1.
- 2.3 **FLOOR DRAINS**
- 2.3.1 **Mechanical Room:** Watts Ancon FD-300-50 cast iron floor drain with adjustable

180 mm (7") diameter CI strainer and heavy duty cast iron grate.

- 2.3.2 **Funnel Floor Drains in Finished Floor (Drawing Reference FFD):** Watts Ancon FD-200-EG-1 cast iron floor drain with adjustable heavy duty cast iron grate. Provide separate cast iron "P" trap and Type NB, 100 mm x 230 mm (4" x 9") oval funnel.

2.4 VALVES

- 2.4.1 Use valves of same manufacturer except where approved otherwise by the Consultant.

- 2.4.2 Use only industrial class valves complying with MSS Specification SP-80.

- 2.4.3 Unless otherwise specified, use valves designed for 1380 kPa (200 psig) cold water minimum. Use rising stem where space permits. Use flanged, screwed, or soldered ends to suit pipe lines, and non-heating malleable iron handles. Use valves which are repackable under pressure.

2.4.4 Domestic Water Systems (Hot and Cold):

Compression stops size 15 mm (1/2") and 20 mm (3/4") Copper pipe: Emco Figure 10120

Gate valves, size 80 mm (3") and smaller Copper pipe: Jenkins 313J

Ball valves, size 50 mm (2") and smaller Copper Pipe: Jenkins Figure 202J
Equal: Crane, Dahl, Watts, Worcester

Globe valves Copper Pipe: Jenkins 106BJ

- 2.4.5 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Crane	(Industrial Class)
Jenkins	(Industrial Class)
Kitz	(Industrial Class)
Newman Hattersley	(Industrial Class)
Red & White	(Industrial Class)

2.4.6 Natural Gas Systems:

Shutoff Valves (line) CGA approved, heavy duty, lubricated plug cock type, bronze, 860 kPa (125 psig).

Shutoff Valves (appliance) CGA approved spring-loaded plug type with hooded handles.

2.5 BACKFLOW PREVENTERS

- 2.5.1 **Double Check Valve Type (DCVA):** Watts No. 709 double check valve assembly, tested and certified under A.S.S.E. Standard 1015 and CSA B64.5, with brass or cast epoxy coated body and stainless steel working parts, strainer and primary and secondary check valves. Check valve seats and disks to be replaceable.

2.5.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Conbraco
Wilkins/Zurn
Febco

2.6 ACID NEUTRALIZING TANK

2.6.1 See Drawings for details.

2.7 PLUMBING FIXTURES

2.7.1 General

2.7.1.1 Use factory chrome plated items for all visible parts of the fixture trim including faucets, escutcheons, waste, strainers, traps, supplies, stops, etc.

2.7.1.2 Unless specified otherwise, the following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

- Plumbing Brass - American Standard, Chicago Faucet, Delta Commercial, Moen Commercial, Zurn, Kohler, T&S
- Stainless Steel Sinks - Architectural Metal Industries, Franke/Kindred Canada

2.7.2 Wall Mount Sink (Drawing Reference SS1)

2.7.2.1 **Sink:** Franke Kindred Aristaline WHB1819, 469 mm x 482 mm x 178 mm (18-1/2" x 19" x 7") 18 gauge type 304 stainless steel single bowl wall mount sink with back ledge drilled for 100 mm (4") centre faucet set, and one piece wall hanger.

2.7.2.2 **Faucet:** Chicago Faucets Ecast 895-GN1AVPA-369CP deck mounted faucet, chrome plated, 100 mm (4") centres, solid cast brass lead-free body, 1/4 turn ceramic disc valve cartridges, 100 mm (4") cast brass rigid gooseneck spout with 8 lpm (2.2 gpm) flow aerator outlet and cast brass lever handles.

2.7.2.3 **Supplies:** McGuire H170BVRB supplies, heavy pattern, chrome plated, polished, short rigid horizontal integral sweat tubes with vandalproof loose key ball valve angle stops, escutcheons and braided flexible risers.

2.7.2.4 **Drain:** McGuire 155A drain, chrome plated with open grid strainer. McGuire 8872C P Trap, 32 mm (1 1/4"), chrome plated, polished cast brass with cleanout and escutcheon.

2.7.3 **Eyewash Station (Drawing Reference EW1):** Haws 7460BT twin head eye wash, stainless steel bowl, chrome plated tailpiece and trap, head dust covers, stainless steel push flag, stay open valve, emergency sign, automatic pressure control.

3 Execution

3.1 SANITARY PIPING

3.1.1 Where pipe sizes are not shown on the Drawings and are not specified, size in accordance with the requirements of the Ontario Plumbing Code.

3.1.2 Use the following minimum slopes on horizontal drains:

Fixture waste or drains	2%
Drains up to and including 80 mm (3")	2%
Drains 100 mm (4") and up to 150 mm (6")	1%
Drains over 150 mm (6")	0.5%

3.2 UNIT DRAIN CONNECTIONS

- 3.2.1 Connect up all from boilers, etc. Run drains to combination drains without crossing or interfering with walkways.

3.3 WATER PIPING

- 3.3.1 Use only solder and fluxes containing less than 0.2% lead.
- 3.3.2 Connect required service to plumbing fixtures, hose bibbs, etc., as shown or as specified.
- 3.3.3 After installation, thoroughly flush out complete system of water piping and remove all scale, etc.

3.4 NATURAL GAS PIPING

- 3.4.1 Install in accordance with the latest C.G.A. Code for Gas Piping, B149, and subsequent supplements and the latest Ministry of Energy & Resources Management Regulations.
- 3.4.2 Provide shutoff valves and cap off where shown on Drawings.
- 3.4.3 Install all piping which is concealed in concrete or masonry walls, or piping which passes through walls or floors, in pipe sleeves so that pipe can be removed or tested in compliance with Code.

3.5 VALVES

- 3.5.1 Install a valve at takeoff point in each main branch which takes off from main and in all locations shown.
- 3.5.2 Install drain valves with hose connections at all low points and at all branch valves for upfeed risers.
- 3.5.3 Use line size valves unless noted otherwise.
- 3.5.4 Use compression stops or ball valves on 15 mm (1/2") and 20 mm (3/4") sizes and gate valves on larger size pipe.

3.6 STERILIZATION OF POTABLE WATER SYSTEMS

- 3.6.1 Thoroughly flush the domestic hot and cold water piping systems using clean potable water to remove dirt and other contaminants. Remove all faucet screens prior to flushing and reinstall after completion of flushing.
- 3.6.2 Disinfect domestic hot and cold water piping systems using a liquid chlorine solution. Introduce the liquid chlorine to ensure the chlorine is distributed throughout the sections being tested. Apply chlorine to achieve a minimum chlorine concentration

of 10 mg/L throughout the sections being tested. Leave the 10 mg/L chlorine solution in place for 24 hours.

- 3.6.3 Test the chlorine residual after 24 hours. If tests show a minimum chlorine residual of 5 mg/L, flush the disinfected sections and recharge with potable water. If the chlorine residual is found to be less than 5 mg/L, repeat the disinfecting procedure until satisfactory results are obtained.
- 3.6.4 After the systems have been flushed and recharged with potable water, arrange and pay for bacteriological tests to be conducted by an independent testing agency. Provide certified reports. If there is evidence of contamination, repeat the disinfecting procedure until satisfactory results are obtained. Obtain the Building Inspector's permission before placing the systems in normal operation.

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- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 15001, "Mechanical General Provisions".
- 1.2 **DESCRIPTION OF SYSTEMS**
- 1.2.1 **Hot Water Heating Systems:** Four heating water boilers are being replaced.
- 1.3 **SHOP DRAWINGS**
- 1.3.1 Submit Shop Drawings in accordance with Section 15001, Clause "Shop Drawings", for the following equipment and materials:
- Air Separators
 - Automatic Air Vents
 - Combination Shutoff and Balancing Valves
 - Expansion Tanks
 - Gauges
 - Pumps
 - Strainers
 - Thermometers
 - Unit Heaters
 - Valves
 - Boilers
- 2 Products
- 2.1 **MATERIALS**
- 2.1.1 Use materials specified herein or approved equal as defined in Section 15001, "Mechanical General Provisions", Clause "Material and Equipment".
- 2.2 **PIPING AND FITTINGS**
- 2.2.1 **General**
- 2.2.1.1 Use the following materials for all piping systems provided by this Section.
- 2.2.1.2 Use long radius elbows. Use manufactured tees.
- 2.2.2 **Water Piping for Sizes 50 mm (2") and Smaller.** Use either copper or steel pipe as follows:
- 2.2.2.1 **Copper**
- Pipe** - Type L hard drawn copper
Joints - Solder
Fittings - Wrought copper or cast bronze
Unions - 1030 kPa (150 psig) octagon end, bronze
- 2.2.2.2 **Steel**

Pipe - Black steel, Schedule 40, ASTM A-53

Joints - Screwed

Fittings - 860 kPa (125 psig) cast iron

Unions - 1030 kPa (150 psig) malleable iron, brass to iron ground joint seat

2.2.3 **Water Piping for Sizes 65 mm (2-1/2") and Larger:**

Pipe - Black steel, Schedule 40.

Joints - Welded and flanged.

Fittings - 1030 kPa (150 psig) Schedule 40, steel.

Unions - 1030 kPa (150 psig) slip-on.

2.3 **VALVES**

2.3.1 **General**

2.3.1.1 Use the following valves for all piping systems provided by this Section, unless specified otherwise.

2.3.1.2 Use only industrial class valves meeting ANSI, ASTM, ASME and applicable MSS standards. Specification MSS-SP-80, MSS-SP-110, MSS-SP-70, 85, 71, MSS-SP-72, MSS-SP-67, API 602, API 598, API 609, API 600.

2.3.2 **Gate Valves**

2.3.2.1 **Copper Pipe:** Use 1380 kPa (200 psig) W.O.G. bronze valves with solder ends and rising stem, Kitz 44, Toyo 299, Jenkins Figure 813J,

2.3.2.2 **Steel Pipe**

2.3.2.2.1 For sizes less than 50 mm (2"), use 1380 kPa (200 psig) W.O.G. bronze valves with screwed ends, solid wedge and rising stem, Kitz 24, Toyo 293, Jenkins Figure 810J.

2.3.2.2.2 For sizes 65 mm (2-1/2") and larger, use 1380 kPa (200 psig) W.O.G. O.S.&Y. valves with flanged ends, iron body, bronze trim, solid wedge and rising stem, Kitz 72, Toyo 421A, American Valve 4000 Cast Iron, Jenkins Figure 454J.

2.3.3 **Globe Valves**

2.3.3.1 **Copper Pipe:** For sizes 50 mm (2") and under use 2070 kPa (150 psig) / 300 W.O.G. bronze body to ASTM B62, rising stem, union bonnet, bronze trim, composition Teflon disc with solder ends. Kitz 10, Toyo 222, Jenkins 106-BPJ.

2.3.3.2 **Steel Pipe**

2.3.3.2.1 For sizes 50 mm (2") and under use 2070 kPa (300 psig) / 600 W.O.G. bronze body to ASTM B61, rising stem, union bonnet, stainless steel plug and seat ring with screwed ends. Kitz 17S, Toyo 335, Jenkins 2032J.

2.3.3.2.2 For sizes 65 mm (2-1/2") and larger, use Class 125 / 200 W.O.G. cast iron body to ASTM A126 Class B, bronze trim, OS&Y, flanged, solid plug type disk and rising stem. Kitz 76, Toyo 400A, Jenkins 2342J.

2.3.4 **Check Valves**

2.3.4.1 **Copper Pipe:** For sizes 50 mm (2") and under use 860 kPa (125 psig) / 200 W.O.G. bronze body to ASTM B62 Y-pattern swing type disc, screw cap, bronze trim valves with solder ends. Kitz 23, Toyo 237, Jenkins 4093J..

2.3.4.2 **Steel Pipe**

2.3.4.2.1 For sizes 50 mm (2") and under use 860 kPa (125 psig) / 200 W.O.G. bronze body to ASTM B62 Y-pattern swing type disc, screw cap, bronze trim valves with screwed ends. Kitz 22, Toyo 236, Jenkins 4092J.

2.3.4.2.2 For sizes 65 mm (2-1/2") and over, use Class 125 / 200 W.O.G. cast iron body to ASTM A126 Class B, bronze trim, bolted cover, swing type disc, flanged. Kitz 78, Toyo 435A, Jenkins 587J.

2.3.4.3 **On Pump Discharge**

2.3.4.3.1 For sizes 50 mm (2") and under, use 1030 kPa (150 psig) APCO or Mueller Steam Specialty spring checks.

2.3.4.3.2 For sizes 65 mm (2-1/2") and over, use 1030 kPa (150 psig) Moygro, Mueller Steam Specialty, Duo-Check or Bell & Gossett spring checks.

2.3.5 **Ball Valves**

2.3.5.1 Use 4052 kPa (600 psig) W.O.G., compact pattern bronze ball valves with stainless steel trim. Use valves with extension stems when installed in insulated piping. Jenkins Figure 202SJ or 201SJ, Kitz 68 AMLL or Kitz 69 AMLL.

2.3.6 **Drain Hose Connections:** Use ball valves: Kitz 68AC, Toyo 5046, Apollo 78-100-01, complete with No. 658 cap and chain.

2.3.7 **Butterfly Valves**

2.3.7.1 For sizes 300 mm (12") and smaller, use iron body valves with 2" extended neck to allow for insulation, lug type having bi-directional pressure rating of 1380 kPa (200 psi). Stem to be stainless steel with positive retention mechanism. Valve to have aluminum bronze disc and molded or bonded style EPDM seat. Valve to be capable of providing bi-directional "Dead End Service" at full rated pressure with the down stream flanged removed. Valve is suitable for both chilled water and hot water operation. Valve to be manufactured in accordance to MSS-SP-67, MSS-SP-25 and API-609.

2.3.7.2 Provide lever on sizes 50 mm (2") to 100 mm (4"). On valves 150 mm (6") and over use manual gear operators. Gear operators to be permanently lubricated, self-locking, with large size position indicator and 330 mm (13") wheels.

2.3.8 The following manufacturers of the above items of equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Gate, Globe and Check Valves

Kitz,
Jenkins
Toyo
Crane
Nibco

Newman Hattersley
American Valve 4000 Cast Iron (Gate)

Ball Valves

Kitz,
Jenkins
Toyo
Crane
Nibco
Newman Hattersley
Apollo
Milwaukee

Butterfly Valves

Centerline
Challenger Valve
Crane
Jenkins
Kitz
Victaulic
Newman Hattersley
Bray Controls/Stealth Valve
Nibco
Toyo Red & White

2.3.9 **Combination Balancing and Shutoff Valves**

2.3.9.1 Use Tour & Andersson Inc. STA-D and STA-F Style Balancing Valves with digital handwheels.

2.3.9.2 Balancing Valves will all be designed for flow measurement, flow balancing and positive shutoff. Size valves in accordance with manufacturer's published guidelines. Provide extended differential ports to enable access without removing insulation.

2.3.9.3 Valves to be calibrated globe style with differential ports providing flow measurement, balancing and positive shutoff. Do not exceed 910 mm (3') head at fully open position.

2.3.9.4 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Armstrong
Newman Hattersley

2.4 **STRAINERS**

2.4.1 Use Spirax Sarco Y-type removable stainless steel strainers, maximum P. D. 6 kPa (0.9 psig). Use line size strainers. Ahead of all circulating pumps, use 3.2 mm (1/8") perforations. Use 1.6 mm (1/16") perforations in all other locations.

2.4.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Armstrong
Colton

Morrison Brass
Victaulic
Zurn

2.5 THERMOMETERS

2.5.1 WEISS 9VS35 vari-angle thermometer 225 mm (9") dual scale complete with separable well or WEISS 35ZL3 80 mm (3-1/2") dial type thermometer, stainless steel case and adjustable bracket. Temperature range: hot water 0 - 100°C (32 - 210°F) cold water 0 - 40°C (32 - 100°F).

2.5.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Ashcroft
Baker
Cambridge
Taylor
Terice
Winters

2.6 PRESSURE GAUGES

2.6.1 WEISS, liquid filled, 110 mm (4-1/20) stainless steel case, gauge accuracy 1% middle half, ANSI B40 Grade A, brass movement, bourdon tube and socket. Use range twice the normal operating pressure of the system, so that the pointer is normally at the mid-point of the range. Provide gauges with dual unit scales.

2.6.2 WEISS TC14 "T" handle brass gauge cocks, threaded both ends, 2100 kPa (300 psig) water. Include WEISS PSN-B brass pressure snubber.

2.6.3 Use maximum 3/8" pipe connections for piping pressure gauges.

2.6.4 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Ashcroft
Terice
Winters
Wika

2.7 AUTOMATIC AIR VENTS

2.7.1 Use Spirax Sarco Canada Type 13W, AWN-150, 1030 kPa (150 psig) float type air vents with semi-steel body and cap, stainless steel float, stainless steel valve seat and neoprene valve head.

2.7.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Spiroventl
Bell and Gossett

2.8 PUMPS

2.8.1 Double Suction Vertically Split

- 2.8.1.1 ITT Bell and Gossett Series 1510 End suction Pumps. Pump rotation to be as shown on Drawings. Use bronze impeller, enclosed double suction type, dynamically balanced, keyed to the shaft and secured with a slightly press and suitable lock-nut arrangement. Pump and motor to be factory aligned. Use only premium efficiency motors.
- 2.8.1.2 The liquid cavity to be sealed off by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225°F. The seals to be capable of being serviced without disconnecting the pump from piping. For both pumps use seals suitable for liquids with solid abrasive particles.
- 2.8.1.3 The pump casing to be of cast iron, suitable for 175 psi working pressure. Use 125 psi FF flanges. The pump volute to be supplied with plugged vent, drain, and gauge tapings. The pump bearings to be regreaseable camlock ball bearing type with provision for purging or flushing through the bearing surface, and capable of being inspected by removing the bearing covers. Pump shaft to be of 416 stainless steel on standard mechanical seal models.
- 2.8.1.4 Each pump to be factory tested per Hydraulic Institute standards prior to shipment.
- 2.8.1.5 Provide ITT Bell & Gossett Suction Diffuser on inlet of each pump, complete with pot type elbow strainer sized to match pump inlet flange. Use cast iron body, steel guide vanes, strainer of 3 mm (1/8") stainless steel mesh, plus a fine mesh brass startup strainer. Inlet to match pipe size indicated. Design for maximum working pressure of 1034 kPa (150 psig).
- 2.8.1.6 Provide ITT Bell & Gossett straight through Triple Duty Valve on outlet of each pump, designed to perform the functions of a non-slam check valve, throttling valve, shutoff valve and calibrated balancing valve. Use cast iron body, 1210 kPa (174 psig) working pressure. Valve to be fitted with a replaceable bronze disc with EPDM seat insert, brass or stainless steel stem and chatter-preventing spring. Valve design to permit repacking under pressure.
- 2.8.1.7 **Motors:** Motors shall be three phase, 60 Hz, 1800 rpm. Use motor efficiencies as specified in Section 15001.
- 2.8.2 **Motors and Pump Curves:** Provide motors which are non-overloading over the complete range of the pump curve. Submit pump curves with the Shop Drawings.
- 2.8.3 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Armstrong
Canada Pump
Flowserve

2.9 AIR SEPARATORS

- 2.9.1 Use Armstrong Model VA Vortex Air Separators with steel shells designed for 860 kPa (125 psig) working pressure. See Equipment Schedules for details and capacities.
- 2.9.2 The following manufacturer of the above equipment will be considered equal, subject

to the requirements of Clause "Material and Equipment":

Bell & Gossett

2.10 UNIT HEATERS

2.10.1 Use Engineer Air unit heaters. See Equipment Schedule for types, sizes and capacities.

2.10.2 Use minimum 1.21 mm (18 gauge) steel casings. Fit horizontal units with adjustable louvre fin diffusers. Equip vertical units with adjustable louvre cone diffusers. Coat all surfaces with baked on primer and finish exterior surfaces with baked on enamel.

2.10.3 Use coils with aluminum fins mechanically bonded to copper tubing. Braze tubes to headers and grade to achieve gravity drainage. Test coils to 2585 kPa (375 psig) pressure, and mount in casings with provision for thermal expansion.

2.10.4 Use four blade propeller direct drive fans with steel blades riveted to hub.

2.10.5 Provide air vents on all upfeed units.

2.10.6 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Sterling
Trane

2.10.7 Boiler BLR-501A/B

2.10.7.1 Condensing Boiler

2.10.7.1.1 Use Buderus condensing type hot water boiler. Boiler size to be as detailed in equipment schedule and suitable for forced draft firing with natural gas. Boiler must be rated, tested and labelled for a 300 kPa (43.5 psi) ASME working pressure and approved by CSA and ULC listed at this pressure.

2.10.7.1.2 Boiler to have a full three pass fire tube design. All flue side surfaces, including the main combustion chamber, second and third flue passages to be constructed of 316 stainless steel designed to maximize condensate formation. All flue passages to be fully water backed to minimize thermal stress.

2.10.7.1.3 Boiler to be suitable for operation under any return water temperature, any water flow rate and without restriction on temperature rise through the boiler vessel. Efficiencies up to 98% to be achieved at suitably low return water temperatures.

2.10.7.1.4 Condensing secondary and tertiary fire tube flue passages to be 316 stainless steel with a reduced cross section in the direction of flue product flow.

2.10.7.1.5 Use an internal water baffle plate to separate return water between second and third flue passages for maximum efficiency.

2.10.7.1.6 Boiler to be fully serviceable from front of unit by means of a reversible swing burner door and removable access cover.

2.10.7.1.7 Vessel to be fully wrapped with a 100 mm thickness thermal insulation blanket and

heavy gauge steel jacket with baked enamel finish. Provide flanged water connections, control connections and a customized steel plate for mounting of burner.

- 2.10.7.1.8 Provide the following accessories with each boiler:
- Honeywell L4006E1042 high limit aquastat
 - combination pressure and temperature gauge
 - low water cutoff
 - relief valve
- 2.10.7.2 Provide slow opening control valve for each boiler. Boiler controller to close valve when boiler is in OFF position. Hard wire valves to prevent both valves to be closed at the same time regardless of boiler status. Provide details with boiler shop drawings. Valve to meet requirements of Clause 2.3 Valves.
- 2.10.7.2.1 Electric Actuators: Fisher or Bray complete with Spring Return (power failure open) with manual override for power failure and open /close speed controls. Actuators to have open or close travel stops as standard.
- 2.10.7.2.2 Limit Switches: Switches to be SPDT micro-switches enclosed in a NAMUR mount switch box. Switch-box shall carry CSA Enclosure 4 approval. A total of two switches shall be provided, set to indicate valve open and closed positions. Switches to be hard wired to a terminal switch inside the switch-box. Additional terminal connections shall be available for wiring the solenoid to the terminal strip. Switchbox shall have dual ¾" conduit connections. Switch-box shall be complete with high-visibility, beacon-style, black/yellow, local position indicator. Switch-box mounting bracket and coupling (where required) shall be of nickel plated steel. Limit switch to be Moniteur FSYB-5120 or equivalent.
- 2.10.7.3 **Burners**
- 2.10.7.3.1 Weishaupt G5/1-D fully modulating, linkageless, burner, 600/3/60 volt, suitable for modulating operation with natural gas. Burner to be ULC listed. Equip each burner with a factory packaged combustion control system complete with fuel supply system and fuel/air ratio controls. Provide two year factory warranty.
- 2.10.7.3.2 Burner housing to be cast aluminum monoblock type. Burner shall be capable of hinging open to the left or right, and incorporating a self checking differential combustion air pressure switch and burner flange safety interlock switch. The housing shall incorporate a large sight glass for flame viewing and a removable cover to allow free access to all serviceable components. Burner mounting flange must support burner weight without additional support. Use a stainless steel flame retention type combustion head, suitable for operation with temperatures up to 760 °C (1400 °F).
- 2.10.7.3.3 Use a high efficiency TEFC motor and a dynamically balanced backward incline blower wheel.
- 2.10.7.3.4 **Fuel Air Ratio:** The entire fuel air ratio control system shall be free of linkages with each control component being individually controlled by a dedicated servo drive programmable via the programming keypad..All functions including burner history, commissioned values, operating parameters and pressure or temperature settings shall be accessible / adjustable without the need for laptop computer or any other special tools. There shall be four levels of password protection and both the

programming pad and the main module shall hold the programmed data with capability of uploading / downloading from one to the other should either module be damaged. The fuel air ratio shall be controlled by individual servo drives, controlling suction side air and gas flow control valve. The fuel air ratio shall be infinitely adjustable throughout the entire firing range.

- 2.10.7.3.5 Burner gas ignition system to include spark ignited pilot assembly, 7000 volt ignition transformer, pilot safety shut off valve, pilot gas pressure regulator and manual gas shutoff valve.
- 2.10.7.3.6 The burner shall incorporate a linkage-less programmable burner management control system and include an integral PID pressure / temperature control.
- 2.10.7.3.7 Provide gas train designed for to 35 kPa (2 to 15 psi) inlet pressure which includes manual gas shutoff valve, main gas pressure regulator, two atomically operated safety shutoff valves, manual reset low and high gas pressure switches and manual leak test cock.
- 2.10.7.4 **Boiler Controls:** Provide BACNet or Lon (coordinate with BCS system supplier) compatible controller to allow boiler to operate in Local or Remote mode. In Remote mode the BCS will provide an analog output signal to reset supply water temperature. Provide fully operational, modulating boiler control system to allow boiler to operate in the absence of the BCS signal or when in Local Operating Mode. System to utilize independent outdoor temperature sensors and pre-programmed indoor outdoor schedule. Provide Local / Remote switch to change operating mode. See 15900 "Controls" for operating sequence for boilers in "Local" mode.
- 2.10.7.5 Provide services of factory trained technician to supervise installation and perform boiler setup and testing, controller programming and startup. Provide written startup report to Consultant. Provide services of factory trained technician to meet with and train building operators in maintenance and operation of boiler, burners and control system, at time convenient for Owner, after installation is complete and system is fully functional.
- 2.10.7.6 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Viessmann

2.11 **Boilers 502 and 503A/B**

- 2.11.1.1 Use Lochinvar Model Knight XL Series KBN700 boilers.
- 2.11.1.2 Lochinvar, Contact: Somers Environmental, Daryl Somers (519) 681-1977.
- 2.11.2 Use Lochinvar Knight XL boilers operating on natural gas with full modulation firing down to 20% of rated input with a turndown ratio of 5:1.
- 2.11.2.1 Boiler to bear the ASME "H" stamp, be national Board listed, C.S.A. listed and a minimum of full fire 94% thermal efficiency to ASHRAE 103. Use no banding material, bolts, gaskets or "O" rings in the header configuration. The stainless steel combustion chamber to be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap is to allow condensation to drain from the heat exchanger assembly. The complete heat exchanger assembly to carry a ten (10) year warranty.

- 2.11.2.2 Construct boiler with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber to be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. Provide a burner/flame observation port. The burner to be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. Supply with a gas valve designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating boiler firing rated for maximum efficiency. the boiler to operate with gas supply pressures as low as 4" of water column.
- 2.11.2.3 Use a 24 VAC control circuit and components. The control system to have an electronic display for boiler setup, boiler status, and boiler diagnostics. all components to be easily accessed and serviceable from the front and top of the jacket. The boiler to be equipped with; a temperature/pressure gauge, high limit temperature control with manual reset; ASME certified pressure relief valve; outlet water temperature sensor; return water temperature sensor; flue temperature sensor; flow switch and built-in freeze protection. The boiler to be equipped with an outdoor air reset function. The manufacturer to verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.
- 2.11.2.4 The boiler to feature the "Smart System" control with a 2 line, 16 character LCD display, password security, outdoor reset, pump delay with freeze protection, pump exercise and PC port connection. The boiler to allow 0-10 VDC input connection for BMS control and have built-in "Cascade" to sequence and rotate while maintaining modulation of up to four boilers without utilization of an external controller. Equip with two terminal strips for electrical connection. A low voltage connection board with 28 data points for safety and operating controls, including Auxiliary Relay, Auxiliary Proving Switch, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure switches, Tank Thermostat, Wall Thermostat/Zone Control, System Supply Sensor, Outdoor Sensor, Building Management System signal and Cascade control circuit. A high voltage terminal strip for supply voltage and independent pump control of the System pump, the Boiler pump and the Domestic hot Water pump. Supply voltage to be 120 volt/60 hertz/single phase. Provide outdoor temperature sensor.
- 2.11.2.5 Direct Vent System with Sidewall or Top Termination of both the vent and combustion air.
- 2.11.2.6 The boiler to have an independent laboratory rating for 20 ppm or less Oxides of Nitrogen (NO_x) corrected to 3% O₂.
- 2.11.2.7 Provide each boiler with:
- safety relief valve
 - water pressure/temperature gauge
 - primary low water flow fuel cutoff
 - high limit water temperature control
 - separate inlet and outlet water temperature sensors to monitor flow
 - exhaust temperature sensor
- 2.12 **ACID NEUTRALIZING TANKS**
- 2.12.1 Use SMS AN-2 acid neutralizing tank for each boiler condensate drain. Tank to have 9 L capacity and 23 kg limestone capacity.

- 2.12.2 The following manufacturer of the above equipment will be considered equal, subject to the requirements of Clause "Material and Equipment":

Orion

2.13 **DIAPHRAGM EXPANSION TANKS**

- 2.13.1 Use Armstrong, ASME certified diaphragm type expansion tanks with heavy duty butyl rubber bladder removable for inspection. Build tanks to Provincial Codes for 862 kPa (125 psig) working pressure. Provide shutoff cocks and drain cock.

- 2.13.2 See Equipment Schedule for details.

- 2.13.3 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Air-Trol
Amtrol

2.14 **PRESSURE CONTROL SYSTEMS**

- 2.14.1 Use Watts No. 909 Series backflow preventer with strainer, pressure reducing valve, pressure gauge and relief valve, all connected with brass nipples. Provide Watts AG Series air gap with EL Series elbow fan vent line.

- 2.14.2 Use Watts pressure relief valves. For tanks, use Watts Series N240 ASME temperature and pressure relief valves. For pipelines, use Watts Series 174A ASME pressure relief valves. Size valves to suit heating equipment rating.

- 2.14.3 The following manufacturers of the above equipment will be considered equal, subject to the requirements of Clause "Materials and Equipment":

Conbraco
Zurn/Wilkins

3 Execution

3.1 **PIPING**

3.1.1 **General**

- 3.1.1.1 Use flanges or unions on all piping connections to equipment.

- 3.1.1.2 Install all control valves, fittings, water temperature sensors and flow switches.

- 3.1.1.3 See Section 15001 "Mechanical General Provisions", Clause "Piping".

3.1.2 **Water Piping**

- 3.1.2.1 Provide drain valves with hose connections at base of all risers, at all low points in piping distribution, and at low points on all equipment connections. Drain valves may be gate or ball valves.

- 3.1.2.2 For upfeed take off top of pipe. For downfeed take off bottom of pipe.

3.2 VALVES

3.2.1 Unless specifically noted, shown or specified otherwise, shutoff valves may be either gate valves or ball valves. Do **not** use ball valves for sizes greater than 50 mm (2").

3.2.2 Use line sized valves unless shown or specified otherwise.

3.3 AIR VENTS

3.3.1 Provide automatic air vents at all high points in piping system and at all points where piping drops to form loops.

3.3.2 Use manual air vents only where shown or specified.

3.3.3 See Detail Sheet included with Section 15001 "Mechanical General Provisions" for installation requirements.

3.4 THERMOMETERS AND PRESSURE GAUGES

3.4.1 Mount all thermometers and gauges so they are easily readable from the floor.

3.4.2 Where this is impossible, for thermometers, provide remote reading dial type thermometers; for gauges extend pressure sensing line with gauge to a location which is easily readable from the floor.

3.4.3 Provide gauge cocks for each pressure gauge.

3.5 PUMPS

3.5.1 Install pumps as shown and in accordance with manufacturer's recommendations.

3.5.2 After one month's operation, remove all startup strainers and replace with new units; clean all permanent style strainers.

3.6 COMBINATION SHUTOFF AND BALANCING VALVES

3.6.1 Provide water combination shutoff and balancing valves in all locations shown. Install in accordance with manufacturer's recommendations.

3.7 TESTING AND BALANCING

3.7.1 Cooperate with and assist the testing and balancing company. See Section 15200 "Testing and Balancing".

3.8 EXISTING PIPING

3.8.1 Where shown, cut back and cap off existing piping. Remove all redundant piping above grade.

3.9 WATER TREATMENT SYSTEMS

3.9.1 Install all water treatment equipment as shown and in accordance with manufacturer's recommendations. Provide all necessary piping and accessories. See Section 15715 "Water Treatment".

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- 3.10 **BOILERS**
- 3.10.1 Provide all fittings and components as shown on the Drawings in compliance with the manufacturer's instructions.
- 3.10.2 Install boilers on existing concrete housekeeping pads, or modify pads to suit.
- 3.10.3 Confirm available gas pressure and size gas trains appropriately before releasing the boiler shop drawings.
- 3.10.4 Provide services of factory trained technician to supervise installation and perform boiler setup and testing, controller programming and startup. Provide written startup report to Consultant. Provide services of factory trained technician to meet with and train building operators in maintenance and operation of boilers, burners and control system, at time convenient for Owner, after installation is complete and system is fully functional. Allow minimum of 8 hours of training for Owner's maintenance staff in addition to training provided by controls contractor.
- 3.10.5 Provide boiler controllers, sensors and associated wiring. Install sensor wells and temperature sensors. Program controllers. Do all wiring in compliance with Division 16 requirements. Wire from controllers to panels, sensors to panels and from panels to boilers. All wiring to be complete for an operational system.
- 3.10.6 Boiler manufacturer to review and confirm venting arrangement prior to installation.
- 3.11 **UNIT HEATERS**
- 3.11.1 Make connections to units with brass seated unions. Install a shutoff valve on each supply and balancing valve on each return.

END OF SECTION

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- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 15001, "Mechanical General Provisions".
- 1.2 **DESCRIPTION OF SYSTEMS**
- 1.2.1 Provide pre-operational cleaning and chemical treatment systems for hot water heating system.
- 1.3 **SHOP DRAWINGS**
- 1.3.1 Submit Shop Drawings in accordance with Section 15001, Clause "Shop Drawings" for the following equipment and materials:
- all chemicals including MSDS
 - bypass feeders
 - chemical feed systems
 - micro filter
 - test cabinet
 - sample of testing reports
- 2 Products
- 2.1 **GENERAL**
- 2.1.1 Use chemicals and chemical feed equipment as supplied by Drew Ashland.
- 2.2 **PRE-OPERATIONAL CLEANING**
- 2.2.1 Provide an adequate quantity of cleaning solutions to thoroughly clean all new piping and associated equipment by removing sludge, oil, dirt and debris. Cleaning products to be used for cleaning and flushing of all new piping systems (excluding domestic water and drains). Cleaning and flushing procedure to be as per manufacturer's instructions and must be performed under the supervision of a manufacturer's representative. Once cleaning is complete, provide a letter certifying that systems have been properly cleaned.
- 2.2.2 Provide temporary piping connection, bypasses and strainers as required for introduction of cleaning chemicals and removal of debris. .
- 2.3 **CLOSED WATER SYSTEM**
- 2.3.1 Furnish a bypass pot feeder with heavy cast iron body with a working pressure of 1390 kPa (200 psig) and 7.5 L (2 USg) capacity, for adding corrosion inhibitor to the system. Include two 20 mm (3/4") isolating globe valves and one 20 mm (3/4") drain valve.
- 2.3.2 Furnish a bypass micron filter with capacity to handle 2.5 to 5.0% of the system flow rate. Include six sets of 20 micron filter cartridges.
- 2.3.3 Two (2) corrosion test coupons; one copper and one steel.

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- 2.3.4 Aluminum Test Coupons for condensing boiler installation
- 2.3.5 Provide a sufficient quantity of molybdate-based corrosion inhibitor chemical to perform all initial system treatment, as well as all required chemicals for the first year after takeover.
- 2.4 **TEST EQUIPMENT**
- 2.4.1 Provide the following:
- 2.4.1.1. Test cabinet fabricated from steel panels with baked on enamel finish. Size cabinet to accommodate three titration tests and contain all associated test control reagent bottles and equipment.
- 2.4.1.2 Test sets for molybdate, pH, and organics.
- 3 Execution
- 3.1 **GENERAL**
- 3.1.1 Provide supervision and assistance during the installation, cleaning and startup procedures, and develop an appropriate water conditioning program to control corrosion, scale, algae and suspended solids. Arrange for the water conditioning company to instruct the operating personnel for a period of not less than one day duration before acceptance of the installation by the Consultant. Provide four copies of written operating instructions on the treatment dosages, control charts and test procedures.
- 3.1.2 Include a monthly (or bimonthly) visit by the treatment supplier for the first year's operation, to check operation. Conduct tests of all pertinent water treatment systems and submit a written report on same.
- 3.1.3 **Treatment Supplies:** Supply all chemicals required for initial cleaning and startup of the systems and a year's supply of inhibitor chemicals for normal operation.
- 3.2 **FLUSHING AND STERILIZATION**
- 3.2.1 Flush hot water heating water piping.
- 3.2.2 Flush water piping with water flowing at a velocity of not less than 1.8 m/sec (6 ft/sec) for a period of 15 minutes or longer as required to remove all dirt, scale, and cuttings from the entire length of the piping.
- 3.2.3 Thoroughly clean sections of new piping which cannot be isolated for flushing purposes, prior to fabrication, and also where possible after welding of joints, by swabbing the interior of the pipe with swabs soaked with a caustic solution to remove all loose scale, oil and dirt from the entire length of the piping.
- 3.3 **PRE-OPERATIONAL CLEANING**
- 3.3.1 Clean all hot water heating.
- 3.3.2 Prior to chemical cleaning, inspect the systems to ensure removal of heavy debris and excessive oil or dirt. Install temporary strainers on the suction of each circulating

pump. Where necessary, make provision for temporary connections between supply and return mains in the distribution system to permit circulation of the cleaning solution. Provide a 25 mm (1") pipe connection on the suction side of the circulating pumps of each system for the admission of the cleaning solution.

- 3.3.3 Flush the systems to remove loose dirt and hydrostatically test to detect excessive water losses. Check rotation of all circulating pumps.
- 3.3.4 Fill the system with water and cleaner at a 1% concentration, or as specifically recommended by the manufacturer. Circulate for 72 hours at a temperature between 21°C - 60°C (70°F - 140°F).
- 3.3.5 Drain system, refill with fresh water and circulate for a minimum of four hours to flush out remaining chemical solution.
- 3.3.6 Following flushing, drain and refill system with fresh, clean water. Adjust inhibitor levels to required concentrations.
- 3.3.7 Submit a report to the Consultant to certify that the systems are clean.

3.4 **CLOSED WATER SYSTEM**

- 3.4.1 Install the feeder and filter in a bypass arrangement where shown on drawings. Include isolation, venting and drain valves in accordance with Installation Drawings and on-site instruction by the water treatment representative. Install corrosion coupons in two 20 mm (3/4") tee fittings on upstream of feeder.
- 3.4.2 Treat system with corrosion inhibitor. Do this immediately after completion of pre-operational cleaning.
- 3.4.3 Install cartridges in the filters.

3.5 **TEST EQUIPMENT**

- 3.5.1 Mount cabinet with 1200 mm (48") between floor and underside of cabinet. Provide Owner with full testing and record keeping instructions.

END OF SECTION

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- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 15001, "Mechanical General Provisions".
- 1.2 **DESCRIPTION OF SYSTEMS**
- 1.2.1 **Air Systems:** Provide ductwork in boiler rooms and boiler venting for all new boilers.
- 1.3 **SHOP DRAWINGS**
- 1.3.1 Submit Shop Drawings in accordance with Section 15001, Clause "Shop Drawings" for the following equipment and materials:
- Gas Vents
 - Makeup Air Units
 - Rooftop Units
- 2 Products
- 2.1 **MATERIALS**
- 2.1.1 Use materials specified herein or approved equal as defined in Section 15001, "Mechanical General Provisions", Clause "Material and Equipment".
- 2.2 **DUCTWORK**
- 2.2.1 **Standards:** Construct all ductwork in accordance with the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) Manual "HVAC Duct Construction Standards - Metal and Flexible".
- 2.2.2 **Materials:** Fabricate all ductwork from galvanized steel. Use SMACNA recommended thicknesses except where specified otherwise.
- 2.3 **ROOFTOP AIR CONDITIONING UNITS RTU-501 AND RTU-502**
- 2.3.1 **General**
- 2.3.1.1 Provide Carrier outdoor rooftop mounted, electrically controlled natural gas heating and electric cooling unit type utilizing scroll hermetic compressors with crankcase heaters for cooling duty and induced draft gas combustion for heating duty.
- 2.3.1.2 Units to have ultra high cooling efficiency and utilize R-410A refrigerant.
- 2.3.1.3 Unit to exceed ASHRAE 90.1-2001 Energy Efficiency Standards. All units to be ENERGY STAR qualified.
- 2.3.1.4 Units to be rated in accordance with ARI Standards 210 (03-12). Units to be rated in accordance with ARI sound standards 270 and 370.
- 2.3.1.5 Units to be designed to conform to ASHRAE 15.
- 2.3.1.6 Unit to be UL and UL, Canada, tested and certified in accordance with ANSI Z21.47

Standards as a total package.

2.3.1.7 Unit casing to be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).

2.3.1.8 Unit to be manufactured in a facility registered to ISO 9001:2008.

2.3.1.9 Equip unit with uni-mounted non-fused disconnect switch.

2.3.2 **Construction**

2.3.2.1 Units to be a factory assembled, single-piece heating and cooling unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant charge and special features required prior to field start-up.

2.3.2.2 **Unit Cabinet**

2.3.2.2.1 Constructed of galvanized steel, bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces. Cabinets have continuous 16 gauge base rail on all sides.

2.3.2.2.2 All airstream interior surfaces to be insulated with a minimum 1/2-in. thick, 1.5 lb density foil-faced cleanable insulation. Insulation to be bonded with a thermosetting resin and coated with an acrylic or other material that meets the NFPA 90 flame retardance requirements and has an "R" Value of 3.70. Use foil-faced insulation in gas heat section.

2.3.2.2.3 Removable cabinet panels to have molded composite handles. Top panel is to be one piece.

2.3.2.2.4 Air filters to be accessible through a single hinged access panel.

2.3.2.2.5 Units to have a factory-installed internally sloped condensate drain pan, providing a minimum 20 mm (3/4") NPT connection. Pan to be fabricated of high impact polycarbonate material. Drain pan to conform to ASHRAE 62 self-draining provisions. Units to have standard thru-the-bottom power and control wiring connection capability.

2.3.2.3 **Fans**

2.3.2.3.1 Indoor blower (evaporator fan): Centrifugal supply air blower to have rubber-isolated, cartridge type ball bearings. Fan wheel to be made from steel with a corrosion resistant finish. It shall be a dynamically balanced, double-inlet type with forward-curved blades. Evaporator-fan motors shall be continuous operation, open drip-proof. Bearings to be sealed, permanently lubricated ball-bearing type for longer life and lower maintenance.

2.3.2.3.2 Condenser fans to be of the direct-driven propeller type, with corrosion-resistant aluminum blades rivetted to corrosion-resistant steel supports. They shall be dynamically balanced and discharge air upwards. Condenser fan motors to be totally enclosed, thermally protected, and be of a shaft down design.

2.3.2.3.3 Induced-draft blower to be of the direct-driven, single inlet, forward-curved, centrifugal type. It shall be made from aluminized steel with a corrosion-resistant

finish and dynamically balanced. Equip with thermal overload protection and automatic reset feature.

2.3.2.3.4 **Compressors:** Fully hermetic, scroll type with crankcase heaters, internal high-pressure and temperature protection. Factory mounted on rubber grommets and internally spring mounted for vibration isolation.

2.3.2.3.5 **Coils:** Standard evaporator and condenser coils to have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed. Dual circuit models (7.5 thru 25 ton) to have face-split type evaporator coil. Condenser coils to be continuous slab design to facilitate easy coil cleaning. Coils to be leak tested at 170 psig and pressure tested at 1875 psig.

2.3.2.4 **Heating Section**

2.3.2.4.1 Induced-draft combustion type with direct-spark ignition system and redundant main gas valve with 2-stage capability on all 3-phase units.

2.3.2.4.2 **Heat Exchanger:** The standard heat exchanger shall be of the tubular-section type constructed of a minimum of 20 gauge steel coated with a nominal 1.2 mil aluminum-silicone alloy for corrosion resistance.

2.3.2.4.3 Burners to be of the in-shot type constructed of aluminum-coated steel.

2.3.2.4.4 The integrated gas controller (IGC) board to include gas heat operation fault notification using an LED.

2.3.2.4.5 Units to be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high-temperature limit switch. Fault indication shall be made using an LED.

2.3.2.4.6 The IGC board to contain algorithms that modify evaporator-fan operation to prevent cycling on high-temperature limit switch.

2.3.2.4.7 The LED to be visible without removal of control box access panel.

2.3.2.4.8 Include vertical flue discharge deflector.

2.3.2.5 **Refrigerant Components:**

2.3.2.5.1 Each refrigerant circuit shall include

- Thermostatic expansion valve (TXV) with removable power element.
- Solid core refrigerant filter driers.
- Gage port and connections on suction, discharge, and liquid lines.

2.3.2.6 **Filter Section**

2.3.2.6.1 Standard filter section shall consist of factory-installed 2-in. thick throwaway fibreglass filters and shall be on a dedicated track.

2.3.2.6.2 Filter section to use standard size filters and be of common sizes within cabinet sizes.

2.3.2.6.3 Provide one spare set of filters with each unit.

2.3.3 Controls and Safeties:

- 2.3.3.1 With each unit provide ComfortLink™ Controls with the following features:
- Scrolling Marquee display.
 - CCN (Carrier Comfort Network)
 - Unit control with standard suction pressure transducers and condensing temperature thermistors.
 - Provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
 - Provide and display a current alarm list and an alarm history list.
 - Automatic compressor redundancy.
 - Service run test capability.
 - Configurable alarm light shall be provided which activates when certain types of alarms occur.
 - Compressor minimum run time (3 minutes) and minimum off time (5 minutes) are provided.
 - Service diagnostic mode.
 - Economizer control

2.3.3.2 Provide following safeties:

- 2.3.3.2.1 Units to incorporate a solid-state compressor lockout, should any of the following safety devices trip and shut off compressor:
- Compressor lockout protection provided for either internal or external overload.
 - Low-pressure protection.
 - Freeze protection (evaporator coil).
 - High-pressure protection (high pressure switch or internal).
 - Compressor reverse rotation protection.
 - Loss of charge protection.
 - Start assist on single-phase units.

2.3.3.2.2 Induced draft heating section to be provided with the following minimum protections:

- High-temperature limit switch.
- Induced-draft motor speed sensor.
- Flame rollout switch.
- Flame proving controls.
- Redundant gas valve.

2.3.4 Electrical Requirements: All unit power wiring to enter unit cabinet at a single location – side and/or bottom.**2.3.4.1 Economizer**

2.3.4.1.1 Equip the unit with integrated economizer using low leakage dampers capable of introducing 100% ODA.

2.3.4.1.2 Equip the economizer damper with a factory-installed actuator.

2.3.4.1.3 The unit is to be capable of using the economizer in a free cooling mode of operation.

2.3.4.1.4 The economizer is to utilize enthalpy sensor controls when in the economizer mode.

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- 2.3.4.1.5 Include power exhaust fan operating in conjunction with the economizer.
- 2.3.5 **Roof Curb:** Adapt RTUs to existing curbs.
- 2.3.6 The following manufacturers of the above equipment will be considered as equal, subject to requirements of Clause "Material and Equipment":
- Trane
- 2.4 **FLEXIBLE DUCT CONNECTORS**
- 2.4.1 Use Duro Dyne "Durolon" or Ventfabrics "Ventlon" pre-assembled flexible duct connectors with 150 mm (6") fabric width.
- 2.5 **MAKEUP AIR UNIT MAU-510**
- 2.5.1 **General**
- 2.5.1.1 Provide a roof-mounted, gas-fired makeup unit.
- 2.5.1.2 Air handling units are to be shipped to the job in one piece, factory assembled. All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as CETL, ETL, UL, CSA prior to shipment.
- 2.5.1.3 Prewired air handling units are to bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code, Part 2 (Canada).
- 2.5.1.4 All electrical circuits to undergo a dielectric strength test, and shall be factory tested and checked as to proper function.
- 2.5.1.5 Provide a system of motor control, including all necessary terminal blocks, motor contractors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays. Gas fired units shall also include high limit and combustion air flow switch.
- 2.5.1.6 House automatic controls in a control panel mounted on the air handling unit, which will meet the standard of the specific installation.
- 2.5.2 **Unit Construction**
- 2.5.2.1 Unit casing is to be fabricated from minimum 18 (1.27 mm) gauge satin coat galvanized sheet metal. Surfaces are to be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. Factory coat all unprotected metal and welds.
- 2.5.2.2 All walls, roofs and floors are to be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and, on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.
- 2.5.2.3 The entire unit is to be provided with a 22 gauge (.85mm) solid galvanized metal liner over insulated areas.

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- 2.5.2.4 Provide access doors to the following components: fans and motors; filters; dampers and operators; access plenums and electrical control panels; burner compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable. Provide hinged access doors, fully lined, with Leverlok handles.
- 2.5.2.5 Hinged access doors to areas of negative pressure are to open out, and to areas of positive pressure to open in.
- 2.5.2.6 Support casings on formed galvanized steel channel or structural channel supports, designed and welded for low deflections. Integral lifting lugs shall be provided for hoisting.
- 2.5.2.7 Internally insulate with 1" (25 mm) thick 1.5 lb./cu.ft. (24 kg./cu.m.) density, neoprene coated fibre glass thermal insulation. All longitudinal insulation joints and butt ends are to be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas to be insulated on the underside.
- 2.5.2.8 Provide reinforcing channels under floor to minimize deflection.
- 2.5.2.9 Non-fused disconnect will be provided by Division 16000.
- 2.5.2.10 Air handling units are to be weatherproofed and equipped for installation outdoors. This will include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1" (25 mm) galvanized inlet screens; rain gutters or diverters over all access doors, all joints caulked with a water resistant sealant; roof joints turned up 2" (50 mm) with three break interlocking design; outer wall panels extend a minimum of 1/4" (6 mm) below the floor panel; drain trap(s) connections for field supply and installation of drain traps. Units mounted on roof curbs incorporate welded floor to base construction. Floors are of three break upstanding design with welded corners and free of penetrations. Unit underside joints are caulked.
- 2.5.2.11 Provide full perimeter roof mounting curb of heavy gauge sheet metal, minimum of 12" (300 mm) high, and complete with wood nailer, neoprene sealing strip and fully welded "Z" bar with 1" (25 mm) upturn on inner perimeter, to provide a complete seal against the elements. External insulation of the roof mounting curb to be provided by the Roofing Subcontractor.
- 2.5.3 **Fans**
- 2.5.3.1 Centrifugal fans are to be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. Dynamically balance all fans and fan assemblies during factory test run. Fan shafts to be provided with a rust inhibiting coating.
- 2.5.3.2 Drives are to be adjustable on fans with motors 5 HP (3.73 kW) or smaller. On fans with larger motors, provide fixed drives. All drives to be provided with a rust inhibiting coating. The air balancer will provide for drive changes (if required) during the air balance procedure.
- 2.5.3.3 Motor, fan bearings and drive assembly to be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor

assembly, where required. Motor mounting to be adjustable to allow for variations in belt tension.

2.5.3.4 Fan and motor assemblies are to be provided with vibration isolators. Isolators are to be bolted to the steel channel welded to unit floor which is welded to the structural frame of the unit. The isolators to be neoprene-in-shear type of single 9" (230 mm) to 15" (380 mm) forward curved fans. All other fans to incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" (25 mm) static deflection designed to achieve high isolation efficiency. Attach fans to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

2.5.3.5 Fan motors are to be totally enclosed TEFC.

2.5.4 Gas Heat Section

2.5.4.1 General

2.5.4.1.1 Heating units are to be indirect natural gas-fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories are to be approved by an independent testing authority, and carry the approval label of that authority as a complete operating package.

2.5.4.1.2 All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire.

2.5.4.1.3 Operating natural gas pressure at unit(s) manifold shall be 7" (1750 Pa) w.c.

2.5.4.1.4 Gas-fired units are to be approved for operation in -40°F (-40°C) locations.

2.5.4.2 Heat Exchanger/ Burner Assembly

2.5.4.2.1 The heat exchanger is to be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane tubulators and a floating stress relieved design. Provide heat exchanger with condensate drain connection. The heat exchanger casing to have 1" (25 mm) of insulation between the outer cabinet and inner liner. Blower assemblies close coupled to duct furnace type heat exchangers are not acceptable.

2.5.4.2.2 Test and certify high efficiency heat exchangers to ANSI standards to provide a minimum of 80% efficiency throughout the entire operating range as required by ASHRAE 90.1. The manufacturer is to be routinely engaged in the manufacture of this type of high efficiency equipment.

2.5.4.2.3 The heat exchanger/burner assembly is to be a blow through positive pressure type. Provide units incorporating the DJM module with an interrupted pilot ignition system to provide increased safety. Units using continuous or intermittent pilots are not acceptable.

2.5.4.2.4 Flame surveillance is to and be from the main flame after ignition not the pilot flame. The burner and gas train are to be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.

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- 2.5.4.2.5 The heat exchanger/burner assembly is to include 15:1 turndown. The high turn down heat exchanger/burner assembly minimum input is to be capable of controlling 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include builtin electronic linearization of fuel and combustion air. Efficiency is to increase from high to low fire.
- 2.5.4.3 **Venting:** Installation and venting provisions must be in accordance with C.G.A. Standards B149.1, ANSI Z223.1-NFPA54, and local authorities have jurisdiction.
- 2.5.4.4 **Controls**
- 2.5.4.4.1 **Electronic DJM (Modulating Fuel w/ Modulating Combustion Air)**
- 2.5.4.4.2 Solid state analyzer complete with proportional and integral control and with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions.
- 2.5.4.4.3 Combustion efficiency of standard heat exchangers shall increase 4 to 5% from high fire to low fire on units incorporating 15:1 turndown. Heat exchangers shall provide a minimum of 78% (DJ) 80% (DJE) efficiency throughout the entire operating range.
- 2.5.4.4.4 Alternate manufacturers units which do not incorporate a variable speed combustion air blower shall have a modulating gas valve and a combustion air damper with a linear linkage connected to an actuator which has a minimum of 100 steps of control.
- 2.5.4.4.5 Controllers for heating units only shall include the following standard features:
- linear gas and combustion air flow obtained via a built in solid state linear algorithm
 - -40°F (-40°C) minimum operating ambient temperature
 - four (4) air change pre-purge on units with over 400 MBH (117 kw) input
 - post purge
 - interrupted pilot
 - self check on start-up to make sure air proving and discharge air sensors are operating within design tolerances
 - low fire start
 - controlled burner start-up and shut down
 - diagnostic lights for ease of set-up and service
 - blower contactor that starts fan after burner pre-purge
 - damper contact that allows fan to start after damper opens, damper to close after fan stops and damper to close on flame failure
 - non-recycling auto by-pass low limit that has built-in sensor checking
 - built-in alternate blower and damper functions and set back temperatures for unoccupied mode operation using a single room thermostat
- 2.5.4.4.6 Heating control function shall be modulating discharge air complete with sensor and intergral selector.
- 2.5.4.4.7 Discharge air sensor is to be shipped loose for installation in ductwork by others.
- 2.5.4.4.8 Provide a discharge air low limit equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure this device will shut down

the fan and close the outdoor air damper. This device shall require resetting by interrupting the electrical circuit.

2.5.4.4.9 Acceptable controllers for heating units are Engineered Air DJM-3, Honeywell ControLinks R7999, or Nexus NX3100.

2.5.4.5 **Filters**

2.5.4.5.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.

2.5.4.5.2 **Pleated Panel Disposable Filters:** 2" (50 mm) Non-woven cotton and synthetic fabric media with a metal support grid and rigid heavy-duty board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Provide permanent reusable metal enclosing frames. The filter media to have an efficiency of 25-30% on ASHRAE Standard 52.1-92, and minimum MERV 6 per ASHRAE 52.2.-1999.

2.5.4.6 **Dampers**

2.5.4.6.1 Damper frames are to be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13 mm) aluminum, with turn in nylon or bronze bushings. Rods are to be secured to the blade by means of straps and set screws.

2.5.4.6.2 Blades are to be 18 gauge (1.3 mm) galvanized metal with two breaks on each edge and three breaks on centreline for rigidity. The pivot rod to "nest" in the centreline break. Damper edges are to interlock. Maximum length of damper between supports to be 42" (1070 mm). Construct damper linkage brackets of galvanized metal.

2.5.4.6.3 Dampers are to be extruded aluminum, low leak, thermally broken, insulated blade Tamco Series 9000.

2.5.4.6.4 Two position inlet dampers are to be parallel blade type.

2.5.4.6.5 **Makeup Air Inlet Damper Control:** Provide a two position, normally closed electric damper operator. Interlock this damper operator so that when the unit is shut down, or on a power failure, the damper will return to the closed position.

2.5.4.7 The following manufacturers of the above equipment will be considered as equal, subject to requirements of Clause "Material and Equipment":

Johnson Marcraft

2.6 **MAKEUP AIR UNIT MAU-511**

2.6.1 **General**

2.6.1.1 Provide an indoor, gas-fired makeup unit.

2.6.1.2 Air handling units are to be shipped to the job in one piece, factory assembled. All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as CETL, ETL, UL, CSA prior to shipment.

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- 2.6.1.3 Prewired air handling units are to bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code, Part 2 (Canada).
- 2.6.1.4 All electrical circuits to undergo a dielectric strength test, and shall be factory tested and checked as to proper function.
- 2.6.1.5 Provide a system of motor control, including all necessary terminal blocks, motor contractors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays. Gas fired units shall also include high limit and combustion air flow switch.
- 2.6.1.6 House automatic controls in a control panel mounted on the air handling unit, which will meet the standard of the specific installation.

2.6.2 **Unit Construction**

- 2.6.2.1 Unit casing is to be fabricated from minimum 18 (1.27 mm) gauge satin coat galvanized sheet metal. Surfaces are to be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. Factory coat all unprotected metal and welds.
- 2.6.2.2 All walls, roofs and floors are to be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and, on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.
- 2.6.2.3 The entire unit is to be provided with a 22 gauge (.85mm) solid galvanized metal liner over insulated areas.
- 2.6.2.4 Provide access doors to the following components: fans and motors; filters; dampers and operators; access plenums and electrical control panels; burner compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable. Provide hinged access doors, fully lined, with Leverlok handles.
- 2.6.2.5 Hinged access doors to areas of negative pressure are to open out, and to areas of positive pressure to open in.
- 2.6.2.6 Support casings on formed galvanized steel channel or structural channel supports, designed and welded for low deflections. Integral lifting lugs shall be provided for hoisting.
- 2.6.2.7 Internally insulate with 1" (25 mm) thick 1.5 lb./cu.ft. (24 kg./cu.m.) density, neoprene coated fibre glass thermal insulation. All longitudinal insulation joints and butt ends are to be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas to be insulated on the underside.
- 2.6.2.8 Provide reinforcing channels under floor to minimize deflection.
- 2.6.2.9 Non-fused disconnect will be provided by Division 16000.

2.6.3 Fans

- 2.6.3.1 Centrifugal fans are to be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. Dynamically balance all fans and fan assemblies during factory test run. Fan shafts to be provided with a rust inhibiting coating.
- 2.6.3.2 Drives are to be adjustable on fans with motors 5 HP (3.73 kW) or smaller. On fans with larger motors, provide fixed drives. All drives to be provided with a rust inhibiting coating. The air balancer will provide for drive changes (if required) during the air balance procedure.
- 2.6.3.3 Motor, fan bearings and drive assembly to be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting to be adjustable to allow for variations in belt tension.
- 2.6.3.4 Fan and motor assemblies are to be provided with vibration isolators. Isolators are to be bolted to the steel channel welded to unit floor which is welded to the structural frame of the unit. The isolators to be neoprene-in-shear type of single 9" (230 mm) to 15" (380 mm) forward curved fans. All other fans to incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" (25 mm) static deflection designed to achieve high isolation efficiency. Attach fans to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.
- 2.6.3.5 Fan motors are to be totally enclosed TEFC.

2.6.4 Gas Heat Section

2.6.4.1 General

- 2.6.4.1.1 Heating units are to be indirect natural gas-fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories are to be approved by an independent testing authority, and carry the approval label of that authority as a complete operating package.
- 2.6.4.1.2 All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire.
- 2.6.4.1.3 Operating natural gas pressure at unit(s) manifold shall be 7" (1750 Pa) w.c.

2.6.4.2 Heat Exchanger/ Burner Assembly

- 2.6.4.2.1 The heat exchanger is to be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane tubulators and a floating stress relieved design. Provide heat exchanger with condensate drain connection. The heat exchanger casing to have 1" (25 mm) of insulation between the outer cabinet and inner liner. Blower assemblies close coupled to duct furnace type heat exchangers are not acceptable.
- 2.6.4.2.2 Test and certify high efficiency heat exchangers to ANSI standards to provide a

minimum of 80% efficiency throughout the entire operating range as required by ASHRAE 90.1. The manufacturer is to be routinely engaged in the manufacture of this type of high efficiency equipment.

- 2.6.4.2.3 The heat exchanger/burner assembly is to be a blow through positive pressure type. Provide units incorporating the DJM module with an interrupted pilot ignition system to provide increased safety. Units using continuous or intermittent pilots are not acceptable.
- 2.6.4.2.4 Flame surveillance is to and be from the main flame after ignition not the pilot flame. The burner and gas train are to be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.
- 2.6.4.2.5 The heat exchanger/burner assembly is to include 15:1 turndown. The high turn down heat exchanger/burner assembly minimum input is to be capable of controlling 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include builtin electronic linearization of fuel and combustion air. Efficiency is to increase from high to low fire.
- 2.6.4.3 **Venting:** Installation and venting provisions must be in accordance with C.G.A. Standards B149.1, ANSI Z223.1-NFPA54, and local authorities have jurisdiction.
- 2.6.4.4 **Controls and Safeties**
- 2.6.4.4.1 **Electronic DJM (Modulating Fuel w/ Modulating Combustion Air)**
- 2.6.4.4.2 Solid state analyzer complete with proportional and integral control and with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions.
- 2.6.4.4.3 Combustion efficiency of standard heat exchangers shall increase 4 to 5% from high fire to low fire on units incorporating 15:1 turndown. Heat exchangers shall provide a minimum of 78% (DJ) 80% (DJE) efficiency throughout the entire operating range.
- 2.6.4.4.4 Alternate manufacturers units which do not incorporate a variable speed combustion air blower shall have a modulating gas valve and a combustion air damper with a linear linkage connected to an actuator which has a minimum of 100 steps of control.
- 2.6.4.4.5 Controllers for heating units only shall include the following standard features:
- linear gas and combustion air flow obtained via a built in solid state linear algorithm
 - -40°F (-40°C) minimum operating ambient temperature
 - four (4) air change pre-purge on units with over 400 MBH (117 kw) input
 - post purge
 - interrupted pilot
 - self check on start-up to make sure air proving and discharge air sensors are operating within design tolerances
 - low fire start
 - controlled burner start-up and shut down
 - diagnostic lights for ease of set-up and service
 - blower contactor that starts fan after burner pre-purge

- damper contact that allows fan to start after damper opens, damper to close after fan stops and damper to close on flame failure
 - non-recycling auto by-pass low limit that has built-in sensor checking
 - built-in alternate blower and damper functions and set back temperatures for unoccupied mode operation using a single room thermostat
- 2.6.4.4.6 Heating control function shall be modulating discharge air complete with sensor and intergral selector.
- 2.6.4.4.7 Discharge air sensor is to be shipped loose for installation in ductwork by others.
- 2.6.4.4.8 Provide a discharge air low limit equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure this device will shut down the fan and close the outdoor air damper. This device shall require resetting by interrupting the electrical circuit.
- 2.6.4.4.9 Acceptable controllers for heating units shall be Engineered Air DJM-3, Honeywell ControLinks R7999, or Nexus NX3100.
- 2.6.4.5 **Filters**
- 2.6.4.5.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.
- 2.6.4.5.2 **Pleated Panel Disposable Filters:** 2" (50 mm) Non-woven cotton and synthetic fabric media with a metal support grid and rigid heavy-duty board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Provide permanent reusable metal enclosing frames. The filter media to have an efficiency of 25-30% on ASHRAE Standard 52.1-92, and minimum MERV 6 per ASHRAE 52.2.-1999.
- 2.6.4.6 **Dampers**
- 2.6.4.6.1 Damper frames are to be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13 mm) aluminum, with turn in nylon or bronze bushings. Rods are to be secured to the blade by means of straps and set screws.
- 2.6.4.6.2 Blades are to be 18 gauge (1.3 mm) galvanized metal with two breaks on each edge and three breaks on centreline for rigidity. The pivot rod to "nest" in the centreline break. Damper edges are to interlock. Maximum length of damper between supports to be 42" (1070 mm). Construct damper linkage brackets of galvanized metal.
- 2.6.4.6.3 Dampers are to be extruded aluminum, low leak, thermally broken, insulated blade Tamco Series 9000.
- 2.6.4.6.4 Two position inlet dampers are to be parallel blade type.
- 2.6.4.6.5 **Makeup Air Inlet Damper Control:** Provide normally closed electric damper operators. Interlock this damper operator so that when the unit is shut down, or on a power failure, the damper will return to the closed position.
- 2.6.4.7 The following manufacturers of the above equipment will be considered as equal,

subject to requirements of Clause "Material and Equipment":

Johnson Marcraft

2.7 **BOILER VENTING (Boilers 502 and 503A/B)**

2.7.1 Use ULC Listed Security Chimneys Model CTXD Secure Seal Double-wall gas vent, Category IV. Provide complete vent system including vent sections, connectors, fittings, tees, elbows, finishing cones, cleanouts, spacers, drains and supports.

2.7.2 Manufacturer to design and size venting systems in accordance with manufacturer's requirements and as shown on Drawings. Provide vent size calculations with Shop Drawings.

2.7.3 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Pro Tech Systems
Selkirk Metalbestos

2.7.4 **Combustion Air Ductwork:** Use CPVC to S636.

2.8 **GAS VENTS (Boiler 501A/B)**

2.8.1 Use ULC Listed Category IV gas vent systems for boilers. Vent construction to be double wall, consisting of inner liner and outer shell of AL 29-4C, 416 or 430 stainless steel with minimum 12 mm (0.5") air space and minimum 1250 Pa (5" wc) positive pressure rating. Longitudinal seams to be welded. Vent sections and fitting to join together with factory installed gasket and mechanical ring clamp. Provide complete vent system including vent sections, connectors, fittings, tees, elbows, finishing cone, cleanouts, spacers, drains and supports. All materials must be listed to ULC S636. Single wall AL 29-4C vent may be used above the roof only.

2.8.2 Design stacks to be self supporting and terminate a minimum of 1.8 m (6 ft) above the roof.

2.8.3 Vent manufacturer to design and size venting systems in accordance with boiler manufacturer's published requirements and in accordance with the routing shown on the Drawings. Provide vent size calculations with Shop Drawings.

2.8.4 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Cheminee
Selkirk Canada
Protech Systems
Selkirk Metalbestos

3 Execution

3.1 **DUCTWORK**

3.1.1 Fabricate and install ductwork in accordance with the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) Manual "HVAC Duct Construction Standards - Metal and Flexible".

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- 3.1.1.1 Fabricate all ductwork to the clear inside dimensions shown on the Drawings. Where internal lining is specified, dimensions shown are inside insulation.
 - 3.1.1.2 Do **not** suspend ducts from metal roof deck.
 - 3.1.1.3 Make duct connections to fans with flexible duct connectors.
 - 3.1.1.4 Where ductwork has to be altered from dimensions shown due to construction conditions, use the same effective cross sectional areas, without exceeding a 4 to 1 aspect ratio. Carry out such changes at no additional cost to the Owner.
 - 3.1.1.5 Install ductwork to maximize clear floor to ceiling heights.
 - 3.1.1.6 Transitions are described in the direction of air flow. For converging transitions, use a maximum slope of 1 in 4 and, for diverging transitions, use a maximum slope of 1 in 7.
 - 3.1.1.7 Apply one coat zinc chromate primer over all welded surfaces.
 - 3.1.1.8 If there is a conflict between the duct sizes shown on the floor plans and the duct sizes shown on sections, elevations or details, the floor plans will govern.

3.1.2 **Low Pressure - Rectangular Ductwork**

- 3.1.2.1 Fabricate and install according to current SMACNA standards. Use 2" W.G. pressure class. Use SMACNA recommended sheet metal thicknesses. Fabricate with all flat surfaces wider than 450 mm (18") either cross broken or transverse beaded, regardless of whether the duct is insulated, lined or bare.

3.2 **BOILER VENTING**

- 3.2.1 Install all boiler venting in strict accordance with venting and boiler manufacturer requirements. Seal all inner joints as detailed in manufacturer's installation manuals. Confirm in writing venting arrangement with boiler manufacturer prior to installing venting.
- 3.2.2 Support all sections of boiler venting independently from boiler. Suspend from roof structure.
- 3.2.3 Extend venting through roof. Cut roof openings to suit. Roof repairs to be done only be approved roofing contractor. See Instructions to Bidders for list of approved roofing contractors. Restore roofing and all interior surfaces to match existing.

3.3 **GAS VENTS**

- 3.3.1 Install boiler vents in accordance with manufacturer's recommendations. Provide Type 304 stainless steel drain lines from all low points and as shown on drawings.

3.4 **FLEXIBLE DUCT CONNECTORS**

- 3.4.1 Make all duct connections to fans, fan cabinets and heat pump units with preassembled duct connectors.

3.5 ROOF CURB INSULATION

- 3.5.1 Provide roof attenuation under roof-mounted air conditioning units as follows:
- 3.5.2 Mount all new rooftop units on prefabricated roof curbs.
- 3.5.3 Apply two layers of 25 mm (1") thick, 4.5 lb/ft³ density, insulating board on roof deck. Stagger board joints. Butt board sections tightly to sides of ductwork and curb.
- 3.5.4 Seal all board joints and edges with acoustic sealant.
- 3.5.5 Advise Consultant when this work is complete, for his review. Seal joints to satisfaction of Consultant.

END OF SECTION

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- 1 General
- 1.1 **GENERAL PROVISIONS**
- 1.1.1 This Section applies to and governs the work of all Sections of Division 16.
- 1.2 **VISITING SITE**
- 1.2.1 Visit the site and be familiar with working conditions and work involved before submitting Bids. **NO EXTRAS WILL BE GRANTED DUE TO LACK OF A THOROUGH PRELIMINARY INVESTIGATION.**
- 1.2.2 Remove and replace existing ceiling tiles to inspect ceiling for existing Mechanical, Electrical and Structural obstructions. Include cost of all necessary changes in Bid Price. No extras will be granted due to lack of a thorough preliminary investigation of accessible ceiling spaces.
- 1.3 **CONTRACT DRAWINGS**
- 1.3.1 Electrical Drawings show Electrical work only and are not intended to show Structural details or Architectural features. Take building dimensions and details from Architectural or Structural Drawings or from job measurements only.
- 1.3.2 Electrical Drawings indicate only the general locations of equipment and outlets. Wiring requirements are shown diagrammatically. Responsibility for the detailed layout of equipment, outlets, raceways and wiring is part of the work of this Division. Specific outlet locations are detailed on elevations.
- 1.3.3 In the event of any discrepancies or ambiguity of any symbol, note, abbreviations, etc., used in this Specification or on the Contract Drawings, obtain clarification from the Consultant prior to submitting Bid. No allowance will be made for additional costs arising from failure to obtain proper clarification of conflicting information before Bid.
- 1.3.4 Where dimensions for mounting heights are shown or specified, they refer to the distance from the finished floor or grade to the centre of equipment or outlets, unless otherwise stated on the Drawings. All layout dimensions are to be consistent throughout the project.
- 1.3.5 The Consultant reserves the right to revise the locations of the equipment and outlets within any given room without altering the Contract Price, provided Notice of Change is given prior to roughing-in.
- 1.3.6 In case of conflict between work of other trades and work of this Division, clarify the location of these items with the Consultant before roughing-in.
- 1.4 **REGULATIONS AND PERMITS**
- 1.4.1 Submit Contract Documents to Building Inspection, and other authorities having jurisdiction, obtain permits and pay all fees. Consultant will submit Drawings to Electrical Safety Authority if required.
- 1.4.2 Enforce all prevailing Provincial and local safety regulations at all times. Abide by all Owner's safety and security policies and procedures and conform to all regulations of the current Occupational Health & Safety Act.

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- 1.4.3 After completion of the work, furnish to Consultant a Certificate of Unconditional Approval from Inspecting Authorities.
- 1.4.4 Carry out the work in accordance with the latest editions of relevant Codes, local bylaws, and requirements of local authorities having jurisdiction.
- 1.5 **SHOP DRAWINGS**
- 1.5.1 Submit Manufacturers' Shop Drawings, Electrical Wiring Diagrams and Control System Drawings to the Consultant. Provide title sheet for Shop Drawing submitted. Include project name, Shop Drawing item and approval stamps. The Consultant reserves the right to have samples submitted of any specified products.
- 1.5.2 Before submitting shop drawings, provide a complete list of shop drawings to be submitted in Microsoft® Excel® format. List all shop drawings and approximate date of submission.
- 1.5.3 Submit all shop drawings electronically in Adobe® Acrobat® PDF format. File attachments to an email must total no more than 5 MB and must be submitted unzipped. If multiple items are submitted in single PDF file, each individual piece of equipment must be "book marked" using equipment labels as per Design Drawings. All shop drawings submitted electronically must be checked and stamped by Contractor as specified below.
- 1.5.4 Catalogues, manuals or price lists will not be accepted as Shop Drawings. Before submission, check Shop Drawings, make necessary corrections, apply stamp "Checked and Certified Correct", sign and date.
- 1.5.5 Submit one reviewed set of Shop Drawings with each set of Maintenance and Operating Instructions.
- 1.5.6 The review of Shop Drawings by Chorley + Bisset Ltd. is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Chorley + Bisset Ltd. approves the detail design inherent in the Shop Drawings, responsibility for which remains with the Contractor. Such review does not relieve the Contractor of his responsibility for errors or omissions in the Shop Drawings or of his responsibility for meeting all requirements of the Construction and Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all subtrades.
- 1.5.7 Ensure at least one copy of the reviewed Shop Drawings is kept on site at all times for reference.
- 1.5.8 Shop Drawings to include the following:
- 1.5.8.1 Indicate details of construction, dimensions, capacities, weight and electrical performance characteristics of equipment or material.
- 1.5.8.2 Where applicable, include wiring, single line and schematic diagram including interconnect with work of other sections.
- 1.5.8.3 Include manufacturer's special installation instructions where applicable.

1.6 FIELD DRAWINGS

- 1.6.1 Submit, to the General Contractor, Drawings accurately showing all openings for busducts, conduits, etc. Drawings must include the size of openings and their locations by dimensions, including the location of the structural members framing these openings. Each trade will be responsible for detail layout of their own work.
- 1.6.2 Assume full responsibility for the detailed coordination of all Division 16 work. Prepare Field Drawings to determine the exact location of each service. On these drawings, include all mechanical and electrical services, architectural features, and structural details. If a conflict becomes apparent after the installation of services, pay all costs associated with removing and reinstalling these services.

1.7 AS-BUILT DRAWINGS

- 1.7.1 The Contractor will be provided with the Electrical Drawings in AutoCAD Version 2010 compatible electronic format. The Contractor is to plot and print Drawings from the disks.
- 1.7.2 Revise and maintain the prints as work progresses. Show all revisions, relocations and changes, to scale. Use colour markings.
- 1.7.3 Transfer information from the marked prints to AutoCAD format on a monthly basis. Have the marked prints and updated AutoCAD prints on site for review by the Consultant at all times. Monthly draws will not be approved unless all changes have been shown.
- 1.7.4 Prior to testing and final commissioning, complete the transfer of all information to the AutoCAD Drawings. The Drawing format is to match exactly the layering system of the Consultant. Mark Drawings "As-Built Drawings" and insert name and logo of Contractor. Submit one set of As-Built Drawing prints for review by the Consultant. Remove Engineers Stamp. Include Contractors Name and Logo.
- 1.7.5 Submit completed As-Built Drawings disks in AutoCAD Version 2006 format and one set of Reproducible Drawings with the Operating and Maintenance Manuals.
- 1.7.6 For the purposes of Contract payments, As-Built Drawings will be assumed to have a value of \$1,500.00 of the contracted total amount. This will not be released until As-Built Drawings have been accepted as complete and acceptable by the Consultant. This amount is in addition to the normal 10% holdback required by the Construction Lien Act, 1983.

1.8 CONFLICTS AND PRECEDENCE

- 1.8.1 Immediately upon discovery of any conflict, ambiguity, error or omission in the Contract Documents, request clarification in writing from Consultant prior to starting the work in questions.
- 1.8.2 Failure to give such written notice will constitute an irrevocable waiver and release of any claim for additional compensation or delays incurred.
- 1.8.3 Where work fails to conform to Contract Documents, as clarified by Consultant, promptly remove and replace such work as directed, without adjustment to Contract price.

1.9 FIRESTOPPING

- 1.9.1 Before starting any work on site, submit detailed Shop Drawings to the Consultant for review and comments. Include:
- 1.9.1.1 Manufacturer's technical product data and installation instructions for each specific type and location of penetration.
- 1.9.1.2 Certification that proposed firestopping materials and assemblies comply with CAN4-115-M.
- 1.9.1.3 For each specific type and location of penetration, provide installation instructions from a recognized independent testing agency.
- 1.9.2 Mark penetration types and locations on set of white prints. At completion of project, transfer this information to As Built Drawings.
- 1.9.3 Comply with all requirements of Ontario Building Code Clause 3.1.9, "Building Services in Fire Separations and Fire Rating Assemblies".

1.10 MAINTENANCE AND OPERATING INSTRUCTIONS

- 1.10.1 Assemble three sets of equipment literature (cuts), operating instructions, maintenance instructions, pressure test results, certificate, other pertinent data and Letter of Warranty. Place in three ring binders, complete with index pages, indexing tabs and cover identification at front and side. Submit to Consultant for approval.
- 1.10.2 Make changes or submit additional information as required to obtain approval. Final Certificate of Completion will not be issued until the Consultant possesses three approved sets. Include copies of approved Shop Drawings and name and address of Spare Parts' Suppliers with manuals.
- 1.10.3 Provide two electronic copies of the maintenance and operating manual in PDF format on a compact disc or DVD and submit with the final version of manuals. Provide separate files on the disc in accordance with the sections of the hard copy manuals. Divide the maintenance manuals into the following sections:
- Section 1 - General
Section 2 - Motor Control
Section 3 - Certificates
- 1.10.4 The following information is to be contained within the Sections:
- 1.10.4.1 **Section 1:** A list of names, addresses and telephone numbers of the Consultants, General Contractor and Electrical Contractor. Written warranty of the systems.
- 1.10.4.2 **Section 2:** A list of names, addresses and telephone numbers of all suppliers. A copy of all approved Shop Drawings.
- 1.10.4.2.1 A complete and comprehensive maintenance and operating instructions details D (daily), W (weekly), M (monthly), SA (semi-annually), A (annually) for maintenance.
- 1.10.4.2.2 Copies of warranties.
- 1.10.4.3 **Section 3:** Electrical Safety Authority Inspection Permit.

1.11 MATERIAL AND EQUIPMENT

- 1.11.1 Where an item of material or any equipment is specifically identified by a manufacturer's trade name and/or catalogue number, make no substitution except as provided for in paragraphs 3, 4 and 5 below.
- 1.11.2 In the case of some items of equipment, one or more additional names of acceptable equal manufacturers are listed in the Clause describing an item or a group of items. The design, layout, space allocation, connection details, etc., are based on the products named first in the description of each item. The products named first in the description of each item establish the quality of manufacture and design standards for all other manufacturers of that item. The general approval indicated by listing the names of other manufacturers is subject to final review of Shop Drawings, performance data, test reports, production samples (if required) by Consultant, and equipment shipped to site. Ensure that the products used meet the requirements specified and as shown on the Contract Drawings.
- 1.11.3 Suppliers wishing to submit other items of equipment for approval as an equal to those specified must apply to the Consultant at least 12 working days before Bid closing date. Requests must be accompanied by complete description and technical data on the items proposed. Approval for substitution of equipment will only be given on the understanding that all details, accessories, features and performance meet the Specifications unless otherwise stated. **Deviations from the Specifications must be stated in writing at time of application for approval.**
- 1.11.4 Include in the Bid, the equipment named in the Specifications or approved as an equal as in paragraph 3 above. This will form the **Base Bid**. Any number of alternative bids, as defined below, may be included in addition to the **Base Bid**.
- 1.11.5 Items of equipment by Manufacturers not named in the Specifications may be offered as **alternatives** to the manufacturers named in the Specifications. The alternative proposals must be accompanied by full descriptive and technical data, together with the statement of amount of addition or deduction from the Base Bid, if the alternative is accepted. Prior approval by the Consultant is **not** required on items submitted as alternative bids.
- 1.11.6 After execution of the Contract, substitution of equipment will be considered only if equipment accepted cannot be delivered in time to complete the work in proper sequence, or if the manufacturer has stopped production of the accepted item. In such cases, requests for substitution must be accompanied by proof of equality and difference in price and delivery, in the form of Certified Quotations from Suppliers of both specified and proposed equipment. Credit any decrease in price involved in substitution to the Owner by reduction of the Contract Price. The Contractor will **not** be reimbursed for any such increase in price.
- 1.11.7 Where equipment other than the equipment used as a basis for design, layout and space allocation is used, produce and submit revised layouts of equipment, pipes, ducts, etc., in the areas affected. Submit these Drawings with the Shop Drawings. Failure to produce these Drawings is indication by the Contractor that they are not required and the original space allocations are adequate for the substituted equipment.
- 1.11.8 Name the Subcontractors and Manufacturers in the Bid as indicated in Clause "List of Electrical Subcontractors and Manufacturers".

1.12 DIMENSIONS AND QUANTITIES

- 1.12.1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.
- 1.12.2 Verify equipment access and coordinate with equipment supplier to ensure equipment can be physically transported to installation location. Under no circumstances will any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which will be considered as part of equipment installation.
- 1.12.3 Quantities or lengths indicated in any of the Contract Documents are approximate only and will not be held to gauge or limit the work. No adjustment to the Contract Price will be allowed to complete the work.
- 1.12.4 Provide labour, products and services specified, but not shown on Drawings and vice versa, and all other labour, products and services necessary for completion of the work.
- 1.12.5 Make any necessary changes or additions to routing of conduit, cables, cable trays, and the like to accommodate structural, mechanical and architectural conditions, without adjustment to Contract price.
- 1.12.6 Provide work in accordance with the approved Schedule to meet completion date and specified interim Schedules.

1.13 COOPERATION BETWEEN TRADES

- 1.13.1 Cooperate and coordinate with other trades as required for satisfactory and expeditious completion of work. Take field dimensions relative to work. Fabricate and erect work to suit field dimensions and field conditions. Pay cost of extra work caused by and make up time lost as result of failure to provide necessary cooperation information or items to be fixed to or built-in, in adequate time.

1.14 COOPERATE WITH OWNER'S STAFF

- 1.14.1 Maintain close cooperation with Owner's staff. The Owner will determine the times during which work may be carried out in certain areas. If the work cannot be completed in the allowed time, the Contractor may be required to clean up the area and finish the work at some future time.
- 1.14.2 Shutdowns will be scheduled during unoccupied times. Include any overtime wages due to conditions stipulated above in the Bid Price.
- 1.14.3 Provide seven day's minimum notice, in writing, prior to any interruptions of service or restriction of use of any service.
- 1.14.4 Provide all phase testing, as required, prior to disconnecting existing and connecting new to avoid damage to equipment.
- 1.14.5 The Owner's operations must take precedence over Contractors' operations at all times. Interruptions due to noise, drilling, etc., will not be allowed without Owner's prior approval.
- 1.14.6 Include any overtime wages due to conditions stipulated above in the Bid Price.

1.15 MAINTENANCE OF EXISTING SERVICES

- 1.15.1 Take every precaution to locate and protect existing services so that no interruption occurs. If any existing service is damaged due to the work of this Division, arrange and pay for repair. Bear any costs due to interruption of existing services.
- 1.15.2 Be responsible for maintaining continuity of existing services, and for programming work so that the Owners can carry out their normal business uninterrupted, with the exception of scheduled shutdowns for connection to or rerouting of existing services, at a time agreed to by the Owners, on weekdays, over weekends or after normal working hours.
- 1.15.3 Permission from the Consultant is required before making any connections to or rerouting of existing services. Give seven days prior notice to the Consultant and Owner.

1.16 EXAMINATION OF DAMAGED DEVICES

- 1.16.1 Report all damaged or defective devices in report form to the Consultant prior to removal and storage.
- 1.16.2 Damage that occurs to devices during storage or removal will be replaced at no cost to the Owner.

1.17 INTERPRETATION OF CONTRACT DOCUMENTS

- 1.17.1 The decision as to which trade provides required labour or materials rests solely with the Contractor. Extra payments will not be considered based on a difference in interpretation of the Contract Documents as to which trade involved provides materials or labour for specific items of work. The Consultant will not enter into such discussions.

1.18 WARRANTY

- 1.18.1 Warrant all workmanship and make good any defects for one year after Owner's takeover except where specifically specified otherwise. Warrant material and equipment supplied by the manufacturers for one year after Owner's takeover. Make good damage caused due to defects and workmanship.

1.19 PROTECTING AND MAKING GOOD

- 1.19.1 Be responsible for protection of Owner's property, as well as finished and unfinished work, from damage due to execution of work under this Contract. Repair damage resulting from failure to provide such protection to the satisfaction of the Consultant, at no expense to the Owner.
- 1.19.2 Attach and fasten fixture and fittings in place in safe, sturdy, secure manner so that they cannot work loose or fall or shift out of position during occupancy of building, as the result of vibrating or other causes in normal use of building.
- 1.19.3 Coordinate and cooperate with other trades, taking into account existing installations, to assure best arrangement of equipment in available space. For critical locations, prepare interface and installation drawing showing work of various sections as well as existing installations, for approval before commencing work.

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- 2 Products
- 2.1 **MATERIALS**
- 2.1.1 Use materials specified herein or approved equal as defined in Clause "Material and Equipment".
- 2.2 **SLEEVES**
- 2.2.1 In general, sleeves are not required through walls or floors except service room floors and foundation walls.
- 2.2.2 Use Schedule 40 steel pipe sleeves through concrete structural members, walls and floor slabs. Extend sleeves minimum 1" AFF and seal pipe to sleeve. For sleeves through other construction - drywall, tiles, masonry, etc., use minimum 22 gauge galvanized steel construction.
- 2.2.3 For all conduits passing through foundation walls, use Link-Seal pre-engineered mechanical seals between sleeves and pipes.
- 2.3 **FIRESTOPPING**
- 2.3.1 Use only service penetration firestop components and assemblies tested in accordance with CAN4-S115-M "Standard Method of Fire Tests of Firestop Systems" and listed in most recent ULC "List of Equipment and Materials" or by another recognized independent testing and certification agency acceptable to the Consultant.
- 2.3.2 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause "Material and Equipment":
- Tremco only - no equals
- 2.4 **IDENTIFICATION NAME LABELS**
- 2.4.1 Provide identification labels for equipment in white lamacoid with black uppercase lettering.
- 2.4.2 Submit a complete list of nameplate wording for review by Consultant prior to installation.
- 2.4.3 Warning plates are to be red with white letters.
- 2.4.4 Labels to be mechanically attached with self-tapping screws.
- 2.4.5 Letter size will vary, but 6 mm (1/4") high is considered minimum.
- 2.5 **SPRINKLERPROOF EQUIPMENT**
- 2.5.1 This building will be fully sprinklered. Use sprinklerproof electrical equipment in service rooms and electrical rooms. All surface panels and equipment to be sprinklered.
- 3 Execution

3.1 GENERAL

- 3.1.1 Instruct and supervise other Sections doing related work.
- 3.1.2 Supply the measurements of equipment to other Sections to allow for necessary openings to be left in the work of other Sections.
- 3.1.3 Carry out all work in accordance with the latest regulations of the Canadian Electrical Code and all applicable Municipal and Provincial Codes and Regulations. In no instance, however, is the standard established by the Drawings and Specifications, to be reduced by any of the Codes referred to above.
- 3.1.4 Install all ceiling components in direct accordance with reflected ceiling plans.
- 3.1.5 Electrical Drawings show approximate locations for wall-mounted devices. Clarify exact location and mounting height with Consultant prior to roughing-in.

3.2 SUPPORTS AND BASES

- 3.2.1 Provide structural work required for installation of equipment provided under this Division.
- 3.2.2 Unless specified otherwise, set floor mounted equipment provided under this Division on concrete bases. Extend existing concrete bases. Match existing height.
- 3.2.3 Provide all brackets and supports required in steel stud walls. All conduits and equipment must be supported on brackets or supports attached to steel studs. Do not support materials or equipment from wall sheathing.
- 3.2.4 Provide independent support; brackets and unistrut structures where required to install electrical equipment; motor controllers, splitters, panels, etc:
- in areas where the equipment is located on walls/columns that are not suitable for direct installation.
 - When installation away from structural building elements is called for.
 - When it is necessary to elevate the electrical equipment to ensure code compliance or ergonomical operator access.
- 3.2.5 Do not mount starters, VFD's, etc. on building equipment.

3.3 STORAGE OF MATERIALS

- 3.3.1 Provide proper weatherproof storage for the protection of materials and equipment on site. Blank off openings in all equipment until required for use.

3.4 SLEEVES

- 3.4.1 Provide sleeves for all conduits which pass through service room floors and foundation walls.

3.5 FIRESTOPPING

- 3.5.1 Provide a listed firestop system in accordance with the Ontario Building Code to seal around all conduits, electrical wires and cables, and other similar electrical services which penetrate part of a building assembly required to have a fire resistance rating

or a fire separation. Refer to Architectural Drawings and Specifications Section "Firestopping and Smoke Seals" for building assembly and fire separation types and locations.

- 3.5.2 For all penetrations through fire separations required to have a fire resistance rating, use firestop systems with an F rating not less than the fire resistance rating for the fire separation. This includes the sealing of any sleeves provided for future uses. Provide an FT rating where required by the Ontario Building Code.
- 3.5.3 All firestopping must be thoroughly reviewed by the Technical Representative of the systems manufacturer on site before any firestopping is concealed and submit a report of compliance with the rating requirements. Technical Representative to complete 3 destructive tests to confirm compliance with ULC listing, minimum one floor test and one wall test, third test to be Contractors choice. Submit a copy of the report to the Consultant.

3.6 CUTTING AND PATCHING

- 3.6.1 Flash holes through walls and roof to make weatherproof.
- 3.6.2 Do not cut or drill holes through floors, roof or structural members before obtaining permission from the Consultant.
- 3.6.3 For penetrations through walls not required to have a fire rating, seal all spaces between pipe or pipe and surrounding wall construction with a fire-rated foam sealant. Use 3M Fire Barrier, Metacaulk, or Dow Fire Stop UL Classified fire rated foam sealants. Do this as the work progresses, to avoid leaving inaccessible holes at completion of the job. For penetrations through parts of the building assembly required to have a fire resistance rating or acting as a fire separation, see Clause "Firestopping" in this Section.
- 3.6.4 Where conduits are shown on the Electrical Drawings passing through existing walls, floors, and roof, cut and patch the necessary openings. Include the cost of all cutting and patching in the Lump Sum Contract Price for the work of Division 16. Before drilling holes through floors or roof slabs, accurately locate and note sizes for each required hole. Get approval of Consultant before any cutting is started.
- 3.6.5 Remove and replace ceiling where necessary to complete the work of this Division unless this work is specifically included in another Division.
- 3.6.6 All cutting and patching to be done by the trade specializing in the materials to be cut.

3.7 PAINTING

- 3.7.1 Touch up minor damage to finish on equipment supplied with factory applied baked enamel finish. Completely refinish items suffering damage which, in the opinion of the Consultant, is too extensive to be remedied by touchup.
- 3.7.2 Paint all steel framework inside the building provided by this Division with a chromium oxide primer. All steel framework outside the building is to be hot dipped galvanized.
- 3.7.3 Paint both sides and edges of plywood backboards for electrical and communications equipment before installing equipment. Use one coat alkyd enamel primer and two coats alkyd enamel finish.

3.7.4 Paint disconnect switch or breaker for exit light systems in red enamel. Use one coat of primer and one finish coat.

3.8 IDENTIFICATION

3.8.1 Colour code control wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components. Match existing colour coding in use on site. Verify with Owner prior to installation.

3.8.2 All 3 phase branch circuits shall be:

- Phase A - red
- Phase B - black
- Phase C - blue

3.8.3 Identify all disconnects, starters, and other control equipment with nameplates indicating the equipment controlled.

3.8.4 Identify **each device** coverplate by marking on the front of the plate the panel and circuit number for the device with Brady self-adhesive label. Use clear tape with 3/16" black lettering.

3.8.5 Identify all pull boxes, junction boxes or octagon boxes located in the ceiling cavity with the exact use of the box. Felt pen is acceptable.

3.8.6 Identify all system terminal cabinets with nameplates indicating the use of the cabinet, e.g., "FIRE ALARM", etc.

3.8.7 Nameplates to be securely fastened to equipment with screws.

3.8.8 Phase all switchboards and panels so that Phase A is on the left side, when viewed from the front.

3.9 LOCKS AND KEYS

3.9.1 Where locked panelboards, control panels, terminal cabinets, etc., are specified, use a separate key pattern for each system with all locks in each system common to one key. Provide two keys of each pattern to the Owner on a 25 mm (1") key ring. Submit one set of keys with manual.

3.10 TESTING

3.10.1 All systems must be thoroughly tested by the Technical Representative of the system manufacturers before arrangements are made for the final demonstration in the presence of the Owner's staff.

3.10.2 At the completion of the work, demonstrate operation of all systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found.

3.10.3 Systems to be tested are:

1. Motor Control Equipment

3.11 TEMPORARY ELECTRICAL FACILITIES FOR CONSTRUCTION

-
- 3.11.1 Provide temporary electrical services as outlined below, and in accordance with all applicable Codes, and in accordance with the Ontario Health and Safety regulations.
- 3.11.2 Include all costs associated with the installation inspection, operating, maintenance and alteration of these temporary electrical facilities in the Base Bid Price. Remove all temporary facilities when they are no longer required.
- 3.11.3 **Minimum Power Requirements:** The requirement to satisfy the required power needs rests solely on the Contractor.
- 3.12 **EQUIPMENT SCHEDULE**
- 3.12.1 Equipment Schedules are as shown on Drawings.
- 3.12.2 In general, the motor or item numbers shown in the Equipment Schedules coincide with those numbers shown for Mechanical Trades.
- 3.13 **GROUNDING**
- 3.13.1 Ground all components of the Electrical system in accordance with the requirements of Section 10 of the Electrical Safety Code latest edition and the Inspection Authority.
- 3.13.2 **Provide a separate ground conductor in all raceways.**
- 3.13.3 Ground secondary neutrals of transformers to building ground conductor.
- 3.13.4 Where attached to equipment, conduits, cabinets, etc., use suitable approved solderless lugs, compression connectors. No soldered or split bolt type connections are to be used on grounding circuits at any point.
- 3.13.5 All compression connectors, lugs, etc., used in grounding circuits in any location are to have bolts, nuts, etc., of silicone bronze alloy equal to "Everdur" metal.
- 3.13.6 Clean all surfaces to which bus or cable are to be bolted, of all paint, rust, etc., and work to a bright, flat surface.
- 3.13.7 Conduit expansion joints and telescoping sections or metal raceways not thoroughly bonded otherwise, are to be provided with approved bonding jumpers or not less than #8 AWG stranded bare copper.
- 3.13.8 Provide a separate #14 green ground wire for all outlets connected to a GFCI circuit breaker.
- 3.14 **REMOVAL OF EXISTING MATERIAL AND EQUIPMENT**
- 3.14.1 Remove existing material and equipment where shown or specified. Equipment such as Fire Alarm devices, and any other special devices are to be turned over to the Owner. Relocate these items to a designated storage site as directed by Owner. Other material and equipment which is removed becomes the property of the Contractor, and must be immediately removed from the site.
- 3.15 **LOAD BALANCE**
- 3.15.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance

of current between phases and record changes.

3.15.2 Measure primary and secondary currents of dry type transformers. If necessary, rearrange phase connections to selected branch feeders from their distribution panels without changing rotation, to minimize current unbalance.

3.15.3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

3.15.4 Submit, at completion of work, a report listing phase and neutral currents on panelboards, dry-core transformers and motor control centre, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.16 **LIST OF MANUFACTURERS**

3.16.1 In the Bid Documents, name the manufacturer of the items listed below. Use only one name for each item. See Clause "Material and Equipment".

- Motor Control Equipment
- Panelboards

END OF SECTION

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-
- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 16001, "Electrical General Provisions".
- 1.2 **DESCRIPTION OF SYSTEM**
- 1.2.1 Provide all new wiring and raceways. Where possible, conceal all wiring and raceways above ceilings, in walls and partitions. See Section 16001, "Electrical General Provisions".
- 2 Products
- 2.1 **MATERIALS**
- 2.1.1 Use materials specified herein or approved equal as defined in Clause "Material and Equipment".
- 2.1.2 All outlet boxes, wiring devices, equipment and accessories must be C.S.A. approved and be designed for the application intended.
- 2.2 **RACEWAYS**
- 2.2.1 Use E.M.T. in concealed locations in concrete block walls, and for main and branch circuit wiring above corridor ceiling spaces.
- 2.2.2 Use minimum 1/2" (16 mm) conduit for power wiring and 3/4" (21 mm) conduit for communication conduit.
- 2.2.3 Use set screw steel couplings and connectors. Use raintight steel connectors complete with "O" rings, where exposed to sprinklers.
- 2.2.4 Use conduit expansion coupling for expansion joint crossing.
- 2.2.5 Use liquid tight flexible metal conduit for all final connections to motors and other equipment subject to vibration or which has adjustable mountings. Minimum size 1/2" (16 mm).
- 2.2.6 **On Roof** - Use rigid aluminum conduits and fittings. All boxes and conduit bodies shall be die-cast, copper-free aluminum with aluminum covers and neoprene gaskets.
- 2.2.7 Fasten all raceways with approved supports. Use clamps and all mounting hardware of the same material as the conduit or compatible material to prevent galvanic corrosion.
- 2.3 **CONDUCTORS**
- 2.3.1 Aluminum conductors are NOT permitted on this project.
- 2.3.2 Use minimum copper #12 AWG **stranded** for branch circuiting, control wiring and receptacle wiring.
- 2.3.3 Type AC-90 cable may be used for final drops (maximum 2 m [6.5']) to lighting

fixtures and devices in accessible ceiling spaces. **DO NOT USE AS MAIN BRANCH WIRING FROM PANELBOARDS OR FOR BRANCH CIRCUIT WIRING (i.e. RECEPTACLES, ETC.).**

- 2.3.4 For wiring to heating equipment, recessed lighting fixtures or where body of fluorescent fixture is used as raceway, use conductors with high temperature insulation of type approved by Electrical Safety Authority.
- 2.3.5 Use all wire and cable insulation rated 600 volts minimum unless specified otherwise.
- 2.3.6 Use RW-90XLPE or T-90/TWN75 for all branch circuits, control wiring and receptacles, up to #10 AWG.
- 2.3.7 Use RW-90XLPE for wiring larger than #10AWG.
- 2.3.8 Use RW-90XLPE-1000 volt rated cables from Variable Frequency Drives to motors.

2.4 **OUTLET BOXES**

- 2.4.1 Use only masonry approved boxes in concrete and masonry construction.
- 2.4.2 Use 100 mm (4") square or utility type boxes for surface-mounted boxes and 100 mm (4") octagonal boxes for ceiling outlet boxes. Use multi-gang boxes for grouped devices. Use wrap-around covers for utility boxes.
- 2.4.3 Use flush-mounted boxes complete with adjustable ears, extension rings and plate rings as required. Do not use shallow or narrow boxes.

2.5 **WIRING DEVICES**

- 2.5.1 Use specification grade wiring devices, types and ratings shown on the Drawings.
- 2.5.2 Weatherproof receptacles to have die-cast aluminum duplex gasketed spring door covers.

2.5.3 **Receptacles**

- 2.5.3.1 20 amp 120 volt ivory U-ground duplex, Hubbell Catalogue No. HBL-5362-I in other areas
- 2.5.4 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause "Material and Equipment":

Arrow-Hart
Bryant
Harvey-Hubbell
Pass & Seymour

2.5.5 **Plates**

- 2.5.6.1 In general, use Hubbell "Indestructible", "smooth" plates, ivory for all ivory devices. Confirm colour of devices with the Consultant prior to ordering.

2.6 **DISCONNECT SWITCHES**

-
- 2.6.1 Fused or unfused disconnect switches to be conditionally hp rated, heavy duty type with visible break industrial safety switches in general purpose or weatherproof enclosures as required.
- 2.6.2 The door to be mechanically interlocked with the operating handle to prevent it from being opened when the switch is in the "ON" position. The handle is to be capable of being padlocked in the "OFF" position.
- 2.6.3 For single phase heat pumps, provide Cutler Hammer Cat. #B100 toggle switch type starter complete with lockable cover.
- 2.6.4 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause "Material and Equipment":

Cutler Hammer
Siemens
Square D

2.7 **OVERCURRENT PROTECTIVE DEVICES - FUSES**

- 2.7.1 Provide fuses for all fusible equipment in this Contract.
- 2.7.2 Fuse interrupting rating is to be 200,000 amps RMS symmetrical unless otherwise noted.
- 2.7.3 Rated 1 to 600 amps, 600 volts AC, fuses will be CSA certified HRCI J/Class J Time Delay with dimensions and current limiting performance in accordance with CSA Specification C22.2 No. 106 1985 or UL Standard 198C for Class J fuses. Ratings as shown. HRCI/JY fuses are not acceptable.
- 2.7.4 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause "Materials and Equipment":

Bussmann
English Electric
Ferraz-Shawmut
Littlefuse

3 Execution

3.1 **GENERAL**

- 3.1.1 Unless shown otherwise, the minimum size of all raceways and conductors to be in accordance with the Canadian Electrical Code.

3.2 **CONDUIT INSTALLATION**

- 3.2.1 Conceal all conduits except in equipment rooms, unfinished area, and where specifically noted. Flush mount all devices, starters, etc., in finished areas. Install all exposed conduits parallel to building walls and partitions. Install escutcheon plates at walls, floors and ceilings where conduit is exposed.

Conduits **must** be supported from building structure. Provide independent unistrut under obstructions such as ductwork for support as required.

3.2.2 Maintain continuity of ground through all connection points. Use sealer lubricant on all threaded connections embedded in concrete, buried in ground or exposed outdoors.

3.2.3 Leave all conduit systems finished complete with outlet boxes, coverplates, bushings, caps, nylon fish wire, etc. Provide bushings for all sleeves.

3.3 CONDUCTORS

3.3.1 Join #8 AWG and larger conductors with compression connectors properly sized. On #10 AWG and smaller, relaxed wing-nut type connectors may be used. Ideal Industries 451, 452 or 453.

3.3.2 Size conductors for a maximum of 2% voltage drop from the supplying panel to the furthest outlet in the circuit.

3.3.3 Draw wiring into raceways only after all other work that may cause injury to the wire is completed. Use only wiring lubricants that do not shorten insulation life. Use continuous lengths for feeders to panels and large equipment. Do not splice without permission from Consultant.

3.4 OUTLET BOXES

3.4.1 Support all boxes independently of the conduits running to them. Use flush boxes in areas where concealed conduit is used.

3.4.2 Check the Drawings to ensure that no outlets are roughed-in at inaccessible locations, where built-in furniture, counters, etc., are to be installed. In such locations, install the outlets above and clear of the trim by approximately 100 mm (4") unless shown otherwise on the Drawings.

3.4.3 **DO NOT INSTALL OUTLET BOXES OF ANY SYSTEM BACK TO BACK.** Offset as necessary to prevent sound transmission between areas.

3.5 WIRING DEVICES

3.5.1 Install light switches on lock jamb side of the door as finally hung. Check door swing before roughing-in. Install switches with the "ON" position up. Locate switch as close as practical to door jamb but not closer than 1". Coordinate location with built-in and Owner supplied equipment and furnishings.

3.5.2 When two or more devices are grouped together, mount under a common coverplate unless shown otherwise.

3.5.3 Mount light switches at height as indicated on Drawings.

3.5.4 Mount duplex receptacles and telephone outlets 25 mm (1") above a countertop backsplash to bottom of device coverplate.

END OF SECTION

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- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 16001, "Electrical General Provisions".
- 1.2 **RELATED WORK**
- 1.2.1 **Power supply wiring and raceways for motors of mechanically driven equipment:** Supply and installation of wiring and disconnect at motor by Division 16, unless otherwise noted on Drawings.
- 1.2.1.1 Wiring and raceways for control devices and instruments, such as automatic temperature and pressure control systems, electrical interlocks between starters, field devices and control panels, heat sensors, water temperature controls, thermostatic controls, "ON-OFF" multi-speed controller for cabinet unit heaters: Supply and installation by Division 15.
- 1.2.1.2 Control wiring and conduit for unit heaters and forced flow units for their associated thermostats and control by Division 15.
- 1.3 **REFERENCES**
- | | | |
|-------------------------|---|---|
| CSA C22.2 No. 14-M91 | - | Industrial Control Equipment |
| CSA C22.2 No. 100-M1985 | - | Motors and Generators |
| CSA C390-M1985 | - | Energy Efficiency Test Methods for 3-Phase Induction Motors |
| EEMAC E14-2 | - | Industrial Controls and Systems Standard |
| EEMAC M1-6 | - | Motors and Generators |
- 1.4 **SYSTEM DESCRIPTION**
- 1.4.1 **Design Requirements**
- 1.4.1.1 Divisions supplying motor-driven equipment are to supply and install factory-wired package assembly, field instruments and control devices, including relevant raceway and wiring forming an integral part of automated control system of equipment.
- 1.4.1.2 Division 16 is to supply and install "power train" such as power supply equipment (switchgears, distribution boards, distribution panels, panelboards), disconnect switches, circuit breakers and splitter boxes, complete with wiring and raceways to termination point at motor or designated power terminals of assembled equipment (packaged unit).
- 1.4.1.3 Division 16 is to install separately mounted starters and other specified motor control devices handed over by other Division, necessary to complete "power train".
- 1.4.1.4 Division 16 is to incorporate into motor control centre all starters, controls, terminals, equipment and wiring as specified herein and/or as indicated on Drawings.
- 1.5 **SUBMITTALS**
- 1.5.1 Submit Shop Drawings as defined in General Conditions of the Contract, to include but not limit following:

1.5.1.1 **Starters and Controllers:** Mounting method and dimensions, starter size and type, layout of identified internal and front panel components, enclosure types, wiring diagram for each type of starter and interconnection diagrams.

2 Products

2.1 MOTOR STARTERS AND CONTACTORS

2.1.1 Common Requirements

2.1.1.1 Provide starters and contactors as specified in the Equipment Schedules and as shown on the Drawings.

2.1.1.2 Starters and contactors are to be complete with enclosures suitable for the area in which they are installed.

2.1.1.3 Magnetic starters and contactors are to be complete with individual control transformer protected by control fuses. Control voltage 120 volt, 60 hertz unless otherwise noted or voltage required by Division 15. Coordinate with Division 15.

2.1.1.4 Use three phase magnetic starters and contactors not smaller than NEMA size 1. Use single phase starters and contactors not smaller than NEMA size 0.

2.1.1.5 Provide 1 N.O. auxiliary contact and 1 N.C. auxiliary contact in all starters.

2.1.1.6 All starters to be NEMA rated. IEC rated starters are not acceptable.

2.1.2 Manual Starters

2.1.2.1 Starters are to have "ON-OFF" snap switch with double-break pure silver contact and complete with neon pilot light. In finished areas, starters are to be flush-mounted with a stainless steel faceplate. Starters to be pad lockable in the OFF position.

2.1.2.2 Three phase manual starters are to have toggle type switch with neon pilot light and provision for locking in the "STOP" position. Switch mechanism is to be quick-make, quick-break. Starters to be pad lockable in the OFF position.

2.1.3 **Magnetic Starters and Contactors:** Unless noted otherwise, magnetic starters are to be combination type across the line full voltage start type with fused disconnect or breaker complete with:

- HAND-OFF-AUTO selector switch as required
- motor overload protective device in each phase, manually reset from outside of enclosure
- red "motor running" pilot light
- capable of being padlocked in the OFF position.

2.1.4 The following manufacturers of the above equipment will be considered as equal, subject to the requirements of Clause "Materials and Equipment":

Allen-Bradley
Cutler Hammer
Moeller
Siemens

Square D

2.2 PILOT DEVICES, RELAYS

- 2.2.1 Selector switches are to be standard duty, oil tight type. When separately mounted, they are to be located in their own enclosures.
- 2.2.2 Install double voltage relays and/or C.S.A approved segregated auxiliary contacts as required to perform interlocking or other functions. Contacts to suit application.
- 2.2.3 Unless noted otherwise, pilot lights to be oil tight, long-life filament bulb type, with transformer.
- 2.2.4 Relays, other than double voltage, to be electrically operated and electrically held and to have coils of the voltage and the number of contacts to suit the details of the control scheme. Relays to be Square D Class 8502 or equal.

3 Execution

3.1 INSTALLATION

- 3.1.1 **Motor:** Installation by Division supplying motor-driven equipment is to comply with governing regulatory authority requirements, applicable Sections of Division 16, and with motor manufacturer's recommended methods.
 - 3.1.1.1 Terminate power supply cables to motor terminal box using liquid-tight flexible conduit connection.
 - 3.1.1.2 Check for correct direction of rotation, with motor not coupled from driven equipment. Cooperate with other Sections supplying motor-driven equipment, to ensure initial start of each motor is correct.
- 3.1.2 **Starters:** Install starters and connect wiring, as indicated on Drawings, in accordance with Code requirements, and in accordance with approved wiring diagrams and manufacturer's Drawings.
 - 3.1.2.1 Provide 19 mm (3/4") thick plywood panel sized to accommodate group-mounted disconnect switch or enclosed circuit breaker, starters, splitter box and other required control devices, as indicated on Drawings.
 - 3.1.2.2 Provide raceways, boxes, cables and wirings from panelboards or switchgear through splitters, starters and field disconnect switches to complete power supply required for motors.
 - 3.1.2.3 Provide raceways and wirings for control devices and instruments for installation by Division 16 when specified herein. Other control wiring and conduits for field instruments and devices forming part of automated control system for equipment are to be supplied and installed by Divisions installing such system and equipment.
 - 3.1.2.4 Provide raceways and wiring, and terminate in designated power supply connection points of pre-wired equipment or package unit supplied by other Divisions. All other outgoing control wiring and conduits are to be installed by Divisions supplying and installing pre-wired equipment or package unit.
- 3.1.3 **Wiring:** Use minimum size of #12 AWG for single phase and 3 phase motor power

supply wiring and control wiring, 600 volt R90 insulation, unless otherwise specified herein or indicated on Drawings.

- 3.1.4 Check in field and coordinate motor nameplate full load amperes and service factor to ensure correct fuses and overload relay heater elements are installed. Set adjustable relays.
- 3.1.5 Provide lamacoid nameplates on front cover of starters, separately-mounted control stations, and field-mounted disconnect switches, indicating function or equipment service identification as indicated on Drawings.
- 3.2 **FIELD QUALITY CONTROL**
 - 3.2.1 **Tests and Inspection**
 - 3.2.1.1 Operate switches, contactors to verify correct functioning.
 - 3.2.1.2 Operate selector switch or pushbuttons for performance of starting and stopping sequences of contactors and relays.
 - 3.2.1.3 Inspect and test starter operation as per starter manufacturer's instructions.
 - 3.2.1.4 Full responsibility for proper performance of motors is to be assumed by Division installing such motors.

END OF SECTION

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- 1 General
- 1.1 **GENERAL REQUIREMENTS**
- 1.1.1 Conform to the requirements of Section 16001, "Electrical General Provisions" and Section 16100, "Basic Materials and Methods".
- 1.2 **DESCRIPTION OF WORK**
- 1.2.1 Provide breakers in existing panels.
- 2 Products
- 2.1 **MATERIALS**
- 2.1.1 Use materials specified herein or approved equal.
- 2.2 **DISTRIBUTION EQUIPMENT**
- 2.2.1 **Circuit Breakers**
- 2.2.1.1 Unless noted otherwise on Drawings, circuit breakers on Lighting and Power Panelboards 120/208 volt and 347/600 volt, 3 phase, 4 wire system, are to be moulded case. Breakers are to have a minimum interrupting capability of 22,000 amperes RMS symmetrical at 240 volt AC. **Series rated breakers are not acceptable unless stated otherwise on the Drawings.**
- 2.2.1.2 All breakers are to be bolted in place, **not** plug-in type.
- 2.2.1.3 Breakers are to be suitable for the panelboards provided.
- 3 Execution
- 3.1 **EXISTING PANELBOARDS**
- 3.1.1 Provide new typewritten directories.
- 3.1.2 Refer to Section 16001 in these Specification re circuit identification on device plates.

END OF SECTION