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END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 National Research Council Canada (NRCC)
 - .1 Alberta Building Code (ABC)
 - .2 National Energy Code of Canada (NECB)

1.2 DEFINED TERMS

- .1 The definitions of this section are not meant to supersede definitions of the Building Code, Standards, or Contract Documents and apply only to these Contract Documents.
- .2 *Acceptable Manufacturer* means the listed manufacturer may bid on the work providing that their submittals meet the requirements of the Contract Documents.
- .3 *Acceptable Material* means the listed material shall form part of the specified requirements for its type of product and sets the standard regarding performance, quality of material and workmanship. In addition to products named in the specification Sections as *acceptable materials*, all equipment, fixtures and products named on the mechanical drawings shall be deemed to be *acceptable materials*. When an *acceptable material* is identified in conjunction with a referenced standard, the requirements set by the *acceptable material* and the referenced standard shall be deemed to supplement each other.
- .4 *As-built Drawing or Document* means a document that reflects the installed, fabricated, constructed, or commissioned condition of an item or project based on information provided by another party and not verified by the professional engineer.
- .5 *As Indicated* means the item is to be as specified or shown as per the drawings.
- .6 *Cash Allowance* means a cost for materials or work that is known to definitely be required, but which cannot be specified with adequate detail to permit accurate pricing by the Contractor at the time of the bid call. A *cash allowance* excludes any amounts for the Contractor's overhead and profit on the *cash allowance* item, which the Contractor is required to carry separately in the Contract Price.
- .7 *Contract Documents* means all documents including the engineering and architectural drawings and specifications as defined in the construction contracts for constructing the building.
- .8 *Deferred Work* means work which the Owner, Consultant, and Contractor agree, or out of necessity, simply cannot be completed in a timely manner and is therefore excluded from the calculation in determining whether *substantial performance* of a contract has been reached.
- .9 *Deficient Work* means work that has been performed, but performed incorrectly or to an inadequate standard, not performed as specified, or damaged prior to turnover to the Owner.
- .10 *Equipment Start-up* means work that is performed by the Contractor in conjunction with the equipment Manufacturer to get the systems ready for *commissioning* or *testing*.

- .11 *Furnish* means supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- .12 *Incomplete Work* means work specified in the *Contract Documents* that has not been performed or completed.
- .13 *Install* means unloading, temporary storage, unpacking, assembly, erecting, placing, anchoring, applying working to dimension, finishing curing, protecting, cleaning, and similar operations.
- .14 *Operation and Maintenance Manual* means a collection of information containing all necessary technical information on building systems for the building owner/user to carry out maintenance and operation.
- .15 *Provide* means to furnish and install, complete and ready for the intended use.
- .16 *Ready for Use for the Purpose Intended* means the system or equipment is safe, code compliant, functionally complete, and ready to be turned over to the building Owner. The specific definition of *ready for use for the purpose intended* is project specific and is the discretion of the Consultant.
- .17 *Record Drawing or Document* means a professional document prepared by a professional engineer to record design changes to an initial design for which he or she has accepted responsibility and which represents the final design of the project. Typically issued or retained as verification that on-site conditions are in accordance with the final design.
- .18 *Samples* means physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.
- .19 *Seasonal Testing* means testing of equipment and systems that have been functionally tested during winter or summer conditions and require retesting during the opposite conditions.
- .20 *Shop Drawings means* drawings, diagrams, illustrations, schedules, performance charts, brochures, product data, and other data specifically prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate details of portions of the work. *Shop Drawings* do not form part of the Contract Documents.
- .21 *Submittals* means items required by the *Contract Documents* to be submitted by the Contractor, such as requests for payment, progress reports, *Shop Drawings*, manufacturer's literature on equipment, reports, schedules. *Submittals* are normally used by the registered professional of record to aid in ascertaining whether the work substantially complies in all material respects with the plans and supporting documents prepared by the registered professional of record.
- .22 *Testing* means work that is performed by the Contractor during installation to prove the quality and workmanship before the equipment or systems are put "on-line".
- .23 *Warranty Work* means completed work that requires completion after the date of a substantial performance and is discovered prior to expiry of the contract warranty period.
- .24 *Work* means any activity, duty or function defined by the *Contract Documents*, the Alberta Building Code, work carried out on or about the construction site or on, in or about a building.

1.3 ABBREVIATIONS

- .1 AABC – Associated Air Balance Council
- .2 ABC – Alberta Building Code
- .3 AHU – Air Handling Unit
- .4 ANSI – American National Standards Institute
- .5 ASTM – American Society for Testing of Materials
- .6 ASHRAE – American Society of Heating Refrigeration and Air Conditioning Engineers
- .7 ASME – American Society of Mechanical Engineers
- .8 BAS – Building Automation System
- .9 CEMA – Canadian Electrical Manufacturers Association
- .10 CGA – Canadian Gas Association
- .11 CGSB – Canadian General Standards Board
- .12 CSA – Canadian Standards Association
- .13 FM – Factory Mutual Engineering Corporation
- .14 HVAC – Heating, Ventilation, and Air Conditioning
- .15 IAO – Insurer's Advisory Organization of Canada
- .16 MERV – Minimum Efficiency Reporting Value
- .17 NECB – Model National Energy Code for Buildings
- .18 NBC – National Building Code
- .19 NC – Noise Criteria
- .20 NFPA – National Fire Protection Association
- .21 NEMA – National Electrical Manufacturers Association
- .22 OH&S – Occupational Health and Safety
- .23 PPE – Personal Protective Equipment
- .24 RC – Room Criteria (for noise measurement)
- .25 SMACNA – Sheet Metal and Air Conditioning Contractors National Association
- .26 ULC – Underwriter's Laboratory of Canada

1.4 INTENT

- .1 This Section specifies the common requirements for the work of Divisions 20 through 25 supplemented by the requirements of Division 01.
- .2 Mechanical Division Contract Documents
 - .1 The mechanical Division Contract Documents shall be read in conjunction with the manufacturer's installation instructions.

- .2 The Mechanical Contract Documents are copyright and may not be reproduced without the explicit written permission of SNC-Lavalin.
- .3 Mechanical Drawings
 - .1 The mechanical drawings are not detailed installation instructions and do not show every pipe or duct elbow, fitting, valve, or system component required by the specifications or show the exact required routing of the services unless specifically indicated.
 - .2 The intended purpose of the mechanical drawings is to show, graphically, quantities and locations of tagged equipment, and how the products interface with other materials and products.
 - .3 The mechanical drawings are diagrammatic and only approximately to scale even when scales are indicated. Do not scale from the mechanical drawings in order to determine dimensions or distances.
- .4 Mechanical Specifications
 - .1 The intent of the mechanical specifications is to define the quality and types of materials and workmanship upon which the contract is based.
 - .2 The mechanical specifications shall be read in conjunction with the mechanical drawings.
 - .3 Where codes or standards are referenced in the mechanical specifications, conform to the date or version of the code or standards referenced by the provincial building code in effect at the time of the submission of bids unless a specific date or edition is referenced.
- .5 Contract Document Discrepancies
 - .1 Review the entire set of Contract Documents (i.e. drawings and specifications of all Divisions) prior to bidding on the work.
 - .2 Where a specific requirement is identified in any portion of the Contract Documents (plan drawing, specifications, equipment schedules, details, sections, schematics, etc.) it shall be considered as a requirement of the Contract Documents regardless of whether it appears, or is represented consistently elsewhere in the Contract Documents.
 - .3 Where a discrepancy exists between portions of the Contract Documents:
 - .1 Submit a written request for clarification during the tendering phase.
 - .2 If a written request for clarification is not received by the Consultant, or if there is insufficient time for the Consultant to provide a written clarification of the design intent by means of an Addendum, include the cost for BOTH requirements inclusive of all affected trades. Do not choose to carry the cost of one interpretation over the other.
 - .3 The Consultant reserves the right to clarify the design intent once a discrepancy within the Contractor Documents has been identified at no additional cost to the Owner.
 - .4 Work that has taken place relating to the discrepancy without first requesting clarification of the design intent is subject to removal and replacement at no additional cost to the Owner.

- .5 A credit shall be provided for work or equipment deemed to be unnecessary after the design intent is confirmed by the Consultant.
- .6 Delegated Design Responsibilities to the Contractor
 - .1 Where design responsibilities are specifically delegated to the Contractor in the Contract Documents:
 - .1 The services shall be provided by a proper licensed professional.
 - .2 Documents shall bear such professional's written approval when submitted to the Consultant.
 - .3 The Owner and Consultant shall be entitled to rely on the adequacy, accuracy, and completeness of the services, certifications, or approvals performed or provided by such design professionals.
 - .4 The licensed designer's signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by the Designer.

1.5 SUSTAINABILITY REQUIREMENTS

- .1 All equipment shall meet the mandatory requirements of the National Energy Code for Buildings (NECB).

1.6 PRODUCT OPTIONS AND SUBSTITUTIONS

- .1 Acceptable Materials
 - .1 Where a list of Acceptable Materials is indicated for a given product, alternate materials may not be used unless added by Addendum or other formal change to the contract.
 - .2 Acceptable materials provided by manufacturers other than the specific material or equipment indicated in the equipment schedules on the drawing shall meet all specified performance parameters including but not limited to materials, weights, dimensions, control parameters, electrical requirements, etc. Additional work required by another Division as the result of a product option or substitution is the responsibility of the Contractor.

1.7 GENERAL INFORMATION DOCUMENT REQUIREMENTS

- .1 Submittal Format
 - .1 Indicate all parameters using metric (SI) units.
 - .2 File Format: Portable document format (PDF) file (complete with content index and embedded bookmarks based on required format Sections).
 - .3 Organize the content of the submittal as follows:
 - .1 General Information
 - .1 Date the document was issued
 - .2 Name of company responsible for issuing the document including contact information for associated personnel
 - .3 Purpose of the document

- .4 Other general information pertinent to the understanding of the document
- .2 Technical Information
 - .1 As required based on the nature of the document
- .2 Submittal Procedure
 - .1 Submit one (1) complete copy to the Consultant for review at the time of Shop Drawing submittal.
 - .2 Include a copy of the report in the Operation and Maintenance Manuals.
- .3 Acceptance Criteria
 - .1 The submittal shall be considered complete upon the Consultant's written acceptance of the documentation.

1.8 GENERAL SHOP DRAWING REQUIREMENTS

- .1 The Manufacturer's Responsibility with Respect to Shop Drawings
 - .1 The Manufacturer shall be solely responsible for ensuring that all product information contained in the Shop Drawing is completely compliant with the Contract Documents prior to submitting for the Consultant's review.
 - .1 The Manufacturer shall be responsible for correcting all products or materials found to be non-compliant with the requirements of the Contract Documents at such time they are discovered.
 - .2 The Manufacturer shall thoroughly review all Shop Drawings to ensure:
 - .1 Their formatting is compliant with the Contract Document requirements
 - .2 The product information is compliant with the Contract Documents
 - .3 The materials and equipment are constructible
 - .4 Any deviances in parameters (such as dimensions, weight, electrical characteristics, performance parameters, etc.) with respect to the basis of design equipment indicated in the Drawing Schedules or specifications will not result in additional costs to other trades.
 - .5 They have been coordinated and verified that the components fit and work together in accordance with the design intent.
 - .3 Where professional design services or certifications are delegated to a responsible design professional retained by the Manufacturer, the properly licensed responsible design professional's signature and seal shall appear on all related Shop Drawings.
 - .4 Contract Document Deviance Summary
 - .1 Should it be impossible for the Manufacturer to provide products and materials that are compliant with the requirements of the Contract Documents, the Manufacturer shall prepare a Contract Document Deviance Summary Sheet and attach it to the front page of the Shop Drawing submittal.
 - .2 The Contract Document Deviance Summary shall include:

- .1 An explanation of why it is not possible to meet the requirements of the Contract Documents with evidence supporting this claim (i.e. a letter or correspondence from the base-specified equipment supplier, etc.).
 - .2 A list of specific performance parameters/functionality that cannot be met.
 - .3 A summary of the Manufacturer recommended substitute products or materials.
 - .4 A written description of all pertinent changes, deviations or substitutions from the requirements of the Contract Documents.
 - .5 The Shop Drawing for the Manufacturer's recommended alternate product or material that best matches the performance criteria for the specified equipment that otherwise meets the requirements of the Contract Documents.
 - .6 A list of other deviations from the Contract Documents that will result of using the alternate material or equipment including, but not limited to:
 - .1 Space requirements
 - .2 Equipment weights
 - .3 Electrical parameters
 - .4 Control or functionality
 - .7 Indication as to whether the alternate product or material will have a cost implication (including that of other trades which may be affected)
 - .1 Where the alternate product is deemed to affect the cost of the work (as either a credit or an extra), the Manufacturer shall prepare a quotation identifying the cost impact (including all affected trades) and include it in the Shop Drawing submission.
- .2 The Consultant's review of the Shop Drawings
- .1 The purpose of the Consultant's review of the Shop Drawings is to:
 - .1 Provide a secondary review of the information provided by the Manufacturer to check if the specified closeout submittal requirements are met (i.e. format, type of content, maintenance requirements, etc.)
 - .2 Review supplemental information about the products and materials being provided by the Manufacturer to assist the Consultant in performing their Field Reviews.
 - .2 The Consultant's review of the Shop Drawings is not:
 - .1 An indication that the Shop Drawing has been reviewed by the Consultant for compliance with the Contract Documents.
 - .2 An indication that deviances of product parameters such as dimensions, quantities, weight, electrical characteristics, performance parameters, etc. are acceptable and will not result in additional costs to other trades.

- .3 The Consultant's review of Shop Drawings that have been stamped as 'Reviewed', or 'Reviewed as Noted', that contain deviations from the Contract Document requirements, regardless of whether they were accompanied by the Manufacturer's Contract Document Deviance Summary, shall not be deemed as an acknowledgement or approval of the deviation.
- .4 The Consultant's review of Shop Drawings produced by a licensed professional retained by the Manufacturer shall be for the purpose of checking for general conformance with the design parameters provided for the purpose of defining the Design Delegate's scope of work and responsibilities in the Contract Documents.
- .5 Consultant's Shop Drawing Comments
 - .1 Shop Drawings submitted for the Consultant's review will be stamped using one of the four responses below and returned to the Manufacturer:
 - .1 Reviewed
 - .2 Reviewed as Noted
 - .3 Revise and Submitted
 - .4 Not Reviewed
 - .2 Shop Drawings marked as 'Reviewed' indicate that the Consultant has reviewed the information provided, but not necessarily that the information is in accordance with the Contract Documents which is the sole responsibility of the Manufacturer.
 - .3 Shop Drawings marked as 'Reviewed as Noted' indicate that the Consultant has reviewed the information provided, but not necessarily that the information is in accordance with the Contract Documents which is the sole responsibility of the Manufacturer. Shop Drawing marked as 'Reviewed as Noted' do not need to be resubmitted and are noted only to provide general comments to the Manufacturer such as reminders of related information contained in the Contract Documents such as site coordination that needs to take place and other general information that is not expected to affect the project cost.
 - .4 Shop Drawings marked as 'Revise and Resubmit' indicate that the Consultant happened to notice information that was not compliant with the requirements of the Contract Documents and therefore must be revised and resubmitted.
 - .5 Shop Drawings marked as 'Not Reviewed' indicate that the Consultant (or specific Sub-Consultant) does not need to review the information.
 - .6 The Manufacturer shall not perform any portion of the work for which Shop Drawings, mock-ups, samples or similar product data submittals are required until the respective submittal has been stamped by the Consultant as either 'Reviewed' or "Reviewed as Noted'.
 - .7 Where the Consultant's review of the shop drawing or Contract Document Deviance Summary results in the need to revise the Contract Documents, the Consultant shall issue a written Change Order.
 - .1 If the Manufacturer believes that a comment made by the Consultant on a shop drawing marked as 'Reviewed as Noted'

will result in additional costs, the Manufacturer shall notify the Consultant immediately.

- .3 Submittal Format
 - .1 Indicate all parameters using metric (SI) units.
 - .2 File Format: Portable document format (PDF) file (complete with content index and embedded bookmarks based on required format Sections).
 - .3 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
 - .4 Each Shop Drawing submittal shall include a cover sheet prepared by the submitting Manufacturer that MUST include the following:
 - .1 Project Name
 - .2 Consultant's Project Number
 - .3 Descriptive title of the Shop Drawing
 - .4 Manufacturer's Shop Drawing tracking number
 - .5 Number of pages under title page
 - .6 Brief description of Shop Drawing contents (including equipment tags that match those shown on the drawings)
 - .7 Specification Section number relating to the Shop Drawing
 - .8 Name and phone number of the Manufacturer responsible for the technical details of the Shop Drawing who may be contacted by Consultant to discuss the submittal details (Providing this information may prevent the need for a Shop Drawing to be stamped as 'Revise and Resubmit')
 - .9 A blank area no smaller than 200 mm wide x 125 mm high for exclusive use by Consultant for stamps and review comments
 - .5 Shop Drawings shall include the following general information as a minimum in addition to that required by individual Sections:
 - .1 Associated equipment tag and functional descriptor
 - .2 Installation instructions
 - .3 Manufacturer certification of current model production
 - .4 Certification of compliance to applicable codes and standards
 - .5 Required operating and maintenance clearances
 - .6 Detailed drawings of bases, supports, and anchor bolts
 - .7 Performance based on specified set-point parameters
 - .8 Electrical information including (but not limited to): voltage, phase, frequency, full-load amps, horsepower, current, and power factors.
 - .9 Weight and dimensions
- .4 Submittal Procedure
 - .1 Submit one (1) copy of each Shop Drawing to the Consultant as required by each Section and for all tagged equipment on the drawings and specifications.

- .2 Thoroughly review the content of each Shop Drawing and stamp it to indicate it is compliant with the Contract Documents prior to submission to the Consultant. The Manufacturer's stamp indicates they have verified it is in strict accordance with the requirements of the Contract Documents.
- .3 Shop Drawings that are not submitted according to the Submittal Procedure, or not in accordance with the Submittal Format, are subject to being returned without review by Consultant. Shop Drawings that are rejected due to a failure to comply with the specification requirements shall be resubmitted allowing the full fifteen (15) working day review period from the date of the re-submittal.
 - .1 The Contractor shall be responsible for submitting Shop Drawings in accordance with the specification requirements in order to not adversely affect the Construction Schedule.
- .4 Where the Consultant has stamped Shop Drawings as 'Revise and Resubmit', make the required changes and/or provide the requested information and resubmit.
 - .1 Allow an additional ten (10) working days (as a minimum) for the Consultant to do a review of the Revise and Resubmit Shop Drawings.
 - .2 Allow sufficient time in the Construction Schedule for Shop Drawing review including sufficient time for subsequent reviews of Shop Drawings that have been noted as "Revise and Resubmit".
- .5 Consultant's Timely Review of Shop Drawings
 - .1 Allow a minimum of ten (10) working days between the date of submission to the Consultant and the requested return date for the Consultant's review.
 - .1 Shop Drawings that indicate a desired return date less than the minimum specified review duration may not be achievable and shall not be considered a construction delay caused by the Consultant if the target return date is not met.
 - .2 Refrain from submitting a large amount of Shop Drawings over a short period of time or in large groups. If this occurs, the Consultant reserves the right to indicate the required amount of time in order to do a proper review of the Shop Drawings. Adequate time for the Consultant to do a thorough review of the Shop Drawings shall be allowed for in the construction schedule and extensions to the review period shall not be deemed as an unforeseen extension to the construction schedule.

1.9 GENERAL SYSTEM DEMONSTRATION AND TRAINING REQUIREMENTS

- .1 General Requirements
 - .1 System Demonstration and Training shall be provided by a Contractor awarded the contract to install the materials provided by the Manufacturer. The Contractor shall provide a System Demonstration and Training Report at a later date, in accordance with Division 01 supplemented by the requirements of this Section.
 - .2 The Manufacturer shall include for sufficient involvement in the Contractor's system demonstration and training to ensure that operations and maintenance personnel will have the knowledge and training to maintain the material properly,

such that it will not void, abridge or modify the Manufacturer's signed statement of warranty.

- .3 The following clauses under subsection 1.9 indicate the demonstration and training requirements that will be imposed on the installing Contractor in another tender package awarded at a later date. The Manufacturer shall include for assisting the Contractor in fulfilling these requirements, including having one of their representatives present at a training session, subject to final determination by the Contractor per clause 1.9.6.4.
- .2 Scope
 - .1 Provide system demonstration and training for each item of equipment and system including start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance
- .3 Quality Assurance
 - .1 Provide competent instructors thoroughly familiar with the system for which demonstration and training are being provided.
 - .2 Provide training sessions that are project specific.
- .4 Timing
 - .1 Arrange for System Demonstration and Training after:
 - .1 Equipment and systems are fully operational and have been tested, adjusted, and balanced
 - .2 All sequences of operation have been verified by the installing Contractor to be functioning in accordance with the Contract Documents for each mode of operation
 - .2 System Demonstration and Training may be performed over the course of multiple days as required based on the amount of work required and availability of those involved.
 - .1 Where System Demonstration and Training is completed in multiple sessions, a System Demonstration and Training Report shall be provided for each session
- .5 Materials
 - .1 Supply all necessary tools, equipment and personnel to facilitate complete system demonstration.
 - .2 Provide visual and audio equipment aids as required to perform training.
 - .3 Provide each trainee with a copy of the System Demonstration and Training Plan at the start of the session as an agenda.
 - .1 Coordinate the number of trainees that will be attending in advance of training.
- .6 Execution
 - .1 The training sessions shall follow the outline in the Table of Contents of the Operation and Maintenance Manual and refer to the location of the information in the Manual for reference.

- .2 System Demonstration and Training shall start with classroom-like sessions followed by hands-on training for each piece of equipment.
 - .1 Provide any pertinent equipment to facilitate the session including overhead projectors, slides, and video/audio material.
- .3 If the equipment or system should fail to operate in accordance with the Contract Documents during the training session, the nature of the failure shall be noted in the System Demonstration and Training Report and the session shall be rescheduled after the issue(s) have been corrected if determined to be necessary by the Owner
- .4 The Contractor shall determine the appropriate trade, manufacturer's representative, or combination of people who shall run each session.
 - .1 When a Commissioning Authority is present on the project, the Contractor shall coordinate with them to determine who will lead the System Demonstration and Training sessions
- .5 Where the Contractor has used systems to maintain an environment at the worksite during the construction process, include lessons learned and information gathered on the operations of the systems
- .6 Training topics shall include:
 - .1 A review of the written Operation and Maintenance Manuals with an emphasis on the safe and proper operating requirements, preventative maintenance, and special tools needed and spare parts inventory suggestions.
 - .2 Demonstration of start-up and operation of equipment (in all control modes), shut-down, seasonal changeover procedures and emergency procedures
 - .3 Discussion of relevant health and safety issues and concerns
 - .4 Discussion of warranties, guarantees, and emergency contact information
 - .5 Common troubleshooting problems and solutions
 - .6 Discussion of any peculiarities of equipment installation or operation

1.10 ACTION AND INFORMATION SUBMITTALS

- .1 Provide the following Action and Information Submittals:
 - .1 Shop Drawings
 - .1 Shop drawings for all equipment required in Division 20 through Division 24 Sections

1.11 CLOSEOUT SUBMITTALS

- .1 Provide the following Closeout Submittals to a Contractor who has been awarded a contract to install the materials:
 - .1 Certification Reports
 - .1 Contractor's Declaration of Warranty
 - .2 Information Documents
 - .1 System Demonstration and Training Plan

- .2 System Demonstration and Training Report
- .3 Record of Service Work
- .3 Operation and Maintenance Manuals Content
 - .1 Operation and Maintenance Manuals requirements where specified in Division 20 through Division 24 Sections
- .4 Spare Parts
 - .1 Spare parts requirements where specified in Division 20 through Division 24 Sections
- .2 A Contractor hired at a later date shall coordinate the submission of these closeout submittals to the Consultant for review.

1.12 CONTRACTOR'S DECLARATION OF WARRANTY

- .1 Specific Requirements
 - .1 Scope of Work
 - .1 A signed statement indicating full warranty for the equipment shall be provided by the Manufacturer to a qualified Contractor bidding on a later tender package to install the material, in accordance with the warranty requirements required by the specifications of Divisions 20 through 25.
 - .2 Submittal Format
 - .1 Include the following:
 - .1 Approved date of Substantial Performance.
 - .2 Description of all equipment covered by the warranty
 - .3 Warranty end date
 - .4 Name of the Contractor Company carrying the warranty (to be determined at a later date)
 - .5 Name and signature of the Contractor's employee having authority to warranty the work (to be determined at a later date)
 - .3 Submittal Procedure
 - .1 A copy of all Declaration of Warranties shall be included in the Operation and Maintenance Manual (to be submitted by the Contractor at a later date).

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 DELIVERY, STORAGE AND HANDLING

- .1 The Manufacturer shall include delivery, storage and handling instructions so that the Owner may store and handle materials in accordance with the Manufacturer's requirements.
- .2 The Manufacturer's statement of warranty per clause 1.12.1.1.1 of this section shall not be abridged or modified in any way provided the Manufacturer's delivery, storage and handling requirements are met.
- .3 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
- .4 The <Departmental Representative? Owner?> shall arrange to have the material stored and handled as per the following Storage and Handling Requirements:
 - .1 Store materials off ground in a dry location and in accordance with the manufacturer's recommendations in clean, dry, well-ventilated area
 - .2 Store and protect materials from nicks, scratches, and blemishes
 - .3 Replace defective or damaged materials with new.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IES Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- .2 Canadian Standards Association (CSA)
 - .1 CSA C390, Test Methods, Marking Requirements, and Energy Efficiency Levels for Three-Phase Induction Motors
- .3 Consortium for Energy Efficiency (CEE)
 - .1 Premium Efficiency Motor Standards
- .4 Institute of Electrical and Electronics Engineers Standards Association (IEEE)
 - .1 IEEE 112, Standard Test Procedure for Polyphase Induction Motors and Generators
- .5 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA MG-1, Motors and Generators
- .6 National Fire Protection Agency (NFPA)
 - .1 NFPA 70, National Electric Code

1.2 ACTION AND INFORMATION SUBMITTALS

- .1 Provide the following Action and Information Submittals:
 - .1 Information Documents
 - .1 Manufacturer's Certification of Motor Efficiency

1.3 MANUFACTURER'S CERTIFICATION OF MOTOR EFFICIENCY

- .1 General Requirements
 - .1 Submit in accordance with the requirements of Section 20 00 10 – Common Work Results - Mechanical.
- .2 Specific Requirements
 - .1 Scope of Work
 - .1 Provide a signed declaration from the motor or equipment manufacturer indicating efficiency for each motor.
 - .2 Submittal Format
 - .1 Signature of compliance for each motor

1.4 CLOSEOUT SUBMITTALS

- .1 Provide the following Closeout Submittals:

- .1 Operation and Maintenance Manuals Content
- .2 Spare Parts

1.5 OPERATION AND MAINTENANCE MANUALS

- .1 General Requirements
 - .1 Incorporate the requirements of this Section in to the Operation and Maintenance Manuals in accordance with Section 20 00 10 – Common Work Results - Mechanical.

1.6 SPARE PARTS

- .1 General Requirements
 - .1 Submit in accordance with the requirements of Section 20 00 10 – Common Work Results - Mechanical.
- .2 Specific Requirements
 - .1 Provide spare parts for this Section as follows:
 - .1 Motor belts: One (1) set of belts for each belt-driven motor.

Part 2 Products

2.1 MOTORS – GENERAL CONSTRUCTION AND REQUIREMENTS

- .1 Efficiency
 - .1 All permanently wired polyphase motors serving the building shall have a nominal full-load motor efficiency equal to or exceeding the minimum requirement CSA C390, Test Methods, Marking Requirements, and Energy Efficiency Levels for Three-Phase Induction Motors.
 - .2 All electric motors manufacturer alone or as a component of another piece of equipment shall meet or exceed the minimum motor efficiency requirements indicated in ASHRAE 90.1 2016 – Energy Standard for Buildings Except Low-Rise Buildings.
- .2 Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
- .3 Electrical Service:
 - .1 Confirm motor size, voltage and phase with Division 26
- .4 Visible Nameplate: Stamped stainless steel indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- .5 Wiring Terminations:
 - .1 Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized in accordance with NFPA 70, National Electric Code, threaded for conduit

- .2 For fractional horsepower motors where connection is made directly, provide conduit connection in end frame
- .6 Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

2.2 MOTORS - SINGLE PHASE POWER

- .1 General: speed as indicated, continuous duty, built-in overload protection, and resilient mount.
- .2 Open Drip-proof or Enclosed Air Over Enclosure: Class A insulation, minimum 1.0 Service Factor, pre-lubricated sleeve or ball bearings, automatic reset overload protector.
- .3 Multiple-Speed: through tapped windings.

2.3 MOTORS - THREE PHASE POWER – UP TO 3 HP

- .1 Type: TEFC, Premium efficiency to meet or exceed the requirements of ASHRAE 90.1.
- .2 Starting Torque, Starting Current, Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- .3 Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- .4 Insulation System: NEMA Class B.
- .5 Inverter Duty: All motors connected to variable speed drives to be Inverter Duty rated and shall be wound using spike resistant magnet wire rated to 1600V.
- .6 Testing Procedure: To IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- .7 Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- .8 Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 50,000 hours when connected to drive belts; 150,000 hours for direct coupled applications. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- .9 Sound Power Levels: To NEMA MG 1.
- .10 Weatherproof Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- .11 Nominal Efficiency: To meet referenced ASHRAE 90.1 standards at full load and rated voltage when tested to IEEE 112.
- .12 Nominal Power Factor: To meet referenced ASHRAE 90.1 at full load and rated voltage when tested to IEEE 112.
- .13 Provide motors for mechanical equipment as specified.

2.4 MOTORS - THREE PHASE POWER –OVER 3HP

- .1 Type: TEFC, Premium efficiency to meet or exceed Consortium for Energy Efficiency (CEE) Premium Efficiency full load efficiencies.
- .2 Starting Torque, Starting Current, Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- .3 Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors. All motors over 50 HP to be complete with internal shaft ground ring.
- .4 Insulation System: NEMA Class F.
- .5 Inverter Duty: All motors connected to variable speed drives to be Inverter Duty rated and shall be wound using spike resistant magnet wire rated to 1600V.
- .6 Testing Procedure: To IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- .7 Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- .8 Thermistor System (Motor Sizes 50 HP and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.
- .9 Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 50,000 hours when connected to drive belts; 150,000 hours for direct coupled applications. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- .10 Sound Power Levels: To NEMA MG 1.
- .11 Weatherproof Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- .12 Nominal Efficiency: To meet referenced CEE standards at full load and rated voltage when tested to IEEE 112.
- .13 Nominal Power Factor: To meet referenced CEE at full load and rated voltage when tested to IEEE 112.
- .14 Provide motors for mechanical equipment as specified.

2.5 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Consultant for temporary use. Work will only be accepted when specified motor is installed.

2.6 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives:

- .1 Expanded metal screen welded to steel frame
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms
- .3 38mm diameter holes on both shaft centres for insertion of tachometer
- .4 Removable for servicing
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel
 - .2 Securely fasten in place
 - .3 Removable for servicing
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh
 - .2 Net free area of guard: not less than 80% of fan openings
 - .3 Securely fasten in place
 - .4 Removable for servicing

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
 - .1 ANSI/AHRI 430, Performance Rating of Central Station Air-Handling Units
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
 - .1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
 - .2 ANSI/ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
- .3 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 15, Safety Standard for Refrigeration Systems
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

1.2 ACTION AND INFORMATION SUBMITTALS

- .1 Provide the following Action and Information Submittals:
 - .1 Shop Drawings
 - .1 Shop drawings for all equipment indicated in this Section.

1.3 SHOP DRAWINGS

- .1 General Requirements
 - .1 Submit in accordance with the requirements of Section 20 00 10 – Common Work Results - Mechanical.
- .2 Specific Requirements
 - .1 In addition to the general Shop Drawing requirements indicated in Section 20 00 10 – Common Work Results – Mechanical indicate the following:
 - .1 Capacities
 - .2 Sound Power Levels
 - .3 Fans
 - .4 Filters
 - .5 Fan curves showing operating point (for all control modes)
 - .6 Motor drive
 - .7 Dampers
 - .8 Variable Volume Devices
 - .9 Mixing box
 - .10 Bearings
 - .11 Coils

.12 VFDs

1.4 CLOSEOUT SUBMITTALS

- .1 Provide the following Closeout Submittals:
 - .1 Operation and Maintenance Manuals Content
 - .2 Spare Parts

1.5 OPERATION AND MAINTENANCE MANUALS

- .1 General Requirements
 - .1 Incorporate the requirements of this Section into the Operation and Maintenance Manuals in accordance with Section 20 00 10 – Common Work Results - Mechanical.

1.6 SPARE PARTS

- .1 General Requirements
 - .1 Submit in accordance with the requirements of Section 20 00 10 – Common Work Results - Mechanical.
- .2 Specific Requirements
 - .1 Provide spare parts for this Section as follows:
 - .1 Filters Elements: One (1) set of filter elements for each filter bank for each air handling unit (in addition to the final filter elements installed in all filter banks at the time of turnover)

Part 2 Products

2.1 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: to ANSI/AHRI 430 with AHRI seal.
- .3 Horizontal type, having air-tight modular components, consisting of casing with:
 - .1 Supply Fan Section (with motor and drive(s))
 - .2 Blender Air Mixing Device
 - .3 Heating Coil
 - .4 Dampers
 - .5 Filter Section
 - .6 Mixing Box Section

2.2 UNIT CONSTRUCTION

- .1 Standard Construction Units: (Tag: AS-8)

- .1 Unit casing shall be of minimum 18 gauge (1.3 mm) satin coat galvanized sheet metal. Surfaces shall 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. All unprotected metal and welds shall be factory coated.
- .2 All high pressure (5" w.c. (1250 Pa) to 9" w.c. (2250 Pa)) fan sections shall be constructed of 14 gauge (2.0 mm) metal. Continuous high pressure sealant shall be provided between all panels.
- .3 All walls, roofs and floors shall 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.
- .4 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums and humidifiers/wet cells, electrical control panels, burner compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.
- .5 Units shall be provided with hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units.

Hinged access doors open outwards on all sections for outdoors units. Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.

Hinged access doors in welded steel frames. Doors shall be fully lined, come complete with bulb trim seal gasket and lever handles, operable from both sides.

Whenever possible, hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label and safety chain must be affixed.

- .6 All units shall be internally insulated with 1"(25mm) thick 1 1/2 lb./cu.ft. (24 kg./cu.m.) density insulation.
- .7 1 1/2 lb./cu.ft. (24 kg/cu.m.) insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 16" (400mm) o/c. Drain pans and all floor areas shall be insulated on the underside.
- .8 Unit casing floors in walk in sections shall be fabricated with 14 ga. (2.0mm) checker plate steel with rust resistant coating, Provide reinforcing channels under floor to minimize deflection.
- .9 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall 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"(25mm) galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼"(6mm) 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.

Units shall be provided with optional channel flashing constructed of 22 gauge (.85mm) galvanized steel, painted to match unit.

.2 Lightweight Aluminum Construction Units: (Tag: AS-1, AS-2, AS-6, AS-7, MUA-1)

- .1 Unit casing shall be of minimum 14 gauge (0.063”) 3003 series aluminum. All unprotected metal and welds shall be factory coated.
- .2 All walls, roofs and floors shall 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.
- .3 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums and humidifiers/wet cells, electrical control panels, burner compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.
- .4 Units shall be provided with hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units.

Hinged access doors open outwards on all sections for outdoors units. Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.

Hinged access doors in welded aluminum frames. Doors shall be fully lined, come complete with bulb trim seal gasket and lever handles, operable from both sides.

Whenever possible, hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label and safety chain must be affixed.

- .5 All units shall be internally insulated with 1"(25mm) thick 1 1/2 lb./cu.ft. (24 kg./cu.m.) density insulation.

1 1/2 lb./cu.ft. (24 kg/cu.m.)insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 16" (400mm) o/c. Drain pans and all floor areas shall be insulated on the underside.

- .6 Unit casing floors in walk in sections shall be fabricated with 14 ga. (0.063”) aluminum, Provide reinforcing channels under floor to minimize deflection.

- .7 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall 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"(25mm) galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼"(6mm) 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.

- .8 Indoor suspended units shall be provided with ½"(13mm) holes in the base channels to accommodate hanger rods (rods supplied by others).

2.3 FANS

.1 General

- .1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.
- .2 Single low pressure forward curved fans of 18" (457mm) or less diameter, shall be equipped with permanently lubricated cartridge ball bearings, supported by a 3 point "spider" bearing bracket in the fan inlets. All other forward curved fan assemblies shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame.
- .3 Drives shall be adjustable on fans with motors 7 1/2 HP (5.6 kW) or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.
- .4 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be neoprene-in-shear type for single 9" (230mm) to 15" (380mm) diameters forward curve fans. All other fans shall incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" (25mm) static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.
- .5 Provide single extended grease line from far side to access side bearing.
- .6 Provide fan scroll access doors and drains.
- .7 Fan motors shall be Super-E high efficiency ODP type.

2.4 GAS HEAT SECTION - Indirect Fired

.1 General

- .1 Heating units shall 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 shall be approved by an independent testing authority and carry the approval label of that authority as a complete operating package.
- .2 All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire operation.
- .3 Operating natural gas pressure at unit(s) manifold shall be 7"w.c. (1750 Pa).
- .4 Gas fired units shall be approved for operation in -40 °F (-40 °C).
- .2 Heat Exchanger/Burner Assembly
 - .1 Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal turbulators and shall be of a floating stress relieved design. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 1"(25mm) of insulation between the outer cabinet and inner heat reflective galvanized steel liner. Blower location shall be engineered to improve the required air flow pattern around the heat exchanger. Using duct type furnaces and closed coupled blowers are not acceptable.
 - .2 The heat exchanger/burner assembly shall be a blow through positive pressure type. Units shall have an interrupted pilot ignition system to provide increased safety. Units using continuous or intermittent pilots are not acceptable.
 - .3 Flame surveillance shall be from the main flame after ignition not the pilot flame. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.
 - .4 The heat exchanger/burner assembly shall include 15:1 turndown for all input ranges from 100 MBH to 1400 MBH (29.3 kW to 410 kW). The high turn down heat exchanger/burner assembly minimum input shall be capable of controlling 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include built in electronic linearization of fuel and combustion air. Efficiency shall increase from high to low fire.
- .3 Factory testing of indirect fired gas heating section.
 - .1 The minimum test requirements on all cabinet / fan size / fan type / fan orientation / heat exchanger / outlet configuration combinations previously built are listed below.
 - .2 Tests shall be performed after complete final unit assembly, just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the gas heating section is certified.
 - .1 Heat exchanger shall be clocked with a dedicated calibrated gas meter to insure proper set up of the gas manifold.
 - .2 High and Low input flue gas combustion analysis using a calibrated combustion analyzer including O₂ and CO to provide proper air fuel ratio throughout the entire operating range.
 - .3 A copy of the combustion test report shall be provided.

- .3 Any previously untested combination of cabinet / fan size / fan type / fan orientation / heat exchanger / outlet orientation and all duct furnaces shall have the following additional tests performed.
- .4 Any single component or size or type or orientation change requires these tests. The tests shall be performed with standard factory temperature air, not design temperature air, through the unit as an additional heat exchanger safety factor.
 - .1 Heat Exchanger airflow pattern shall be tested to ensure uniform airflow across all parts of the heat exchanger.
 - .2 Once the equilibrium operating temperatures have been reached, the heat exchanger temperatures shall be checked to ensure that all surfaces are below 1075 °F (579.4 °C). Temperatures above this can lead to premature heat exchanger failure.
 - .3 Flue gas temperature and combustion analysis shall be performed. The heat exchanger efficiency shall be analyzed and must meet current requirements.
 - .4 High limit operational check shall be performed to ensure proper function at all normal airflows including loaded filters.
 - .5 If the unit is capable of or intended to operate at varying air flows, all of the above tests must be performed at high flow and low flow.
 - .6 A copy of the test report shall be provided.
- .4 Venting
 - .1 Installation and venting provisions must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA 54, and local authorities having jurisdiction. Type A, L, and/or PS venting is required on DJE and DJS indoor units.
 - .2 Optional indoor unit manufacturer supplied draft hoods for field installation to accommodate "B" type venting. "B" vent sizing must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA 54, and local authorities having jurisdiction.
 - .3 Unit(s) requiring sidewall venting shall be CETL, ETLUS approved for use with a sidewall venter. The sidewall venter shall be supplied by the unit manufacturer. The unit manufacturer must also supply the air proving switch, wall cap, double acting barometric damper, and all necessary control interlocks.
- .5 Outdoor venting when installed close to a parapet or wall.
 - .1 Venting is to be provided by the installing contractor using materials approved for outdoors. Installation and venting provisions must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA54 and local authorities having jurisdiction. Where flue requirements exceed 6" (150 mm) above the unit casing height, it is the installing contractor's responsibility to provide and install venting including all structural-supporting requirements. Support is to be independent of the unit.
- .6 Controls
 - .1 Electronic module (Modulating Fuel w/ Modulating Combustion Air) complete with proportional and integral control with discharge air sensor to maintain set

point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies proportionally in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions. Combustion blower RPM shall be proved using a hall effect speed sensor. Two speed or step speed combustion blowers are not acceptable.

- .2 Combustion efficiency of high efficiency heat exchangers shall increase by up to 1-3% from high fire to low fire while turning down on units incorporating 15:1 turndown. Heat exchangers shall provide a minimum of 80% efficiency throughout the entire operating range.
- .3 Alternate manufacturers units that 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.
- .4 Controllers for heating only units incorporating the DJM3 module shall include the following standard features:
 - .1 Service analyzer with diagnostic lights for ease of set-up and service
 - .2 linear gas and combustion air flow obtained via a built in solid-state linear algorithm
 - .3 -40 °F (-40 °C) minimum operating ambient temperature
 - .4 four air change pre-purge on units with over 400 MBH (117kW) input
 - .5 maintained purge to decrease temperature cycles
 - .6 post purge
 - .7 interrupted pilot
 - .8 self check on start-up to make sure air proving and discharge air sensors are operating within design tolerances
 - .9 low fire start
 - .10 controlled burner start-up and shut down
 - .11 blower contactor that starts fan after burner prepurge
 - .12 economizer enable control
 - .13 damper contact that allows fan to start after damper opens, damper to close after fan stops, and damper to close on flame failure
 - .14 non-recycling auto by-pass low limit with alarm contacts and built-in sensor checking
 - .15 built-in alternate blower and damper functions and set back temperatures for unoccupied mode operation using a single room thermostat
 - .16 separate gas and air actuators independently controlled to give the correct air to fuel ratio though out the entire firing range.
- .5 Heating control function shall be 0-10 VDC BMS reset. Minimum discharge air set point is 50 °F (10 °C) if BMS control signal fails.
- .6 Controllers for heating only units to incorporate low limit feature.
- .7 Discharge air sensor shall be field mounted in supply ductwork by installing contractor.

- .8 Provide a make up air reverse airflow high limit switch in series with the standard high limit switch mounted in the blower discharge.

2.5 FILTERS

.1 General

- .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 For units with filter banks up to 72" (1825 mm) high, the filter modules shall be designed to slide out of the unit. Side removal 1" (25 mm) or 2" (50 mm) filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.
- .3 2"(50mm) Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Permanent re-usable metal enclosing frame. The filter media shall have an average efficiency of 80-85% on ASHRAE 52.1-92 and a MERV of 13 when tested under ASHRAE 52.2.
- .4 Where filters are provided in air handling units for make-up air applications and where hoar frost may occur, only steel frame filters are acceptable. Where indicated, units shall have both summer (upstream of heating coil or gas heat exchanger) and winter (downstream of heating coil or gas heat exchanger) filter sections. Only one set of filters is installed depending on ambient conditions.
- .5 Filter media shall meet UL Class 2 standards.
- .6 Provide filter bank with "Dwyer 2000 magnehelic" air filter gauge complete with static pressure tips and aluminum tubing all factory installed. Filter gauge to have a range of 0 to 1" (0-250 Pa). Where two or more filter banks are connected to a single gauge, a multiple gauge kit with manual shut-off cocks in the air tubing shall be provided.
- .7 Where the filter gauges are provided on outdoor units they shall be mounted inside of a weatherproof enclosure with viewing window.

2.6 DAMPERS

.1 General

- .1 Damper frames shall be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13mm) aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.
- .2 Dampers shall be extruded aluminum low leak airfoil.
- .3 Mixing dampers shall be parallel blade type.
- .4 Mixing Box Controls shall provide an adjustable high ambient set back thermostat, temperature controller, and relay to return the outside air damper to the minimum setting when the outdoor ambient temperature rises above 59°F(15°C).

2.7 FACTORY SUPPLIED CONTROLS/WIRING

.1 General

- .1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.
- .2 Gas fired units shall also include high limit and combustion airflow switch.
- .3 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.
- .4 Factory installed and wired non-fused disconnect switch in CEMA/NEMA 1 configuration, or disconnect with integral door closure mounted on face of control panel.
- .5 Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet that standard of the specific installation.
- .6 Provide an automatic recycling low limit to shut down fan and close the outside air dampers on a heating system failure. This device will automatically recycle the system when the temperature rises above its set point. (Do not use on medium to high % of outside air applications).

Part 3 Execution

- .1 Not Used

END OF SECTION