END

1.1 LAYOUT OF WORK

.1 The Contractor's superintendent on the jobsite shall lay out the Work correctly, establishing schedules and shutdowns, etc.

1.2 WORK PERIODS

.1 The site will be accessible from 8:00 a.m. to 4:30 p.m., Monday through Friday. All Work shall be scheduled by the Contractor and approved by the Contract Administrator.

.2 It is imperative that all Work be carried out such that the period of interruption of services is minimized. All required interruptions must be scheduled with and co-ordinated with the Contract Administrator. Where deemed necessary by Contract Administrator, this Work shall be carried out at night and on weekends.

.3 All Work shall be done in such a manner that it does not disrupt the normal operation of the Building. All additional costs for overtime, or for Work required at other than normal working hours shall be included in the bid price.

1.3 SECURITY

.1 All perimeter doors and storage area doors shall be kept closed and locked.

.2 Identification Security Badges will be issued by the Winnipeg Police Services. Submit names of all employees of all trades who will be on site for the project.

.3 Contractor shall provide the necessary personal particulars of employees for inclusion in security identification badges.

.4 Contractor shall include for time required for issuing of security identification.

1.4 ADDITIONAL REQUIREMENTS OF BUILDING PROJECT

.1 Comply with the following additional requirements as set out by the Contract Administrator:
.1 The Contract Administrator must be notified of all contractors involved in the project, including a contact name and telephone number.
.2 Building Permit will be posted at the job site.
.3 Delivery or removal of building materials must be scheduled with the Contract Administrator.
.4 Contract Administrator will identify which elevators will be used for deliveries.

Co-ordinate with Contract Administrator for weight restrictions, cab dimensions, door openings, etc.

.5 Deliveries may be restricted to after normal business hours to avoid disruption to building operation.

.6 Carts for moving supplies will be supplied by Contractor.

.7 Contractor's employees working in the building after hours must report to security desk or designated person and present identification for sign-in procedure. They must also report when leaving the building.

.8 Public corridors are to be kept free of construction materials, tools or debris and are NOT to be used as storage areas.

.9 Contractor shall leave all public areas in a neat and tidy appearance.

.10 WHMIS product data sheets will be supplied to the Contract Administrator prior to use on job site. This includes all chemicals, paints, glues, cleaners, or odour causing substances, etc. The Contract Administrator reserves the right to deny permission for use of substances deemed to be a health or safety hazard to building occupants.

.11 Use of all odour producing substances will be restricted to hours outside of normal business hours.

.12 All garbage must be removed from the site by the contractors. The building garbage bins are NOT available to contractors. Contractors must co-ordinate storage of garbage disposal bins on the site with the Contract Administrator.

.13 Contractor is responsible for after construction cleanup.

.14 Contractor will supply vacuums, brooms, etc. for use at the job site - equipment belonging to building maintenance will NOT be used by contractor's staff.

.2 Fire Safety Precautions:

.1 While brazing, soldering, grinding, cutting or welding, protect building and contents against heat, sparks and fire by shielding. Maintain a fire extinguisher (ABC Multipurpose Class, minimum 10 lb. capacity) in working order, at each workstation, within close reach of all personnel located at that station, including stations where lead or lead joints are heated and where materials are heated with torches or open flames.

.2 Maintain cleanliness and order in all areas at all times. DO NOT ALLOW RUBBISH TO COLLECT. Keep fire alarm pull stations, alarm panels, doorways, exits and corridors free of obstructions. Do not use wood wedges or other objects to hold open fire doors.

.3 Personnel shall know location of fire alarm pull stations, fire extinguishing equipment and fire exits and evacuation routes for areas in which they are working.

.4 Personnel shall know proper method of operating portable fire extinguishers, be familiar with various classifications of fire and appropriate method of extinguishers agent for each classification.

.5 Store flammable or combustible gases used on construction site in ULC containers. Use and storage of these materials is subject to approval of Contract Administrator.

END

1.1 CODES AND STANDARDS

.1 Perform Work in accordance with CSA, ULC and manufacturers recommendations.

.2 Before any Work is proceeded with, approved layouts to be filed with and approved by proper authorities.

.3 Provide necessary notices, obtain permits and pay all fees, in order that Work specified may be carried out. Changes and alterations required by authorized inspector of any authority having jurisdiction, to be carried out without charge or expense to Buyer. Pay all charges for service connections to municipal mains.

.4 Materials and workmanship must conform to or exceed applicable standards for Canadian Government Specifications Board of Canadian General Standards Board (CGSB), Canadian Standards Association (CSA), American Society for Testing and Material (ASTM) and other referenced organizations.

.5 Conform to latest revision of dated reference standards as reaffirmed or revised to date of Specifications. Standards or codes not dated shall be deemed editions in force on date of Specifications.

.6 Furnish certificates confirming Work installed conforms to requirements of authorities having jurisdiction.

END

1.1 GENERAL

.1 In addition to the information and documents requested prior to the award of a Contract, the Contractor shall submit to Contract Administrator the other several items called for in the Contract Documents. Submittals called for in the various Specification Sections, which are required during the performance of the Work, shall include, but not be limited to the following:
Shop Drawings
Product Data
Samples
Inspection Reports
Test Reports

1.2 SHOP DRAWINGS

.1 The Contractor shall submit one sepia transparency and one ozalid (blue line print) copy of each shop drawing which has been made on a transparent material. The Contractor shall legibly mark and date each copy of each item submitted indicating his approval of the submission, and compliance with all requirements of the General Conditions and these instructions, and shall identify the Section of the Specifications to which it applies.

.2

.1 When the Contract Administrator has marked the shop drawings "Reviewed" on the sepia transparency returned to Contractor, the Contractor shall make as many prints as he needs for the execution of the Work.
.2 When the Contract Administrator has marked the shop drawings "Reviewed as Modified" on the sepia transparency return to Contractor, the Contractor shall cause the required modifications to be transferred to the original drawings, and shall submit two ozalid (blue line prints) copies to Contract Administrator. The Contract Administrator will not return either of the blue line prints to Contractor, unless the required modifications have not been properly incorporated. Should the latter be the case, the Contractor shall cause the modifications to be properly made, and shall then submit two new blue line prints to the Contract Administrator for his records.
.3 When the Contract Administrator has marked the shop drawings "Revise and Re-submit", or words of similar import, the Contractor shall cause the corrections to be made to the original drawing, and shall then proceed as specified for a new submission.
.4 The Contractor at the time of resubmission of the sepia transparency shall indicate on the back by circling, or by other approved means, the changes made after the original submission.
.5 The Contract Administrator reserves the right to receive and review shop drawings in a proper sequence, reflecting the logical sequence of erection, installation, and assembly of the various parts of the Work.

.6 In instances where shop drawings affect the Work of more than one Section, and when directed by the Contract Administrator, the Contractor shall prepare and submit composite drawings which indicate and define the Work under all affected Sections and obtain the approval of the Contract Administrator. Upon receipt of final approval the Contractor shall distribute blue line print copies of the approved drawings to all affected Sections. All affected Sections shall cooperate in the preparation of the composite drawings to assure proper coordination. The Contract Administrator will coordinate this Work with that of Other Contractors whose Work is related to that indicted on the composite drawings.

.3 The Contractor shall be responsible for the delivery of the shop drawings to the office of Contract Administrator, with all handling charges prepaid or assumed by Contractor.

1.3 PRODUCT DATA

.1 Certain sections of the specifications allow standard descriptive data to be submitted in lieu of shop drawings. This may consist of manufacturer's standard schematic drawings, catalog sheets, diagrams, schedules, performance charts, and illustrations, etc.

.2 Such product data will only be accepted if it conforms to the following:
.1 Delete information which is not applicable to project.
.2 Supplement standard information to provide additional information applicable to project.
.3 Show dimensions and clearances required.
.4 Show performance characteristics and capacities.
.5 Show wiring diagrams and controls.

.3 Submit six copies of such product data.

.4 The requirements of 1.2.2 and 1.2.5 above shall apply to product data submitted.

.5 For submissions of information which have not been originally prepared on the transparent material, the Contract Administrator will return to Contractor the number of copies listed below for each category of acceptance, and the Contractor shall proceed as indicated:

Contract Administrator's Notations	Copies Returned	Contractor Required Action
"Reviewed"	3	As for transparencies
"Reviewed as Modified"	5	As for transparencies
"Revise and Resubmit"	5	Complete new submission

END

1.1 TEMPORARY UTILITIES

.1 Electricity: The Contractor shall make arrangements with building operations staff for the supply of electrical light and power for construction purposes: and shall employ to provide, maintain, and move necessary temporary service outlets as required. Outlets shall be adequate for the purpose and safe at all times. Use only existing system outlets designated by building operations staff to ensure operation of computer systems cannot be disrupted.

.2 Sanitary Facilities: Use only sanitary facilities designated by Contract Administrator.

1.2 BARRIERS

.1 Erect and maintain guard rails, fences, temporary enclosures, gates, warning signs and lighting, etc., as may be required by local by-laws, ordinances, and regulations, etc.

1.3 SECURITY

.1 All temporary doors, or other access to the Work shall be equipped with secure locking devices, and upon completion of each day's Work all such accesses shall be securely closed and locked.

1.4 PARKING

.1 Parking in the surrounding areas is controlled. Comply with all Civic Parking Regulations.

END

1.1 GENERAL

.1 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

.2 Store volatile wastes in covered metal containers, and remove from premises daily.

.3 Prevent accumulation of wastes which create hazardous conditions.

.4 Provide adequate ventilation during use of volatile or noxious substances.

1.2 MATERIALS

.1 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.3 CLEANING DURING CONSTRUCTION

.1 Maintain site grounds, and public properties free from accumulations of construction waste materials and rubbish.

.2 Provide trash receptacles where Work is being done, for storing trash and construction debris. Construction debris shall be removed from the premises in accordance with job progress.

.3 Dispose of waste materials, and rubbish at designated areas, or at authorized public refuse grounds.

.4 Vacuum clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until building is ready for substantial completion or occupancy.

.5 Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

.6 Coordinate protection of site to ensure no disruption to operation of computer facilities.

.7 Prior to removal of ceiling tiles, access ceiling at one point and vacuum top of all tiles to be removed.

END

1.1 GENERAL

.1 Unless specified otherwise in their respective technical Sections, all materials, products and equipment shall be the best quality and grade of their kind, free from defects impairing strength, durability, and appearance, etc. All shall be of new stock, of standard sizes specified for the use intended.

1.2 AVAILABILITY

.1 The Specifications are based on materials, products and equipment believed to be readily available, unless noted otherwise in the respective technical sections. Delays in the Work will not be allowed because of failure of Contractor to obtain items which have to be custom-made or imported, if he has not placed his order(s) for these in a time that could reasonably be expected to be sufficient for installation, application or erection, etc.

1.3 HANDLING

.1 Protect and keep finished materials, products and equipment under cover both in transit and at the job site.

.2 Do not deliver items unduly long before required for the proper conduct of the Work.

.3 Items on the site shall be neatly stored in an orderly fashion at all times. Storage shall be close by the place of Work.

.4 Store items subject to damage from elements, in a weather-proof shed, free of contact with the ground.

END

1.1 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy of each of the following:
- .1 Contract Drawings
- .2 Contract Specifications
- .3 Addenda
- .4 Reviewed shop drawings
- .5 Change Orders
- .6 Other modifications to Contract
- .7 Field test records, etc.

.2 Maintain documents in clean, dry, legible condition.

.3 Make documents available at all times for inspection of Contract Administrator.

1.2 WORKMANSHIP STANDARDS

.1 Provide and make available on site one copy of each workmanship standard called for under "Reference Standards" in project specifications.

1.3 RECORD DRAWINGS

.1 One set of blue prints shall be used by Contractor for record drawing purposes.

.2 Maintain project "as-built" record drawings and record accurately significant deviations from Contract Documents caused by site conditions, and alterations or additions that may otherwise occur during progress of the Work, and changes ordered by the Contract Administrator.

.3 Mark "as-built" changes, at least once each week, in red pencil. Use other colours where required to avoid confusion of lines.

.4 The "as-built" drawings shall be submitted to Contract Administrator before final payment may be considered to be due.

.5 As-built drawing information shall be transferred to Autocad format.

END

1.1 MAINTENANCE MANUAL

.1 At completion of project, submit to Contract Administrator, four copies of Operating and Maintenance Manual in English, made up as follows:
.1 Bind data in vinyl hard-covered, standard three-ring, loose leaf binder(s) for 215mm x 280mm size paper.
.2 Enclose title sheet, labelled "Operating and Maintenance Data", project name, date and list of contents.
.3 Organize contents into applicable Sections of Work to parallel Specifications breakdown. Mark each Section by labelled tabs protected with celluloid covers fastened to hard paper dividing sheets.

.2 Include the following supplementary information, plus data specified in Division 16.
.1 Maintenance instructions for finished surfaces and materials.
.2 Description, operation and maintenance instructions for equipment and systems, including complete list of equipment. Indicate nameplate information such as make, size, capacity and serial number, etc.
.3 Provide names, addresses, and phone numbers of contractors and suppliers.
.4 Include three complete sets of final shop drawings (each set bound separately) indicating corrections and changes made during fabrication and installation.
.5 Performance curves and test results for fans and pumps.

END

1.1 GENERAL

.1 On completion of project, provide to the Contract Administrator a manual containing specified warranties, which shall complement the Operation and Maintenance Manual(s).

.2 Bind and organize this and all supplementary information in the manner specified for Operating and Maintenance Manual(s).

END

1.1 GENERAL

.1 On completion of project, provide to the Contract Administrator a spare parts manual and maintenance materials, which shall complement the Operating and Maintenance Manual(s).

.2 Bind and organize this and all supplementary information in the manner specified for Operating and Maintenance Manual(s).

.3 Provide all the supplementary information specified for Operating and Maintenance Manual(s).

1.2 SPARE PARTS MANUAL

.1 Provide spare parts list for equipment identified as requiring such a list, in the various technical Sections in following Divisions of the Specifications.

1.3 MAINTENANCE MATERIALS

.1 Where supply of maintenance materials are specified, deliver to Contract Administrator as follows:
.1 Materials in unbroken cartons, or if not supplied in cartons, they shall be strongly packaged.
.2 Clearly mark as to contents.
.3 If applicable give colour, Room No. or name of area where material is used.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Provide all labour, materials, methods, equipment and accessories to do all demolition, renovations, alterations, removals work.
.1 Temporary, permanent shoring, protective devices, etc.

.2 Co-ordinate work of trades, schedule elements of demolition, renovations work, by procedures, methods to expedite completion.

.3 Cut, move or remove items as necessary to provide access, to allow alterations, new Work to proceed. Include such items as:
.1 Remove existing precast concrete indicated.
.2 Break through new openings, fill in openings, etc. in remaining construction indicated.
.3 Repair or remove hazardous conditions.
.4 Remove abandoned items, items serving no useful purpose, such as abandoned conduit, wiring.
.5 Clean surfaces, remove surface finishes as required to install new Work, and finishes.
.6 Other existing work, materials, etc. required for new Work in this Contract.

.4 Patch, repair, refinish existing items and surfaces to remain to new condition for each material, with approved transition to adjacent new construction.

.5 Repair all damage done to remaining existing walls, other materials, surfaces, properties, etc. caused by Work of this Contract.

1.2 EXAMINATION

.1 Examine all areas undergoing renovation, alteration and demolition work, and determine nature and extent of existing materials to remain.

1.3 ALTERATIONS, CUTTING, PROTECTION

.1 Assign work of moving, removal, cutting and patching to trades qualified to perform work in manner to cause least damage to each type of work.

.2 Perform cutting, removal work to remove minimum necessary, in manner to avoid damage to adjacent work.

.3 Provide temporary enclosures to separate Work areas from existing areas occupied by occupants, provide protection, as required.

PART 2 - PRODUCTS

2.1 SALVAGED PRODUCTS

.1 Salvage sufficient quantities of cut or removed materials to replace damaged Work of existing construction, when material is not readily obtainable on current market.

.2 Incorporate salvaged or used material in new construction only with permission of Contract Administrator, as specified, indicated.

2.2 MATERIAL FOR PATCHING, EXTENDING MATCHING

.1 Where partitions are removed, patch floors and wall with finish materials to match existing.

.2 Patch, replace any portion of remaining existing finished surfaces with matching material.

PART 3 - EXECUTION

3.1 PERFORMANCE

.1 Make smooth, workmanlike transition when new Work abuts, finishes flush with existing work.

.2 Terminate existing surface in neat manner along straight line. Provide trim appropriate to finished surfaces.

3.2 RENOVATION ALTERATION

.1 Co-operate fully, work in conjunction with other trades for removal, breaking through, patching, repairing in existing building.

.2 Execute all Work in orderly, careful manner, with due consideration for occupants of existing buildings. ARRANGE RENOVATION/ALTERATION SO USE OF EXISTING BUILDING REQUIRED BY AREA STAFF IS MAINTAINED.

.3 Note that building areas where Work takes place will remain in continual occupancy.

.4 Provide, maintain temporary access indicated, required, as directed.

.5 Arrange renovation, alteration so operations required, used in present function of adjacent existing building is/are maintained in full use.

.6 Arrange to disconnect, relocate items at time satisfactory to Computer Room staff. Phase all operations to suit staff. Co-operate with staff.

.7 Comply with Section 8, National Building Code for all Work.

.8 Do not allow accumulation of scrap materials on jobsite.

.9 Rebuild, restore work demolished, damaged beyond limits shown, at no cost to Buyer.

.10 Provide adequate protection to persons, property. Execute Work in manner to avoid interference with use of, passage to, from adjoining buildings, facilities.

3.3 CLEANING

.1 Clean occupied areas daily.

.2 Provide temporary filters on return air openings; turn off ventilation systems, etc. all as required to minimize dust migration during dust producing operations.

.3 Clean spillage, overspray, and heavy collection of dust in occupied areas immediately.

END

1.1 GENERAL

.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

1.2 SCOPE OF WORK

.1 Work to include all labour, material and equipment required for installing, testing and placing in initial operation the following systems as detailed in specifications of each section and as shown on drawings.
.1 Section 15400 Plumbing
.2 Section 15600 Liquid Heat Transfer
.3 Section 15800 Air Distribution

.2 All Mechanical Work to be bid as a single complete sub-contract even though Work of various mechanical trades has been further sub-divided into each Section noted above.

1.3 EXISTING CONDITIONS

.1 Examine site, existing adjacent buildings and local conditions affecting Work under this contract. Examine Structural, Architectural, Mechanical and Electrical and all other Contract drawings to ensure Work can be performed without changes to the building as shown on plans. No allowance will be made later for necessary changes, unless notification of interferences have been brought to Contract Administrator, in writing, prior to closing of tenders.

1.4 SITE SERVICE INFORMATION

.1 Location, routing and depth of existing mechanical services shown on drawings are based on recorded information and are approximate only. Contractor and his subtrades shall verify exact location at jobsite.

.2 Prior to installation of piping, advise Contract Administrator of any discrepancy found during above procedure. Revised drawings or instructions will be given to Contractor.

.3 Avoid damaging or displacing existing services where exact position is not known. Should any damage occur, advise Contract Administrator in writing for remedial instructions.

1.5 REGULATIONS

.1 Comply with, most stringent requirements of Manitoba Building Code, National Building Code and local regulations and by-laws, with specified standards and codes and this specification. Before

any Work is proceeded with, approved layouts to be filed with and approved by proper authorities.

.2 Provide necessary notices, obtain permits and pay all fees, in order that Work specified may be carried out. Charges and alterations required by authorized inspector of any authority having jurisdiction, to be carried out without charge or expense to The City of Winnipeg. Pay all charges for service connections to municipal mains.

.3 Furnish certificates confirming Work installed conforms to requirements of authorities having jurisdiction.

1.6 LIABILITY

.1 Install concealed pipes and ducts neatly, close to building structure so furring is minimum size. Pipes, ducts and equipment installed improperly, to be removed and replaced without cost to The City of Winnipeg.

.2 Protect and maintain Work until building has been completed and accepted. Protect Work against damage during installation. Cover with tarpaulins if necessary. Repair all damage to floor and wall surfaces resulting from carrying out of Work, without expense to The City of Winnipeg.

.3 During welding or soldering ensure structure is protected against fire, shield with fire-rated sheets and galvanized iron sheets. Mount portable fire extinguishers in welding or soldering areas.

.4 During welding or soldering ensure structure is protected against fire by shielding, using fire-rated sheets and galvanized iron sheets. Contractor shall provide trained persons armed with suitable type extinguishers, with no other duties than to watch for and extinguish sparks, etc.

.5 Co-ordinate Work with other sections to avoid conflict and to ensure proper installation of all equipment. Review all contract drawings.

.6 On completion of Work, remove tools, surplus and waste material and leave Work in clean, perfect condition.

1.7 GUARANTEE

.1 Guarantee satisfactory operation of all Work and apparatus installed under this contract. Replace, at no expense to The City of Winnipeg, all items which fail or prove defective within a period of one year after final acceptance of complete contract by The City of Winnipeg, always provided such failure is not due to improper usage by The City of Winnipeg. Make good all damage to

building incurred as a result of failure or repair of mechanical Work.

.2 No certification given, payment made, partial or entire use of equipment by The City of Winnipeg, shall be construed as acceptance of defective Work or acceptance of improper materials. Make good at once, without cost to the City of Winnipeg all such defective Work or materials and consequence resulting therefrom, within one year of final acceptance date.

.3 This general guarantee shall not act as a waiver for any specified guarantee and/or warranty of greater length of time noted elsewhere in these documents.

.4 Refrigeration compressor circuit connected to air-conditioning systems shall have manufacturer's warrantee period of four (4) years after initial one year guarantee.

1.8 ENGINEERING OBSERVATIONS

.1 The term "Contract Administrator" in all mechanical sections of specification shall mean:

SMS Engineering Ltd.
770 Bradford Street
Winnipeg, Manitoba
R3H 0N3

.2 Contractor's Work will be observed periodically by The City of Winnipeg, and/or Contract Administrator or their representatives, solely for purpose of determining general quality of Work, and not for any other purpose. Guidance will be offered to Contractor in interpretation of plans and specifications to assist him to carry out Work. Observations and directives given to Contractor does not relieve Contractor and his agents, servants and employees of their responsibility to erect and install Work in all its parts in a safe and workmanlike manner, and in accordance with plans and specifications, nor impose upon The City of Winnipeg, and/or Contract Administrator or their representatives, any responsibility to supervise or oversee erection or installation of any Work.

1.9 MECHANICAL SHOP DRAWINGS

.1 Submit for review a minimum of six sets of detailed shop drawings. Refer to Section 15051 "Acceptable Materials & Equipment" for shop drawings requirements.

.2 Check shop drawings for conformity to plans and specifications before submission.

.3 Each drawing to bear a signed stamp including project name and Contractor's Firm name verifying drawings have been checked prior to submission to Contract Administrator. Signature of stamp shall signify the Contractor has checked and found all dimensions to be compatible with the contract drawings and all capacities, quantities, sizes and other data contained in the contract documents have been listed by the supplier on the drawings and have been checked by the undersigned and found correct.

.4 Clearly show division of responsibility. No item, equipment or description of Work shall be indicated to be supplied or Work to be done "By Other's or By Purchaser". Any item, equipment or description of Work shown on shop drawings shall form part of contract, unless specifically noted to contrary.

.5 Take full responsibility for securing and verifying field dimensions. In case where fabrication must proceed prior to field dimensions being available, check all shop drawings and approve for dimensions only. In this case guarantee that dimensions will be worked to and ensure that other sub-trades are aware of these dimensions and shall comply to them.

.6 Review by Contract Administrator shall be mutually understood to refer to general design only. If errors in detailed dimensions or interference with Work are noticed, attention of Contractor will be called to such errors of interferences, but Contract Administrator's review of drawings will not in any way relieve Contractor from responsibility for said errors or interferences, or from necessity of furnishing such Work, and materials as may be required for completion of Work as called for in contract documents.

1.10 SCHEDULING OF WORK

.1 Existing buildings to be in use during construction of the addition. Arrange Work so that interruption of services is kept to minimum. Obtain permission from Contract Administrator, prior to cutting into mechanical services. Where deemed necessary by Contract Administrator, temporary piping to be installed, and/or Work to be carried out at night and on weekends.

1.11 DRAWINGS

.1 Drawings are diagrammatic only and do not show all details. Information involving accurate measurements of building to be taken from existing Architectural Drawings and/or at building. Make, without additional expense to The City of Winnipeg, all necessary changes or additions to runs to accomodate structural conditions. Locations of pipes, ducts and other equipment to be altered without charge to The City of Winnipeg, provided change is made before installation and does not necessitate additional

materials and that all such changes are ratified by Contract Administrator, recorded on Record Set of Drawings.

.2 Drawings and specifications to be considered as an integral part of Contract Documents. Neither drawings nor specifications to be used alone. Misinterpretation of requirements of plans or specifications shall not relieve Contractor of responsibility of properly completing Work to approval of Contract Administrator.

.3 As Work progresses and before installing piping and equipment interfering with interior treatment and use of building, consult Consultant for comments. This applies to all levels and proper grading of piping. If Contractor fails to perform above checking and fails to inform Contract Administrator of such interference, Contractor to bear all subsequent expense to make good the installation.

.4 Drawings indicate general location and route to be followed by pipes and ducts. Where required pipes and/or ducts are not shown on plans or only shown diagrammatically, install in such a way as to conserve head room and interfere as little as possible with free use or space through which they pass.

.5 Spaces reserved for equipment noted as "future" or future extension to buildings, to be left clear as noted on drawings so that future connections can be made.

.6 Refer to existing Architectural Drawings for roof construction details. These shall relate to roof supports, piping penetrating roofs, etc. as indicated on mechanical detail sheets.

1.12 MATERIALS

.1 Materials and equipment specified and acceptable manufacturers are named in this specification for the purpose of establishing the standard of materials and workmanship to which Contractor shall adhere. Bid opportunity price shall be based on the use of materials and equipment as specified.

.2

.1 Materials of same general type to be of same manufacture (e.g. all air supply units shall be of same manufacturer). Contractor to ensure that all sub-trades provide products of same manufacturer.

.1 Follow manufacturer's recommendations for safety, adequate access for inspection, maintenance and repairs of individual equipment installed.

.2 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems and without interference with building structure or other equipment.

.3 Provide accessible lubricating means for bearings, including permanent lubricated 'Lifetime' bearings.

.3 Equipment and materials shown on drawings and not specified herein, or specified herein and not shown on drawings, shall be included in this contract as though both shown and specified.

1.13 REMOVAL AND DISCONNECTION OF THE CITY OF WINNIPEG'S EXISTING EQUIPMENT

.1 All mechanical equipment conflicting with new equipment being installed to be removed or disconnected by Contractor shall remain property of The City of Winnipeg. Remove ducts and piping not required in revised systems and interfering with new installation which shall become property of Contractor.

1.14 ELECTRIC MOTORS, STARTERS AND WIRING

.1 Determine from electrical drawings and specifications, voltage characteristics applying to each individual motor. Where motor voltages are mentioned in this specification, confirmation to be made by reference to electrical drawings and specifications ordering motors.

.2 Division 16 - Electrical to provide starters for all motors, except as otherwise noted. Division 16 - Electrical shall wire from starters to motors.

.3 Wiring required between starters and switching apparatus such as wiring from starters to float switches, pressure switches and all control wiring to be by Division 16 - Electrical except as noted otherwise on drawings and in specifications. Provide proper terminal connections and lead wires at motors and other apparatus ready for connection by Division 16 - Electrical. Provide Division 16 - Electrical with accurate locations of electrical connection points and all necessary schematic and other drawings to facilitate electric Work.

.4 Wiring required under Section 15900 to be performed by Section 15900 except as noted otherwise. Refer also to Section 15900 for further requirements.

.5

.1 Division 16 - Electrical to perform all wiring and make final connections to all controls for AC-1 and AC-2 indoor evaporator units and all mechanical equipment where controls are supplied with equipment.
.2 Division 15 shall provide wiring diagrams indicating all power and control wiring requirements.

.6 Division 16 - Electrical to perform all wiring and make final connections to all controls for air cooled condensing units. Refer to Clause "Refrigeration Piping and Accessories".

.7 Division 15 shall provide wiring diagrams indicating all power and control wiring requirements for equipment supplied by Division 15.

1.15 HANGERS AND SUPPORTS

.1 General

.1 Piping, ductwork and equipment shall be securely supported from building structure. Perforated strap or wire hangers are not permitted.

.2 Support components shall conform to Manufacturers Standardization Society Specification SP-38.

.2 Installation - Horizontal

.1 Hangers shall adequately support piping system. Locate hangers near or at changes in piping direction and concentrated loads. Provide vertical adjustment to maintain pitch required for proper drainage. Allow for piping expansion and contraction. Piping weight and stresses shall be supported independently of any equipment.

.2 Maximum spacing between pipe supports:

.1 Steel Pipe:

.1 Up to 50mm (2") diam. - 2.4m (8 ft.)

.2 62mm (2-1/2") and larger - 3.6m (12 ft.)

.2 Copper Tubing (Hard):

.1 Up to 25mm (1") diam. - 1.8m (6 ft.)

.2 32mm and larger - 2.4m (8 ft.)

.3 Plastic Pipe As recommended by manufacturer.

.3 Installation - Vertical Piping

.1 Support vertical pipes at each floor by Grinnell Fig. 261 riser clamps. Locate clamps immediately below coupling if possible. Support soil pipe at hub. Brace risers up to 50mm (2") size at intervals not over 2.13m (7'). Support base in approved manner.

.4 Structural Attachments

.1 To Concrete:

.1 Place inserts in structural floors for support of piping and equipment prior to pouring of concrete. Inserts in concrete slabs shall be Grinnell Fig. 285 Light Weight Concrete Insert for loads up to 182 Kg (400#) or Grinnell Fig. 281 Wedge type concrete insert for loads up to 544 Kg (1200#).

.2 Support hangers in corrugated steel deck by 50mm (2") piece of 3mm (1/8") thick steel plate placed across top of steel deck, secured to hanger rod by washer and nut; prior to pouring of concrete topping.

.3 Where inserts must be placed in existing concrete use Hilti H.D.I. steel anchors as recommended by manufacturer, or if heavy weights must be supported, drill hole through slab and provide 50mm x 50mm (2" x 2") washer and nut above rough slab before floor finish is poured.

.2 To Steel Beams:
.1 Where pipe size is 50mm (2") or less, use Grinnell Fig. 87 Malleable Iron C-Clamp and Retaining Clip, or equal.
.2 Where pipe size is over 50mm (2"), use Grinnell Fig. 229 Malleable Beam Clamp or Fig. 228 Forged Steel Beam Clamp.
.3 Miscellaneous:
.1 Provide suitable attachments equal in quality to above where required.

.5 Hangers and Supports
.1 Steel Pipe: Up to 50mm (2") - Grinnell Fig. 65 light clevis - size to suit O.D. of pipe. 62mm (2-1/2") and larger - Fig. 260 clevis - size to suit O.D. of insulation.
.2 Copper Tubing (Hard):
.1 Up to 50mm (2") - Grinnell CT65 copper plated clevis - size to suit O.D. of pipe. Fig. 65 may be used if isolation is provided - see below.
.2 62mm (2-1/2") and larger - Fig. 260 clevis - size to suit O.D. of insulation - on uninsulated pipe provide isolation as specified below.
.3 Cast Iron Pipe:
.1 All sizes - Fig. 260 clevis - size to suit O.D. of pipe.
.4 Plastic and Other Types of Piping: Support as recommended by manufacturer.
.5 Provide fabricated steel supports as detailed on drawings or as required to adequately support piping and equipment. Details to be approved by Consultant. Supports shall be of welded construction except where adjustment is required.
.6 For vertical piping support, use Grinnell Fig. 261 clamp. For vertical copper piping, use Fig. CT-121-C.
.7 Above indicates general requirements. Provide hangers and supports of equal quality to suit job requirements where not covered by the above.
.8 Hangers to be adjustable after pipe is in place. Parts must be of adequate strength for weight to be supported with safety factor of 5 to 1.
.9 Hanger Rod:
.1 Support hangers with mild steel rod. Load on hanger not to exceed capacity indicated in following table:
.2 Rod Diam. Max. Safe Load
.1 9.5mm(3/8") 277 Kg(610 lbs.)
.2 13mm(1/2") 514 Kg(1130 lbs.)
.3 16mm(5/8") 822 Kg(1818 lbs.)
.4 19mm(3/4") 1232 Kg(2710 lbs.)
.3 Rods to have sufficient threaded length to allow for vertical adjustment after pipe is in place. Use two nuts in each rod, one above clevis or angle iron, and one below.

.6 Isolation
.1 Copper piping shall be isolated from steel supports by copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators.

Where no pipe movement or abrasion is expected, suitable plastic electricians tape may be wrapped around pipe at hangers.

.7 Protection Saddles

.1 On piping 50mm (2") and smaller, carry insulation over pipe hangers. Canvas jacket shall be neatly cut and formed to fit over hangers. On chilled and cold water piping, insert sections of insulation into space above pipe at each hanger. Seal saddle and pipe with insulation.

1.16 FLASHING

.1 Where pipes or ducts go through a roof or wall, they should be boxed-in and flashed as per Division 3. Allow for expansion and contraction of pipe. Flashing shall be waterproof.

1.17 IDENTIFICATION OF EQUIPMENT

.1 Provide manufacturer's nameplate on each piece of equipment.

.2 In addition Mechanical Contractor shall provide equipment I.D. tag minimum size 87mm x 32mm x 2.3mm (3-1/2" x 1-1/2" x 3/32") nominal thickness laminated phenolic plastic with black face and white centre. Engraved 6mm (1/4") high lettering. For motors and controls and for larger equipment such as chillers, tanks, 25mm (1") high lettering; for hot equipment such as boilers and convertors, provide engraved brass or bronze plates with black paint filled identification.

.3 Identify as follows: equipment type and number (e.g. pump no. 2), service or areas or zone building served (e.g. south zone chilled water primary).

.4 Provide manufacturers' registration plates (e.g. pressure vessel, Underwriters' Laboratories and CSA approval plates) as required by respective agency and as specified.

1.18 FLOOR PLATES AND SLEEVES

.1 Set sleeves in concrete forms for all pipes and ducts passing through concrete walls, beams and slabs.

.2 Pipe sleeves to extend above floor line as follows:

.1 Unfinished areas - 25mm (1")
.2 Finished areas (copper sleeves) - 6mm (1/4")
.3 Mechanical rooms, kitchens and washrooms - 100mm (4")
.4 Caulk sleeves to provide watertight installation.

.3 Where pipes pass through floors and walls in finished areas and where exposed to view, provide Crane #10 B.C. chrome-plated pressed floor plates.

.4 Install galv. oversize pipe sleeves on passing through walls or partitions, for building into wall construction, by other trades.

.5 Sleeves and holes for cold water, chilled water and ice water lines to be large enough to accommodate pipe insulation. Insulation on hot water lines may stop at walls or floors.

1.19 SCREWS, BOLTS AND FASTENERS

.1 Use standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hex heads, semi-finished unless otherwise specified. Use non-ferrous material throughout for plumbing services. Use type 304 stainless steel for exterior areas.

.3 Bolts used on fan equipment for access to motors, bearings, filters and the like shall be heavy-duty.

.4 Bolts shall not project more than one diameter beyond nuts.

.5 Washers
.1 Use plain-type washers on equipment, sheet metal and soft gaskets, lock-type washers where vibration occurs, and resilient washers with stainless steel.

1.20 SPECIAL TOOLS AND SPARE PARTS

.1 Furnish the City of Winnipeg with spare parts as follows:
.1 One spare set of filters for each piece of equipment requiring such.

.2 Provide one set of all specialized tools required to service equipment as recommended by manufacturers.

1.21 TRIAL USAGE

.1 The City of Winnipeg reserves right to use any piece of mechanical equipment, device or material installed under this contract, for such reasonable lengths of time and at such times as Consultant may require, to make complete and thorough test of same, before final completion and acceptance of any part of contract. It is agreed and understood, that no claim for damage will be made for any injury or breakage to any part or parts of the above due to aforementioned tests, whether caused by weakness or inaccuracy of parts, or by defective materials or workmanship of any kind whatsoever. Supply all labour and equipment for such tests.

1.22 RECORD DRAWINGS

.1 Provide one set of Contract prints to form Record Drawings, marked clearly in red pencil with all changes and deviations from piping and ductwork, including all Contract Changes.

.2 Update Record drawings on a regular basis to ensure they are accurate.

.3 This information will be used by others to create Record Drawings on CAD.

1.23 INSTRUCTIONS TO THE CITY OF WINNIPEG'S PERSONNEL

.1 In addition to start-up supervision and instruction of The City of Winnpeg's personnel required of individual equipment manufacturers and systems as noted, Contractor's construction supervisor to instruct The City of Winnipeg's personnel in operation and maintenance of all equipment and systems to satisfaction of Contract Administrator.

.2

.1 All instructions to The City of Winnipeg's personnel shall be video taped by the Contractor.
.2 This video will remain property of the City of Winnipeg and will be used for the sole purpose of training and orientation of The City of Winnipeg's maintenance staff.
.3 Instruction shall include visual materials such as drawings, diagrams, and printed handouts.
.4 Instructor(s) shall provide the necessary audio-visual equipment and other aids necessary to convey thorough understanding of system and/or equipment operation and maintenance.
.5 Provide The City of Winnipeg with one copy of video taped session in VHS or DVD format. The City of Winnipeg to decide, and confirm format.

.3 Provide The City of Winnipeg with four copies of manuals incorporating following:
.1 Service instructions - including lists of spare and replacement parts and names and addresses of suppliers.
.2 Maintenance & Operating instructions.
.3 Revised shop drawings.

.4 Forward manuals to Contract Administrator for review. Final payment will not be made until all required manuals have been received.

.5 Review instructions with The City of Winnipeg to ensure The City of Winnipeg has a thorough understanding of equipment and its operation.

.6 Contractor shall submit to Contract Administrator, suitable document signed by The City of Winnipeg's representative, stating:
.1 The City of Winnipeg has received satisfactory instruction in operation and maintenance of all equipment and systems.
.2 Operation and maintenance manuals have been reviewed with. The City of Winnipeg
.3 Specified spare parts. keys, removable handles and the like, have been turned over to The City of Winnipeg.

1.24 IDENTIFICATION OF PIPING

.1 Identify fluids in piping with Mystic markers showing name and service, including temperature and pressure where relevant, and with Mystic arrows to indicate flow direction.

.2 For building additions and alterations, use existing coding system. For new buildings, use CGSB 24-GP-3a and CSA and B53 colour codings and identification systems, using CGSB 1-GP-12c colour coding system schedule.

.1

Primary Classification		Secondary Classification		Legend and Direction Arrows
Yellow	505-101	Orange	508-102	Black 512-101
Green	503-107	Purple	511-101	White 513-101
Blue	202-101	Black	512-101	
Red	505-102	Yellow	505-101	
White	513-101			

.3 Paint: For primary colour paint conform to CGSB 1-GP-60C.

.4 Standard of Acceptance: WH Brady identification tapes, bands, markers.

.5 Location of Identification
.1 Locate markers and classifying colours on piping systems, so that they can be seen from floor or platform.
.2 Identify piping runs at least once in each room.
.3 Identify piping runs at least once in each mechanical room.

.6 Legends and colour classifications: Submit to Contract Administrator for approval, where differing from following table, at least two weeks before ordering material.

.7 Table: Pipe and valve identification. Note: Information in brackets under Pipe Marker Legend column is explanatory and need not be included as part of legend test.

.11

PIPE MARKER LEGEND	VALVE TAG LEGEND	PRIMARY COLOUR	SECONDARY COLOUR
Cold water	C.W.	Green	None
San sewer	SAN.S	Green	None

Refrigerant suction (include refrigerant no.)	REF.S. (N.O.)	Yellow	Black

1.25 CUTTING AND PATCHING

.1 Cutting, patching and repairs to existing surfaces required as a result of the removal and/or relocation of existing equipment and piping, and/or installation of new equipment and piping in existing building(s) to be included by Div. 15 - Mechanical in bid opportunity price. Division 15 - Mechanical to employ and pay appropriate sub-trade whose Work is involved, for carrying out Work described above.

.2 Refer to Section 01600.
.1 Div. 15 shall mark all openings required for pipes, ducts, grilles and the like.
.2 Cutting to be 'neat' sizes. Patch all edges so grille frames hide cut edges.

.3 Where services are concealed within walls, floors or ceilings and cannot be visually identified, Contractor shall provide electronic scanning devices or other approved means to locate and identify concealed services prior to drilling.

1.26 SALVAGE

.1 All usable salvaged equipment and materials shall remain the property of the City of Winnipeg unless specifically noted otherwise. Such material shall be neatly stored on site for removal by the City of Winnipeg. Contractor shall remove all rejected salvage from the site and legally dispose of it.

.2 Mechanical equipment, and piping for mechanical systems not required in new layout to become property of Contractor. Remove material from site.

.3 Mechanical drawings indicate most mechanical equipment to be removed and/or disconnected. Mechanical equipment not indicated on drawings as being removed or disconnected, but which has to be removed to be removed and pipes capped off by Contractor at no additional cost to The City of Winnipeg.

1.27 CLEANING AND FLUSHING OF PIPING SYSTEMS

.1 On completion, each piping system shall be flushed out before installation of equipment, fixtures, etc. in order to remove any foreign material in piping.

.2 Flush with water, unless noted otherwise in individual mechanical sections of specifications.

.3 All plumbing fixtures and all equipment shall be thoroughly cleaned and left in first class operating condition.

END

1.1 GENERAL

.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

1.2 WORK INCLUDED

.1 Provide labour, material, equipment and services necessary for and incidental to the supply and installation of the systems shown on the drawings and hereinafter specified.

.2 Generally this shall include:
.1 Sanitary Drainage System
.2 Cold and Hot Water Supply System

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

.1 General
.1 Pipe and fittings shall conform to the standards listed in the applicable Building Code (latest revision).
.1 Use brass nipples between copper piping and flush valves or c.p. brass goods.
.2 Where alternate piping materials or jointing are specified a uniform type of pipe and fittings shall be used throughout each system.
.2 Drains and vents - sanitary
.1 Drains and vent pipes shall be in accordance with local or provincial regulations with the following exceptions, unless otherwise specified.
.2 No plastic, asbestos cement or aluminum pipe will be accepted unless specifically called for by the Contract Administrator.
.3 Water Piping - Domestic Cold
.1 Pipe - Type 'L' third party certified hard copper tube to ASTM B.88. Fittings - Wrought copper or cast brass, solder joint pressure fitting. Flanges - Cast brass 1034 kPa (150 lb.) ANSI B16.24.

2.2 VALVES

.1 General
.1 Valve parts must be of material recommended by mfg. for service specified. Valves must be installed with stems upright or horizontal, not inverted. Valves not specifically covered herein shall be of comparable quality to those specified.

.2 Water
.1 Domestic cold
.1 Ball valves up to 50mm (2"): Toyo Fig. 5049A, Newman Hattersley 1979, Kitz 59, Crane 9322, Nibco S-585-70.

2.3 CLEANOUTS

.1 Cleanouts in copper drainage: Brass screwed plugs with raised head.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

.1 All pipe shall be cut accurately to measurements taken at site, installed without springing or forcing. All changes in direction made with fittings.

.2 All connections to equipment made with unions or flanges.

.3 Remove valve working parts during installation to prevent damage from heat where brazing, soldering, or welding is used.

.4 Comply with latest CSA Standard W117.2 "Code for Safety in Welding and Cutting".

.5 Run all piping in accessible pipe spaces in such a way that it does not interfere with free access into pipe space.

.6 Co-operate with all sub-trades to properly locate all equipment connections.

.7 Provide a shutoff valve on supply connections at each piece of equipment.

3.2 DRAINAGE SYSTEMS

.1 Sanitary Drains
.1 Provide complete systems of sanitary drainage and venting to serve equipment. This includes local drains from equipment in contract such as fan units, pump bases, etc.
.2 Cleanouts:
.1 Install cleanouts at all changes of direction, at intervals of not over 15m (50') in horizontal runs, at all points where obstructions might be formed and at points required by plumbing regulations or shown on drawings.
.2 Cleanouts shall be accessible. Cleanouts above furred ceilings or in concrete slabs on grade shall be extended to floor level with cleanout access cover and frame.

.3 Cleanouts behind walls shall have access panel. Cooperate in locating cleanouts adjacent to access panels, etc. All cleanout plugs lubricated/sealed with mixture of graphite and linseed oil or Teflon tape. Check all cleanouts immediately prior to turning the job over to The City of Winnipeg. Remove plugs, re-lubricate with graphite and oil, and re-install using only enough force to insure permanent joint, depending on location.

3.3 CLEANING AND FLUSHING

.1 On completion, flush out piping systems before installation of equipment, in order to remove any foreign material in piping.

.2 Clean out all equipment and leave in first class operating condition.

3.4 TESTING

.1 All piping systems shall be pressure tested as follows:
.1 Plumbing, drainage and natural gas systems - in accordance with local regulations.
.2 Water supply piping - test with water to 690 kPa (100 psig) at the highest point of system. Maintain pressure without loss for 4 hours.

END

PART 1 - GENERL

1.1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

PART 2 - PRODUCTS

2.1 AIR COOLED CONDENSING UNITS

.1 Liebert Model DCDL205-B air cooled condensing units as noted.
  .1 System Description
    .1 Outdoor-mounted, air-cooled condensing unit suitable for on-the-ground or rooftop installation. Unit shall consist of a semi-hermetic reciprocating compressor, an air-cooled coil, propeller-type condenser fans, and a control box. Unit shall discharge supply air upward as shown on contract drawings. Unit shall be used in a refrigeration circuit to match a packaged fan coil unit.
  .2 Equipment
    .1 General:
      .1 Factory assembled, single piece, air-cooled condensing unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge R-407C, and special features required prior to field start-up.
    .2 Unit Cabinet:
      .1 Unit cabinet shall be constructed of G-90 galvanized steel, bonderized and coated with a prepainted, baked enamel finish.
    .3 Fans:
      .1 Condenser fans shall be direct-drive propeller type, discharging air vertically upward.
      .2 Condenser fan motor shall be ball bearing type compatible with accessory low-ambient control.
      .3 Shaft shall have inherent corrosion resistance.
      .4 Fan blades shall be statically and dynamically balanced.
      .5 Condenser fan openings shall be equipped with PVC-coated steel wire safety guards.
    .4 Compressor:
      .1 Compressor shall be serviceable, reciprocating, semi-hermetic type.
      .2 Compressor shall be equipped with an automatically reversible oil pump, operating oil charge, suction and discharge shutoff valves, and an insert type, factory-sized crankcase heater to control oil dilution.
      .3 Compressor shall be mounted on spring vibration isolators with an isolation efficiency of no less than 95%.

.4 Compressor speed shall not exceed 1750 rpm.
.5 Compressor shall unload using suction cutoff unloading (electrical solenoid unloading shall be available as an accessory).

.5 Condenser Coil:
.1 Condenser coil shall be air cooled, circuited for integral subcooler.
.2 Coil shall be constructed of aluminum fins mechanically bonded to copper tubes which are then cleaned, dehydrated, and sealed. Copper fins shall be available as an option.

.6 Refrigeration Components:
.1 Refrigeration circuit components shall include hot gas muffler, high-side pressure relief device, liquid line shutoff valve, suction and discharge shutoff valves, holding charge of refrigerant R-22, and compressor oil.

.7 Controls and safeties:
.1 Minimum control functions shall include:
.1 Power and control terminal blocks.
.2 Protection to prevent compressor short-cycling.
.3 Capacity control on the compressor shall be by suction cutoff unloader in response to compressor suction pressure. Electric solenoid unloading shall be available as an accessory.
.4 Head pressure control by fan cycling. One condenser fan shall be cycled by discharge pressure to maintain proper head pressure.

.2 Minimum safety devices shall include:
.1 Automatic reset (after resetting first at thermostat)
.1 High discharge-pressure cutout.
.2 Low suction pressure cutout.
.3 Condenser fan motors to be protected against overload condition by internal overloads.
.2 Manual reset at the unit
.1 Electrical overload protection through the use of definite-purpose contactor and calibrated, ambient compensated, magnetic trip circuit breakers. Circuit breakers shall open all 3 phases in the event of an overload in any one of the phases or a single phase condition.

2.2 REFRIGERANT PIPING AND ACCESSORIES

.1 All refrigerant piping to be type 'L' copper with long radius elbows. All joints to be brazed with Silfos. Continuously bleed oil-free nitrogen through piping when brazing to prevent oxidation of internal pipe surface. All piping to be installed in accordance with good refrigerant piping practice with minimum

number of fittings to minimize friction loss. Pipe sizes as specified in schedule on detail sheet. Provide separate piping for split refrigerant circuits.

.2 Provide flexible vibration eliminators on liquid and suction pipe connections to condensing unit.

.3 Install refrigerant controls supplied by condensing unit manufacturer. Install thermo-expansion valve on each DX coil liquid line with external equalizer connection. Valve c/w external remote bulb, set to provide 5.5 deg C superheat. Install solenoid pilot control with filter drier in external equalizer line for on-off control of refrigerant flow. Install Henry angle drier immediately upstream of thermo-expansion valve. Provide Henry sight glass between drier and valve only on DX coils located above air cooled condensers.

.4 Provide initial charge of refrigerant R-407C and oil, as well as any additional amounts required during system warranty.

.5 Provide manual valves as required to isolate individual system components to minimize refrigerant loss during replacement of individual components. Valves welded/brazed with Silfos to copper piping. No flare or compression fittings. No ball valves. Valves up to 5/8" - packless line by Streamline; 7/8" and larger - packed line by Globemaster, Streamline or Henry.

.6 Provide refrigeration equipment manufacturer - approved wiring diagram illustrating all electrical wiring for refrigeration system.

.7 Refrigeration Contractor shall include for system check-out during extreme cold weather in first year of operation (below -28 deg. C) outdoor ambient) to ensure proper operation. Reports for operation shall be issued to Division 15, and Contract Administrator.

2.3 PRECISION A/C UNIT

.1 Design Requirements

.1 The precision environmental control systems AC-1 & AC-2 shall be Liebert Model DS035AUBOE1 self-contained factory assembled units with air delivery. The systems shall have a total cooling capacity of 35.2 Kw (120,000 BTUH) each with a sensible cooling capacity of 30.2kW (103,000 BTUH) each based on an entering air temperature of 24°C (75°F) DB and 17°C (62°F) WB. The unit is to be supplied with 575 volt 3 ph 60Hz electrical service. The refrigerant shall be R-407C.

.2 Submittals

.1 Submittals shall be provided with the proposal and shall include: Single-Line Diagrams; Dimensional, Electrical, and Capacity Data; Piping and Electrical Connection Drawings.

.3 Cabinet and Frame Construction

.1 The frame shall be constructed of mig welded tubular steel. It shall be painted using the autophorectic coating process for maximum corrosion protection. The exterior panels shall be insulated with a minimum 1in. (25.4mm), 1.5lbs. (.68kg) density fiber insulation. The main front panel shall have captive 1/4 turn fasteners. The main unit color shall be off-white. The accent color shall be black. The exterior panels shall be powder coated.

.4 Fan Section

.1 The fan section shall be designed for 9,350 L/S (5,500 CFM) at an external static pressure of 125 Pa (0.5"w.c. ESP). The fans shall be the centrifugal type, double width double inlet, and shall be statically and dynamically balanced as a completed assembly to a maximum vibration level of two mils in any plane. The shaft shall be heavy duty steel with self-aligning ball bearings with a minimum life span of 100,00 hours. The fan motor shall be 2.2kW (3HP) at 1750RPM and mounted on an adjustable slide base. The drive package shall be multi-belt, variable speed, sized for 200% of the fan motor horsepower. the fans shall be located to draw air over the A-Frame coil to ensure even air distribution and maximum coil performance.

.5 Advanced Control Processor

.1 The Advanced control processor shall be microprocessor based with 128 x 64 large graphic display panel Liebert iCOM. The controls shall be menu driven with on-screen prompts for easy user operation. The system shall allow user review and programming of temperature and humidity setpoints, alarm parameters, and setup selections including choice of control type. A password shall be required to make system changes. For all user selections, the range of acceptable input (temperature, humidity, or time delay) shall be displayed on the monitor screen. The system shall provide monitoring of room conditions, operational status in % of each function, component run times, date and time, and four analog inputs from sensors provided by others.

.2 Control

.1 The control system shall allow programming of the following room conditions:

.1 Temperature Setpoint 18-29°C (65-85°F)

.2 Temperature Sensitivity 0.6 to 5.6°C (± 1° to 9.9°F) in .1°C (0.1°F) increments.

.3 Humidity Setpoint 20-80% R.H.

.4 Humidity Sensitivity +1% to +30% R.H.

.2 All setpoints shall be adjustable from the Liebert iCOM panel. Temperature and Humidity Sensors shall be capable of being calibrated using the panel controls to coordinate with other temperature and humidity sensors in the room.

.3 In addition, the system shall provide the following internal controls:

.1 Compressor Short-Cycle Control

.1 The control system shall include a program to prevent compressor short cycling.

.4 Automatic Short-Cycle Control

.1 The microprocessor shall automatically change the lead/lag sequence of the compressors after each start to lengthen compressor-on cycles and even compressor wear.

.5 System Auto-Restart

.1 For start-up after power failure, the system shall provide automatic restart witha programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the unit or from the central site monitoring system.

.6 Sequential Load Activation

.1 During start-up, or after power failure, the microprocessor shall sequence operational load activation to minimize inrush current. Systems allowing multiple loads to start simultaneously are unacceptable.

.7 Front Monitor Display Panel

.1 The microprocessor shall provide a 128 x 64 dot matrix backlit display panel with adjustable contrast. This display shall be the only operator interface required to obtain all available system information such as room conditions, operational status, alarms, control and alarm setpoints, and all user selections including alarm delays, sensor calibration, DIP switch selections, and diagnostics. All indicators shall be in language form. No symbols or codes shall be acceptable.

.8 Alarms

.1 The microprocessor shall activate an audible and visual alarm in event of any of the following conditions:

.1 High Temperature
.2 Low Temperature
.3 Compressor
.4 Overload (#1 and #2)
.5 Main Fan Overload
.6 High Head Pressure (#1 and #2)
.7 Change Filters
.8 Loss of Air Flow
.9 Low Suction Pressure
.10 Loss of Power
.11 Custom Alarm (#1 to #4)

.1 Custom alarms are four customer accessible alarm inputs to be indicated on the front panel. Custom alarms can be identified with prepared (programmed) labels for the following frequently used inputs:

.1 Water under floor
.2 Smoke Detected
.3 Standby unit on

.2 Each alarm (unit and custom) can be seperately enabled or disabled, selected to

activate the common alarm, and programmed for a time delay of 0 to 255 seconds.

.9 Audible Alarm

.1 The audible alarm shall annunciate any alarm that is enabled by the operator.

.10 Common Alarm

.1 A programmable common alarm shall be provided to interface user selected alarms with a remote alarm device.

.11 Control Type

.1 The user shall be able to select the type of control the advanced microprocessor will use. Selections available shall be intelligent, proportional, and tunable PID (proportional, integral, and derivative gains). The intellegent control shall incorporate control logic that uses artificial intelligence techniques including "fuzzy logic" and "expert systems" methods to maintain precise, stable control. If turnable PID is selected, the user shall be able to program each of the three gains.

.12 Analog Inputs

.1 The system shall include four customer accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20 mA signal. The user shall be able to change the input to 0 to 5 vdc or 0 to 10 vdc if desired. The gains for each analog input shall be programmable from the front panel. The analog input shall be able to be monitored from the front panel.

.13 Diagnostics

.1 The control system and electronic circuitry shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front monitor panel. Control outputs shall be able to be turned on or off from the front monitor panel without using jumpers or a service terminal.

.14 Data Collection

.1 The control system shall maintain accumulative operating hours of compressors and fan motor. The ten most recent alarms shall also be reatined.

.6 Compressorized Systems

.1 Dual Refrigeration Systems

.1 Each refrigeration circuit shall include hot gas mufflers, liquid line filter dryers, refrigerant sight galss with moisture indicator adjustable, externally equalized expansion values, and liquid line solenoid valves.

.2 Semi-Hermetic Compressors

.1 The compressors shall be located in a separate compartment so they may be serviced during operation of the equipment. the compressor shall be semi-hermetic with a suction gas cooled motor, vibration isolators, thermal overlaods, oil sight glass, manual reset high pressure switch, pump down low pressure switch, suction line strainer, reversible oil pumps for forced feed lubrication, a maximum operating speed of 1750 RPM.

.3 Four-Step Refrigeration System

.1 The environment control system shall include cylinder unloaders on the semi-hermetic compressors. The unloaders shall be activated by solenoid valves which are controlled from the microprocessor control. In response to the return air temperature, the microprocessor control shall activate the unloader solenoids and the liquid line solenoids such that four stages of refrigeration cooling are obtained. The stages shall be:

.1 One compressor, partially loaded,

.2 two compressors partially loaded,

.3 one compressor partially loaded, one compressor fully loaded

.4 two compressors fully loaded

.2 On a call for dehumidification, the microprocessor control shall insure that at least one compressor is on full for proper humidity control.

.4 A-Frame DX Coil

.1 The evaporator coil shall be an A-Frame design and have 1.32m^2 (14.2 sq.ft.) face area. It shall be constructed of copper tubes and aluminum fins and have a maximum face velocity of 1.6 M/S (313 FPM). Refrigerant of each system shall be distributed throughout the entire coil face area. A stainless steel condensate drain pan shall be provided.

.5 Air Cooled Systems

.1 The Liebert manufactured air cooled condensers CU-1 & CU-2 shall be the low profile, show speed, multiple direct drive, propeller fan type. The condensers shall balance the heat rejection of the compressor at 35°C (95°F) ambient. The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for vertical air discharge.

.6 Fan Speed Control Condenser

.1 The winter control system for the air cooled condenser shall be Liebert Fan Speed Control. The variable speed motor shall operate from 0 to 230 volts single phase, 10 to 1050 RPM. It shall be designed with ball bearings, permanent lubrication, internal overload protection, 40°C rise at full speed, 65°C rise at 10 RPM.

.2 The control system shall be complete with transudcers, thermostats and electrical control circuit, factory prepackaged in the integral condenser control box. The transducer shall automatically sense the highest head pressure of either operating compressor and control the variable speed fan on the air cooled condenser to properly maintain the head pressure. The fan speed control system shall provide positive start-up and operation in ambient temperature as low as -28.9°C(-20°F). The air cooled condenser shall have a 575 volt, 3ph 60 Hz power supply.

.7 Lee-Temp Winter Control System

.1 The winter contro system for the air cooled condenser shall be Lee-Temp. The Lee-Temp system shall allow start-up and positive head pressure control with ambient temperatures

as low as -34.4°C(-30°F). The Lee-Temp package shall include the following componenets for each refrigeration circuit: insulated receiver, pressure relief valve, head pressure three-way control valve, and rotoloc valve for isolating the refrigerant charge. The Lee-Temp receiver shall be factory insulated and mounted ready for the field connection to the air cooled condenser. The Lee-Temp heater shall require a separate power supply of 575 volt, single phase.

.8 Air Cooled Condenser

.1 Disconnect switch. Provide a disconnect switch factory mounted and wired to the condenser control panel, accessible from the exterior.

.7 Optional Components

.1 The precision environmental control system shall be equipped with the following optional components.

.2 Disconnect Switch (Locking Type)

.1 The manual disconnect switch shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible from the outside of the unit with the door closed, and prevent access to the high voltage electrical componenets until switched to the "OFF" positiion.

.3 Temperature and Humidity Recorder

.1 Provide a 7-day/24 hour temperature and humidity recorder of the full scope, two pen, surface mounted type with 100 recording charts, one red and one blue bottle of recording ink. Recorder shall have 60 Hz power supply.

.4 Smoke Detector

.1 The smoke detector shall immediately shut down the environmental control system when activated. The smoke detector shall be mounted in the electrical panel with the sensing element in the return air compartment.

PART 3 - EXECUTION

3.1 REFRIGERANT PIPING AND ACCESSORIES

.1 Insulate all liquid and suction refrigerant piping lines with 12mm (1/2") Armstrong Armaflex AP sealed with Armstrong 520 adhesive. Refinish with Armstrong WB Armaflex finish.

.2 Finish refrigerant piping located outdoors with Armstrong WB white Armaflex finish.

.3 Retain services of experienced refrigeration subtrade to install refrigerant piping.

.4 Bleed nitrogen through piping when welding to prevent oxidation of internal pipe surface. All piping to be installed in accordance with good refrigerant piping practice with minimum

number of fittings to minimize friction loss. Provide separate piping or split refrigerant circuits.

.5 Pressure test refrigerant piping with nitrogen 2068 kPa (300 psig) for four hours.

.6 Suction piping to be installed to ensure oil return to compressor. Grade lines toward compressor and provide oil traps. Where specified on drawings, provide double suction risers with oil traps and inverted loop connections for all vertical lines in system.

.7 Provide additional amounts of oil and refrigerant required during system warranty.

.8 Provide horizontal and vertical piping support in accordance with accepted standards.

.9 Refrigeration Contractor to provide detailed wiring diagram showing all power and control wiring related to refrigeration cycle, including refrigerant solenoid pilot control, interlocks between condensing units and supply fan, temperature control interlocks and all other control wiring for complete refrigeration system operation to approval of refrigeration equipment manufacturer and Contract Administrator. Supply all control transformers and all necessary auxiliary controls to provide complete operational system to approval of equipment manufacturer and Consultant. Automatic control contractor shall provide single or multiple stage start/stop control contacts and interconnecting wiring only.

.10 Refrigeration sub-trade shall provide startup of refrigeration system with The City's representative present. Instruct The City on proper operation of the system and equipment. Providing that equipment functions satisfactorily, refrigeration contractor shall confirm in writing date of this startup to contractor, contractor, The City of Winnipeg and Contract Administrator. This letter will form part of warranty period documents.

.11 Manufacturer's warranty for refrigeration compressor to be 5 years. Refrigeration contractor to provide 13 month warranty on entire refrigeration system including equipment, piping and accessories, such that any further adjustments or alterations during warranty period required to achieve specified refrigeration system performance to be at no additional cost to owner. Warranty to commence after date of satisfactory start-up and upon receipt of refrigeration manufacturer's report of the overall system. Provide system charge weight in report. Actual date to be determined by the Contract Administrator.

.12 Refrigeration contractor is to use virgin refrigerant only.

.13 Refrigeration contractor shall include for normal Fall shutdown services as recommended by refrigeration manufacturer. Include in

quotation for startup during second cooling season. Issue reports for each operation to The City of Winnipeg and Contract Administrator. Refrigeration subtrade shall ensure that The City of Winnipeg's Representative is present during second cooling season startup to verify that refrigerant and oil levels are satisfactory. Provide The City of Winnipeg with 48 hour prior notice. The City of Winnipeg shall pay for necessary refrigerant, oil and parts required providing system warranty period has terminated.

.14 Provide three hard cover copies of information pertaining to temperature control system for The City of Winnipeg's permanent record. Include schematic drawings and control sequence write-ups of all control systems.

END

1.1 General

.1 This Section covers items common to Sections of Division 16. This section supplements requirements of Division 1.

.2 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

1.2 Time/Date Sensitive Electronic Equipment and Software

.1 All time/date sensitive electronic equipment and software provided on this project and shall be based on the use of full, unabbreviated, unambiguous discrete time and date codes.

1.3 Codes and Standards

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3No.1 except where specified otherwise.

.3 Abbreviations for electrical terms: to CSA Z85.

.4 The electrical installation shall comply with the requirements of the Electrical Supply Authority, the latest edition of the Canadian Electrical Code, with all Provincial and Municipal Laws, Rules and Ordinances, and to the satisfaction of those persons having jurisdiction over same.

.5 Notify the Contract Administrator of any discrepancies or conflictions with any regulation seven (7) working days before bid opportunities close. Failing such notification, meet all such requirements without change to the contract price.

.6 In no instance shall the standard established by these specifications and drawings be reduced by any of the codes, rules or ordinances.

1.4 Care, Operation and Start-up

.1 Upon completion of the project, demonstrate the operation of all equipment in the presence of The City of Winnipeg, and the Contract Administrator. Obtain signed certification from The City of Winnipeg that such equipment was shown to be fully operational and that all necessary operating instructions have been provided.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance, calibrate, test and commission components as specified in subsequent sections.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

.4 Carefully examine all plans and specifications pertaining to this Contract and become familiar with all details. Visit the site and determine all factors affecting this section of the Work and include all costs for same in bid opportunity.

1.5 Voltage Ratings

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.6 Permits, Fees and Inspection

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of Work.

.2 Pay all associated fees for inspection of the Work by authorities having jurisdiction.

.3 Notify Contract Adminstrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of Work to Contract Administrator. Copies to be included in Maintenance Manuals.

1.7 Materials and Equipment

.1 Provide materials and equipment in accordance with Div. 1.

.2 Equipment and material to be CSA certified or certified by an equivalent recognized certifying agency to meet Canadian Standards. Where there is no alternative to supplying equipment which is certified, obtain special approval from local Electrical Inspection Department or authority having jurisdiction.

.3 Factory assemble control panels and component assemblies.

.4 Submit for Contract Administrator's approval, a duplicate list of makes and types of all equipment and materials for this project, prior to placing of orders for same. This shall be done

within fourteen (14) days of the award of the project contract to the General Contractor in order to avoid delays in delivery and completion.

.5 Any material or equipment ordered or installed without the Contract Administrator's prior approval shall, if so directed by the Contract Administrator, be removed and replaced with approved material or equipment without a change in the contract price.

1.8 Responsibility

.1 Be responsible for any damage caused the City of Winnipeg, or their Contractors due to improperly carrying out this Work.

.2 Install all components of this Work promptly and where applicable, in advance of concrete pouring, or similar construction. Provide and set in the proper sequence of construction, all sleeves, hangers, inserts, etc. and arrange for all necessary openings, where required to accommodate the electrical installation.

.3 Work shall be arranged in co-operation with other divisions of this specification in such a manner that it doesn't interfere with the progress of the project. In areas where ducts or pipes must be installed along with conduit or cable, co-operate with other divisions so that the finished job will represent the most efficient use of the space.

.4 In no case proceed with any Work in uncertainty. Obtain, from the Contract Administrator, any clarification necessary and thoroughly understand all portions of the Work to be performed.

1.9 Electric Motors, Equipment and Controls

.1 Supplier and installer responsibility is indicated in Motor Schedule on electrical drawings, or in this specification and related mechanical responsibility is indicated in Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Division 16 except for conduit, wiring and connections below 50V which are related to temperature control systems specified in Division 15 and/or shown on mechanical drawings.

1.10 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.
.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

1.11 Workmanship and Materials

.1 The installation shall consist of material and equipment specified unless as provided herein. Electrical equipment provided under this contract shall be built in accordance with EEMAC standards and shall be C.S.A. certified (or certified by an equivalent recognized certifying agency to meet Canadian Standards) and/or locally approved. All equipment supplied under this contract shall be new and the best of its respective kind and of uniform pattern throughout.

.2 Any material or equipment ordered or installed without the Consultant's prior approval shall, if so directed by the Consultant, be removed and replaced with approved material or equipment without a change to the contract.

.3 Replace inferior Work if so ordered by Contract Administrator without a change to the contract.

.4 Retain same foreman or superintendent on the job until completed, unless otherwise directed by the Contract Administrator

.

.5 All tradesmen shall carry all tools on their person at all times. Any tool not in use shall be under lock and key in an area authorized by the building supervisor.

1.12 Cleanliness and Cleaning

.1 This division shall maintain a clean tidy job site. All boxes, crates, and construction debris due to this portion of the Work shall be neatly piled outside the construction area and shall be removed at least weekly during the construction period. All construction areas shall be kept clear of debris.

.2 Before the project will be accepted by the City of Winnipeg, all lighting fixtures, lamps, lens, panelboards, switches, receptacles, cover plates, and other electrical equipment shall be clean and free of dust, plaster, paint, etc. Any equipment which is scratched or damaged shall be refinished or replaced if so designated by the Contract Administrator.

1.13 Modifications

.1 Locations of all light fixtures, convenience receptacles, outlets, switches, telephone or similar outlets, fire alarm stations, bells, etc. are subject to modification by the Contract Administrator, who reserves the right to move these up to 3000 mm from the position shown, without change to the contract price, provided notice is given before the related Work has commenced.

1.14 Request for Equal

.1 Applications for approval of equal, or alternate materials, or methods, as substitutions for those specified or shown, shall be submitted to the Contract Administrator not later than five (5) working days before bid opportunities are due. If approval is to be granted, the Contract Administrator will reply prior to the closing of bid opportunities. Request shall be in writing, in duplicate, and shall be accompanied by a self-addressed stamped envelope.

.2 If an "Equal" has been granted, the choice between the materials or methods specified and those approved as equal shall be optional with this Contractor.

.3 If an "Alternate" has been approved, the difference in cost between this alternate and the specified material or method shall be stated in the bid opportunity as an "add to" or "delete from" the bid opportunity price and the choice of materials or methods shall rest with the Contract Administrator.

.4 Costs for any required additional material, wiring and labour due to the granted equal or approved alternate shall be included in the bid opportunity price or alternate price. This shall include costs which are incurred by other Divisions of this specification.

.5 Any request for equal shall include the following:
.1 Catalogue information, all technical data, full detail and size of the proposed equipment and all components.
.2 Any information requested in the related specification section.
.3 Provide block and riser diagram showing wiring and conduits required, power requirements, etc. with any requests. Maintain maximum allowable conduit sizes.

.4 Provide comply/non-comply list addressing each item of the specifications and drawings with each request for equal. This shall include a photocopy of all applicable specification sections showing a complete compliance / non-compliance listing. Refer to spec detail sheet "Shop Drawing Compliance List Sample", for example, (this detail sheet applies to Requests for Equal as well).

1.15 Engineering Observations

.1 The term "Contract Administrator" in all electrical sections of specification shall mean:

SMS Engineering Ltd.
770 Bradford Street
Winnipeg, Manitoba
R3H ON3

.2 Contractor's Work will be observed periodically by The City of Winnipeg, and/or Contract Administrator solely for purpose of determining general quality of Work, and not for any other purpose. Guidance will be offered to Contractor in interpretation of plans and specifications to assist him to carry out Work. Observation and directives given to Contractor does not relieve Contractor and his agents, servants and employees of their responsibility to erect and install Work in all its parts in a safe and workmanlike manner, and in accordance with plans and specifications, nor impose upon The City of Winnipeg, and/or Contract Administrator any responsibility to supervise or oversee erection or installation of any Work.

.3 Contractor shall notify Contract Administrator for a final distribution inspection prior to energizing distribution system. All distribution equipment shall be left with covers removed to allow a thorough inspection.

1.16 Guarantee

.1 Guarantee the satisfactory operation of all Work and equipment supplied and installed as a part of this section of the specifications.

.2 Replace forthwith, at no additional material or labour cost, any part which may fail, or prove defective within a period of twelve (12) calendar months after the final acceptance of the complete installation, provided that such failure is not due to improper usage, or ordinary wear and tear.

.3 No certificate given, payment made, partial or entire use of the equipment by the City of Winnipeg or their contract administrator shall be construed as acceptance of defective workmanship or materials.

.4 This general guarantee shall not act as a waiver of any specified guarantee or special equipment guarantees covering a greater length of time.

1.17 Identification of Equipment

.1 Identify electrical equipment with nameplates and labels as follows and as indicated in other specification sections.

.2 Nameplates:
.1 Lamacoid 3mm thick plastic engraving sheet, shall be white with black letters or as directed, mechanically attached with self tapping screws. Nameplates for equipment fed from emergency power or from emergency UPS power (increase nameplate size as required to suit wording) shall be white with red letters.

NAMEPLATE SIZES

Size 1	10 x 50mm	1 line	3mm high letters
Size 2	12 x 70mm	1 lines	5mm high letters
Size 3	12 x 70mm	2 lines	3mm high letters
Size 4	20 x 90mm	1 line	8mm high letters
Size 5	20 x 90mm	2 lines	5mm high letters
Size 6	25 x 100mm	1 line	12mm high letters
Size 7	25 x 100mm	2 lines	6mm high letters

.3 Labels:
.1 Embossed plastic labels with 6mm high letters unless specified otherwise.

.4 Fabrication details of all nameplates labels and wording on nameplates and labels to be approved by Consultant prior to manufacture.

.5 Allow an average of twenty-five (25) letters per nameplate and label.

.6 Room names and numbers used shall be actual room names and numbers that will be used on the project. Division 16 to co-ordinate and confirm with trades involved.

.7 Identification to be English.

.8 Co-ordinate names of equipment and systems with Division 15 to ensure that identical names are used.

.9 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.10 Nameplates for disconnects, starters and contactors: Indicate equipment being controlled and voltage.

.11 Nameplates for terminal cabinets and pull boxes: Indicate system and voltage.

.12 Nameplates for control devices: indicate equipment controlled.

.13 Adjacent to each breaker in CDP type panelboards, provide and mount lamacoid nameplates identifying the respective load and location.

.14 To match existing where applicable.

1.18 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings on both ends of phase conductors of feeders (coloured plastic tapes) and branch circuit wiring (numbered wire markers). Conductor marker identification shall correspond with panel or terminal board directory information.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour Code: To CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system. Colour coding used shall be documented by individual systems in Maintenance Manuals.

.5 Insulated grounding conductors shall have a green finish and shall be used only as a grounding conductor.

1.19 Conduit, Outlet Boxes and Cable Identification

.1 Colour code conduits, boxes and metallic sheathed cable.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m intervals.

.3 Colours: 25mm wide prime colour and 20mm wide auxiliary colour.

	Prime	Auxiliary
Up to 250V (normal power)	yellow	
Up to 600V (normal power)	yellow	green
Up to 250V (emergency power)	yellow & red	
Up to 600V (emergency power)	yellow & red	green
Telephone	green	
Other communication systems	green	blue
Fire alarm	red	
Emergency voice	red	blue
Other security systems	red	yellow
Control	blue	
Fibre optic	orange	

.4 Other conduit systems as directed on site; all conduit systems shall be identified.

.5 Color outlet box covers to color designated and show circuit numbers in black felt marker on inside of covers.

1.20 Wiring Terminations

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.21 Manufacturers and CSA Certification Labels (or equivalent)

.1 Visible and legible after equipment is installed.

1.22 Warning Signs

.1 As specified and to meet requirements of Electrical Inspection Department and Contract Administrator.

.2 Decal signs, minimum size 175 x 250mm.

1.23 Single Line Electrical Diagrams

.1 Provide single line electrical diagrams under plexiglass as follows:
.1 Electrical distribution system: Locate in main electrical room or as designated by contract administrator.
.2 Electrical power generation and distribution systems: Locate in power plant rooms.

.2 Provide fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.

.3 Drawings: 600 x 900mm minimum size.

1.24 Location of Outlets

.1 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.

.3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

1.25 Load Balance

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

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

.3 Submit, at completion of Work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test. Provide copy of report in all maintenance manuals.

1.26 Conduit and Cable Installation

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: Schedule 40 steel pipe, sized for free passage of conduit, and protruding 50mm each side.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduit and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.4 Arrange for holes through exterior wall and roof to be flashed and made weatherproof.

1.27 Field Quality Control

.1 Conduct and pay for following tests:
.1 Power distribution system including phasing, voltage, grounding and load balancing.
.2 Circuits originating from branch distribution panels.
.3 Lighting and its control.
.4 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable.
.5 Systems: Fire alarm system, security system, communication systems.
.6 Any other electrical systems.

.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.3 All circuits shall be tested to ensure that the circuit numbers are correct and that the proper neutral conductors have been provided and installed.

.4 Insulation resistance testing:
.1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
.2 Megger 350V - 600V circuits, feeders and equipment with a 1000V instrument.
.3 Check resistance to ground before energizing.

.5 Advise Contract Administrator of dates and times for all testing with sufficient advance notice to allow Consultant to make arrangements to attend.

.6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.7 Submit test results for Contract Administrator's review.

.8 Insert test results and supplier's certifications in Maintenance Manuals.

1.28 Drawings

.1 Carefully examine all drawings and specifications relating to all Work, and all electrical Work indicated thereon shall be considered as a part of the Work by this section unless indicated otherwise. Prior to the date of the last addendum report at once to the Contract Administrator, any defect, discrepancy, omission or interference affecting the Work of this section, or the guarantee of same.

.2 Install all equipment as shown or as specified and in accordance with manufacturer's approved shop drawings.

.3 The drawings accompanying these specifications are intended to show the general arrangement and extent of the Work to be carried out, but the exact location and arrangement of all parts shall be determined as the Work progresses. The location of equipment, outlets, etc., as given on the drawings are approximately correct, but it shall be understood that they are subject to such modifications as may be found necessary or desirable at the time of installation to meet any structural or architectural requirements. Such changes shall be implemented as directed by the Contract Administrator, without additional charge.

.4 Electrical drawings do not show all structural and other details. Architectural and structural conditions shall govern, and this Section shall make without charge, changes or additions to accommodate these conditions.

.5 Where drawings indicate the general location and route to be followed by conduit, cable, etc., these locations must be governed by job conditions. Where the required conduit, cable, an boxes are not shown on drawings or only shown diagrammatically, they shall be installed to conserve maximum head room and

interfere as little as possible with free use of space through which they pass. Maximum clearance above floor shall be maintained under all suspended conduit and equipment, unless otherwise shown on the drawings, or approved by the Contract Administrator.

.6 Submit a complete set of drawings for the proposed installation to the Inspection Department having jurisdiction and receive written approval before installation or fabrication of any equipment. No extra compensation will be allowed for any changes or rearrangement of any electrical apparatus or materials necessary due to failure to receive this approval.

.7 Provide the Electric Utility with three copies of a drawing showing the main distribution and the proposed method of metering for approval prior to the manufacture of equipment.

1.29 Shop Drawings, Product Data and Samples

.1 Submit shop drawings, produce detailed data and samples in accordance with previous sections, as specified herein, and to Contract Administrator's satisfaction.

.2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.3 Where applicable, include actual wiring, single line and schematic diagrams. Include all technical data and full details of each component.

.4 Include wiring drawings or diagrams showing interconnection with Work of other sections.

.5 Shop drawings of all equipment must be submitted to the Contract Administrator for review in sufficient time to enable him to retain them for at least ten (10) working days.

.6 One print and one reproducible sepia of each shop drawing shall be submitted.

.7 Cross out or eradicate all non-related items.

.8 Bind each system separately. One common binder from one supplier will not be acceptable.

.9 Shop drawing submission shall include a photocopy of all applicable specification sections showing a complete compliance/ non-compliance listing. Refer to spec. detail sheet "Shop Drawing Compliance List Sample" for example.

.10 Division 16 shall check all shop drawings and make necessary changes, or cause the supplier to make necessary changes, prior

to submission to the Contract Administrator. Shop drawings will be reviewed by the Contract Administrator and if re-submission is required, Division 16 shall ensure that the supplier's drawings have been changed to comply before returning them to the Contract Administrator for review again.

.11 Review of the shop drawings by the Contract Administratorshall not relieve the Contractor from responsibility for errors and omissions therein.

.12 Each drawing submission to bear the following signed stamp, and shall include name of project, equipment supplier, and clause number equipment is specified under.

CONTRACTOR'S CERTIFICATION
This drawing has been reviewed by
(firm name) .
All dimensions have been checked and found compatible with the contract drawings and all capacities, quantities, sizes, and other data contained in the contract documents have been listed by the supplier on this drawing and have been checked by the undersigned and found correct.

Date Per:

.13 Clearly show division of responsibility. No item, equipment or description of Work shall be indicated to be supplied or Work to be done "By Others" or "By Purchaser". Any item, equipment or description of Work shown on shop drawings shall form part of contract, unless specifically noted to the contrary.

.14 Provide field dimensions required by electrical suppliers and sub-subcontractors. In cases where fabrication is required prior to field dimensions being available, check all related drawings and obtain clarification from Contract Administrator if necessary.

.15 Main distribution and utility metering shop drawings must be approved by local utility prior to submission to Contract Administrator.

.16 Incomplete submissions will be returned for updating and re-submittal without Contract Administrator's review.

1.30 Mounting Heights

.1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.
.1 Panelboards, annunciators etc.: 2000mm to top.
.2 Voice/data and interphone outlets: 400mm (unless otherwise stated).
.3 Heights to match existing where applicable.

1.31 Operation and Maintenance Data

.1 Provide operation and maintenance data for incorporation into operation and maintenance manuals specified.

.2 Include in operations and maintenance data:
.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension, and expansion of any portion or feature of the electrical installation.
.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature alone is not acceptable.
.3 Wiring and schematic diagrams and performance curves.
.4 Names and addresses of local suppliers.
.5 Copy of reviewed shop drawings.

.3 Provide five (5) complete, hard-backed, D-ring loose leaf Maintenance Manuals. These shall consist of typewritten or printed instructions for operating and maintaining all systems and equipment provided under this section of the specification. Manuals shall also contain shop drawings, wiring diagrams, test results and manufacturer's brochures on all equipment, together with typed index tab sheets.

.4 As Work progresses, record on one (1) set of drawings, installed conduit layout as well as any approved changes and deviations from the original contract and/or working drawings, including outlets, equipment and panel locations. At completion of Work, submit to the Consultant, at the contractor's costs, reproducible mylar Record Drawings. The contract shall not be considered complete and no final payment shall be made until these drawings are accepted by the Contract Administrator. (Provide separate drawings for each system in order not to "crowd" drawings.)

.5 Site record drawings will be used to generate Autocad record drawings by others.

1.32 Temporary Lighting and Power

.1 All temporary and construction lighting and power work and costs for same are not included as part of the scope of the Work of this section. Refer to such clauses in other sections of the specification.

1.33 Testing

.1 Test all circuits and wires for continuity, insulation resistance and high impedance grounds. Those circuits which test non-continuous, with an insulation resistance less than 2 Megohms or with high impedance grounds shall be replaced.

.2 All empty conduits shall be left with an insulated #14 AWG fish wire.

.3 Test all panels under full load and make necessary reconnection of single phase loads from one leg or phase to another to balance the load on legs or phases as nearly as possible. Test results, test values measured, date of each measurement, company name and signature of person making each measurement shall be neatly recorded. Record all changes on Record Drawings.

.4 Test all required ground rods for ground resistance, with standard test equipment.

.5 Keep a record of all final tests, bind, and turn over typewritten results to the Contract Administrator as a part of the maintenance manual. All final test values measured, date of each measurement, company name and signature of person making each measurement shall be neatly recorded. After all tests have been successfully completed, each test report shall contain a summary which clearly states that all results were satisfactory.

.6 Upon completion of the Work and adjustments of all equipment, all systems shall be tested in the presence of the Contract Administrator to demonstrate that all equipment furnished and installed or connected as a part of this section of the contract shall function electrically in the required manner as determined by the Consultant.

.7 All circuits shall be tested to ensure that the circuit numbers are correct and that the proper neutral conductors have been provided and installed.

.8 Voltage tests shall be conducted and transformer taps adjusted or other corrective measures carried out as directed by the Contract Administrator. Refer also to 4.1 Care, Operation and Start-Up.

1.34 Cutting and Patching

.1 Cutting, patching and repairs to existing surfaces required as a result of the removal and/or relocation of existing equipment and piping, and/or installation of new equipment and piping in existing building(s) to be included by Div. 16 - Electrical in bid opportunity price. Division 16 - Electrical to employ and pay appropriate sub-trade whose Work is involved, for carrying out Work described above.

.2 Perform all cutting and patching required for installing electrical systems.

.3 Division 16 shall retain services of necessary contractors to carry out actual Work involved in cutting wall openings, floor openings and the like, and in patching up after installation has been completed.

.4 Division 16 shall mark all openings required for conduits, cables, ducts, and the like.

.5 Cutting to be 'neat' sizes. Patch all edges such as cover plates, etc. Hide cut edges.

.6 Div. 16 - Electrical to perform all cutting only of existing surfaces as required as a result of the removal and/or relocation of existing equipment and conduit and/or installation of new equipment and conduit in the existing building to be included by the Div. 16 in the bid opportunity price.

.7 If, in the opinion of Contract Administrator, cutting of holes has been improperly performed (i.e. too large for conduits or cables) Division 16 - Electrical to do all patching as per original specifications and all costs will be borne by him.

1.35 Fireproofing

.1 Where cables or conduits pass through floors, block or concrete walls and fire rated walls, seal openings with 3 M Brand 7900 Series Fire Barrier System or equivalent, to maintain fire rating.

.2 Fireproofing of electrical cables, conduits, trays, etc. passing through fire barriers shall conform to local codes and inspection authorities.

1.36 Access Doors

.1 Provide and install access doors where electrical equipment requiring access is built-in. Access doors to be 2.5mm (12 ga.) steel, approximately 300mm x 300mm (12" x 12") minimum or as approved, finished prime coat only, with concealed hinges, anchor

straps, plaster lock and without screws, all equal to Milcor manufacturer. All locks to be flush type, screwdriver operated. Where it is necessary for persons to enter through door, doors to be at least 600mm x 600mm.

.2 In applied tile or exposed glazed or unglazed structural tile, access doors shall take the tile and be sized and located to suit tile patterns. In masonry walls access doors to be sized and located to suit masonry unit sizes. In removable acoustic tile ceilings, no access doors are required.

.3 Access doors located in fire rated ceilings or walls shall be approved fire rated doors and frames.

.4 Co-ordinate access door types, locations, etc. with Architect.

1.37 Security Fasteners and Hardware

.1 Refer to other sections of the specifications for Security Fasteners. Division 16 to install security fasteners required for Division 16 Work.

.2 This shall also include security tamperproof screws that are exposed such as in light fixtures, coverplates, system devices, outlet covers, etc.

.3 Refer to other sections of the specifications for security hardware.

1.38 Protection

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts "LIVE 120 VOLTS", or with an appropriate voltage in English.

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

1.39 Scheduling of Work

.1 Existing buildings will remain in use during construction. Arrange Work so that interruption of services is kept to a minimum. Obtain permission from The City of Winnipeg prior to cutting into electrical services. Where deemed necessary by Contract Administrator, temporary electrical shall be installed and/or Work shall be carried out at night and on weekends.

.2 Contractor to maintain continuous and adequate all existing electrical systems and other services during entire time of this contract. Provide temporary conduit, wire, equipment, etc. where necessary to meet this requirement.

1.40 Examination of Documents and Site

.1 Carefully examine all plans and specifications pertaining to this contract and become familiar with all details. Visit the site and determine all factors affecting this section of the Work; include all costs for same in bid opportunity.

1.41 Demolition of Existing Electrical

.1 Remove all unnecessary existing electrical equipment, wiring, fixtures, in those portions of the existing building which are being remodelled or demolished. All devices/fixtures, etc. are not necessarily shown on the plans. The City of Winnipeg shall select from the materials and/or equipment remaining that which he wishes to retain, and the remainder shall be removed from the site. Any electrical equipment in remodelled sections or in structures removed or altered, adjacent to new Work, necessary for the operation of existing building, shall be relocated as necessary. All existing equipment re-used shall be made good and guaranteed. Power interruptions to be kept to a minimum and shall be at a time suitable to the building occupant.

.2 Drawings do not show all electrical requiring removal to accommodate renovations such as receptacles, switches, lights, starters, motors, nurse call systems, components, heaters, etc. Division 16 shall visit site, refer to architectural and electrical drawings and include all costs for demolition.

.3 Refer to Specification Section 16195 - Work in Existing Building.

1.42 Spare Parts

.1 The Contractor shall submit 15 days after bid opportunity a list of spare parts that the Contractor considers essential/important/useful to the operation of the systems described herein. This list shall be in addition to any spares/consumables called for in the Contract Documents and those which are required up to practical completion and hand over.

.2 Each spare part listed shall include the manufacturer's/ supplier's price including all mark-ups, delivery and packaging. The prices shall remain valid for 12 months following handover of the project.

.3 These spare parts may or may not be ordered during the Contract period. The Contractor shall only include these items in the Contract sum if specifically instructed to do so.

.4 Any spare parts listed shall be completely interchangeable with those specified in the Contract Documents and included in the Works.

.5 Any spares ordered shall be delivered to the The City of Winnipeg complete with all documents/instructions.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1 Electrical General Requirements Section 16010

1.2 Location of Conduit

.1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

.2 Produce layout sketches of conduit runs through mechanical and electrical service areas in order to pre-avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

PART 2 - PRODUCTS

2.1 Conduits

.1 Rigid galvanized steel threaded conduit.

.2 Epoxy coated conduit: with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): with couplings. Minimum size shall be 19mm.

.4 Rigid pvc conduit.

.5 Flexible metal conduit and liquid-tight flexible metal conduit.

.6 FRE conduit: Size 75 mm and above.

.7 Flexible pvc conduit.

2.2 Conduit Fastenings

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 U channel type supports for two or more conduits at 1500 mm oc. (Surface mounted or suspended).

.4 Six mm dia. galv. threaded rods to support suspended channels.

2.3 Conduit Fittings

.1 Fittings for raceways: to CSA C22.2 No. 18.

.2 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.3 Factory "ells" where 90 deg. bends are required for 25 mm and larger conduits.

.4 Steel set screw connectors and couplings. Insulated throat liners on connectors.

.5 Raintight connectors and fittings c/w O-rings for use on weatherproof or sprinklerproof enclosures. Raintight couplings to be used for surface conduit installations exposed to moisture or sprinkler heads.

.6 Explosion proof in hazardous areas to meet requirements of authorities having jurisdiction.

2.4 Expansion Fittings for Rigid Conduit

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 or 200 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 Fish Cord

.1 Polypropylene c/w 3m spare length at each conduit end.

PART 3 - EXECUTION

3.1 Installation

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms.

.3 Use rigid galvanized steel threaded conduit where specified.

.4 Use epoxy coated conduit in corrosive areas.

.5 Use electrical metallic tubing (EMT) except where specified otherwise.

.6 Use rigid pvc conduit or FRE duct for underground installations.

.7 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures, transformers and equipment subject to vibration or movement. Provide a separate insulated grounding conductor within flexible conduit.

.8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.9 Install conduit sealing fittings in hazardous areas. Fill with compound.

.10 Conduit stubs from floor slabs where exposed to damage to be rigid galv. steel.

.11 The conduit sizes as shown or indicated are the minimum acceptable and shall not be reduced without the approval of the Consultant.

.12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.13 Mechanically bend steel conduit over 19 mm dia.

.14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.15 Install fish cord in empty conduits.

.16 Run a minimum of 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.

.17 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.18 Dry conduits out before installing wire.

.19 Conduit to be sized as per Canadian Electrical Code or as shown on drawings. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit.

.20 Running threads will not be permitted; proper couplings shall be used.

.21 Not less than 900mm (3'-0") of flexible conduit (and of sufficient length to allow the lighting fixture to be relocated to any location within a 6 ft. (1.8m) radius) shall be used for the connection of recessed lighting fixtures. A separate drop to be used for each fixture unless fixtures are mounted in continuous rows.

.22 No circuits fed from emergency or essential power sources shall be run in the same conduit as other systems.

.23 Provide separate conduit system for emergency distribution.

.24 All conduit runs passing across expansion joints of the building shall be installed utilizing approved expansion fittings, and bonding devices.

.25 Refer to 16010 for identification requirements.

.26 All conduit systems in hazardous areas to be rigid galvanized steel to meet the requirements of the authorities having jurisdiction.

3.2 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Run conduits in flanged portion of structural steel.

.3 Group conduits wherever possible on suspended or surface channels.

.4 Do not pass conduits through structural members except as indicated.

.5 Do not locate conduits less than 150 mm parallel to steam or hot water lines with minimum of 75 mm at crossovers.

.6 No power driven pins (Ramset) shall be utilized to secure any portion of the conduit.

3.3 Concealed Conduits

.1 Do not install horizontal runs in masonry walls.

.2 Do not install conduits in terrazzo or concrete toppings.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1	Electrical General Requirements	Section 16010
.2	Conduits, Conduit Fastenings and Conduit Fittings	Section 16111
.3	Fastenings and Support	Section 16191

PART 2 - PRODUCTS

2.1 Materials

.1 Conductors in Conduit:
- .1 Type: RW90
- .2 Conductors:
  - .1 Solid Copper #10 AWG and smaller.
  - .2 Stranded Copper #8 AWG and larger.
  - .3 Sized as indicated (Minimum # 12 AWG).
- .3 Insulation: cross link polyethylene (RW90), (RWU90), 90 deg. C.
- .4 Configuration: Single conductor.
- .5 Voltage Rating: Minimum 600V.
- .6 Certification: CSA C22.22 No. 38 or latest revision.

.2 Armored Cable (TECK):
- .1 Type: TECK
- .2 Conductors:
  - .1 Solid Copper #10 AWG and smaller.
  - .2 Stranded Copper #8 AWG and larger.
  - .3 Sized as indicated (Minimum # 12 AWG).
- .3 Insulation: cross link polyethylene (RW90), 90 deg. C.
- .4 Configuration: Multi-conductor, as required, c/w a separate bare CU ground wire.
- .5 Colour Code: Black, red, blue and white in 4/C cable. Cables of more than 4/C to be number coded.
- .6 Voltage Rating: 1KV, 5KV, or 15KV as indicated.
- .7 Inner Jacket:
  - .1 Black polyvinyl chloride (PVC)
  - .2 Low Flame Spread (LFS)
  - .3 Low Gas Emission (LGE)
- .8 Armor: Inter-locked aluminum
- .9 Outer Jacket:
  - .1 Black polyvinyl chloride (PVC), -40 deg. C
  - .2 Low Flame Spread (LFS)
  - .3 Low Gas Emission (LGE)
- .10 Flame Rating: FT4
- .11 Certification: CSA C22.22 No. 131 or latest revision.

PART 3 - EXECUTION

3.1 Installation of Cables

.1 Do not install PVC jacketted cables in circulating air plenums.

3.2 Installation in Equipment

.1 Group and lace-in neatly wire and cable installed in switchboards, panelboards, cabinets, wireways and other such enclosures.

3.3 Terminations

.1 Terminate wires and cables with appropriate connectors in an approved manner.

3.4 Identification

.1 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, color coded as listed below.

.2 Wire in conduit 1/0 AWG and larger and single conductor cables for normal power feeders shall be identified at each outlet box and termination with a 150 mm band of coloured vinyl tape of the appropriate colour. Emergency power feeders shall be provided with an additional 75 mm band of red vinyl tape installed adjacent to the 150 mm band of the coloured phase identification tape, as listed below. Neutral and ground conductors shall be identified. Paint or other means of colouring the insulation shall not be used.

.3 Color code wire in conduit and single conductor cables as follows:

Phase A - red
Phase B - black
Phase C - blue
Neutral - white
Ground - green

.4 Maintain phase sequence and colour coding throughout project.

.5 Use colour coded wires in communication cables, matched throughout system.

.6 Identify control conductors in motor control equipment, contactors, fire alarm panels, etc. with mylar/cloth wire markers.

.7 Refer to 16010 for additional requirements.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1 Electrical General Requirements Section 16010

.2 Conduits, Conduit Fastenings and Conduit Fittings Section 16111

.3 Fastenings & Supports Section 16191

1.2 Location

.1 Locate splitters, junction and pull boxes as indicated or as needed for each system.

PART 2 - PRODUCTS

2.1 Splitters

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. Sprinklerproof

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 Minimum three spare terminals on each set of lugs in splitters.

.4 Explosion proof in hazardous areas to suit the hazardous classification.

.5 Weatherproof where installed outdoors.

.6 Enclosures in other areas to suit environment.

2.2 Junction and Pull Boxes

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

.3 Cast type with gasketted covers where exposed to weather.

.4 Explosion proof in hazardous areas to suit the hazardous classification.

2.3 Cabinets

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm G1S fir plywood backboard. Cabinets to be flush or surface mounted as indicated.

.3 Provide other systems cabinets as specified and located on drawings.

PART 3 - EXECUTION

3.1 Splitter Installation

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction, Pull Boxes and Cabinets Installation

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Install terminal block as indicated.

.4 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

.5 Install junction and pull boxes clear of all mechanical ductwork and piping.

3.3 Identification

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

.2 Identify splitters with size 7 nameplates.

.3 Identify junction and pull boxes with size 3 nameplates.

.4 Identify cabinets with size 5 nameplates.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1 Electrical General Requirements Section 16010

.2 Conduits, Conduit Fastenings and Conduit Fittings Section 16111

PART 2 - PRODUCTS

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 Sectional boxes shall not be used without specific approval of the Consultant.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

.6 In finished areas switch, convenience receptacle, voice/data and blank cover plates shall be stainless steel. In finished area ceilings, junction and pull box covers shall be solid covers, painted to match the finish of the adjacent surface.

.7 In moist or dusty areas, gasketted watertight or dust tight boxes and covers shall be provided.

2.2 Sheet Steel Outlet Boxes

.1 Electro-galvanized steel device boxes for flush installation, minimum size 102 mm square outlet boxes with extension and plaster rings as required.

.2 Electro-galvanized steel device boxes for flush installation in drywall and minimum size 102mm square outlet boxes with extension and square cornered tile covers as required.

.3 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, sized as required for the installation.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

2.3 Conduit Boxes

.1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle where exposed to moisture.

2.4 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Maintain continuity of vapor barrier where boxes are installed in exterior walls and ceilings. Use air/vapor barrier boxes for outlets installed in walls or ceilings with a vapor barrier.

.6 Boxes to be mounted plumb and square with building lines.

.7 Where outlet boxes are shown on the drawings as being "back-to-back" shall have a minimum offset of 200 mm (8") between boxes to reduce sound transmission. In no case shall "thru-wall" boxes be used.

.8 Install pull boxes, or fittings, in conduit runs where more than four bends are necessary.

.9 Install pull boxes where run exceeds 23.0 (75 feet) in length.

.10 All junction, outlets and pull boxes shall be so installed that they are always readily accessible.

.11 No power driven pins (Ramset) shall be utilized to secure boxes without specific approval from Consultant.

.12 Check opening provided for each recessed outlet box and if it is not completely covered by cover plate, report discrepancy to the division responsible and ensure that it is rectified.

.13 All concealed junction boxes, conduit fittings, etc. to be c/w galv. steel covers, secured with two bolts.

.14 Co-ordinate boxes in masonry with brick or block configuration, boxes to be saw cut in bottom of appropriate brick or block. They shall be of sufficient depth to allow conduit to pass through center of block.

.15 Co-ordinate locations with millwork.

.16 Apply acoustic sealant to and seal wires penetrating moulded vapour barrier boxes.

.17 Verify exact location of floor boxes with Contract Administrator. Adjust floor boxes level with finished floor.

.18 Verify exact location of service fittings with furniture drawings and/or Contract Administrator. Service fittings to be installed parallel and perpendicular to building lines.

.19 No more than two extension rings shall be used in sequence.

.20 For installations in hazardous areas, meet all requirements of authorities having jurisdiction.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1 Electrical General Requirements Section 16010

.2 Conduits, Conduit Fastenings and Conduit Fittings Section 16111

.3 Wires and Cables Section 16122

PART 2 - PRODUCT

2.1 Support Channels

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings or as required.
.1 Manufacturers: B-Line, Burndy, Electrovert, Unistrut, Pilgrim, Pursley.

PART 3 - EXECUTION

3.1 Installation

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with cast in or expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation. Provide additional support as required.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.
.1 One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.
.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.
.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1500 mm oc spacing.

.9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.14 Threaded rod to be minimum 6 mm diam. galv. or nickel plated. Black steel rod is not acceptable.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1	Mechanical Specifications	Division 15000
.2	Electrical General Requirements	Section 16010
.3	Conduits, Conduit Fastenings and Conduit Fittings	Section 16111
.4	Wires and Cables	Section 16122
.5	Outlet Boxes, Conduit Boxes and Fittings	Section 16132
.6	Disconnect Switches - Fused and Non-Fused up to 1000V	Section 16440

1.2 System Description

.1 Provide complete electrical power and control connections for mechanical equipment, except as noted herein.

PART 2 - PRODUCTS

2.1 Materials

.1 Include disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.

.2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices and fittings required to provide control wiring for mechanical equipment except for temperature/humidity control systems.

.3 Unless otherwise noted, motors and control devices shall be supplied by Div. 15. Motor horsepower ratings shall be as shown in the Div. 15 specifications. Motor voltage and phase ratings shall be as shown on the Div. 16 drawings.

2.2 Exterior Equipment

.1 All equipment mounted on the exterior of the building shall be weatherproof.

PART 3 - EXECUTION

3.1 Power Wiring

.1 Install power feeders, disconnects and associated equipment and make connections to all mechanical equipment.

.2 Install branch circuit wiring for mechanical systems control panels, time clocks and control transformers. Control panels for equipment on emergency power to be connected to emergency branch circuits.

.3 Install main power feeders to control panels furnished by Div. 15. Install branch circuit wiring for motors, electric coils, etc.

3.2 Controls

.1 Install all electrical controls except controls supplied under Division 15, unless otherwise noted herein. Controls which have both electrical and mechanical connections shall be installed by the trade supplying the control.

.2 Wire and connect remote thermostats, control panels, P/E switches, etc. condensing units, and rooftop HVAC units. Interlock rooftop units to condensing units as required.

.3 Install, wire and connect controls which are an integral part of any packaged unit and are supplied by the trade supplying the packaged unit. Include wiring for controls for such items as roof-top units, etc.

3.3 Coordination

.1 Refer to mechanical drawings for the exact location of motor control devices, and other mechanical equipment requiring an electrical connection.

.2 Obtain full information from Div. 15, regarding wiring, controls, overload heaters, equipment ratings and overcurrent protection. Notify the Div. 15 contractor, at once, if any information provided is incorrect or unsatisfactory.

.3 Coordinate control wiring requirements with Div. 15 and provide all control wiring and connections as required to make the control systems operate as specified.

.4 Refer to Div. 15 specifications for any further electrical requirements.

3.4 Shop Drawing Review

.1 Review Div. 15 equipment shop drawings and adjust breaker/feeder sizes as required.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1	Electrical General Requirements	Section 16010
.2	Conduits, Conduit Fastenings and Conduit Fittings	Section 16111
.3	Splitters, Junction, Pull Boxes and Cabinets	Section 16131
.4	Outlet Boxes, Conduit Boxes and Fittings	Section 16132
.5	Fastenings and Supports	Section 16191

1.2 Coordination

.1 The building shall remain open and in normal operation during the construction period.

.2 Where existing services such as electrical power, fire alarm system, sound system, etc. are required to be disrupted and/or shut down, coordinate the shut-downs with the Owner and carry out the Work at a time and in a manner acceptable to them. Carefully schedule all disruption and/or shut-downs and ensure that the duration of same is kept to the absolute minimum. Submit for approval a written, concise schedule of each disruption at least 120 hours in advance of performing Work and obtain The City of Winnipeg's written consent prior to implementing.

.3 Should any temporary connections be required to maintain services during Work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing system be damaged, make full repairs without extra cost, and to the satisfaction of the Owner and Contract Administrator.

.4 If existing equipment shown on drawings is defective it shall be brought to the Contract Administrator and The City of Winnipeg's attention prior to Work completion.

.5 Refer to General Conditions for phasing and staging of Work and adhere to that schedule. Comply with instructions regarding working hours necessary to maintain the building in operation.

.6 Coordinate complete installation of relocated utility services, if required, with Utilities to ensure minimum interruption of service. Coordinate the transfer of the existing hydro service point to the new service point with the Hydro utility in order to keep power interruptions to a minimum.

1.3 Existing Devices in New Construction

.1 Where existing devices (receptacles, switches, etc.) presently mounted on a wall which will be covered with a new finish, provide an extension ring, coverplate, etc. or relocate as required to mount the device to the new wall.

.2 Where existing conduits pass vertically through a floor area, relocate those conduits to be installed concealed in a new wall or surface mounted in a service area. Extend conduit, wiring, etc. as required.

.3 Existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.

.4 Where services are concealed within walls, floors or ceilings and cannot be visually identified, Contractor shall provide electronic scanning devices or other approved means to locate and identify concealed services prior to drilling.

1.4 Schedule of Work

.1 Carefully note and refer to the Contract Administrator's general schedule of Work and include for all requirements to conform to it.

PART 2 - PRODUCTS

2.1 Materials

.1 Provide all materials required for the complete interface and reconnection installation as herein described and as indicated on the drawings.

.2 New fire alarm devices, speakers, starters, panelboards, etc. required to be tied in to existing systems shall match the existing devices.

.3 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturers requirements and instructions.

PART 3 - EXECUTION

3.1 Installation

.1 Install boxes, conduit and wiring through existing areas as required for the new installation.

.2 Add modules, switches, etc. in existing control panels, as required, to extend existing systems to new or renovated areas.

.3 Patch and repair walls and ceilings in existing areas that have been damaged or cut open due to the new electrical installation.

.4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.

END

PART 1 - GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 16010.

PART 2 - PRODUCTS

2.1 Disconnect Switches

.1 Fusible and non-fusible disconnect switch in CSA Enclosure and size as indicated. To suit the environment (i.e. weatherproof, watertight, dust-tight, general purpose, etc.)

.2 Provision for padlocking in on-off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated, to Section 16478 - Fuses - Low Voltage.

.5 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action, heavy duty industrial grade.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 Disconnects used for service entrances shall be approved service entrance switches.

.9 Disconnects for two speed motors to be six pole. Refer to motor schedule and drawings for two speed motors and provide a six pole disconnect switch for each two speed motor.

2.2 Equipment Identification

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

.2 Indicate name of load controlled and voltage on size 6 nameplate.

PART 3 - EXECUTION

3.1 Installation

.1 Install disconnect switches complete with fuses as indicated.

.2 Install additional brackets, supports, etc. required for mounting the disconnect switches.

.3 Install six pole disconnects at all two speed motors.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1 Electrical General Requirements Section 16010

.2 Wires and Cables Section 16122

1.2 References

.1 Ground equipment to: CSA C22.2 No. 41.

.2 Copper grounding conductors to: CSA G7.1.

PART 2 - PRODUCTS

2.1 Equipment

.1 Grounding conductors system, circuit and equipment, grounding to be bare (or green insulated if indicated/required) stranded copper sized in accordance with the Canadian Electrical Code.

.2 Clamps for grounding of conductor, size as required to electrically conductive underground water pipe.

.3 Copper conductor minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.4 Rod electrodes, galvanized steel 19 mm dia by minimum 3 m long. Threaded to accept 3m extensions if required.

.5 Plate electrodes, copper, surface area 0.2 m^2, 1.6 mm thick.

.6 System and circuit, equipment, grounding conductors, bare stranded copper, tinned, soft annealed, size as indicated.

.7 Insulated grounding conductors: green, type RW-90.

.8 Ground bus: copper, size 50 mm by 6 mm by 300 mm long complete with insulated supports, fastenings, connectors.

.9 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
.1 Grounding and bonding bushings.
.2 Grounding or bonding clamps. All grounding and bonding clamps shall be brass where attached to copper pipes. Clamps for other applications shall be of a type and material that will

minimize deterioration from galvanic action due to dissimilar metals.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

PART 3 - EXECUTION

3.1 Installation General

.1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of local authority having jurisdiction over installation.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs. Soldered joints not permitted.

.5 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.6 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.7 Install separate ground conductor to outdoor lighting standards.

.8 Connect building structural steel and metal siding to ground by welding copper to steel.

.9 Make grounding connections in radial configuration only, with connections terminating at single grounding point street side of water pipe. Avoid loop connections.

.10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.11 All conduit runs containing feeders and branch circuits shall be complete with an insulated green ground wire bonded to all outlet boxes, junction boxes, pull boxes, equipment enclosures, etc. The conduit system shall be continuous but shall not be relied on to serve as the equipment grounding means. Ground conductors shall be sized according to the Canadian Electrical Code, but shall be minimum #12 AWG. All locknuts and couplings shall be securely tightened. All flexible conduit shall include an insulated ground

wire and shall be properly grounded through an approved fitting. A separate ground conductor shall be installed in all fibre, PVC or plastic duct runs and shall be connected to maintain the grounding of the system.

.12 A minimum #3/0 AWG bare ground wire shall be installed in all cable trays.

3.2 System and Circuit Grounding

.1 Install system and circuit grounding connections to neutral points of 600V and 208 V system.

3.3 Equipment Grounding

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevator distributions, panels, outdoor lighting.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 16010.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the local inspection authority. A report shall be submitted to the Contract Administrator from the testing agency.

.3 Perform tests before energizing electrical system.

END

PART 1 - GENERAL

1.1 Related Work Specified Elsewhere

.1 Electrical General Requirements Section 16010

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 16010.

.2 Submit fuse performance data characteristics for each fuse type and size above 30 A. Performance data to include: average melting time-current characteristics, I^2t (for fuse coordination), and peak let-through current.

1.3 Maintenance Materials

.1 Provide maintenance materials in accordance with Section 16010.

.2 Three spare fuses of each type and size installed above 600 A.

.3 Six spare fuses of each type and size installed up to and including 600 A.

1.4 Delivery and Storage

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in storage cabinet.

PART 2 - PRODUCTS

2.1 Fuses General

.1 Plug and cartrige fuses: to CSA C22.2 No. 59.

.2 Fuse type references L1, L2, J1 etc. have been adopted for use in this specification.

.3 Fuses: product of one manufacturer.

2.2 Fuse Types

.1 HRC-L fuses (formerly Class L), motor loads:
.1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
.2 Type L2, fast acting.

.2 HRCI-J fuses (formerly Class J), Panel loads:
.1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
.2 Type J2, fast acting.

PART 3 - EXECUTION

3.1 Installation

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.
.1 Install Class R rejection clips for HRCI-R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

END