

PART 1 - GENERAL

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| <u>1.1 Related Sections</u> | <ul style="list-style-type: none">.1 Section 01 00 10 - General Instructions..2 Section 01 33 00 - Submittal Procedures..3 Section 01 35 29.06 - Health and Safety Requirements..4 Section 01 74 21 - Construction/Demolition Waste Management And Disposal..5 Section 01 78 00 - Closeout Submittals..6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC..7 Section 23 65 10 - Condensers,Coolers and Cooling Towers. |
| <u>1.2 Equipment Requirements and Installations</u> | <ul style="list-style-type: none">.1 Unions or flanges: provide for ease of maintenance and disassembly..2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.3 Equipment drains: pipe to floor drains..4 Install equipment, rectangular cleanouts and similar items parallel to, or perpendicular to, building lines..5 Provide new materials and equipment of proven design, quality and or current models with published ratings for which replacement parts are readily available..6 The word "provide" shall mean "supply and install"..7 Review Section 23 65 10 - Condensers,Coolers and Cooling Towers, for data and information of pre-purchasing equipment. Deliver to site, hoist, install in place, connect all services and coordinate start up of pre-purchased equipment..8 Uniformity:<ul style="list-style-type: none">.1 Use product of one manufacturer unless otherwise specified, for equipment or material of the same type of classification..2 Installation:<ul style="list-style-type: none">.1 Unless otherwise specified, follow manufacturer's recommendations for safety, adequate access for inspection, maintenance and repairs..2 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems without interference with building structure or other equipment..3 Lubrication:<ul style="list-style-type: none">.1 Provide accessible lubricating means for bearings, including permanent lubrication "Lifetime" bearings. Extended grease nipples to be supplied. |

1.2 Equipment Requirements and Installations (Cont'd)	.9	Site condition: .1 Drawings indicate approximate location of equipment and services. Perform site measurements prior to installation. Do not scale drawings. .2 To avoid interference closely coordinate installation of mechanical services and equipment with other trades. Advise of any possible interference in timely fashion. Do not proceed with system or equipment installation without Departmental Representative's instruction. In case that system has to be relocated within 1000mm radius from anticipated location, no additional charge or credit will be expected and approved. .3 Prepare and submit for review, set of interference drawings for each area affected by this contract. .4 Review contract instruction and specification for work restriction and phasing. The work will be conducted in fully occupied and functional building. Any interruptions and shut downs to be kept to minimum.
1.3 Anchor Bolts and Templates	.1	Provide, locate and set all anchor bolts and fastening devices and equipment.
1.4 Trial Usage	.1	Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
	.2	Trial usage to apply to following equipment and systems: .1 Plumbing system. .2 HVAC system. .3 Control system.
1.5 Protection of Openings	.1	Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
1.6 Cutting, Patching Core Drilling and Surface Restoration	.1	All cutting, patching, core drilling and surface restoration by General Contractor. Each Division shall clearly mark extent of work required for this trade and coordinate the work. .1 Scan section of floor or wall for presence of any conduits wires, pipes and structural obstruction prior to cutting procedure.
1.7 Demonstration and Operating and Maintenance Instructions	.1	Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
	.2	Where specified elsewhere in appropriate Division, manufacturers to provide demonstrations and instructions.
	.3	Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

1.7 Demonstration and Operating and Maintenance Instructions (Cont'd)	.4	Instruction duration time requirements as specified in appropriate sections. If specific requirements are not listed, allow for two separate 8 hours demonstration sessions.
1.8 Closeout Submittals	.1	Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
	.2	Operation and maintenance manual to be approved by, and final copies deposited with, Departmental Representative before final inspection.
	.3	Operation data to include: <ul style="list-style-type: none">.1 Control schematics for each system including environmental controls..2 Description of each system and its controls..3 Description of operation of each system at various loads together with reset schedules and seasonal variances..4 Operation instruction for each system and each component..5 Description of actions to be taken in event of equipment failure..6 Valves schedule and flow diagram..7 Colour coding chart..8 Data and Maintenance requirements for pre-purchasing equipment.
	.4	Maintenance data shall include: <ul style="list-style-type: none">.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment..2 Data to include schedules of tasks, frequency, tools required and task time.
	.5	Performance data to include: <ul style="list-style-type: none">.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete..2 Equipment performance verification test results..3 Special performance data as specified elsewhere..4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
	.6	Approvals: <ul style="list-style-type: none">.1 Submit 1 copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by Departmental Representative..2 Make changes as required and re-submit as directed by Departmental Representative.
	.7	Additional data: <ul style="list-style-type: none">.1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

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- 1.9 Shop Drawings and Product Data
- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. eg. access door swing spaces.
 - .3 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts, method of anchorage.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify as to current model production.
 - .5 Certification of compliance to applicable Codes.
 - .6 Indicate materials, finishes, dimensions, construction and assembly details and accessories.
 - .7 Accessories supplied with the product.
 - .8 Accessories not supplied but necessary for proper unit or system operation.
 - .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedure use "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
 - .1 In case such a template is not provided Contractor shall create one and provide sample for review prior to shop drawings submission.
 - .2 Shop drawings without the "Shop Drawing Submittal Title Sheet" without job specific equipment selection and without contractor review stamp will not be reviewed.
 - .5 Obtain from Departmental Representative copy of shop drawings and Maintenance Manuals of pre-purchased equipment. Include in shop drawings submission pre-purchased equipment data to assure contractor familiarize himself and sub-contractors with material information and installation requirements.
- 1.10 Cleaning
- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
- 1.11 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal, and Section 21 05 01 Common Work Results Mechanical.
 - .2 Place materials defined as hazardous or toxic waste in designated containers.
 - .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
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| 1.12 <u>Delivery, Storage and Handling</u> | .1 | Deliver, store and handle materials in accordance with Section 01 00 10 - General Instructions and Section 21 05 01 - Common Work Results Mechanical. |
| | .2 | Leave protective covering in place until final cleaning of building. |
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| 1.13 <u>As-built Drawings</u> | .1 | Site records: <ul style="list-style-type: none">.1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring..2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed..3 Use different colour waterproof ink for each service..4 Make available for reference purposes and inspection at all times. |
| | .2 | As-built drawings: <ul style="list-style-type: none">.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings..2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date)..3 Submit to Departmental Representative for approval and make corrections as directed..4 TAB to be performed using as-built drawings..5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals. |
| | .3 | Submit copies of as-built drawings for inclusion in final TAB report. |
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| 1.14 <u>Commissioning</u> | .1 | Review requirements of Section 01 91 13 - General Commissioning (Cx) Requirements and arrange for staff familiar with the project to be present, provide equipment and system information and data, provide small tools and assist during commissioning. |
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PART 2 - PRODUCTS

2.1 Not Used .1 Not used.

PART 3 - EXECUTION

3.1 Not Used .1 Not used.

PART 1 - GENERAL1.1 Related
Sections

- .1 Section 01 00 10 - General Instructions.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 35 29.06 - Health and Safety Requirements.
- .4 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 01 91 13 - General Commissioning (Cx) Requirements.
- .7 Section 07 92 10 - Joint Sealing.
- .8 Section 21 05 01 - Common Work Results - Mechanical.

1.2 References

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-2010, Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 335-2010e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C 411-2005, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C 449/C449M-2007, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C 921-2010, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 1999).
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-2010, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-2005, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-2009, Thermal Insulation, Mineral Fibre, for Buildings

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| <u>1.3 Definitions</u> | .1 | For purposes of this section:
.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
.2 "EXPOSED" - will mean "not concealed" as defined herein. |
| | .2 | TIAC ss:
.1 CRF: Code Rectangular Finish.
.2 CPF: Code Piping Finish. |
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| <u>1.4 Shop Drawings</u> | .1 | Submit shop drawings in accordance with Section 01 00 10 - General Instructions. |
| | .2 | Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations. |
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| <u>1.5 Manufacturers' Instructions</u> | .1 | Submit manufacturers' installation instructions in accordance with Section 01 00 10 - General Instructions. |
| | .2 | Installation instructions to include procedures to be used, installation standards to be achieved. |
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| <u>1.6 Qualifications</u> | .1 | Installer to be specialist in performing work of this section, have successful experience in size and type of similar projects and be qualified to standards of TIAC. |
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| <u>1.7 Waste Management and Disposal</u> | .1 | Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal, and Section 21 05 01 Common Work Results Mechanical. |
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| <u>1.8 Delivery, Storage and Handling</u> | .1 | While delivering materials to site follow requirements of Section 01 00 10 - General Instructions and Section 21 05 01 - Common Work Results Mechanical. |
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PART 2 - PRODUCTS

<u>2.1 Fire and Smoke Rating</u>	.1	In accordance with CAN/ULC-S102.
	.1	Maximum flame spread rating: 25.
	.2	Maximum smoke developed rating: 50.
<u>2.2 Insulation</u>	.1	Mineral fibre specified includes glass fibre, rock wool, slag wool.
	.2	Thermal conductivity ("k" factor) not to exceed specified values at 24 °C mean temperature when tested in accordance with ASTM C 335.
	.3	TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
	.1	Mineral fibre: to CAN/ULC-S702.
	.2	Maximum "k" factor: to CAN/ULC-S702.
	.4	TIAC Code C-4: Mineral fibre blanket faced with factory applied vapour retarder jacket.
	.1	Mineral fibre: to CAN/ULC-S701.
	.2	Maximum "k" factor: to CAN/ULC-S701.
<u>2.3 Insulation Securement</u>	.1	Tape: Self-adhesive, aluminum, reinforced, 50 mm wide minimum.
	.2	Canvas adhesive: Washable.
	.3	Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
<u>2.4 Cement</u>	.1	Thermal insulating and finishing cement:
	.1	Hydraulic setting on mineral wool, to ASTM C 449/C449M.
<u>2.5 Vapour Retarder Lap Adhesive</u>	.1	Water based, fire retardant type, compatible with insulation.
<u>2.6 Indoor Vapour Retarder Finish</u>	.1	Vinyl emulsion type acrylic, compatible with insulation.
<u>2.7 Jackets</u>	.1	Aluminum:
	.1	To ASTM B 209.
	.2	Thickness: 0.50 mm sheet.
	.3	Finish: stucco embossed.
	.4	Joining: longitudinal and circumferential slip joints with 50 mm laps.

2.7 Jackets
(Cont'd)

- .1 Aluminum:(Cont'd)
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing
- .2 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB 51.53 with pre-formed shapes as required.
 - .2 Colours:white.
 - .3 Minimum service temperatures: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0.5 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.

PART 3 - EXECUTION3.1 Pre-
Installation
Requirement

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry, free from foreign material.
- .3 A complete inspection by the Departmental Representative must be completed and signed off before the piping system or portion of piping system is insulated.

3.2 Installation

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Coordinate work with installation of heat trace cable. Commence work after heat trace cable is installed and commissioned.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

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| 3.3 Removable,
Pre-fabricated,
Insulation and
Enclosures | .1 | Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment. |
| | .2 | Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation. |
| | .3 | Insulation: |
| | .1 | Insulation, fastenings and finishes: same as system. |
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| 3.4 Piping
Insulation
Schedules | .1 | Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified. |
| | .2 | TIAC Code: A-3. |
| | .1 | Securements: SS Bands at 300 mm oc. |
| | .2 | Seals: lap seal adhesive, lagging adhesive. |
| | .3 | Installation: TIAC Code 1501-H. |
| | .3 | TIAC Code: C-4 with and without vapour retarder jacket. |
| | .1 | Insulation securements: Combination of wires and bands and tape, spacing to suit condition. |
| | .2 | Seals: lap seal adhesive, lagging adhesive. |
| | .4 | Thickness of insulation to be as follows: |
| | .1 | Make-up water - 25 mm thick. |
| | .5 | Finishes: |
| | .1 | Exposed indoors: PVC jacket. |
| | .2 | Exposed outdoors: Aluminum jacket. |
| | .3 | Installation: To appropriate TIAC code CRF/1 through CPF/5. |