

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
- .2 Section 26 05 00 - Common Work Results for Electrical.

**1.2 REGULATIONS AND PERMITS**

- .1 Comply with most stringent requirements of National Building Code, Provincial and Municipal regulations and by-laws, specified standards, codes, and this specification.
- .2 Furnish inspection certificates prior to final payment to show that the installed work conforms with the drawings and specifications and with laws and regulations of all Authorities having jurisdiction.
- .3 Obtain and pay for all permits and inspections required by Authorities having jurisdiction for all aspects of work described in the documents.

**1.3 CODES AND STANDARDS**

- .1 Systems and installation must comply with the latest editions and all amendments of the following codes and standards. Where conflicts in requirements occur, the higher standards shall apply.
  - .1 ASHRAE Standards.
  - .2 CSA Standards.
  - .3 AMCA Standards.
  - .4 CGA Standards.
  - .5 NFPA Fire Codes.
  - .6 Ontario Building Code, 2016 edition.
  - .7 All governing Municipal requirements.
  - .8 Canadian Underwriter's Association Standards.

**1.4 WORK SCHEDULE**

- .1 Review starting dates, milestone dates, and completion dates of all aspects of the Work Schedule and confirm that these dates can be met. The absence of comments will be construed as agreement and ability to meet the schedule dates.
- .2 Interim reviews of the project schedule will be made as work progresses and the schedule will be updated where necessary by the General Contractor in conjunction with the Departmental Representative.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- .1 All roof equipment to be existing to remain, unless otherwise noted.
- .2 Comply with manufacturers' instructions, unless stated otherwise.
- .3 Ensure that all materials used are compatible with all adhesives, caulking, sealers, coatings, and any other materials that may make contact. Ensure that there is no contact between any materials that may cause corrosion or otherwise attack and cause any deterioration.

## **2.2 DEFINITIONS**

- .1 The word "provide" means the supply and installation of all required labour, materials and accessories for complete systems or parts thereof.

## **2.3 SCREWS, BOLTS AND FASTENINGS**

- .1 Use standard commercial sizes and patterns with material and finish suitable for service.
- .2 Keep exposed fastenings to minimum. Space evenly and lay out neatly.

## **2.4 ACCESSORIES**

- .1 Provide accessory items or materials required such as equipment supports, fabricated bases, brackets, cleats, connectors, sealants, lubricants, cleaners, protection, etc., whether specified or not, so that the work is complete and will perform as required by the Contract.

## **2.5 ELECTRIC EQUIPMENT AND CONTROLS**

- .1 All electrical work shall conform to Division 26 requirements.
- .2 Disconnect and re-connect the power wiring and control wiring and conduits for roof mounted existing mechanical equipment will be provided by Division 26.
- .3 All mechanical equipment motors to be existing to remain.
- .4 Coordinate the electrical requirements for mechanical equipment with the Division 26 Contractor.

## **2.6 EQUIPMENT BASES, SUPPORTS**

- .1 Reinstall the existing roof equipment. Provide equipment bases, supports as required.
- .2 Anchor bolts and fastenings, and equipment stands and supports are part of Mechanical work.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- .1 Cooperate and coordinate work prior to starting and during execution with respective Trades as required for satisfactory and expeditious completion of the contract. Take field dimensions relative to this Work. Fabricate and erect work to suit field dimensions and field conditions. Pay cost or extra work caused by, and make up time lost as a result of, failure to provide necessary cooperation and/or information.
- .2 Provide all forms, templates, anchors, sleeves, inserts and accessories required to execute the Work and instruct related trades as to location.
- .3 Allow adequate space for servicing and dismantling and removal of equipment and components.
- .4 Provide drains for equipment as applicable, piped to sanitary drainage system.
- .5 Install equipment and system components parallel or perpendicular to building lines, unless indicated otherwise.

### **3.2 EXISTING BUILDINGS AND SERVICES**

- .1 Where work involves breaking into or connecting to existing services, perform work at times directed by the Departmental Representative, with minimum disturbance to occupants, pedestrian and vehicular traffic. Perform this work during normal working hours unless otherwise specified.
- .2 Before commencing Work, establish location and extent of service lines in areas of Work, mark their locations and notify Departmental Representative of findings.
- .3 Submit schedule and obtain approval from the Departmental Representative for any shutdown or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.
- .4 Where unknown services are encountered, immediately advise the Departmental Representative and confirm findings in writing.
- .5 Remove abandoned service lines when so directed. Cap or otherwise seal lines at cut-off points as directed by the Departmental Representative.
- .6 Record on record drawings the locations of maintained, re-routed and abandoned service lines.
- .7 Obtain and pay for permits necessary for changes required to existing services.
- .8 This Contractor is responsible for making good any damage caused when making connections to existing services.
- .9 All systems are to be kept fully functional, where applicable and required. Provide temporary measures, if necessary, to achieve this.
- .10 Noise generating work to be performed off hours per section 01 00 10 General Instructions

### **3.3 DEMOLITIONS AND REMOVALS**

- .1 Material removed under this contract is to become the property of the contractor unless otherwise noted and must be promptly removed from the site.
- .2 Coordinate with the General Contractor for the provision of a suitable refuse container. Costs for the provision and/or use of the refuse container shall form part of the General Contractor's responsibility.
- .3 Disconnect and/or valve or cap all services to equipment being removed under this contract. Termination of services shall be made at their source or at their branch point off existing services being retained.
- .4 The clean-up of all areas involved in mechanical demolition shall be the responsibility of the mechanical contractor. Remove all refuse, stains and scratches from surfaces or equipment. Repair any damage to surrounding surfaces and equipment. Paint any items damaged by removal cutting or patching.

### **3.4 HOISTING AND RIGGING**

- .1 In accordance with the construction schedule provide and arrange for transportation of all equipment and materials to the site, and for the rigging, hoisting, storing and setting in place of equipment.

### **3.5 SITE MEETINGS**

- .1 Attend all regularly scheduled Contractors' site meetings.

- .2 Acquire full knowledge of the nature of the Work involved in this project and be familiar with the progress made.

### **3.6 PROTECTION OF MATERIALS**

- .1 Protect openings in pipes, ducts and factory fabricated equipment stored or installed on site from damage and the entry of dust, grit, sand, water or any other foreign material. Protect threaded connections with temporary threaded caps.

### **3.7 PROTECTION OF BUILDING**

- .1 Do not overload any part of the structure during construction. Make every temporary support as strong as permanent support. Place no load on concrete slabs until they have cured (as specified in the Concrete Section) and have achieved sufficient strength to safely carry such loads.
- .2 Adequately protect concrete floors and finished flooring from damage. Take special measures when moving heavy loads or equipment.
- .3 Keep floors free from oils, grease or other materials likely to discolour them or affect bond of applied surfaces.
- .4 Protect work of other Sections from damage.
- .5 Damaged work shall be made good by appropriate trades but at the expense of those causing damage.
- .6 Attach and fasten fixtures and fittings in place in a safe, sturdy, secure manner so that they cannot work loose, fall or shift out of position during normal use of the building.
- .7 Protect existing buildings, curbs, roads and lanes. If, during work, any existing items are damaged, arrange for repair or replacement at no extra expense to the contract.

### **3.8 CUTTING AND PATCHING**

- .1 Cutting and patching of new work to accommodate the mechanical systems, unless otherwise noted, will be performed by the General Contractor with guidance from the appropriate Mechanical Contractor, and paid for by the appropriate Mechanical Contractor.
- .2 Take precautions to avoid cutting electrical cables or conduits buried in walls or floor slabs.
- .3 Make cuts with clean, true, smooth edges. Make patches inconspicuous.
- .4 After making good, caulk gaps between pipes, sleeves, ducts and conduits, and openings.
- .5 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work.

### **3.9 PROVISIONS FOR INSULATION**

- .1 Provisions shall be made by all Mechanical Trades for neat insulation finish around damper quadrants, damper motors and shafts, access doors, coil connections, instruments, switches, thermometer wells, etc. and at junction with concrete bases or curbs.

### **3.10 COORDINATION OF WORK**

- .1 Prime Mechanical Contractor shall provide a full-time on-site superintendent to oversee and coordinate all trades and sub-trades involved in Mechanical work.
- .2 The work of each trade shall be laid out so that it does not conflict or interfere with the work of other Divisions. Make any adjustments required to the Mechanical work as a result of improper location or sequencing, at no additional cost to the Project.

### **3.11 WORKMANSHIP**

- .1 Perform the work in a neat and careful manner so that items are installed, and will remain, plumb, square and straight. Items not so installed will be rejected and redone at no extra cost to the project.
- .2 Ensure that products are properly related to form close joints and appropriately aligned junctions, edges and surfaces, and that elements are free of warp, twist or other irregularities.
- .3 Except where specified otherwise, use products in strict accordance with manufacturers' published or written instructions, specifications or recommendations regarding handling, storage, preparation, site conditions, ancillary products or accessories, methods of installation, protection and cleaning.
- .4 When required either by the specifications or manufacturers' instructions, have manufacturer or his accredited agent or the supplier supervise the work.

### **3.12 INSTALLATION OF MECHANICAL EQUIPMENT**

- .1 All rooftop equipment existing to remain and keeps working without having shut down during the roof replacement. Except the LIEBERT rooftop condenser unit.
- .2 Shut down and disconnect the LIEBERT rooftop condenser unit before the roof replacement. Contractor have to support temporarily condenser if the building operator required. Raising and reinstate the existing condenser unit after completing the roofing installation. Contractor to coordinate the condenser units shut down with building operator.
- .3 Provide for equipment maintenance and of Mechanical disassembly by use of unions or flanges in appropriate places.
- .4 Install base-mounted equipment on chamfered edge housekeeping pads a minimum of 80 mm high and 50 mm larger all around than equipment dimensions. Pads to be provided by others under the direction of the appropriate Mechanical Contractor.
- .5 Position equipment to allow for easy removal of components such as filters, tubes, coils, etc., according to manufacturers' recommendations.

### **3.13 ISOLATION**

- .1 Select and install equipment, pipe and duct supports so as to prevent the transmission of noise and vibration within the structure. Where supports are attached to building structure and vibration or noise could be transmitted to the structure, insert resilient members between support and structure.
- .2 Supply to the isolation manufacturer a copy of all approved drawings of applicable equipment layouts and of the equipment to be installed, showing weights, shaft centres, dimensions and performance data.

- .3 Vibration isolation manufacturer shall supply drawings showing isolation locations, concrete slab dimensions, anchor positions, etc. and shall furnish installation instructions and supervision where required to obtain optimum results.
- .4 On system start-up, isolation manufacturer shall inspect the entire installation and report in writing any changes necessary to obtain optimum results.
- .5 The refrigeration machine manufacturer must ensure that equipment is sufficiently rigid for isolator point loading.
- .6 Unless otherwise specified, install isolation materials on concrete sub-bases which extend beyond the full base area of the isolated equipment.

**3.14 DEMONSTRATION**

- .1 Departmental Representative will 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 Existing roof mounted mechanical equipment.
- .3 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.
- .4 Use operation and maintenance manual, as-built drawings, and audio-visual aids as part of instruction materials.

**3.15 CLEANING (GENERAL)**

- .1 Upon completion of work remove temporary protection, stains and smudges from paint work, hardware, aluminum and other finished surfaces, and wash and polish plumbing fixtures.
- .2 Replace broken, damaged or scratched fixtures installed by Mechanical Contractor to the satisfaction of the Departmental Representative.
- .3 Upon completion of final cleaning, remove cleaning equipment, materials and debris from the building and site.
- .4 Work will not be considered finished until final cleaning of the project is completed to standards which would normally be expected to be maintained by occupants in their continued use of the premises.

**3.16 PAINTING**

- .1 Appropriate Sections of the Mechanical Contract shall touch up minor damage to finish on equipment to match standard factory applied baked enamel finish. Items suffering major damage to finish shall be replaced entirely if, in the opinion of the Departmental Representative, the damage is too extensive to be remedied by touch-up.
- .2 Provide for all painting of equipment or materials as specified or required by regulations. Where painting is to be performed by Painting Contractor, clean and leave surfaces ready for painting.

**3.17 SEISMIC PROTECTION**

- .1 The design and construction of all mechanical and electrical components and their connections, including, but not limited to, machinery, fixtures, ducts, and pipes (including contents), to be in

accordance with clause 4.1.8 of the Ontario Building Code, latest edition. Design of structural elements, including connections, to be performed by a registered structural Engineer, engaged by the Contractor and licensed in the province of Ontario, who shall seal and sign the design drawings. The sealed drawings shall be submitted along with the mechanical and electrical shop drawings for review. The structural Engineer who seals the drawings shall carry out sufficient on-site review of the mechanical/electrical work to ensure and to certify in writing that the work is in general compliance with his design.

### 3.18 START UP COMMISSIONING

- .1 Systematically check and test components of all systems to ensure correct functioning of each system before balancing commences.
- .2 Record all checking and testing on proper forms, indicating items listed below, and submit to the Departmental Representative for approval.
- .3 Ensure that each fan is free-wheeling and that there is no abnormal vibration at any speed. Check fan starting and stopping time against time recorded on shop drawings. Start and stop all fans at least five (5) times.
- .4 Bring each fan up to maximum design operating speed, check RPM with tachometer, check amperage drawn by motor. If amperage drawn exceeds nameplate amps by more than 10%, shut the fan down immediately and do not re-start until adjustments have been made to the fan drive. Run each fan for one hour and check motor temperature rise.
- .5 All heating and cooling units shall be commissioned for operation at the start of the heating and cooling seasons during the initial year of operation.
- .6 **System Commissioning Check List:**
  - ☐ Instrumentation installation completed
  - ☐ System start-up complete
  - ☐ Rotation of electric motor and ratings of overload heaters verified
  - ☐ Rotating equipment aligned and belt drive tension adjusted
  - ☐ Control diagrams and sequences corrected to "as-builts"
  - ☐ Safety and operating control setpoints are as designed and automatic control sequences have been checked
  - ☐ Installation cleaned up and temporary coverings, stickers and tags removed
  - ☐ Painted finishes touched up where damaged
  - ☐ Equipment and duct identification work completed
  - ☐ Fins on extended surface heat transfer coils combed out where damaged
- .7 **Check List of Start-up Procedure:**
  - .1 Pre-Start-Up Inspection:
    - ☐ Verify proper equipment mounting and setting
    - ☐ Verify that control, interlock and power wiring is correct
    - ☐ Verify alignment of motor and drive.
    - ☐ Verify proper piping connections and accessories
  - .2 First Run Observation:
    - ☐ Verify setting of safety controls
    - ☐ Check motor loads against nameplate
  - .3 Equipment Check:
    - ☐ Verify function of safety and operating controls

- ☐ Verify proper operation of equipment
- ☐ Report on inspection, observation and checking procedures

### 3.19 FINAL INSPECTION

- .1 When the work required under this Division has been completed to the best of the Contractor's knowledge, inform the Departmental Representative in writing that the job is ready for final inspection.
- .2 If a preliminary inspection by the Departmental Representative indicates that a list of the outstanding deficiencies will exceed 25 items, the job shall be considered not ready for final inspection and no further action will be taken by the Departmental Representative until further confirmation is received. Contractually, this will count as one regular site inspection. The Mechanical Contractor shall arrange to have themselves, their sub-trades and the General Contractor accompany the Departmental Representative on the final inspection.
- .3 Upon receipt of a deficiency list proceed immediately with steps to correct the deficiencies and report to the Departmental Representative within fifteen (15) days as to the status of same.
- .4 Before final payment is made provide a written guarantee covering all defects in equipment, materials and workmanship for a period of one year from the date of substantial completion.

### 3.20 GUARANTEES

- .1 Furnish a written guarantee for the satisfactory operation of all work and apparatus installed under this contract. At no cost to the Departmental Representative, replace immediately any part which may fail or prove defective within a period of twelve (12) months after date of substantial completion (unless specified otherwise). Guarantees do not apply to failure due to improper usage or ordinary wear and tear.
- .2 All hermetically sealed compressors are to be covered by a five-year part and labour extended warranty.
- .3 No certificate issued, payment made or partial use of the equipment by the Departmental Representative shall be construed as acceptance of defective work or improper materials.
- .4 This general guarantee shall not act as a waiver to any specified guarantee for any other length of time.

**END OF SECTION**



**PART 1        General**

**1.1        RELATED SECTIONS**

- .1        Section 23 05 00 – Common Work Results for Mechanical.

**1.2        QUALIFICATIONS OF TAB PERSONNEL**

- .1        Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of contract.
- .2        Provide documentation confirming qualifications, successful experience.
- .3        TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
  - .1        National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
- .4        Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5        Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6        Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7        Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8        TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
  - .1        For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
  - .2        Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

**1.3        PURPOSE OF TAB**

- .1        Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2        Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

**1.4        SCOPE OF WORK**

- .1        TAB for this project shall consist of verification of performance characteristics for each mechanical equipment reinstallation.

- .2 Balancing of air distribution is not required.
- 1.5 **EXCEPTIONS**
  - .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.
- 1.6 **CO-ORDINATION**
  - .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
  - .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.
- 1.7 **PRE-TAB REVIEW**
  - .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
  - .2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.
  - .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.
- 1.8 **START-UP**
  - .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- 1.9 **OPERATION OF SYSTEMS DURING TAB**
  - .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.
- 1.10 **START OF TAB**
  - .1 Notify Departmental Representative 7 days prior to start of TAB.
  - .2 Start TAB when building roof replacement completed.
  - .3 Application of weather stripping, sealing, and caulking.
  - .4 Provisions for TAB installed and operational.
- 1.11 **PRELIMINARY TAB REPORT**
  - .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
    - .1 Details of instruments used.
    - .2 Details of TAB procedures employed.
    - .3 Calculations procedures.

.4 Summaries.

**PART 2 Products**

**2.1 NOT USED**

.1 Not used.

**PART 3 Execution**

**3.1 BALANCING, ADJUSTMENT AND START-UP**

- .1 As soon as conditions permit, conduct acceptance tests to demonstrate that the equipment and systems meet the specified requirements. Written start-up reports shall be provided to the Departmental Representative. Prior to final tests make changes, adjustments or replacements shown to be required by results of preliminary tests, ready for performance of air and water balancing of systems.
- .2 Operate equipment for a minimum of five days. Repair defects and repeat tests until satisfactory results are obtained, lubricate bearings and adjust and set drives for proper alignment and tensions.
- .3 Calibrate and adjust thermostats, thermometers, linkages and dampers. Operate and test motors and speed switches for correct wiring sequences, check overload heaters in motor starters, replace and clean filters, flush out lines and equipment, remove and clean strainers, and flush out systems with chemically treated water to recommendations of the chemical treatment manufacturer. Fill water systems to purge air. Clean fan wheels and heating coils. Comb fins on air coils. Check all bolts and screws for tightness.
- .4 Conduct final tests in the presence of the Departmental Representative. Give advance notice in writing that preliminary tests have been completed and that final tests are ready to be conducted. During the final tests demonstrate to the satisfaction of the Departmental Representative that the equipment is operating as intended, without undue noise or vibration.

**END OF SECTION**

