

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with the requirements of Section 21 05 01, Mechanical General Provisions.
- .2 Comply with the requirements of Section 21 05 05, Basic Materials and Methods.
- .3 Comply with the requirements of Sections 22 06 01 and 23 06 01, Approved Substitute Schedules.

1.2 WORK FURNISHED BUT NOT INSTALLED

- .1 The materials and systems specified in this Section shall be purchased from a single vibration isolation materials manufacturer to assure single source responsibility for the performance of isolation materials used.
- .2 The materials and systems specified in this section can, at the Subcontractor's option, be installed by the Sub-Subcontractors who install the mechanical equipment, piping or ductwork.

1.3 DESCRIPTION OF SYSTEM

- .1 The Work under this section shall include furnishing all labor, materials, tools, appliances and equipment, and performing all operations necessary for the complete execution of the installation of vibration isolation devices and systems as shown, detailed, and/or scheduled on the drawing and/or specified in this section of the specifications. This work in general shall include but not necessarily be limited to the following:
 - .1 All motor driven mechanical equipment shall be isolated from the building structure by means of vibration isolators.
 - .2 All piping connected to isolated equipment shall be supported on the first three support points by spring hangers.
 - .3 All ductwork connected to isolated equipment shall be isolated using flexible duct connectors, provided under Section 23 31 00.
- .2 Equipment Isolation Schedule
 - .1 Furnaces:
Flexible Duct Connections,
Fan Isolation
 - .2 Ceiling Exhaust Fans:
Suspended Spring Isolation, Flexible Duct Connections.
 - .3 Condensing Units (Rooftop):
Floor Isolation, Flexible Pipe Connections.

1.4 SYSTEM DESIGN

- .1 The isolation materials manufacturer shall be responsible for the proper selection of isolators to accomplish the specified minimum static deflections, for all isolators, based

- on the actual weight distribution of the equipment and pipe to be isolated, and the piping layout.
- .2 The Subcontractor shall furnish to the vibration isolation supplier, a complete set of approved shop drawings of all mechanical equipment to receive vibration isolation devices to the vibration isolation materials manufacturer, based upon which the selection of vibration isolators will be completed. The shop drawings to be furnished shall include operating weights of the equipment to be isolated and the distribution of weight at the support points.
 - .3 The Subcontractor shall furnish to the vibration isolation supplier, a complete layout of the piping to be isolated, showing the size and/or weight, and the support points of the piping system.
 - .4 It is a requirement of this Specification that the Mechanical equipment be designed and installed so that the average noise criteria curves as outlined in the latest edition of the ASHRAE guide for this type of project are not exceeded. Where objectionable noise or vibration is encountered due to faulty equipment or inefficient vibration reduction devices, as determined by the Contract Administrator, make necessary tests, change and provide additional equipment as may be required and approved, without extra charge.
 - .5 Give consideration to side loading of equipment when calculating maximum loads on isolators; provide pairs of side snubbers and/or restraining springs where side torque or thrust may develop. When properly adjusted, the equipment shall be level when operating.
 - .6 Provide all spring isolators with height and levelling adjustment and set on neoprene antisound pads 6 mm (1/4") or thicker. Do not use sponge rubber for side snubbers.
 - .7 All hardware shall be corrosion resistant.

1.5 SUBMITTALS

- .1 Samples:
 - .1 The Subcontractor shall submit samples, for approval, of isolation devices offered as substitutions to those specified, on the request of the Contract Administrator. The Subcontractor shall also submit samples, for approval, of specified isolation devices, on the request of the Contract Administrator.
- .2 Shop Drawings
 - .1 Submit shop drawings showing:
 - .1 The construction of the isolation devices to be used, including specific selection of isolators for the equipment to be furnished for this project,
 - .2 A tabulation of the design data for each isolator, including spring O.D., free operating, and solid heights,
 - .3 Ratio of horizontal to vertical stiffness,
 - .4 Isolator location,
 - .5 Load forces,
 - .6 Anchor positions,
 - .7 Installation and adjustment instructions,

- .8 Other required data to clearly indicate that the specified isolator types and minimum static deflections are provided by the system submitted.

PART 2 PRODUCTS AND MATERIALS

2.1 SOURCE OF MATERIALS

- .1 All vibration isolation materials shall be provided by a single manufacturer to assure single source responsibility for the proper performance of materials used.
- .2 Materials and systems specified herein and as detailed or scheduled on the drawings are based on materials manufactured by Kinetics Noise Control, Inc.

2.2 ISOLATOR TYPES

- .1 Type 1, Floor-Mounted Equipment:
- .1 Vibration isolation pads shall be pre-compressed molded fiber glass pads individually coated with a flexible, moisture impervious elastomeric membrane. Vibration isolation pads shall be molded from glass fibers with fiber diameters not exceeding 0.00027 in. and with a modulus of elasticity of 10.5 million PSI. Natural frequency of fiberglass vibration isolation pads shall be essentially constant for the operating load range of the supported equipment. Vibration isolation pads shall be color coded or otherwise identified to indicate the load capacity. Vibration isolation pads shall be Model KIP, as manufactured by Kinetics Noise Control, Inc.
- or -
- .2 Vibration isolators shall be as described above but bonded to a steel load transfer plate and a formed steel bolt-down bracket, and shall also include an equipment mounting bolt with an anti-short-circuit neoprene grommet. Anchored vibration isolators shall be Model AC as manufactured by Kinetics Noise Control, Inc.
- or -
- .3 Vibration Isolators shall be neoprene, molded from oil-resistant compounds, with cast-in-top steel load transfer plate for bolting to supported equipment, and a bolt-down plate with holes provided for anchoring to supporting structure. Top and bottom surfaces shall have non-skid ribs. Neoprene vibration isolators shall have minimum operating static deflections not exceeding published load capabilities. Neoprene vibration isolators shall be Model RD, as manufactured by Kinetics Noise Control, Inc.
- .2 Type 1, Suspended Equipment:
- .1 Vibration isolators with maximum static deflection requirements under operating load conditions not exceeding 0.40" shall be hangers consisting of an elastomer-in-shear insert encased in a welded steel bracket and provided with a stamped load transfer cap.

- .2 The elastomer insert shall be neoprene, molded from oil resistant compounds and shall be color-coded to indicate load capacity and selected to operate within its published load range.
 - .3 The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30 degree arc without metal-to-metal contact or other short circuit.
 - .4 Vibration isolation hanger assembly shall be Model RH, as manufactured by Kinetics Noise Control, Inc.
- .3 Type 2, Floor-Mounted Equipment:
- .1 Vibration isolators shall be free standing, unboxed, laterally stable steel springs wound from high strength spring steel. Springs shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections not exceeding published load capabilities. Springs shall be color coded or otherwise identified to indicate load capacity.
 - .2 Springs shall be assembled between a top and bottom steel load plate. The upper load plate shall be provided with a steel leveling bolt lock-nut and washer for attachment to the supported equipment.
 - .3 The lower load plate shall have a non-skid noise isolation pad bonded to the bottom and have provisions for bolting the isolator to the supporting structure.
 - .4 Spring isolation mounts for floor mounted equipment shall be Model FDS, as manufactured by Kinetics Noise Control, Inc.
- .4 Type 2, Suspended Equipment, Piping, Ductwork:
- .1 Vibration isolators for suspended equipment, with minimum static deflection requirement exceeding 0.4", shall be hangers consisting of a free-standing laterally stable steel spring and elastomeric washer in series, assembled in a stamped or welded steel bracket.

The spring element shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections not exceeding published load capabilities. Springs shall be color coded or otherwise identified to indicate load capacity.

Vibration isolation hangers shall be Model SH, as manufactured by Kinetics Noise Control, Inc.

- or -
 - .2 Vibration isolators for suspend equipment with minimum static deflection requirement exceeding 0.4", and where both high and low frequency vibrations are to be isolated, shall be hangers consisting of a laterally stable steel spring in series with a pre-compressed molded fiberglass insert, complete with load transfer plates and assembled in a stamped or welded steel bracket.

The fiberglass insert element shall be molded from glass fibers with fiber diameters not exceeding 0.00027 in. and with a modulus of elasticity of 10.5 million PSI. Natural frequency of fiberglass vibration isolation pads shall be essentially constant for the operating load range of the supported equipment. Vibration isolation pads shall be color coded or otherwise identified to indicate the load capacity.

The spring element shall have a lateral stiffness greater than 0.8 times the rated vertical stiffness and shall be designed to provide up to 50% overload capacity. Springs shall be selected to provide operating static deflections not exceeding published load capabilities. Springs shall be color coded or otherwise identified to indicate load capacity.

The stamped or welded hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30 degree arc without metal-to-metal contact or other short circuit.

The combination isolation hanger assembly with fiberglass inserts shall be Model SFH, as manufactured by Kinetics Noise Control, Inc

2.3 VIBRATION ISOLATOR SELECTION

- .1 Selection of vibration isolator types, and minimum operating static deflections, shall be the responsibility of the isolation materials manufacturer/supplier.
- .2 Vibration isolator types and minimum operating static deflections for suspended or floor mounted piping shall be as follows:
 - .1 Types 1 and 2 hangers, or Type 2 floor mounts, with minimum operating static deflections equal to 50% of connected equipment isolator deflection, or one (1) inch, whichever is greater, shall be used to support all piping for a minimum of three support locations.
- .3 Vibration isolator types and minimum operating static deflections for suspended air distribution elements shall be as follows:
 - .1 Type 2 hangers, or Type 2 floor mounts with minimum operating static deflections equal to 50% of connected equipment isolator deflection.
- .4 Isolator types are scheduled to establish minimum standards. At the Contractor's option, labor saving accessories can be an integral part of the isolators supplied, to provide initial lift of equipment to operating height, to hold piping at fixed elevations during installation and initial system filling operations, and for similar installation advantages, provided the isolators supplied incorporate the specified isolator type, and do not degrade the noise and vibration isolation of the equipment.

PART 3 INSTALLATION AND EXECUTION

3.1 GENERAL

- .1 Isolator natural frequency to be 40% of the lowest equipment operating speed.

- .2 Provide HSR thrust restraints for air moving equipment operating at 2.1" static pressure and above.

3.2 INSTALLATION

- .1 Installation of all vibration isolation materials specified in this section shall be accomplished as per manufacturers written instructions.
- .2 On completion of the installation of all isolation materials, and before start-up of isolated equipment, all debris shall be cleared from the areas surrounding, and from beneath, all isolated equipment, leaving the equipment free to move on the isolation supports.
- .3 No rigid connections between the equipment and the building structure shall be made that degrades the noise and vibration isolation system herein specified. Electrical conduit connections to isolated equipment shall be looped to allow free motion of isolated equipment.

3.3 INSPECTION

- .1 The Subcontractor shall notify the local representative of the vibration isolation materials manufacturer prior to installing any vibration isolation devices. The Subcontractor shall seek the representative's guidance in any installation procedures with which he is unfamiliar.
- .2 The local representative of the vibration isolation materials manufacturer shall conduct periodic inspections of the installation of materials herein specified, and shall report in writing to the Subcontractor any deviations from good installation practice observed.
- .3 On completion of the installation of all noise and vibration isolation devices herein specified, the local representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation devices, or other fault in the system that could affect the performance of the system.
- .4 The installing Contractor shall submit a report to the Contract Administrator, including the manufacturer representative's final report, indicating all isolation material is properly installed or the steps to be taken by the Subcontractor to properly complete the isolation work as per the specifications.

END OF SECTION 23 05 53

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with requirements of Section 21 05 01, Mechanical General Provisions.
- .2 Comply with requirements of Section 21 05 05, Basic Materials and Methods.
- .3 Comply with requirements of Sections 22 06 01 and 23 06 01, Approved Substitute Schedules.

1.2 REFERENCE STANDARDS

- .1 Conform with the requirements of the drawings and specifications, the local Authorities Having Jurisdiction and the Building Code. In the case of conflicting requirements, be governed by the most severe regulations.
- .2 Conform to the most recent Associated Air Balance Council's 'National Standards for Field Measurement and Instrumentation - Total System Balance'.

1.3 QUALIFICATIONS OF TESTING AGENCY

- .1 Minimum qualifications shall be General Membership Standards of Associated Air Balance Council, as published in the AABC 'National Standards for Field Measurement and Instrumentation - Total System Balance'.
- .2 Testing Agency must be independent of affiliation with manufacturers and Contractors.
- .3 The testing agency shall be a certified member of Associated Air Balance Council (AABC).

1.4 ACCURACY OF INSTRUMENTATION

- .1 Measuring instruments shall be accurate. Factory re-calibrate and/or recheck calibration of equipment immediately prior to use on this project.
- .2 Include in the final air balance report, separate test results indicating accuracy of instrumentation.
- .3 Contract Administrator may request re-calibration or use of other instruments where accuracy is questionable.
- .4 When requested by the Contract Administrator, provide certified proof of accuracy of instrumentation at no extra cost.

1.5 GENERAL SCOPE OF WORK

- .1 Provide personnel for the purpose of making site visits, preparing reports and taking responsibility for ensuring that the specified air and water systems operate in accordance with specified requirements, within a tolerance of plus or minus 5%.
- .2 Review and check the Contract Drawings and specifications, and installed work, to ensure that modifications, if required, are implemented prior to the execution of the work.

- Provide a report to the Contract Administrator as required, making whatever recommendations are necessary in the interests of ensuring proper system balance.
- .3 After the installation is adequately completed, inspect, test and balance the specified air and water systems. Co-operate with the Controls Contractor to achieve required air quantities where modulating dampers etc., are installed.
 - .4 After inspecting, testing and balancing the systems, provide a preliminary written report to the Contract Administrator.
 - .5 Make any modifications to the systems as recommended by the Contract Administrator, Retest and Rebalance the System(s) as required, and submit a final report to the Contract Administrator.
 - .6 In general terms, the scope of work is comprised of the following:
 - .1 Preliminary leak testing - Prior to the final installations perform a preliminary air system leak test after the related systems are complete and before final testing is done. If necessary sections of large ductwork systems may be tested at a time.
 - .2 After the installations, Balance/Rebalance/Measure/Test the Systems, and provide a Report to the Contract Administrator.
 - .1 Perform all necessary testing, balancing and adjustments to provide peak performance of systems.
 - .2 Perform all necessary testing to confirm system conformance to the specifications and drawings.
 - .3 Items to be balanced, rebalanced, measured and tested include:
 - .1 Test all fire dampers.
 - .2 Balance the Air Volumes for all Air Handling Units (Furnaces) including motorized mixed air damper systems.
 - .3 Balance the air volumes for the Exhaust Fans.

1.6 START-UP AND COMMISSIONING

- .1 Start-up and Commissioning shall be undertaken prior to the Occupancy Stage of each Construction Phase.
- .2 Provide the Equipment, Personnel, Materials and Information necessary to assist the Mechanical Subcontractor in completing the Commissioning Process. Refer to Specification Section 23 08 05.
- .3 Assist in completing the required Forms as set forth in Specification Section 23 08 05.
- .4 Provide instructions to City as required. Refer to Specification Section 21 05 01.

PART 2 PRODUCTS AND MATERIALS

2.1 REPORTS - GENERAL

- .1 The Contractor shall provide two copies of the preliminary Testing/Balancing Report directly to the Contract Administrator's office for review and comment. Make any changes requested by the Contract Administrator, and re-submit two copies. Submission and re-submission shall continue in this manner until the preliminary Testing/Balancing Report has been accepted by the Contract Administrator. Copies of the final Testing/Balancing Report shall be included in the Operation and Maintenance Manuals.
- .2 Allow for technically qualified personnel to attend meetings at the Contract Administrator's office to discuss and clarify the preliminary Testing/Balancing Report.
- .3 The review of the Testing/Balancing Report is for the sole purpose of ascertaining conformance with the general design concept. The review shall not mean approval of the detailed testing and balancing procedures inherent in the work, the responsibility for which shall remain with the Contractor. The review shall not relieve the Contractor of the responsibility to meet the requirements of the contract documents. The Contractor shall remain responsible for confirming and correlating the information on the jobsite, and for coordinating the work with the other Contractors.

2.2 REPORTS

- .1 Reports shall contain the following:
 - .1 Preliminary Air System Leak testing.
 - .2 Installed Equipment Identification including:
 - .1 Location and Unit Identification data.
 - .2 Nameplate Data: Manufacturer, Model, Size, Discharge arrangement and class, HP, voltage, phase, cycles, and full load amps.
 - .3 Installed overload heater size and manufacturer.
 - .4 Identify all required pulleys, sheaves, belts, and adjustments, including sizes and quantities.
 - .3 Specified design data and achieved performance data, including:
 - .1 General: HP, voltage, phase, cycles, and full load amps.
 - .2 Air Systems: Total air flow, individual air flow per outlet with supporting schematic diagrams, fan total static pressures with breakdown showing inlet and discharge pressures, fan R.P.M., O/A and R/A and REL/A air volumes, and inlet and outlet dry bulb and wet bulb temperatures across thermal transmission and mixing equipment.
 - .3 Duct Systems: Air volumes and velocities at equipment and main branches.

- .4 Verification of fire protection equipment, including:
 - .1 Permanent location number (eg. Rm-M02) where access to fire damper is possible including description as to which wall in that location fire damper is located (eg. north wall), verification that unit is accessible and has been tested and reset, and date of successful test.

PART 3 INSTALLATION AND EXECUTION

3.1 LEAK TESTING

- .1 Perform preliminary duct system leak test:
 - .1 Test after installation of related systems are complete, and before final balancing is done. If necessary sections of large ductwork systems may be tested at a time.
 - .2 Leak test low pressure ductwork in accordance with AABC standards. Leak test medium pressure ductwork at 1.5 times the normal duct operating pressure with leakage not to exceed 5% of design CFM for duct branch under test.
 - .3 Leak testing shall be performed prior to the installation of insulation. Insulation shall not be applied until duct system is tested and proven to be tight.
 - .4 Coordinate with Ventilation Contractor for installation of required equipment.
 - .5 Submit a report with results for review.

3.2 AIR SYSTEM PROCEDURE

- .1 Prior to final inspection, adjust air systems to provide required or specified design air flow quantities. Balance systems to suit space cooling requirements, unless otherwise specified.
- .2 Measure air flow in ducts by velocity traverse of entire cross-sectional area of duct. Measure air flow with appropriate micro-manometers and/or state of the art instruments. Instrument test holes must be approved by Contract Administrator.
- .3 Measure air quantities at each inlet and outlet. Use approved tube or vane type meters.
- .4 Use volume control devices to regulate air quantities at supply air inlets and exhaust air outlets without creating objectionable air motion or sound levels.
- .5 Make final measurements only after air inlets and outlets are adjusted for optimum air distribution patterns.
- .6 Vary total system air quantities by adjustment of fan speeds. Vary branch duct air quantities by damper regulation.
- .7 Air inlet and outlet air quantities shall be within +/- 10% of specified values. Fan air quantities shall be +/- 5% of specified values.

3.3 FIRE DAMPER TESTING

- .1 Testing shall be performed before air balancing has been started.
- .2 Testing shall include the following:
 - .1 Visual inspection to confirm:
 - .1 Appropriately rated unit has been installed and CSA/ULC label is affixed and visible through duct/ceiling access door.
 - .2 Appropriate duct and/or ceiling access door is installed to permit servicing of unit. Confirm duct access door is openable without interference from adjacent ceiling, pipes, ducts, etc.
 - .3 Unit has been installed in accordance to specifications and codes. Confirm clearances, angle framing in place, fire rated material in wall opening, breakaway joints, unit not painted.
 - .2 Operational inspection to include:
 - .1 Manual release of fusible link allowing unit to close. Confirm tight fit closure without binding.
 - .2 Confirm that appropriate fusible link is installed.
 - .3 Re-open unit and reset fusible link connection.
- .3 Balancing Contractor shall instruct Ventilation Contractor to repair all fire dampers that have been identified as being faulty. After faulty fire dampers have been repaired, retest them, as indicated above.

3.4 FINAL INSPECTION AND ACCEPTANCE

- .1 At final inspection, recheck to the approval of the Contract Administrator, data recorded in certified report. Points or areas for check shall be selected by the Contract Administrator.
- .2 If report is rejected, re-balance systems, submit new certified reports, and make re-inspection at no extra cost.
- .3 After acceptance of certified reports by the Contract Administrator, permanently mark settings of valves, splitters, dampers and other adjustment devices so that adjustments can be restored if disturbed.

END OF SECTION 23 05 93

PART 1

1.1 GENERAL REQUIREMENTS

- .1 Comply with the requirements of Section 21 05 01, Mechanical General Provisions.
- .2 Comply with the requirements of Section 21 05 05, Basic Materials and Methods.

1.2 APPROVED 'SUBSTITUTES' AND 'ALTERNATES'

- .1 Where a Manufacturer's name, make, model, and/or size is specified, it is for the purpose of setting a standard of quality, performance, capacity, appearance and/or serviceability, and is acceptable without qualification. Manufacturers listed as acceptable 'Substitutes' have been deemed by the Contract Administrator as capable of producing equipment and/or material of comparable quality, performance and approximate dimensions, and can be used in the preparation of the tender. Where no substitutes are indicated, provide the exact make specified or provide the necessary documents for review.
- .2 Substitute or Alternate requests are to be provided in accordance with B6.

1.3 APPROVED 'SUBSTITUTES'

- .1 The following is the list of pre-approved 'Substitutes' for HVAC:
 - .1 Access Doors: Lehage; Milcor; Acudor; Mifab;
 - .2 Actuators for Valves and Dampers: Belimo
 - .3 Air Cooled DX
Condensing Units: Keeprite; Carrier; Lennox;
McQuay; York;
 - .4 Air Filters: Farr; AAF; Continental;
 - .5 Air Handling Units (HRS's): Nu Air; Venmar
 - .6 Air Vents: Hamlet and Garneau; Bell and Gossett; Dole;
Maid-O-Mist; Armstrong; Braukman;
 - .7 Back Flow Preventors: Conbraco; Beeco; Febco;
Watts; Kunkle; Taylor; Consolidated;
Fisher; Singer; Crosby-Ashton;
Boylston; Lonergan; Masoneilan;Wilkins
 - .8 Chemical Treatment: Bird Archer; Calgon;
Dearborne; Mogul; Drew Chemical;
 - .9 Cleanouts: Ancon; Smith; Zurn; Mifab;
 - .10 Controls (Building): Johnson Metasys
 - .11 Furnaces: Lennox;

.12	Fans (Washroom and Cabinet):	Greenheck; Penn; Broan;	Delhi;	Reversomatic; Cook;
.13	Filter Gauges:	Dwyer;		
.14	Grilles and Diffusers:	Carnes; Titus;	Kreuger; Nailor Hart;	E.H. Price; Hart and Cooley;
.15	Humidifiers:			
.16	Insulation (General):	Fibreglas;	Manson;	Knauf;
.17	Level and Flow Switches:	Magnetrol;		
.18	Louvres:	Aiolite; Carnes; Greenheck; Ruskin; Ventex; Westvent		
.19	Pressure Gauges:	Taylor; Ashcroft; Trece; Ametek;	Weiss; Duro;	Marshalltown; Lunkenheimer; Marsh; Winters;
.20	Pressure Relief Valves, Pressure Regulating Valves:	Conbraco; Kunkle; Taylor; Fisher; Boylston;	Beeco; Consolidated; Singer; Lonergan;	Febco; Watts; Crosby-Ashton; Masoneilan;
.21	Pumps (Circulating):	Armstrong;	Bell and Gossett;	Taco
.22	Sound and Vibration Isolation:	Vibron; Kinetics;	Airmaster; Vibro-Acoustics;	Amber-Booth; SVC Ind.
.23	Special Duct Cleaning:	Power-Vac;	Advance Robotic;	
.24	Strainers:	Armstrong; Sarco;	Crane; Streamflo;	Mueller; Kitz; Toyo
.25	Thermometers:	Taylor; Ashcroft; Trece; Ametek;	Weiss; Duro;	Marshalltown; Lunkenheimer; Marsh; Winters;
.26	Vacuum Breakers:	Febco;	Watts;	Wilkins;
.27	Valves (General):	Crane; Kitz; Nibco; Toyo;	Apollo; Jenkins;	Newman-Hattersley; American Valve;
.28	Valves (Butterfly):	Kitz; Hattersley;	Nibco; Apollo;	Jenkins; Newman- Dezurik
.29	Valves (Check):	Centerline; Singer;	Hagen; Dezurik;	Mueller; Crane

.30 Ventilation Specialties: Nailor Hart; Greenheck; Ruskin;
Carnes; Titus; EH Price;

END OF SECTION 23 06 01

FAN NO.	NAME	FAN MANUF.	LOCATION	FAN MODEL	CFM (l/s)	ESP "wg	RPM	BHP (WATTS)	MOTOR HP (WATTS)	REMARKS(Also refer to notes)
EF-1	Servery Exhaust	GREENHECK	Servery 102	SP-A250	185 (87)	0.5	1000	(83.1)		1, 2, 3, 4
CF-1,2,3,4	Ceiling Fan	BANVIL	Multi-Purpose 107	FP-36R	10,500 (4935)			40		Reversible, c/w variable speed switch, wire cage, restraint cable for fan and cage. Fan to be supplied by Mechanical installed by Electrical.

Notes:

1. PROVIDE FLEXIBLE DUCT CONNECTIONS @ UNIT.
2. C/W VIBRATION ISOLATION.
3. C/W FLAT ROOF CAP.
4. WALL SWITCH WITH PILOT LIGHT.

AIR OUTLETS AND INLETS
GRILLES / DIFFUSERS / REGISTERS / LOUVRES

(Based on E. H. Price unless noted otherwise.)
Note: All face and neck sizes are shown on the drawings.

TYPE	DESCRIPTION
S1	Model SPD31/3C/B-12 steel plaque ceiling diffuser, equal 4-way deflection, white finish (provide in 24"x24" panel for T-bar ceilings). Provide surface mount type 1 framing (& omit panel) for drywall ceilings. Face and neck sizes as shown on drawings.
S2	Model RSG/SM/B-12 round, supply air grille. Final colour/finish to be confirmed by Architect. Sizes & types as shown on drawings.
S3	Model 520D/F/B13 supply air register with volume damper. Sizes shown on drawings.
S4	Model RCDA/31/3C/B-12 round, adjustable, steel ceiling diffuser. Adjustable air pattern. Final colour/finish to be confirmed by Architect. Sizes & types as shown on drawings.
R1	Model 80/TB/B13, egg crate return for lay in T-bar ceiling. Sizes shown on drawings. Final colour/finish to be confirmed by architect.
R2	Model 96/L/A/B12, heavy duty return air grille. 45 degree blades with ¾" spacing. To be installed with blades pointed up. Sizes shown on drawings. Final colour/finish to be confirmed by architect.
E1	Model 80D/F/B12, egg crate exhaust/return air register. Ceiling mounted eggcrate grille c/w screw mounting & flat border suitable for drywall/gypsum ceilings. Sizes shown on drawings. Final colour/finish to be confirmed by Architect
T1	Model ATGH/1BF/B12 door mounted transfer grille. Sizes shown on drawings. Final colour/finish to be confirmed by Architect.
T2	Model LBPH26C/1000 heavy duty linear floor grille. Sizes shown on drawings. Final colour/finish to be confirmed by Architect.
L1	Airolite model K609X extruded aluminum louvre c/w bird-screen for exhaust & bug screen for intake. Final finish by Architect. Sizes shown on drawings.

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with the requirements of Section 21 05 01, Mechanical General Provisions.

1.2 APPLICATION

- .1 This Section applies to and is part of all Parts of Division 21 and Division 22.

1.3 INTENT

- .1 The intent of the Commissioning Process is to provide assurance that the system(s) are:
 - .1 Installed and complete as designed and specified.
 - .2 Functioning as intended.
 - .3 Optimized to meet the performance criteria specified and implied in the Contract Documents.
- .2 The City will not take over the Systems without complete acceptable Verification and Certification.
- .3 The intent of this section is not for LEED compliance.

1.4 THE COMMISSIONING AGENT

- .1 The Commissioning Agent:
 - .1 May be in the direct employ of the Mechanical Contractor, and may be the Project Coordinator or Foreman.
 - .2 May be an individual or agency hired on a Contract Basis to undertake the Commissioning Process.

1.5 GENERAL

- .1 Systems Commissioning and the Submission of the appropriate Check sheets will be required to be done at the Occupancy Stage of each Construction Phase. Refer to Specification Section 21 05 01 (Mechanical General Provisions).
- .2 Systems Commissioning will be conducted prior to turnover to the City. The purpose of the Commissioning is to ensure all systems are functioning as designed prior to building turnover to the City.
- .3 Commissioning will require the presence of knowledgeable representatives of the necessary Mechanical Sub-subcontractors, Major Equipment Suppliers and Facility Maintenance Staff. Include all necessary costs for systems commissioning. The Contract Administrator will participate to the extent deemed necessary.
- .4 All aspects of the mechanical systems operations will be operated, checked and verified. If any portion of the work fails to meet the design requirements, the Commissioning procedure will be halted and only resumed when all necessary repairs are completed.

- .1 All extra costs resulting from this postponement, including costs for the Contract Administrator to revisit the site, will be borne by the Subcontractor.
- .5 Provide and pay for all required testing and repairs where, in the opinion of the Contract Administrator, Manufacturer's ratings or specified performance is not being achieved.

1.6 COMMISSIONING PROCESS

- .1 The Commissioning Process will consist of the following:
 - .1 Periodic Inspections by the Contract Administrator.
 - .2 Start-up of the Systems and Equipment by the Mechanical Contractor.
 - .3 Testing and Balancing of the System Components by the Mechanical Contractor and his Sub-subcontractors.
 - .4 Verification and Certification of the System Components by the Commissioning Agent.
 - .5 Performance Testing by the City and/or its Representatives.

1.7 INSPECTIONS

- .1 Periodic Inspections by the City and/or his Representatives of the Mechanical Systems during Installation will be made as per Specification Section 21 05 01 (Mechanical General Provisions) to ensure General Compliance with the Contract Documents.

1.8 START-UP

- .1 Start-up of Equipment and Systems is to be undertaken as per Specification Section 21 05 01 (Mechanical General Provisions).
- .2 Start-up shall only be undertaken after a complete review of the Equipment and Systems
 - .1 All Systems must be clean and ready for use.
 - .2 All System Safeties must be in place.
- .3 Start-up of the Systems and Equipment is the responsibility of the Mechanical Contractor
 - .1 The presence of knowledgeable representatives of the necessary Mechanical Subcontractors and Major Equipment Suppliers may be required.
 - .2 In some instances, especially where existing Equipment and Systems are being used, the presence of the Facility Maintenance Staff will be required.
 - .3 The Mechanical Contractor will be responsible for Coordinating all necessary personnel, equipment and materials.

- .4 All System Start-up Check Sheets must be completed at the time of Start-up.
 - .1 Copies of the Start-up Check Sheets are to be submitted to the Commissioning Agent immediately after Start-up.

1.9 TESTING AND BALANCING

- .1 Testing and Balancing of the System Components is the responsibility of the Mechanical Contractor and his Subcontractors.
- .2 Testing and Balancing shall only be undertaken after the Systems and Equipment have been started-up and run-in to the extent that the Systems are relatively stable and there are no obvious deficiencies or problems.
- .3 Testing and Balancing shall be undertaken as per Specification Section 23 05 93.
- .4 Preliminary Copies of the Testing and Balancing Report are to be submitted to the Commissioning Agent immediately after Testing and Balancing.

1.10 VERIFICATION AND CERTIFICATION

- .1 Verification and Certification shall be undertaken in stages:
 - .1 After Start-up, for review of the installed systems.
 - .2 After Testing and Balancing, for review of system operation.
- .2 Scope of Work:
 - .1 The Commissioning Agent shall perform the following tasks:
 - .1 Review all system documentation including:
 - .1 The Contract Documents.
 - .2 The Operation and Maintenance Manuals.
 - .3 The 'As-Built' and 'Record' Drawings.
 - .4 The Air and Water Balance Reports.
 - .5 All Test Results.
 - .2 Ensure all documentation is complete.
 - .1 Notify the Contractors of any deficiencies.
 - .2 Review corrected documentation.
 - .3 Review, Notification and re-review shall continue until all documentation is complete.
 - .3 Review the installed systems to ensure that they are complete and correct.
 - .1 Notify the Contractors of any deficiencies.
 - .2 Review corrected installations.
 - .3 Review, Notification and re-review shall continue until all installations are complete.

- .4 Operate the systems to ensure they are functioning properly.
 - .1 Function Review shall include:
 - .1 All setpoints are properly set.
 - .2 All balance points are properly set.
 - .3 Sequences of Operation are correct.
 - .2 Notify the Contractors of any deficiencies.
 - .1 Review corrected installations.
 - .3 Review, Notification and re-review shall continue until all systems are functioning properly.
- .5 Provide a Preliminary Report to the City and Contract Administrator.
- .6 Provide a copy of the final Report in each Operation and Maintenance Manual.

1.11 REPORT

- .1 The Report shall contain a detailed sequence of the Verification Procedure, with the appropriate system responses, and a Letter of Certification of Operation.
- .2 The Report shall contain a completed copy of all Start-up and Verification Check Sheets.
- .3 Provide a preliminary copy of the Report to the City and Contract Administrator.
 - .1 The City/Contract Administrator will review the Report and request Clarifications and Revisions. After all Clarifications and Revisions have been completed, the Report will be deemed Final.
- .4 Provide a copy of the Final Report in each Maintenance Manual.

1.12 PERFORMANCE TESTING

- .1 Performance Testing by the City and/or his Representatives will commence after the Systems have been turned over to the City.
- .2 The City reserves the right to call in Third Party Individuals or Companies to verify that the Systems and Equipment are operating as specified.

END OF SECTION 23 08 05

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with the requirements of Section 21 05 01, Mechanical General Provisions.
- .2 Comply with the requirements of Section 21 05 05, Basic Materials and Methods.
- .3 Comply with the requirements of Sections 22 06 01 and 23 06 01, Approved Substitute Schedules.

1.2 WORK PERFORMED UNDER THIS SECTION

- .1 Provision of all required equipment, piping, and chemicals, for the flushing, cleaning and degreasing of all piping systems.

1.3 START-UP AND COMMISSIONING

- .1 Provide the Equipment, Personnel, Material and Information necessary to assist the Mechanical Contractor in completing the Commissioning Process.
- .2 Complete the required forms as set forth in Specification Section 23 08 05.

1.4 QUALITY ASSURANCE

- .1 Qualifications: Execute work of this section only by skilled tradesman, technicians, and manufacturers regularly employed in the administration of piping system chemical treatment.

1.5 SUBMITTALS

- .1 Submit shop drawings on all equipment and piping arrangements, and provide a list of chemicals.

PART 2 PRODUCTS AND MATERIALS

2.1 WATER TREATMENT

- .1 Domestic Water Piping:
 - .1 Thoroughly flush and disinfect all new Domestic Water Piping Systems as per Municipal Standards.
 - .2 Use Chlorine (gas or liquid). Calcium or Sodium Hypochlorite, or other approved disinfectant may also be used.
- .2 Provide welding sockets where required or shown on the drawings, and piping from there to the equipment required for water treatment such as pumps, chemical storage tanks, etc. Include all necessary piping, valves, accessories and control wiring.
- .3 Use only chemicals and methods that comply with local health codes and do not have a detrimental effect on non-metallic materials such as rubber, neoprene, etc., used in the systems.

- .4 Provide pot type feeders on all closed piping systems for the administration of chemical treatment.
- .5 Test equipment: Provide all test apparatus which shall include all required chemicals, comparator, titration equipment, test tubes, etc. to provide a complete testing facility for the treated systems, and turn over to the City's authorized representative.

PART 3 INSTALLATION AND EXECUTION

3.1 GENERAL

- .1 Clean and disinfect systems only after all pipes, valves, fittings, fixtures and other components have been installed, tested, and proven ready for operation.
- .2 If at any time during the treatment, test results prove unsatisfactory, treatment shall be stopped and redone until results prove satisfactory.

3.2 PROCEDURE FOR OPEN SYSTEMS

- .1 Remove screens from faucets.
- .2 Flush systems with clean potable water to remove dirt and other contaminants.
- .3 Replace screens in faucets.
- .4 Inject the disinfectant at a service cock and ensure all sections of piping are treated.
- .5 Open each outlet at least twice during injection.
- .6 Test chlorine concentration before and after retention. Initial Chlorine concentration shall be not less than 50 ppm, and shall be retained in the system for a minimum of 24 hours. Concentration after retention shall be no less than 5 ppm.
- .7 Flush system with clean potable water until residual chlorine concentration is no greater than that of the incoming water supply. Test Chlorine concentration.
- .8 Submit a written report showing methods, tests and results.
- .9 Submit a written report of the system start-up showing water analysis test. Include copies in the O & M manuals.

END OF SECTION 23 25 13

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with the requirements of Section 21 05 01, Mechanical General Provisions.
- .2 Comply with the requirements of Section 21 05 05, Basic Materials and Methods.
- .3 Comply with the requirements of Sections 22 06 01 and 23 06 01, Approved Substitute Schedules.

1.2 WORK PERFORMED UNDER THIS SECTION

- .1 The mechanical subcontractor shall provide all labour, materials, equipment and services necessary for and reasonably incidental to the supply and installation of the ductwork for the air conditioning systems as shown on the drawings and hereinafter specified. Generally, this shall include the following:
 - .1 Provision of a Heat Recovery Air Handling system for the ventilation of the building.
 - .2 Duct systems for the new Furnaces.
 - .3 Miscellaneous exhaust ventilation systems.
- .2 Provide a complete installation of all ventilation systems including fans, ductwork, grilles, diffusers, louvres, dampers, filters, etc.
- .3 Provide Equipment, Personnel and Material necessary to assist with Air and Water Balancing.

1.3 START-UP AND COMMISSIONING

- .1 Start-up and Commissioning shall be undertaken prior to the Occupancy stage of each Construction Phase.
- .2 Provide the Equipment, Personnel and Material necessary to put the Air Distribution Systems into Operation.
- .3 Provide the Equipment, Personnel, Material and Information necessary to assist the Mechanical Contractor in completing the Commissioning Process.
- .4 Complete the required forms as set forth in Specification Section 23 08 05.

1.4 QUALITY ASSURANCE

- .1 Execute Work of this Section only by skilled tradesmen regularly employed in the manufacture and installation of sheet metal ductwork and air handling equipment.

1.5 SUBMITTALS

- .1 Submit shop drawings on fans, grilles, diffusers, louvres, fire dampers, fire/smoke dampers, filters, and filter gauges.

PART 2 PRODUCTS AND MATERIALS

2.1 FANS

- .1 The following are general specifications. Refer to the Individual Fan Specifications on the Drawings for operating characteristics, specific requirements, and any deviations.
- .2 In-line Cabinet Fans:
 - .1 Galvanized steel housing c/w access panel(s)
 - .2 Internal acoustic lining
 - .3 Horizontal in-line configuration
 - .4 Double strength mounting flanges/brackets
 - .5 Permanently lubricated, 115V/1 phase, motor
 - .6 Motor suitable for use with speed controller
 - .7 Motor directly connected to fan wheel
 - .8 Motor/fan assembly to be mounted with vibration isolation/rubber grommets
 - .9 Plug-in power cord
 - .10 Motor assembly to be removeable through access panel without disturbing housing
 - .11 Integral chatter-proof backdraft damper
 - .12 When specified: roof or wall cap
 - .13 When specified: time delay, wall-mounted, on-off switch
 - .14 When specified: 115V/1 phase, variable (infinite) speed controller, suitable for wall mounting
 - .15 Rated in accordance with CAN/CSA-C260-M and conforming to CSA C22.2

2.2 FILTER GAUGES

- .1 Across the filter bank of each air handling unit, and each air-to-air heat exchanger provide magnehelic differential pressure gauges, Dwyer series 2000 range 0 to 2" w.c. (0 to 50 mm w.c.).

2.3 FILTERS

- .1 General:
 - .1 Equipment manufacturer to provide filters in filter sections provided with equipment.
 - .2 Filter supplier to provide all other filters.
 - .3 This section shall fabricate filter sections not provided with equipment. Provide hinged access panels with latching handles. Filter sections shall be sized for maximum 500 fpm through media.
 - .4 Provide one spare set of media for each filter bank.
 - .5 Some filter frames are specified without filters. During cold winter periods some filters can be relocated by the City or their forces to the discharge side of heating equipment to prevent the frosting of filters.
 - .6 All filter media used during "temporary heating" shall be replaced by new media at regular intervals during equipment use. Contractor shall allow for two (2) complete filter changes after substantial completion, ie. one set installed immediately prior to opening, and a spare set handed over to City. The Contractor shall coordinate with the City regarding timing. Install a new set of filter media and hand one spare set of media (for each filter) to the City's

representative at substantial completion. Obtain written statement from the City acknowledging the receipt of the spare sets. Forward one copy of the written statement from the City to the Contract Administrator.

- .2 Filter Media:
 - .1 High capacity pleated panel, 4" depth.
 - .2 Value of MERV 8 and MERV-A when evaluated under ASHRAE Testing Standard 52.2.
 - .3 Recommended final pressure drop: 1.0" w.g. when operated at 500 fpm.
 - .4 Standard of Acceptance: Equal to Camfil Farr 30/30.

2.4 MOTORIZED DAMPERS

- .1 Unless noted otherwise, motorized dampers are to be provided on equipment, or supplied by the controls contractor and installed by the sheet metal contractor.
- .2 Where motorized dampers are to be provided by the sheet metal contractor, they shall be opposed blade style, with neoprene edge and blade seals, and rated for maximum 5% leakage.
- .3 Dampers for Outside Air, Exhaust Air, Relief air and all uses where the indoors are isolated from the outdoors shall be ultra-low leakage, opposed blade style, thermally broken with neoprene edge and blade seals; equal to TAMCO 9000, Extreme Cold Technology.

2.5 FIRE DAMPERS AND FIRE STOP FLAPS

- .1 Provide where shown on the drawings and required to maintain fire separations, type 'B' or 'C', gravity or spring type, U.L.C. labeled and listed, curtain type fire dampers. Use type "A" only where mounted directly behind supply or return grilles.
- .2 Do not use asbestos in any form in the construction of fire dampers or fire stop flaps.

2.6 COMBINATION FIRE/SMOKE DAMPERS

- .1 Provide where shown on the drawings, and where required to maintain smoke separations, combination fire/smoke dampers meeting all requirements of ULC, UL, NBC and NFC.
- .2 Dampers shall be equipped with fusible linkages for fire operation.
- .3 Dampers shall be equipped with 120V (spring close) damper motors mounted outside of the airstream and wired to the fire alarm system. Motors shall be c/w an end switch, suitable for wiring to a test switch and light.
- .4 Motors shall be Honeywell Model ML-4115, or Belimo FS-NF-120-S, with no alternates or equals.

2.7 FLEXIBLE CONNECTIONS

- .1 General HVAC System: provide where indicated, at fans and at air handling units, neoprene coated glass fabric, factory fabricated, flexible connections, as approved by the Authorities Having Jurisdiction.
- .2 Except where noted otherwise, connections up to 750 mm (30") in the largest dimension shall be 100 mm (4"). Connections larger than 750 mm to be 150 mm (6").

2.8 TURNING VANES

- .1 Use in duct elbows which have a throat radius of 1-1/2 times the diameter.
- .2 Where use of above item is precluded by space limitations or where shown, use duct elbows fabricated with square throats and backs and fitted with "Rovane", single thickness turning vanes with trailing edge.

2.9 DUCTWORK

- .1 Provide all ductwork including all appurtenances, hangers, dampers, turning vanes, etc.
- .2 All ductwork shall be constructed of new, prime material free of imperfections, which is guaranteed to bend and flatten without fracture.
- .3 Low and Medium Pressure Ductwork:
 - .1 Except as noted above, provide ductwork constructed of galvanized steel sheets as follows:
 - .1 Round spiral 4 ply seam
 - .1 Up to 450 mm (18") 26 Ga.
 - .2 457 to 750 mm (19" to 30") 24 Ga.
 - .3 Slip joint with 3 @ #8 screws evenly spaced.
 - .2 Rectangular with Longitudinal seam
 - .1 Up to 300 mm (12") 26 Ga.
S and Drive cleat
 - .2 325 to 750 mm (13" to 30") 24 Ga.
S and Drive cleat
 - .3 775 to 1275 mm (31" to 50") 22 Ga.
25 mm (1") bar slip or standing T @ 1.5 m (60") o.c. (max).
 - .4 1300 to 1500 mm (51" to 60") 20 Ga.
40 mm (1-1/2") bar slip or standing T @ 1.5 m (60") o.c. (max).
 - .3 Cross break all rectangular ductwork greater than 600 mm (24") wide.
 - .2 Flexible, insulated duct may be used for diffuser connections. Maximum length: 1800mm (6'-0").

2.10 ACOUSTIC INSULATION

- .1 Provide acoustic lining in all ductwork where indicated on the drawings at a thickness of 25 mm (1").
- .2 The use of fiberglass liner is not allowed. All acoustic duct liner must be constructed of closed-cell, polymer sheet insulation materials.

- .3 Product must be cleanable and have a zero perm rating and zero water absorption.
- .4 Installation shall not include any tapes, fabrics, cements or other materials which are not cleanable or which offer opportunity for mold growth.
- .5 Installation shall be to Manufacturer's standards and shall withstand air velocities of 12.7 m/s (2500 feet per minute).
- .6 Duct sizes shown on the drawings are clear inside dimensions. Sheet metal sizes shall increase as required to accommodate the thickness of the internal insulation, to maintain the equivalent free area noted on the drawings.
- .7 Submit shop drawings for approval.

2.11 DUCT ACCESS DOORS

- .1 Access doors shall be latched and gasketed, constructed of 22 gauge materials with flat iron or angle iron stiffening forms, so constructed that the door can be operated without twisting or distortion.
- .2 Doors in insulated ductwork: double panel construction with a 25 mm (1") insulating filler.

2.12 REGISTERS, GRILLES, DIFFUSERS

- .1 Refer to Grille and Diffuser Specifications on the Drawings and Specification Schedule.
- .2 Air extractors shall be provided where indicated and/or where supply outlets are directly connected to a trunk duct.
- .3 All supply diffusers shall be equipped with manufactured balancing dampers where branch duct dampers are not shown.

2.13 LOUVRES

- .1 Louvres shall be 100mm (4") thick, extruded aluminum, c/w bird screen, equal to Aiolite K-609 or Ventex LVR-4.

2.14 SPLITTER AND QUADRANT DAMPERS

- .1 Provide splitter and quadrant dampers where shown on the drawings and as directed by the air balancing contractor.
- .2 Construct dampers of not less than 22 gauge material. Where installed in ducts up to 300 mm (12") high, provide single blade dampers. Where installed in ducts greater than 300 mm (12") high, provide multi-blade dampers, each blade being not higher than 228 mm (9").

2.15 DRIP PANS

- .1 Drip pans shall be constructed of galvanized steel one gauge heavier than indicated in duct gauge schedule, with all joints soldered. Line inside with two coats of mastic and insulate exterior.

- .2 Pans shall have 50 mm (2") high sides and shall be 150 mm (6") larger in both directions than the size of the device or opening requiring the pan.
- .3 Provide soldered drain fitting and 25mm (1") drain line to nearest floor drain, or to location noted on the drawings.

2.16 SECURITY BARS

- .1 Provide in all ductwork and openings penetrating exterior walls and roofs that are 300mmx300mm (12"x12") in size and over.
- .2 Security bars to be steel rods of ½" diameter at 6" on center in both directions, securely anchored to the structure.
- .3 Coordinate the installation with all trades.

2.17 HEAT RECOVER VENTILATOR

- .1 System Description
 - .1 Energy recovery ventilators (ERV) manufactured by Life Breath or approved equal in accordance with B6.
- .2 Quality Assurance
 - .1 Unit shall be constructed with polypropylene or other material as approved by the Contract Administrator, and heat exchanger factory installed.
 - .2 Unit shall be free from defects in materials and workmanship under normal use and service for eighteen months after shipment, parts only.
 - .3 Cabinet walls and each heat exchanger shall be guaranteed for life not to become unusable for providing breathable air ventilation due to rust, rot, or corrosion due to condensation or other exposure to liquid water in such use.
 - .4 Units shall be tested 100% prior to shipment.
- .3 Operating Characteristics
 - .1 Unit shall be capable of providing a constant volume of air at a specified external static pressure as specified.
 - .2 Refer to Schedule 23 72 13 for capacities and operating characteristics.
- .4 Controls
 - .1 Controls and sensors are to be furnished by the installing contractor.
 - .2 Refer to Controls section for Sequence of Operation.

PART 3 INSTALLATION AND EXECUTION

3.1 AIR BALANCING

- .1 Provide personnel and materials to assist and work under the direction of the air balancing firm for air testing and balancing of the systems. This shall include but not be limited to:

- .1 The removal and replacement of ceiling tiles; installation of pitot tube test opening enclosures; installation of dampers and baffles; provision of access openings and covers; provision of ladders and scaffolds; removal and replacement of guards; removal and replacement, and provision of, required sheave and belt sizes as directed; and other items as necessary for complete and acceptable air balancing procedures.
- .2 Preliminary leak testing.
 - .1 Provide assistance to the balancing contractor in the performance of a preliminary leak test. Work shall include connection of pressurization fans provided by the balancing contractor, capping of branch ducts, etc. If necessary sections of large ductwork systems may be tested at a time.
 - .2 Assure that all duct seams are sealed as required prior to test.
 - .3 After preliminary testing is complete, correct leaks and replace all defective materials. Ductwork shall be free of all audible leaks in a quiet ambient.
 - .4 Refer to section 23 05 93 for coordination of Work.

3.1 FANS

- .1 Comply with manufacturers requirements.
- .2 Ensure vibration free installation.
- .3 Leave access for servicing.
- .4 Install belt guards and weather proof covers as required.

3.2 MOTORIZED DAMPERS

- .1 Install automatic dampers free from distortion and binding of linkages.
- .2 Thoroughly caulk around damper frame.

3.3 FIRE DAMPERS AND FIRE STOP FLAPS

- .1 Locate in fire assemblies and where indicated on the Drawings.
- .2 Install to U.L.C. requirements. Refer to detail drawings.
- .3 Seal around fire damper assembly.
- .4 After completion, have installation approved prior to concealment.

3.4 FILTER GAUGES

- .1 Sensing Points: Locate as directed by the manufacturer and carefully clip tubing to avoid damage and interference with filter removal or servicing.
- .2 Mount gauges for convenient observation.

3.5 DUCT INSTALLATION

- .1 Install ductwork in accordance with SMACNA duct construction standards.
- .2 Ground across flexible connectors with No. 2/0 braided copper strap.
- .3 Install balancing dampers at branch ducts.
- .4 Seal all ductwork joints with high velocity duct sealer - maximum leakage 5%.
- .5 Hangers: Galvanized steel angle with supports rods, locking nuts and washers to the following table. For ducts up to 600mm (24") diameter, 25mm (1") x 20 ga strap hangers may be substituted. Strap hangers to be screw fastened at 100mm (4") o.c. along sides and with at least one screw through the bottom of the duct. Space strap hangers at 2400mm (8'-0") o.c.

<u>Duct Size</u>	<u>Angle Size</u>	<u>Rod Size</u>	<u>Spacing</u>
Up to 750mm (30")	25mm x 25mm x 3mm (1" x 1" x 1/8")	6mm (1/4")	3000mm (10'-0")
755mm to 1000mm (31" to 40")	40mm x 40mm x 3mm (1-1/2" x 1-1/2" x 1/8")	6mm (1/4")	3000mm (10'-0")
1005mm to 1500mm (41" to 60")	40mm x 40mm x 3mm (1-1/2" x 1-1/2" x 1/8")	10mm (3/8")	3000mm (10'-0")

- .6 During installation, protect open ends of ducts to prevent debris and dirt from entering.
- .7 Where ducts are shown alongside of partitions, place tight to the surface.
- .8 Provide baffles, where required to reduce problems of air stratification, as directed by the Contract Administrator.
- .9 Provide flashings and counter-flashings to suit individual locations.

3.6 VIBRATION AND OBJECTIONABLE NOISES

- .1 Install ductwork free from pulsation, chatter, vibration or objectionable noises. Should any of these defects appear after the system is in operation, correct same by either removing, replacing or reinforcing the Work as directed by the Contract Administrator.

3.7 PLENUMS AND CASINGS

- .1 Install hinged doors to swing outward on the suction side of the fan and inward where a positive pressure may exist in the plenum.

- .2 Provide gasketting around all doors and seal all seams and joints with high velocity duct sealer.
- .3 Construct coil mounting racks to ensure capability of future removal.
- .4 Provide two coats of mastic compound on inner surface of drip trays.
- .5 Seal all joints in filler pieces to prevent by-pass and install filter banks for easy servicing.

3.8 GRILLES, REGISTERS AND DIFFUSERS

- .1 Set squarely in place parallel to adjacent building lines.
- .2 Floor grilles to be set flush with floor coverings except carpet. Frame to lap over carpet.
- .3 Ensure devices are set rigidly in place and properly secured.

3.9 FRESH AIR AND EXHAUST LOUVRES

- .1 Caulk all joints at louvre connection and make duct connection water tight.
- .2 Provide ¼" mesh screen to prevent foreign matter from entering ductwork.

3.10 DUCT AND PLENUM CLEANING

- .1 Responsibility: it is the responsibility of the sheet metal sub-trade to ensure that all ductwork installed or modified under this contract is internally and externally clean when handed over to the City. It includes all ductwork whether lined or not, all plenums and all equipment within duct and plenums.
- .2 Installation Procedure: Wipe or brush ducts clean immediately before installation. Close all dampers immediately following installation thus checking the operation and retarding movement of contaminants through the system. Seal all openings at the end of each day and at such other time as site conditions dictate. Floor opening to be capped with sheet metal or floor grilles plus 0.15 mm thick poly. Other openings to be covered with 0.15 mm thick poly sheet taped so as to be air tight. The ducts must remain sealed until the systems area is ready to be started up and must be resealed if subsequent construction creates a risk of dust entering the ductwork.
- .3 Cleaning Procedure:
 - .1 On completion of the duct and plenum installation and prior to the installation of grilles, registers and diffusers and the use of air systems:
 - .2 Vacuum clean all plenums.
 - .3 Install air filters of the specified performance.
 - .4 Blow-out all supply ducts by operating the supply fan.
 - .5 Install grilles, registers and diffusers.
 - .6 Prior to balancing the air systems, but not until authorized by the Contract Administrator.
 - .7 Vacuum clean all supply and return air ducts, all plenums and all coils.
 - .8 Submit a report that certifies all specified air systems have been cleaned. The Contract Administrator will inspect for cleanliness of ductwork at Substantial Performance.

.9 The cleaning shall be to the satisfaction of the Contract Administrator and City.

3.11 START-UP AND COMMISSIONING

.1 Prior to the Occupancy Stage of each Construction Phase:

.1 Start up the Equipment and Systems as per Specification Section 23 08 05.

.2 Calibrate and adjust all items provided under this contract.

.3 Assist in the Commissioning Process as required. Refer to Specification Section 23 08 05.

.4 Provide instructions to City as required. Refer to Specification Section 21 05 01.

END OF SECTION 23 31 00

GAS FIRED FURNACE AND CONDENSING UNITS

FU-1, 2 (Serving MPR-1):

1. LENNOX model G51MP-60C-110, high efficiency, up-flow furnace unit, single stage heating. Unit c/w 5" filter section and two spare filters. Refer to drawings for unit orientation. C/w direct vent concentric roof termination kit & flashing kit.
2. Heating: 110,000 btu/hr input & 103,000 btu/hr output (on high fire), Unit to supply 2000 cfm @ 0.70" w.c. ESP (on medium-low speed), 1 hp motor. Units to be matched with condensing units CU-1, 2 (below).
3. Supply with Lennox cooling coil c/w Copper tubing, ripple-edged aluminum fins, twin coil construction, non-corrosive polymer drain pan with dual fpt drain connections, sweat connections on both liquid & suction lines. Drain condensate drain to nearest suitable drain service.
4. Coordinate all electrical requirements with the Electrical division.
5. FU-1 and FU-2 shall be c/w twinning kit for coupled operation of both furnaces.

CU-1, 2 (Serving MPR-1):

1. LENNOX model: XC14-060 Elite series roof mounted condensing unit. Heavy duty louvred steel fan guard, heavy gauge steel cabinet w/ powder paint finish, brass service valves, copper tube outdoor coil, PVC coated coil guard, CSA certified.
2. Nominal 5 ton cooling capacity, SEER=14, EER=11.7. C/w refrigerant line kit, full charge of refrigerant, low ambient cut-off, unit stand-off kit, & all accessories.
3. Coordinate all electrical requirements with the Electrical division.

FU-3 (Serving MPR-2):

1. LENNOX model G61MP-60C-090, high efficiency, up-flow furnace unit, two-stage heating. Unit c/w 5" filter section and two spare filters. Refer to drawings for unit orientation, c/w direct vent concentric roof termination kit & flashing kit.
2. Heating: 88,000 btu/hr input, 83,000 btu/hr output on high fire; 60,000 btu/hr input, 58,000 btu/hr output on low fire. Unit to supply 2000 cfm @ 0.70" w.c. ESP (on medium-low speed), 1 hp motor (120v/1Ø/60hz). Unit to be matched with condensing unit CU-3 (below).
3. Supply with Lennox cooling coil c/w copper tubing, ripple-edged aluminum fins, twin coil construction, non-corrosive polymer drain pan with dual fpt drain connections, sweat connections on both liquid & suction lines. Drain condensate drain to nearest suitable drain service.
4. Coordinate all electrical requirements with the Electrical division.

CU-3 (Serving MPR-2):

1. Same as CU-1.

1. GENERAL

- .1 Air Handling Units shall be built to the level of quality as herein specified and to the described.
- .2 Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors.
- .3 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close approximation to the intent of this specification will not be considered equal. All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as ETL, UL, CSA prior to shipment.
- .4 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

2. UNIT CONSTRUCTION

- .1 Unit casing shall be of minimum 20 gauge pre-painted galvanized steel (G60) for superior corrosion resistance. Insulated with foil faced insulation where required to prevent exterior condensation.
- .2 Drain connections; two - 1/2" (12 mm) O.D.
- .3 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums and humidifiers/wet cells, electrical control panels, burner compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels is not acceptable.
- .4 Units shall be provided with access doors, gasketed and fully lined. Access doors shall be large enough for easy access to the following components: Fans and motors, filters, dampers and operators and access plenum.
- .5 Four - 14" x 8" (356 mm x 200 mm) duct connections.
- .6 Unit Weight 142 lbs. (64.4 kg).

3. BLOWERS

- .1 Centrifugal type rated at 329 L/s (700 CFM) free air delivery. Each air stream has one single shafted motor driving a centrifugal blower.

4. MOTORS

- .1 Two PSC, 3 speed single shafted, 120 VAC, 2.75 Amps each (5.5 total on high speed). HP - 1/10, 1625 RPM.
- .2 Watts - total on high speed - 648.

5. FILTERS

- .1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings
- .2 Washable air filters in exhaust and supply air streams.

6. AIR PLATE HEAT EXCHANGER

- .1 Provide an air-to-air heat exchanger with performance as shown in the schedule.
- .2 Modular (2 section) patented aluminum heat recovery cores arranged for efficient cross-flow ventilation.

7. ELECTRONICS AND CONTROLS

- .1 Integrated microprocessor circuit board. Built-in interlock contacts. Automatic Self Test. Optional remote speed control.
- .2 Complete with model 700DD - Supply bypass routes indoor air to defrost core.
- .3 Refer to Control Section for operating sequence.

CENTRAL VENTILATING UNIT		
TAG		HRV-1
SERVICE		CENTRAL VENTILATION UNIT
MANUFACTURER		LIFE BREATH
MODEL		700 DD Plus
SUPPLY (Horizontal discharge, horizontal inlet)	CFM	610
	E.S.P. (Awg)	0.40
	MOTOR DRAW	5.5 AMPS
	BLOWER	(1)
EXHAUST (Horizontal discharge, horizontal inlet)	CFM	610
	E.S.P. (Awg)	0.40
	MOTOR DRAW	5.5 AMPS
	BLOWER	(1)
EFFECTIVENESS AT OPERATING CONDITIONS		65%
PRE-HEATING	KW	10
	EAT (DB) deg F	-35
	LAT (DB) deg F	21.4
COOLING NOT APPLICABLE	CFM	
	SIZE (inches)	
	BTU/H	
	EAT (DB/WB) deg F	
	LAT (DB/WB) deg F	
	APD (Awg)	

Remarks: Provide spare set of filters for installation just prior to turn over of building.