Part 1 General

1.1 GENERAL

.1 The following Appendix of Manufacturers lists manufacturers of equipment and Materials acceptable to Contract Administrator, subject to individual clauses under the various sub-sections of Mechanical Work Specifications. See item 'Materials' under this section of Specification.

.2 Product noted in individual Specification clauses is an item that meets Specification in all respects regarding performance, quality of Material and Workmanship, and is acceptable to Contract Administrator without qualification. Equipment proposed from other manufacturers listed as 'Approved Manufacturers or approved equal in accordance with B7' and alternates shall meet same standards.

.3 Contractor to submit within forty-eight hours of notification from Contract Administrator, one (1) copy of fully and properly completed Appendix of Manufacturers listing thereon names of manufacturers of products which shall be used to execute Work of Contract. If list is not submitted within 48 hours, Contractor must use product named in each individual clause.

.4 Submit Shop Drawings for all items marked with asterisk(*).

.5 Request for equal shall be in accordance with B7.

1.2 EQUIPMENT OR MATERIAL & APPROVED MANUFACTURERS OR APPROVED EQUAL IN ACCORDANCE WITH B7

.1 ELECTRIC MOTORS

.1 G.E.; Siemens; Tamper; Reliance; Leland; Lincoln; U.S. Electric; Century; Baldor; WEG; Toshiba

.2 AIR DISTRIBUTION

.1 Heat recovery units* Tempeff

***** HRU request for equal must be accompanied by a full shop drawing*****

END OF SECTION

Part 1 General

1.1 GENERAL

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 21 05 10 Acceptable Materials & Equipment

Part 2 Products

2.1 HEAT RECOVERY UNITS (TEMPEFF)

.1 Refer to HRU Schedule.

.2 General Description
- .1 Configuration: Fabricate as detailed on drawings.
- .2 Performance: As detailed in schedules.

.3 Unit Construction
- .1 Fabricate unit with extruded aluminum panels secured with mechanical fasteners. All access doors shall be sealed with permanently applied bulb-type gasket.
  - .1 Panels and access doors shall be constructed as a 2-inch (50-mm) nominal thick; with injected polyurethane foam insulation. R value shall be 6.5 per inch of wall thickness. The outer panel shall be constructed of G90 galvanized steel. The inner liner shall be constructed of G90 galvanized steel. Module to module assembly shall be accomplished with self adhering foam gaskets. Manufacturer shall supply test data demonstrating less than 0.2” deflection for an unsupported 48x48 panel under 30” W.C pressure. Units that cannot demonstrate this deflection are unacceptable.
- .2 Access Doors shall be flush mounted to cabinetry, with minimum of two hinges, locking latch and full size handle assembly.
- .3 All outdoor units will have an 18 gauge roof and gutters. The gutters will cover the entire perimeter of the unit.

.4 Supply / Return Fans
- .1 Provide direct-drive airfoil plenum supply & return fans. Fan assemblies including fan, motor and sheaves shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Manufacturer must ensure maximum fan RPM is below the first critical speed.
- .2 Bearings shall be self-aligning, grease lubricated, ball or roller bearings with extended copper lubrication lines to access side of unit. Grease fittings shall be attached to the fan base assembly near access door. If not supplied at the factory, Contractor shall mount copper lube lines in the field.
- .3 Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 1" deflection spring vibration type isolators inside cabinetry.

.5 Electrical

.1 The air handler(s) shall bear an ETL listing label for the entire assembly. Units with only components bearing third party safety listing are unacceptable.

.2 All controls shall be located on the side of the unit for ease of servicing. Controls located on the top or the bottom of the unit are not acceptable.

.3 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. All wires shall be number tagged and cross-referenced to the wiring diagram for ease of troubleshooting.

.4 Controls must include Self Diagnostics with fault error and PLC error code. On board fault detection and diagnostics that sense and alerts when the damper is not operating correctly.

.5 Fan motors shall be1800 rpm, totally enclosed fan-cooled (TEFC) type. Motors shall be premium efficiency, and inverter duty rated. Electrical characteristics shall be as shown in schedule.

.6 Provide and mount ABB variable speed drives in heated enclosure for each fan.

.7 Air handler manufacturer shall provide and mount a damper hand-off-auto (HOA) switch.

.8 Unit shall be supplied with single point power connection complete.

.6 Heating Coil Sections

.1 Provide access to coils from connection side of unit for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5" beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

.1 Identify fin, tube & casing material type and thickness.

.2 Show coil weights (shipping & operating).

.3 State air and fluid flow amounts with its associated pressure drops.

.2 Glycol Coils:

.1 Certification - Acceptable water coils are to be certified in accordance with ARI Standard 410 and bear the ARI label. Coils exceeding the scope of the manufacturer's certification and/or the range of ARI's standard rating conditions will be considered provided the manufacturer is a current member of the ARI Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with ARI Standard 410. Manufacturer must be ISO 9002 certified.

.2 Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.

.3 Fins shall have a minimum thickness of 0.0075" of aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous

primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.

.4 Coil tubes shall be 5/8 inch (16mm) OD seamless copper, 0.020" nominal tube wall thickness, expanded into fins, brazed at joints. Soldered U-bends shall be provided to minimize the effects of erosion and premature failure having a minimum tube wall thickness of .025".

.5 Coil connections shall be N.P.T. threaded carbon steel with connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.

.6 Coil casings shall be a formed channel frame of galvanized steel. Water heating coils, 1 & 2 row only shall be furnished as uncased to allow for thermal movement and slide into a pitched track for fluid drainage.

.7 Particulate Filters

.1 Filter section with filter racks and guides with hinged and latching access doors on either, or both sides, for side loading and removal of filters.

.2 Filter media shall be UL 900 listed, Class I or Class II.

.3 Flat arrangement with 2", 50mm deep pleated panel filters.

.8 Energy Recovery

.1 Dual CoreTM Energy Recovery

.1 Unit shall be equipped with Dual CoreTM energy recovery technology. The unit shall be 90% efficient (sensible +-5%) at equal airflow in winter and up to 80% sensible in summer. It shall also provide up to 70% latent recovery. Unit shall accomplish this recovery without a defrost cycle that will reduce the effectiveness of the device. Devices employing defrost cycles that bypass the energy recovery device, or reduce the effectiveness are not acceptable. Energy recovery device shall not require frost protection in applications down to -40 degrees.

.2 Energy Cores shall be Generation 3, comprised of precisely corrugated high grade aluminum. Maximum allowable face velocity across heat exchangers shall be 500 fpm (free area face velocity). Heat exchanger face velocities exceeding 500 fpm are not acceptable.

.3 Switchover damper section shall be comprised of multi section low leakage dampers operated by fast acting electric actuators. RG 1000-6500 shall have damper switching times of 0.75 seconds. RG 7500-18000 shall have damper switching times of 1.5 seconds. Dampers that do not switch within the specified times without objectionable noise are not acceptable. Single blade damper sections are not acceptable. Each damper shall control one of the 4 airways, upper-horizontal, lower-horizontal, forward-vertical and rear-vertical. Dampers shall be capable of orienting to close off outside air to the building without needing external shut off dampers. Dampers shall also be capable of orienting to allow 100% recirculation of air without using heat recovery device for off peak or unoccupied heating modes. Units incapable of these operations without extra ductwork are not acceptable.

.4 Recovery cycles shall be controlled by internal programmed thermostats measuring both supply and exhaust air, and optimizing performance of both heat recovery and free cooling modes.

.9 External Dampers

.1 External Damper Leakage: Leakage rate shall be less than two tenths of one percent leakage at 2 inches static pressure differential. Leakage rate tested in accordance with AMCA Standard 500.

.10 BMS Controls

.1 Unit shall come with its own controls wired to a terminal strip for connection to the BMS.

.11 Installation

.1 Install in accordance with manufacturer's Installation & Maintenance instructions.

.12 Environmental Requirements

.1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

Part 3 Execution

3.1 HEAT RECOVERY UNIT SEQUENCE

.1 Heat Recovery Units, HRU-9/10/11

.1 HRU shall come with own control components (ie actuators) wired to a terminal strip with two relays (run unit enable signal and free cooling mode to switch dampers every 3 hours).

.2 HRU shall be configured to suit the following controls sequences that will be completed at a later date under a separate contract:

.1 HRU will operate continuously. Heating control valve will modulate to maintain a space temperature of 70°F (adjustable).

.2 Provide the following DDC points for future connection:

.1 Supply Fan Status and Command
.2 Exhaust Fan Status and Command
.3 Supply Air Temperature
.4 Exhaust Air Temperature
.5 Pre Heat Air Temperature (ie Temperature before Heating Coil)
.6 Supply Air Low Limit Status (ie Freeze Stat)
.7 Free Cooling Command
.8 Filter differential sensor
.9 Heating Control Valve Position

END OF SECTION

Heat Recovery Units

AIR HANDLING UNIT No.	**HRU-9 & 11**			
SERVICE AREA	Bus Storage Track 25-36			
MANUFACTURER	Tempeff			
MODEL	RG 33000			
SUPPLY FAN - SIZE/TYPE	ANPA 36			
AIRFLOW RATE (cfm) (l/s)	**27692**		13069	
TOTAL STATIC REQUIRED (in.H_2O) (Pa)	**3.37**		842.50	
EXTERNAL STATIC REQUIRED (in.H2O) (Pa)	**1.50**		375.00	
MOTOR (Bhp/Hp) (bkW/kW)	**24.14**	**30.00**	18.00	22.37
SPEED (rpm)	1175			
EXHAUST FAN - SIZE/TYPE	ANPA 36			
AIRFLOW RATE (cfm) (l/s)	**27692**		13069	
TOTAL STATIC REQUIRED (in.H_2O) (Pa)	**1.76**		440.00	
EXTERNAL STATIC REQUIRED (in.H2O) (Pa)	**1.00**		250.00	
MOTOR (Bhp/Hp) (bkW/kW)	**18.49**	**25.00**	13.79	18.64
SPEED (rpm)	1175			
SUPPLY FILTER TYPE	**Merv-10**			
EXHAUST FILTER TYPE	**None**			
HEAT RECOVERY SECTION				
AIRFLOW (cfm) (l/s)	**27692**		13069	
WINTER ENERGY RECOVERY (MBH) (kW)	**2586.40**		758.0	
WINTER RECOVERY FACTOR (%)	**86.70**			
WINTER SUPPLY AIR TEMP. AFTER UNIT (°F) (°C)	**56.50**		13.61	
HEATING COIL				
SIZE, h x l (in) (mm)	**81.0**	**72**	2057	1829
QUANTITY OF COILS	**1**			
MEDIUM	55% Ethylene Glycol			
ENTERING FLUID TEMP (°F) (°C)	**170.0**		76.7	
LEAVING FLUID TEMP. (°F) (°C)	**130.0**		54.4	
ENTERING AIR TEMP (°F) (°C)	**56.5**		13.6	
LEAVING AIR TEMP (°F) (°C)	**90.0**		32.2	
HRV-9 UNIT TOTAL LENGTH (in.) (mm)	**353.0**		8966	
HRV-11 UNIT TOTAL LENGTH (in.) (mm)	**346.5**		8801	
UNIT TOTAL WIDTH (in.) (mm)	**237.9**		6042	
UNIT TOTAL HEIGHT (in.) (mm)	**96.0**		2438	
HRV-9 UNIT WEIGHT (lbs) (kg)	**20177**		9152	
HRV-11 UNIT WEIGHT (lbs) (kg)	**20177**		9152	
Notes:	**HRV-9 to be min. 276" clear b/w supply and exhaust openings**			
	HRV-11 to be min. 306" clear b/w outer edge of exhaust			
	opening and inner edge of supply opening.			

SMS ENGINEERING

Heat Recovery Unit Schedule

Project: **Supply and Delivery of Storage Track 25-36**
Heat Recovery Units at Fort Rouge Transit Base

File: 19-332-01 Designer: JTRH

Date: Nov-19 Sheet: **MS-1a**

Heat Recovery Units

AIR HANDLING UNIT No.	**HRU-10**			
SERVICE AREA	Bus Storage Track 25-36			
MANUFACTURER	Tempeff			
MODEL	RG 5500			
SUPPLY FAN - SIZE/TYPE	ANPA 18			
AIRFLOW RATE (cfm) (l/s)	**5152**		2431	
TOTAL STATIC REQUIRED (in.H_2O) (Pa)	**2.47**		617.50	
EXTERNAL STATIC REQUIRED (in.H2O) (Pa)	**1.50**		375.00	
MOTOR (Bhp/Hp) (bkW/kW)	**3.46**	**5.00**	2.58	3.73
SPEED (rpm)	1755			
EXHAUST FAN - SIZE/TYPE	ANPA 18			
AIRFLOW RATE (cfm) (l/s)	**5152**		2431	
TOTAL STATIC REQUIRED (in.H_2O) (Pa)	**1.41**		352.50	
EXTERNAL STATIC REQUIRED (in.H2O) (Pa)	**1.00**		250.00	
MOTOR (Bhp/Hp) (bkW/kW)	**2.43**	**3.00**	1.81	2.24
SPEED (rpm)	1755			
SUPPLY FILTER TYPE	**Merv-10**			
EXHAUST FILTER TYPE	**None**			
HEAT RECOVERY SECTION				
AIRFLOW (cfm) (l/s)	**5152**		2431	
WINTER ENERGY RECOVERY (MBH) (kW)	**504.00**		147.7	
WINTER RECOVERY FACTOR (%)	**90.50**			
WINTER SUPPLY AIR TEMP. AFTER UNIT (°F) (°C)	**60.51**		15.84	
HEATING COIL				
SIZE, h x l (in) (mm)	**30.0**	**57**	762	1448
QUANTITY OF COILS	**1**			
MEDIUM	55% Ethylene Glycol			
ENTERING FLUID TEMP (°F) (°C)	**170.0**		76.7	
LEAVING FLUID TEMP. (°F) (°C)	**130.0**		54.4	
ENTERING AIR TEMP (°F) (°C)	**60.5**		15.8	
LEAVING AIR TEMP (°F) (°C)	**90.0**		32.2	
HRV-10 UNIT TOTAL LENGTH (in.) (mm)	**250.3**		6356	
UNIT TOTAL WIDTH (in.) (mm)	**71.6**		1819	
UNIT TOTAL HEIGHT (in.) (mm)	**78.8**		2000	
HRV-10 UNIT WEIGHT (lbs) (kg)	**6830**		3098	
Notes:				

SMS ENGINEERING

Heat Recovery Unit Schedule

Project: **Supply and Delivery of Storage Track 25-36**
Heat Recovery Units at Fort Rouge Transit Base

File: 19-332-01 Designer: JTRH

Date: Nov-19 Sheet: **MS-1b**