

SECTION 23 72 00
AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies air-to-air plate heat exchangers recovery systems and rooftop weatherproof, insulated enclosures in which to mount each heat exchanger.
- B. Definitions: Roof Top Weatherproof, Insulated Enclosure (RTE): A factory fabricated assembly consisting of double-wall factory-insulated panels, structural steel base and frame, access doors, 12-inch insulated roof curb, and other necessary equipment to perform the following functions: Ducted inlet connections to permit two incoming air streams to exchange sensible heat by passing the air streams in a counterflow pattern through parallel plates without mixing and be separately discharged from two ducted outlets. The assembly shall include filtration for each air stream, face and bypass dampers for controlling the capacity of the heat transfer and a defrost mechanism to prevent buildup of frost on the heat exchanger plates. Design capacities of units shall be as scheduled on the drawings.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- D. Section 23 21 23, HYDRONIC PUMPS: Requirements for pumping equipment.
- E. Section 23 07 11, HVAC: Requirements for piping insulation.
- F. Section 23 21 13, HYDRONIC PIPING: Requirements for piping for expansion tanks.
- G. Section 23 82 16, AIR COILS: Requirements for run-around system coils.
- H. Section 23 31 00, HVAC DUCTS and CASINGS: Requirements for sheet metal ducts and fittings.
- I. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for filters used before heat recovery coils.
- J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Requirements for controls and instrumentation.
- K. Section 23 05 93, TESTING, ADJUSTING and BALANCING FOR HVAC: Requirements for testing, adjusting and balancing of HVAC system.

L. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

M. Section 01 91 00 - GENERAL COMMISSIONING REQUIREMENTS

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, GUARANTEE in specification Section 00 72 00, GENERAL CONDITIONS.
- B. Refer to Article, Quality Assurance, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- C. Refer to specification Section 01 00 00, GENERAL REQUIREMENTS for performance tests and instructions to VA personnel.
- D. Refer to paragraph QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. Performance Criteria: Heat recovery equipment shall be provided by a manufacturer who has been manufacturing such equipment and the equipment has a good track record for at least 3 years.
Performance Test: In accordance with PART 3.
- E. RTE Units shall be constructed by a manufacturer who has been manufacturing roof top units for at least five (5) years.
- F. RTE Units shall be shipped in one (1) piece where possible and in shrink wrapping to protect the unit from dirt, moisture and /or road salt.
Shipping splits can be provided as required for installation. Lifting lugs will be supplied on each side of the split to facilitate rigging and joining of segments.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Plate Heat Exchanger
- C. Certificate: Submit, simultaneously with shop drawings, an evidence of satisfactory service of the equipment on three similar installations.
- D. Submit type, size, arrangement and performance details. Present application ratings in the form of tables, charts or curves.
- E. Provide installation, operating and maintenance instructions, in accordance with Article, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.
- F. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.
 - 1. Submittals for RTE Enclosures shall include panel construction details, face and bypass air dampers, filter on entering air sides of

heat exchanger, insulated roof curb and all other related accessories. The contractor shall provide custom drawings showing total RTE assembly including dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, plenum lights, duplex receptacles, wiring, unit support system, drain pans at condensation point on heat exchanger, pressure drops through each component (filter, HX plates, etc) and rigging points. Submittal drawings of section or component only, will not be acceptable.

2. Contractor shall also submit certified performance data on air-to-air heat exchangers including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details; and the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements. This data shall be submitted in hard copies and in electronic version compatible to AutoCAD version used by the VA at the time of submission.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating, and Refrigeration Institute (AHRI)
AHRI 1060-2005.....Performance Rating of Air-to-Air Heat Exchangers
for Energy Recovery Ventilation Equipment
- C. American Society of Heating, Refrigeration and Air Conditioning
Engineers (ASHRAE):
15-10.....Safety Standard for Refrigeration Systems (ANSI)
52.1-92.....Gravimetric and Dust-Spot Procedures for Testing
Air-Cleaning Devices Used in General Ventilation
for Removing Particulate Matter
52.2-07.....Method of Testing General Ventilation Air-
Cleaning Devices for Removal Efficiency by
Particle Size
84-08.....Method of Testing Air-to-Air Heat/Energy
Exchangers
- D. American Society for Testing and materials (ASTM)
D635-10.....Standard Test Method for Rate of Burning and/or
Extent and Time of Burning of Plastics in a
Horizontal Position
E84-10.....Standard Test Method for Surface Burning
Characteristics of Building Materials

- E. American Society of Civil Engineers (ASCE)
ASCE 7-10.....Minimum Design Loads for Buildings and Other
Structures
- F. Underwriters Laboratories, Inc (UL)
1812-2009.....Standard for Ducted Heat Recovery Ventilators
1815-2009.....Standard for Nonducted Heat Recovery Ventilators

PART 2 - PRODUCTS

2.1 AIR-TO-AIR PLATE HEAT EXCHANGER

- A. Comply with UL Standards 1812.
- B. Plates: Corrugated 0.53 mm (0.021 inch) diamond embossed aluminum, spacing as recommended by the manufacturer.
- C. Bedding: Thermosetting reinforced resin. Provide plate seal-off and passage separation at top, bottom and center divider. The resins shall be self-extinguishing type in accordance with ASTM D635.
- D. Casing and End Strips: Casing of 1.6 mm (16 gage) galvanized steel, except casings for corrosive air streams shall be stainless steel. End strips of the same material as exchanger plates. Ends of unit exchanger plates shall be sealed with high temperature silicon sealant prior to installation of end strip for corrosive air streams provide welded end strips to avoid cross contaminations.
- E. Casings shall have integral flanges for flanged duct connections and shall have lifting holes or lugs.
- F. Drain Pan: Same material as unit casing. Drain-pan surface shall be covered with molded ABS, and shall have drain connections on exhaust and supply side. Comply with requirements in ASHRAE 62.1-2004.
- G. Accessories: Furnish where indicated on the drawings.
 - 1. Face and Bypass Dampers: Manufacturer's standard, complete with operators, with factory-installed controls to operate face-and-bypass dampers during summer and winter.
 - 3. Defrost System. Factory installed and capable of maintaining at least 85 percent of the non-frosted performance at -29 degrees C (-20 degrees F).
 - 4. Automatic Damper at outlet connection for discharge exhaust air stream.
- I. Extended-Surface, Disposable Panel Filters: MERV 7, 2-inch throw-away type. Refer to Section 23 40 00 HVAC Air Cleaning Devices.

2.2 AIR FILTERS

- A. Air Filters: Disposable air filters, with a MERV rating of 7, shall be provided standard on all air entering sides of air-to-air heat exchangers as indicated on the drawings. Comply with requirements in specification Section 23 40 00, HVAC AIR CLEANING DEVICES.

- B. Provide insulated double wall access doors on both sides of unit for side removal of filters. Doors shall be equipped with hinges and non-corrosive alloy construction latches.

2.3 ROOFTOP ENCLOSURE (RTE):

- A. RTE units shall be entirely of double wall galvanized steel construction. Casing is specified in paragraph 2.1.C. Foil face lining is not an acceptable substitute for double wall construction. Galvanizing shall be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.275 kg of zinc per square meter (0.90 oz. of zinc per square foot) (G90). Aluminum constructed units may be provided subject to VA approval and documentation that structural rigidity is equal or greater than the galvanized steel specified.
 - 1. The contractor and the RTE manufacturer shall be responsible for insuring that the unit will not exceed the allocated space shown on the drawings, including required clearances for service and future overhaul or removal of unit components. All structural, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost to the government.
 - 2. RTEs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include airflow direction to facilitate assembly at the job site. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
 - 3. The RTE manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a local representative at the job site to supervise the assembly and to assure the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation that this representative has provided this service on similar jobs to the Contracting Officer. If a local representative cannot be

provided, the manufacturer shall provide a factory representative.

4. Gaskets: All door and casing and panel gaskets and gaskets between unit components, if joined in the field, shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.
5. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed 1/200 of the span based on a differential static pressure of 1991 Pa (8 inches water gage) or higher.

B. Base:

1. Provide a heavy duty steel base and 100-150 mm (4-6 inch) mounting flanges for supporting and sealing the air-to-air plate heat exchanger within the unit. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 125 mm (5 inch) high 3.5 mm (10 gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability.
2. Contractor shall provide supplemental galvanized steel supports for the insulated ductwork routed across the roof and connected to the heat exchanger's inlets and outlets.
3. RTEs shall be completely self supporting for installation on an insulated galvanized steel roof curb.
3. The RTE bases not constructed of galvanized material shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.

C. Casing (including wall, floor and roof):

1. General: RTE casing shall be entirely double wall insulated panels, integral of or attached to a structural frame. Construction shall be such that removal of any panel shall not affect the structural integrity of the unit.
2. Casing finished shall meet salt-spray test as specified in paragraph 2.1.C.10. All casing and panel sections shall be tightly butted and gasketed. No gaps of double wall construction will be allowed where panels bolt to RTE unit structural member. Structural members, not covered by the double wall panels, shall have equivalent insulated double wall construction.

3. Double wall galvanized steel panels, minimum 51 mm (2 inches) thick, constructed of minimum 1.3 mm (18 gauge) outer skin and 1.0 mm (20 gauge) solid inner skin.
4. Blank-Off: Provide where required to insure no air bypass between sections, through or around the heat exchanger or filters. Blank-Off shall be installed at each component of the RTE unit and also at the internal panels to prevent recirculation of the air through panels. Seal any holes where bypass occurs.
4. Insulation: Insulation shall be encased in double-wall casing between exterior and interior panels such that no insulation can erode to the air stream. Insulation shall be 50 mm (2 inch) thick, 24 kg/m³ and (1.5 lb/ft³) density with a thermal conductivity R of approximately 13.8 W/m.K (8.0 BTU/hr-ft² °F). Units with less than 50 mm (2 inch) of insulation in any part of the walls, floor, roof or drain pan shall not be acceptable. The insulation shall comply with NFPA 90-A for the flame and smoke generation requirements. Also, refer to specification Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
5. Condensation through metal connections between inner and outer panels shall be kept to an absolute minimum.
6. Casing panels shall be secured to the support structure with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications. Welded exterior panels are not acceptable.
7. Access Doors: Provide in each access section and where shown on drawings. Doors shall be a minimum of 50 mm (2 inches) thick with same double wall construction as the unit casing. Doors shall be a minimum of 600 mm (24 inches) wide, unless shown of different size on drawings, and shall be the full casing height up to a maximum of 1850 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal.
 - a. Hinges: Manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 pound) weight hung on latch side of door.
 - b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside. Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45

degrees) further movement of the handle for complete opening.

Latch shall be capable of restraining explosive opening of door with a force not less than 1991 Pa (8 inches water gage).

- c. Gaskets: Neoprene, continuous around door, positioned for direct compression with no sliding action between the door and gasket.

Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.

8. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and tubing. Coordinate with electrical and temperature control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.
 9. Roof of the unit shall be sloped to have a minimum pitch of 1/4 inch per foot. The roof shall overhang the side panels by a minimum of three inches to prevent precipitation drainage from streaming down the unit side panels.
 10. Casing finished shall meet ASTM B117, 500-hour salt spray test, using 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no sign of blistering, wrinkling, or cracking, no loss of adhesion, and the specimen shall show no sign of rust creepage beyond 1/8-inch on either side of scratch mark.
- D. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 pounds per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation. Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.
 - E. Condensate Drain Pan: Drain pan shall be designed to extend entire length of plate heat exchanger. Depth of drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be double wall construction, 304 stainless steel and have a minimum of 50 mm (2 inch) insulation, and shall be sloped to drain. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan

shall be placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.

F. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.

G. Installation, including frame, shall be designed and sealed to prevent blow-by.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow the equipment manufacturer's instructions for handling and installation, and setting up of ductwork for makeup and exhaust air steamers for maximum efficiency.

B. Seal ductwork tightly to avoid air leakage.

C. Install units with adequate spacing and access for cleaning and maintenance of heat exchangers as well as filters.

E. Brace heat exchangers installed in projects in the Seismic area according to specification Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

F. Secure RTE outdoor heat recovery units to withstand a wind velocity of 90 mph.

3.2 FIELD QUALITY CONTROL

A. Operational Test: Perform tests as per manufacturer's written instructions for proper and safe operation of the heat recovery system.

1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Adjust seals and purge.

3. Test and adjust controls and safeties.

B. Replace damaged and malfunctioning controls and equipment.

C. Set initial temperature set points. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Prepare test and inspection reports to the Senior Resident Engineer in accordance with specification Section 01 00 00, GENERAL REQUIREMENTS.

3.3 INSTRUCTIONS

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of heat recovery equipment.

3.4 STARTUP AND TESTING

A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.5 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.6 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.

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