

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

SPEC WRITER NOTES:

1. Delete between // -- --- // if not applicable to project. Also delete any other item or paragraph not applicable in the Section and renumber the paragraphs.
2. Provide the year of latest edition to each publication given in paragraph APPLICABLE PUBLICATIONS.
3. There may be several acceptable refrigerants, listing more than one type of acceptable refrigerants is authorized for increased competition.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. This section specifies //air-to-air heat pipe heat exchangers//
//rotary air-to-air heat exchangers// //air-to-air plate heat exchangers// //and// //run-around heat recovery systems//.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- D. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- E. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- G. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
- H. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.
- I. Section 23 07 11, HVAC and BOILER PLANT INSULATION.
- J. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- K. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- L. Section 23 21 13, HYDRONIC PIPING.
- M. Section 23 21 23, HYDRONIC PUMPS.
- N. Section 23 31 00, HVAC DUCTS and CASINGS.
- O. Section 23 40 00, HVAC AIR CLEANING DEVICES.
- P. Section 23 82 16, AIR COILS.

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTES:

1. Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project unless the reference applies to all HVAC systems. Publications that apply to all HVAC systems may not be specifically referenced in the body of the specification but shall form a part of this specification.
2. Insert the year of approved latest edition of the publications between the brackets // // and delete the brackets if applicable to this project.

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. Where conflicts occur these specifications and the VHA standards will govern.

B. Air Conditioning, Heating, and Refrigeration Institute (AHRI):

1060-//2018//.....Performance Rating of Air-to-Air Heat
Exchangers for Energy Recovery Ventilation
Equipment

C. American Society of Civil Engineers (ASCE):

7-//2016//.....Minimum Design Loads for Associated Criteria
for Buildings and Other Structures

D. American Society of Heating, Refrigeration, and Air Conditioning
Engineers (ASHRAE):

15-//2019//.....Safety Standard for Refrigeration Systems

34-//2022//.....Designation and Classification of Refrigerants
(ANSI)

52.2-//2017//.....Method of Testing General Ventilation
Air-Cleaning Devices for Removal Efficiency by
Particle Size

62.1-//2019//.....Ventilation for Acceptable Indoor Air Quality

84-//2020//.....Method of Testing Air-to-Air Heat/Energy
Exchangers

- E. American Society for Testing and materials (ASTM):
 D635-//2018//.....Standard Test Method for Rate of Burning and/or
 Extent and Time of Burning of Plastics in a
 Horizontal Position
 E84-//2021a//.....Standard Test Method for Surface Burning
 Characteristics of Building Materials
- F. Underwriters Laboratories, Inc (UL):
 1812-//2013(R2021)//....Standard for Ducted Heat Recovery Ventilators
 1815-//2012(R2021)//....Standard for Nonducted Heat Recovery
 Ventilators)
- G. Department of Veterans Affairs (VA):
 PG-18-10-//2017(R2023)// HVAC Design Manual

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 XX XX, SECTION TITLE", with applicable paragraph identification.
- C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
1. Heat Pipe Heat Exchanger
 2. Rotary Heat Exchanger
 3. Plate Heat Exchanger
 4. Run-Around Energy Recovery System
- D. Certificate: Submit, simultaneously with shop drawings, an evidence of satisfactory service of the equipment on three similar installations.
- E. Submit type, size, arrangement, and performance details. Present application ratings in the form of tables, charts, or curves.

SPEC WRITER NOTE: Coordinate O&M Manual and commissioning requirements with Section 01 00 00, GENERAL REQUIREMENTS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS. O&M Manuals shall be submitted for content review as part of closeout documents.

- F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replaceable parts, and troubleshooting guide:
1. Include complete list indicating all components of the systems.
 2. Include complete diagrams of the internal wiring for each item of equipment.
 3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.
- G. //Completed System Readiness Checklist provided by the CxA 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.//
- H. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

1.5 QUALITY ASSURANCE

- A. Refer to Section 01 00 00, GENERAL REQUIREMENTS for performance tests and instructions to VA personnel.
- B. 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.
- C. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.
- D. Refer to Section 01 8113, SUSTAINABLE CONSTRUCTION REQUIREMENTS for additional sustainable design requirements.

1.6 AS-BUILT DOCUMENTATION

- A. Comply with requirements in paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

PART 2 - PRODUCTS

2.1 AIR-TO-AIR HEAT PIPE HEAT EXCHANGERS

SPEC WRITER NOTE: For high humidity locations refer to VA HVAC Design Manual, provide copper tubes and copper fins. Refer to Section 23 82 16, AIR COILS for details.

- A. Thermal recovery units shall be capable of operating at temperatures ranging from a minimum of -29 degrees C (-20 degrees F) to a maximum of 49 degrees C (120 degrees F). The heat transfer between air streams shall take place in a counterflow arrangement. The unit shall have no moving part and shall be one piece construction.
- B. Tube core shall be either 16 mm (5/8 inch) or 25 mm (1 inch) OD seamless //aluminum// //copper// tubing permanently expanded into the fins to form a firm, rigid and complete metal pressure contact between the tube and fin collar of all operating conditions. For high humidity locations, provide copper tubes and copper fins.
- C. Fin: //Aluminum// //Integral aluminum// Copper//.
 - 1. Fin Spacing: //3.2 mm (0.125 inch)// //2.3 mm (0.091 inch)// //1.8 mm (0.071 inch)// //1.7 mm (0.067 inch)// //1.4 mm (0.056 inch)// //0.2 mm (0.0075 inch)//.
 - 2. Fin and Tube Joint: Mechanical bond and silver brazed.
- D. Coating: //Thermoplastic vinyl// //Epoxy// //Synthetic resin// //Phenolic// //Polytetrafluoroethylene// //Vinyl ester// apply to supply and exhaust.
- E. Secondary surfaces shall be of continuous plate type aluminum fins, 0.18 mm (0.007 inch) thick, and of corrugated design to produce maximum heat transfer efficiencies.
- F. Basic capillary wick shall be an integral part of the inner wall of the tube and provide a completely wetted surface for maximum heat pipe capacity with minimum heat transfer resistance.

SPEC WRITER NOTE: Refrigerant must be an
EPA approved refrigerant listed in
<https://www.epa.gov/snap/>.

- G. Use refrigerant type //____//. EPA approved refrigerants are listed at <https://www.epa.gov/snap/>. Submit selected refrigerant for government approval.
- H. Exhaust and supply airstreams shall be separated from each other by a vertical partition, so that there will be no cross-contamination.
 - 1. Partition Material: //Galvanized steel// //Stainless steel//.
 - 2. Partition Material Thickness: 1.6 mm (16 gauge).
- I. Casing shall be a minimum of 1.9 mm (14gauge) galvanized steel flanged casing, with airtight partition between airstreams.
- J. End covers shall be a minimum of 1.0 mm (20gauge) galvanized steel.

- K. Tilt Control Mechanism: For summer/winter operation with an electric actuator; and having control panels and sensing bulbs as shown on the contract drawings.

SPEC WRITER NOTE: Show control panels and sensing bulbs on the contract drawings.

- L. Provide flexible connectors for each side of the unit. The flexible connector shall be fabricated in a manner that will allow the unit to tilt without binding.
- M. //Control: Integral plenum containing heat pipe coil and gasketed, face-and-bypass, opposed-blade dampers with rods extended outside casing for damper operator and linkage.//
- N. //Control: Pivot center of bottom of heat pipe coil on shaft and bearings to tilt coil. Include tilt controls with electric actuator and linkage, thermostats, sensors, and polyester fabric with PVC-coated flexible connector for automatic supply temperature regulation, summer/winter changeover, and frost protection.//

2.2 ROTARY AIR-TO-AIR HEAT EXCHANGER

- A. Exchanger Rotor or Wheel: Aluminum transfer media with a flame spread rating of 25 and less and smoke developed rating of 50 and less, and independently tested in accordance with ASTM E84. Rotor media shall be independently tested in accordance with ASHRAE 84. It shall allow laminar flow (but not radial) when operating within published operating airflow ranges and prevent leakage, bypassing and cross contamination by cross flow within wheel. Size the transfer media to allow passage of //300// //500// //800// //1200// micrometers particles without fouling or clogging. When latent heat transfer is required, treat media with non-degrading //desiccant// //silica-gel desiccant coating// that is bacteriostatic, non-corroding and non-toxic. No asbestos material will be allowed. Wheel shall not condense water directly or require a condensate drain for summer or winter operation. Performance rating shall be in accordance with AHRI 1060.

SPEC WRITER NOTE: 3 Angstrom (3A) and 4 Angstrom (4A) molecular sieves desiccant coatings provide superior protection to cross contamination.

- B. Rotor: //Glass-fiber// //Polymer// segmented wheel strengthened with radial spokes impregnated with non-migrating, water-selected, //3A// //4A// molecular-sieve desiccant coating.

1. Maximum Solid Size for Media To Pass://500// //800// //1200// micrometers.
- C. Casings shall be sealed on periphery of rotor as well as on duct divider and purge section. Seals shall be adjustable, of extended life materials and effective in limiting air leakage.
- D. Wheel shall be supported by ball or roller bearings and belt driven by a fractional horsepower, totally enclosed, NEMA Standard motor through a close coupled positively lubricated speed reducer, or gear/chain speed reduction. Refer to Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT.
 1. Motors for constant speed exchanger wheels shall be an AC motor.
 2. Variable-speed exchanger wheels shall have exchanger wheel speed and leaving air temperature controlled by means of a variable-speed motor controller. //Operation shall be from 115 V/1 ph/60 Hz and by a proportioning temperature controller which shall vary output voltage of a silicon controlled rectifier (SCR) to a rectified power motor which will change speed in proportion to changes of voltage to its armature.// Automatic changeover for summer/winter operations shall be controlled by an adjustable thermostatswitch. Set point of adjustable proportioning temperature controller and thermostatswitch shall be indicated on visible scale. System shall be capable of speed reduction down to 5 percent of capacity while maintaining adequate torque at any point of operation to rotate wheel.
- E. An automatic, factory-fabricated, field-adjustable purge unit shall limit exhaust air carry-over to less than 1.0 percent of rated volume. Purge shall be effective when static pressure difference between supply and exhaust is 125 Pa (1/2 inch WG) or greater, and it shall have provision for restriction or adjustment to limit purge air volume to not over five percent of rated air flow when a static pressure difference up to 2.5 kPa (10 inch WG) exists.
- F. Unit shall be constructed of heavy gauge steel to ensure rigidity and stability. Casing side panels shall be removable to ensure easy access to internal parts and have integral flanges for flanged duct connection and lifting holes or lugs.
- G. Controls starting relay shall be factory mounted and wired and include a manual motor starter for field wiring. //Variable frequency controller shall be factory mounted and wired, permitting input of field connected 4-20 mA or 1-10-V control signal.// //Variable

frequency controller shall be factory mounted and wired, with exhaust-air sensor to vary rotor speed and maintain exhaust temperature above freezing.// //Variable frequency controller shall be factory mounted and wired, with exhaust- and outdoor-air sensors, automatic changeover thermostat and set-point adjuster, to vary rotor speed and maintain //exhaust temperature above freezing and// air differential temperature above set point.// When exhaust-air temperature is less than outdoor-air temperature, the rotor shall be at maximum speed.

1. //Pilot-Light Indicator: Display rotor rotation and speed. Speed Settings: Adjustable settings for maximum and minimum rotor speed limits.//

H. Filters: MERV 7, 50 mm (2 inch) throw-away type. Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES.

2.3 AIR-TO-AIR PLATE HEAT EXCHANGER

A. Comply with UL 1812.

B. Plates: Corrugated 0.53 mm (0.021 inch) //diamond embossed aluminum// //stainless steel// //polypropylene copolymer (high density plastic)// //enthalpic// 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 gauge) 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.

G. Accessories: Furnish where indicated on the contract 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.

2. //Defrost System: Factory installed and capable of maintaining at least 85 percent of the non-frosted performance at -29 degrees C (-20 degrees F).//
- H. //Water Wash: Automatic system with spray manifold to individual spray tubes or traversing type with stainless-steel-screw operating mechanism and electric motor drive; activated by time clock with detergent injection.//
- I. Extended-Surface, Disposable Panel Filters: MERV 7, 50 mm (2 inch) throw-away type. Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES.

2.4 RUN-AROUND ENERGY RECOVERY SYSTEM

SPEC WRITER NOTE: For high humidity locations refer to VA HVAC Design Manual, provide E-coated aluminum fins.

- A. System shall be field fabricated, as shown, containing coils, piping and // // percent glycol, pumps, insulation, and accessories.
- B. Automatic Temperature Controls and Sequence of Operations: As shown on the contract drawings and as specified in Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. //In areas with climates where the outdoor design temperature is below freezing, the sequence shall include a defrost cycle to modulate glycol flow to the outdoor air coil as required to maintain the exhaust air temperature above freezing.//
- C. Components shall comply with requirements in the following specification sections:
1. Pumps: Section 23 21 23, HYDRONIC PUMPS.
 2. Insulation: Section 23 07 11, HVAC AND BOILER PLANT INSULATION.
 3. Pipes, Fittings, and Specialties: Section 23 21 13, HYDRONIC PIPING.
 4. Coils: Section 23 82 16, AIR COILS.
 5. Controls: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

2.5 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, // //upstream of outdoor air and exhaust run-around loop air coils// and as indicated on the contract drawings. Comply with requirements in Section 23 40 00, HVAC AIR CLEANING DEVICES.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. If an installation is unsatisfactory to the COR, the contractor shall correct the installation at no additional cost or time to the Government.
- B. Follow the equipment manufacturer's instructions for handling and installation and setting up of ductwork for makeup and exhaust air steamers for maximum efficiency.
- C. Rotary Air-to-Air Exchanger: Adjust seals and purge as recommended by the manufacturer. Verify correct installation of controls.
- D. Seal ductwork tightly to avoid air leakage.
- E. Install units with adequate spacing and access for cleaning and maintenance of heat recovery coils as well as filters.
- F. //Brace heat recovery equipment installed in projects in the seismic area according to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//

SPEC WRITER NOTE:

Specify wind velocity as per ASCE 7.

- G. //Secure outdoor heat recovery equipment to withstand a wind velocity of // // km/h (// // 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 and humidity set points. Set field-adjustable switches and circuit breaker trip ranges as indicated.
- D. Prepare test and inspection reports to the COR in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

3.3 STARTUP AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.

- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. //The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Provide a minimum notice of 10 working days prior to startup and testing.//

3.4 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //4//
// // hour//s// to instruct each VA personnel responsible in operation and maintenance of the system.
- 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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