

PACKAGED ROOFTOP UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes variable volume, packaged rooftop units, associated VFDs and controls

1.02 SUBMITTALS

- A. Product Data: For each rooftop unit indicated.
1. Unit dimensions and weight.
 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 3. Fans:
 - a) Certified fan-performance curves with system operating conditions indicated.
 - b) Certified fan-sound power ratings.
 - c) Fan construction and accessories.
 - d) Motor ratings, electrical characteristics, and motor accessories.
 4. Certified coil-performance ratings with system operating conditions indicated.
 5. Dampers, including housings, linkages, and operators.
 6. Filters with performance characteristics.
 7. Roof Curb.
 - a. Adapters if required to be compatible with new units
- B. Wiring diagrams detailing wiring for power and controls and differentiating between manufacturer-installed wiring and field-installed wiring.

1.03 QUALITY ASSURANCE

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
1. The rooftop unit(s) shall be certified in accordance with UL Standard 1995 and ANSI Standard Z21.47
 2. The rooftop unit(s) shall be safety certified by an accredited testing laboratory and the nameplate shall carry the label of the certification agency.
 3. Unit and components shall be designed, manufactured, and independently analyzed, rated, and certified to meet with the seismic compliance standards of the International Building Code, 2003 edition, Section 1621. If requested unit shall be provided with Certificate of

Compliance from an independent certifying Professional Engineer clearly indicating that the unit and components meet seismic design requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support units with the manufacturer's designated lifting or supporting points.
- B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.
- C. Deliver rooftop air-handling units factory-assembled to the extent allowable by shipping limitations, with protective crating and covering.

1.05 EXTRA MATERIALS

- A. Furnish one additional complete set of belts and adjustable sheaves for each rooftop unit.
- B. Provide a minimum of two sets of both pre and final filters for each unit. Install a clean set of both pre and final filters just prior to system balancing. Coordinate scheduling with the Test and Balance Contractor to ensure that new filters are installed when Test and Balance work begins. Deliver to the Owner all remaining filters. A minimum of one set of both pre and final filters shall be turned over. Obtain a receipt from the Owner that new filters have been installed and the quantity of additional filters that have been turned over.

1.06 WARRANTY

- A. Provide a written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within one year, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
- B. Compressors shall carry a 5 year non pro-rated parts warranty.
- C. Heat exchanger shall have a 10 year non pro-rated parts warranty.

PART 2 EQUIPMENT AND EXECUTION

2.01 ROOFTOP HEATING AND AIR CONDITIONING UNITS

- A. General
 - 1. Provide factory-fabricated air handling units with capacity as indicated on the schedule. Units shall have overall dimensions as indicated and fit into the space available with adequate clearance for service. Unit manufacturer shall provide certified ratings conforming to the latest edition of AMCA 210, 310, 500 and ARI 410. All electrical components and assemblies shall comply with NEMA standards. Unit internal insulation must have a flame spread rating not over 25 and smoke developed rating no higher than 50 complying with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems." Units shall comply with NFPA 70, "National Electrical Code," as applicable for installation and electrical connections of ancillary electrical components of air handling units. Units shall be UL or ETL listed.
 - 2. Unit shall be completely factory assembled, piped, wired, and shipped in one section. Construction is suitable for outdoor installation.

3. Manufacturers:
 - a) Trane
 - b) Aaon
 - c) Daikin
 - d) York

- B. Roof Curb
 1. Existing curbs to remain in place and be utilized to receive new units.
 2. Rooftop manufacturer to provide curb gasket to be installed between unit and top of curb by contractor.
 3. Advise general contractor of the dimensional requirements for roof openings required.
 4. Fully gasket between the curb top and unit bottom, with the curb providing full perimeter support and air seal for the unit.
 5. Any additional height above existing is subject to approval from owner.

- C. Unit Casing
 1. The unit casing shall be constructed of heavy gauge galvanized steel.
 2. Cabinet surface shall be tested 672 hours in salt spray in compliance with ASTM B117.
 3. All components shall be mounted in a weather resistant steel cabinet with a painted exterior. Where top cover seems exist, they shall be double hemmed and gasket sealed to prevent water leakage.
 4. Cabinet construction shall allow for all maintenance on one side of the unit.
 5. Service panels shall have handles and shall be removable while providing a water and air right seal.
 6. Control box access shall be hinged.
 7. The indoor air section shall be completely insulated with fire resistant, permanent, odorless, foil faced glass fiber material.
 8. The base of the unit shall have provisions for crane lifting.
 9. Provide hail guards at condenser sections

- D. Cooling System
 1. Evaporator Section:
 - a) Evaporator section shall consist of direct expansion coil with circuiting split for row control. The refrigerant piping shall be provided with flexible piping connectors. Each evaporator coil shall be provided with a drain pan which shall be fabricated of galvanized steel and coated with a corrosion resistant material which shall be fire resistant (shall meet wet flammability per ASTM D93-73 and

dry flammability per ASTM E84- 70). Provide drain pans with vibration dampening and thermal insulation.

- b) Coils shall be multi-row (4 row minimum) fabricated film seamless copper tubing mechanically bonded to aluminum fins. Coils shall have a maximum of 12 fins per inch. Coil shall be leak tested at 315 PSIG. Each refrigeration circuit shall have a thermal expansion valve, adjustable superheat controls and external equalizers.

2. Compressors:

- a) Compressors shall be of the heavy duty suction cooled, 1750 RPM, scroll or accessible semi-hermetic type complete with forced feed lubrication, suction and discharge service valves, suction strainer, oil level sight glass, internal relief valve, internal crank-case heater, and internal 3 phase solid state thermal motor protection.
- b) The refrigerant circuits shall be multiple independent circuits, completely piped, tested, dehydrated, and fully charged with oil and refrigerant R-410a. The refrigerant circuit components shall include compressor, condenser and integral liquid subcooler, liquid line solenoid valve, liquid line service and charging valve, filter drier, sight glass, and fusible plug. Suction and discharge line piping shall include braided wire flexible line isolators.
- c) Provide low ambient lockout to prevent refrigeration system from operating below 55 degrees F. (adjustable).
- d) Capacity reduction shall be attained by providing multiple compressors with unloading steps indicated on drawings. Provide variable air volume units with factory installed hot gas bypass to evaporator suction.
- e) Provide time delay device on each compressor to prevent short cycling.
- f) Compressors shall be complete with five year parts warranty.

3. Air Cooled Condensing Section

- a) Condenser fans shall be direct drive, propeller type, designed for low tip speed and vertical air discharge. Condenser fan motors shall be three phase, 1140 RPM, ODP type. Fans shall be cycled off when not required for minimum electrical usage.
- b) Condenser coils shall be seamless copper tubes, expanded into aluminum fins, with a maximum of 14 fins per inch. Each coil shall be provided with 15 degrees F. subcooling circuit. The mechanical refrigerant systems shall be capable of operating at ambient conditions down to 45 degrees F.
- c) Provide hail guards

E. Fan Sections

1. Fans:

- a) The fan wheels shall be single airfoil, backward inclined or forward curved single width/single inlet (SWSI) type, secured to a machined, ground and polished solid steel shaft. The shaft shall be coated with a rust inhibitor and shall be supported by two outboard bearings. The fan assembly shall be dynamically balanced.

Bearings shall be of the self-aligning ball bearing pillow block type and shall be designed for at least 200,000 hours average life. Drive shall be by means of multiple V-belts with a minimum service factor of 150%.

- b) Motors shall be heavy duty open-drip-proof, 3 phase, 1800 RPM, mounted on a heavy duty sliding base.

2. Variable Air Volume Units

- a) The supply fans shall be capable of delivering variable air volume to full shut off by means of variable frequency drives. Drives shall be provided by the unit manufacturer factory installed in the control cabinet. Drives shall comply with the specifications of this Section complete with manual bypass and a 36 month warranty.

G. Heating Section

- 1. Natural gas fired with AGA certified gas train approved for use in the Minnesota.
- 2. Heat exchangers of stainless steel construction with induced draft combustion.
- 3. Heat exchangers shall have a ten year warranty against corrosion.
- 4. Intermittent electronic ignition pilot.
- 5. Stages of heat shall be as scheduled.

H. Filter Section

- 1. Filter section shall be provided complete with galvanized steel filter rack and access doors from both sides of unit.
- 2. Filter rack shall be universal type designed to accept 2" thick filters.
- 3. Provide two complete sets of filter media. Filters shall be Farr 30/30 or approved equal.
- 4. Provide each set of filters with a Dwyer series 2000 filter gauge mounted on control compartment of unit.

I. Power Return Air, Outside Air and Relief Air Section

- 1. Unit shall be provided with a factory fabricated and assembled combination outside-return-relief air section complete with weather louvers, motorized return, relief and blower section, and insulated return air segment.
- 2. Weather louvers/hoods for outside air intake and relief air exhaust shall be of an approved weatherproof, rain tight type complete with 1/2" mesh galvanized steel bird screen mounted on the inside surface of each louver.
- 3. Outside air, return air and relief air dampers shall be constructed of heavy gauge aluminum airfoil shaped blades and 14 gauge galvanized steel frames. The damper blades shall be mounted to plated, square shafts which shall rotate in permanently lubricated nylon bearings to insure smooth operation. Blade seals shall be of flexible metal compression type. Damper blades shall operate without vibration or binding, damper

linkage shall be located out of the airstream in the frame and damper shall be capable of handling 0% to 100% outside air. Leakage rate of dampers shall be maximum of 1/2" of 1% of rated flow.

J. Electrical

1. Each unit shall be complete with magnetic starters, weatherproof disconnect switch, control circuit fuse and internal wiring. Provide single point power connection for motors and controls.

K. Motor Efficiencies

1. All 60 Hz supply fan motors shall meet the Energy Independence and Security Act of 2009 (EISA).

2.02 FAN DRIVES

- A. All belt drive fans and air handling units shall have Gates, Dodge, Goodyear or Browning drives selected to conform the following requirements.

- B. All V-belt drives shall be equipped with adjustable pitch motor sheaves.

- C. All adjustable motor sheaves shall be selected to produce the specified fan speed while operating at approximately the midpoint of the motor sheave pitch adjustment.

- D. All V-belt drives shall be sized at least 50% above operating horsepower requirements.

- E. All drives shall be supplied with at least the minimum number of belts as outlined below with respect to motor horsepower:

0 – 1 ¼ HP	1 belt
2 – 7 ½ HP	2 belts

- F. High capacity belts will be acceptable for all non-intermittent loads; that is, applications when the fan will not start and stop more than once per day. Standard belts will be required for all intermittent loads.

- G. All drives are to be selected to maintain belt speeds of from 3,500 to 4,500 FPM where space will permit.

2.03 BELT GUARDS

- A. All fans shall be furnished and installed with guards to enclose all belt drives, drive sheaves and rotating equipment. These guards are to be constructed of 20 gauge galvanized steel with 16 gauge 3/4" diamond mesh screen or expanded metal. The screen or expanded metal shall be spot or stitch welded to the frame. The guard shall supported on bracket from the floor or fan base. Openings shall be provided in guards to permit tachometer readings for both motor and driven unit. Guards shall comply with the requirements of the Minnesota Industrial Commission and be designed for easy removal for belt replacement.

2.04 VARIABLE FREQUENCY DRIVE

A. General

1. The adjustable frequency controller (AFC) shall convert three-phase, 60 HZ utility power to adjustable voltage and frequency, three-phase, AC power for stepless motor speed

control from 10% to 100% of the motor's 60 HZ speed. Input voltage shall be as specified on the drawing schedules.

2. The AFC shall include a converter and in inverter section. The converter section shall convert fixed frequency and voltage AC utility power to a variable DC voltage. AFC's that use silicon controlled rectifiers in the converter bridge shall also include input line reactors.
3. The inverter section of the AFC shall invert the variable voltage into a six- step waveform, adjustable voltage and frequency output for stepless motor speed control.
4. The AFC maximum output current emitting shall be 110% of the motor nameplate full load current.
5. The AFC and options shall be tested to ANSI/UL Standard 508 and listed by a nationally recognized testing agency such as UL or ETL.
6. The AFC shall comply with the applicable requirements of the latest standards of ANSI, IEEE, and the National Electrical Code.
7. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in IEEE Standard 519-1981, Guide for Harmonic Control and Reactive Compensation of Static Power Converters.
8. The AFC shall not emit either conducted or radiated RFI in excess of limitations set forth in the FCC Rules and Regulations, Part 15, Subpart J.
9. Drives shall be provided by the rooftop unit manufacturer.

B. Basic Features

1. The AFC shall be housed in a NEMA 1 enclosure.
2. The following operator controls shall be located on the front of the enclosure:
 - a) Hand/off/auto selector switch to start and stop motor. In the auto position, the drive will start/stop from a remote contact enclosure.
 - b) Auto/manual selector switch. In the auto position, motor speed is determined by the follower signal. In the manual positions, motor speed is determined by the manual speed potentiometer.
 - c) Manual speed potentiometer.
 - d) Power on pilot light to indicate that the AFC is being supplied by the power line.
 - e) Fault pilot light to indicate that the AFC has tripped on a fault condition.
 - f) Digital meter with selector switch to indicate percent speed and percent load.
3. A set of form C, dry contacts to indicate when the AFC is in the run mode.
4. A set of form C, dry contacts to indicate when the AFC is in the fault mode.

5. When input power returns to normal following a fault trip for undervoltage, overvoltage or phase loss, the AFC shall automatically restart. The AFC shall not automatically restart following fault trips due to overload or overcurrent.
6. The AFC shall include a door interlocked, padlockable, input power disconnect switch.

C. Protective Features

1. Protection against input transient voltage spikes.
2. Separate overload protection for each motor controlled.
3. Protection against input power undervoltage, and phase loss.
4. Protection against output current overload and overcurrent.
5. Protection against overtemperature within the AFC enclosure.
6. Protection against overvoltage on the DC bus.
7. Coordinate with Division 16 that any disconnect switches between the AFC and the motor shall include an auxiliary contact interlocked to the AFC fault trip circuit. In the event that a disconnect switch is opened while the drive is running, the drive shall shut down. The AFC shall include an adjustable time delay to prevent AFC from starting into a rotating motor when the disconnect switch is closed.
8. Bus discharge circuit for protection of service personnel.
9. Insensitive to incoming power phase sequence.

D. Adjustments

1. Maximum speed, adjustable 50-100% base speed.
2. Maximum speed, adjustable 0-50% base speed.
3. Acceleration time, adjustable to 2-60 seconds.
4. Deceleration time, adjustable 2-60 seconds with worried circuit to prevent nuisance trips if decal time is set too short.
5. Current limit, adjustable 0-100%.

E. Service Conditions

1. Ambient temperature, 0-40 degrees Celsius.
2. 0-95% relative humidity, non-condensing.
3. Elevation to 3300 feet without derating.
4. AC line voltage variation, -5% to +10% of nominal.

F. Special Features

1. Manual Bypass

- a) Manual bypass shall provide all the circuitry necessary to transfer the motor from the AFC to the power line, or from the line to the controller while the motor is at zero speed. The bypass circuitry shall be mounted in a separate section of the AFC enclosure.
- b) Two motor contactors, electrically interlocked, shall be utilized. One contactor is to be between the bypass power line and the motor. The other contactor is to be between the bypass power line and the motor providing across-the-line starting. Motor overload protection is to be provided in both the controller mode and the bypass mode.
- c) The bypass section door shall include a switch to transfer motor operation from drive to line or line to drive, and a pilot light to indicate whether motor is operating in drive or line mode.
- d) The bypass circuitry shall include a fused disconnect switch or circuit breaker to provide a means of disconnecting all power to both the bypass circuitry and the controller. The disconnect switch or circuit breaker shall be door interlocked and padlockable. The fuses or circuit breaker shall be sized to provide short circuit protection for the motor when in the bypass mode per the NEC.

2.05 Temperature Controls

1. General

- a) The RTU equipment supplier shall coordinate exact control requirements and communication protocol with the Temperature Control contractor.
- b) Subject to compliance with requirements, manufacturers offering energy management and control systems which may be incorporated in the work include the following: The building automation system shall be an extension of the existing control system, utilizing the existing central computer workstation.
 - 1) Extension of existing JCI FX system – installed by Northern Air Corporation, St. Paul, MN 651-255-3520.
- c) The unit manufacturer shall be responsible for the complete installation, including wiring of all unit control components.
- d) The unit manufacturer shall submit control wiring diagrams and written sequence of control with shop drawings for submittal.
- e) The main control panel shall have access door(s) for direct access to controls. The panel shall be the equivalent to NEMA Type 3R (rainproof) and shall contain a single externally operated molded case switch. Wire and conduit entrance shall be inside of unit curbing. The control panel shall include the following:
 - 1) A power terminal block.
 - 2) A power transformer with 115 secondary and 115 volt control fuse.
 - 3) A 24 volt control transformer and fuse.
 - 4) Necessary relays.
 - 5) A 115 volt terminal strip.

- 6) A 24 volt strip which shall contain wired terminal for all controls, numbered in accordance with the wiring diagram.
- 7) An isolated 24 volt field wiring terminal strip.
- 8) An electrical print pocket which in addition to the electrical print shall contain a pre-start-up form, a start-up form and maintenance instructions.
- 9) Diagnostics and trouble light strip

The above components shall be in addition to electrical components associated with other functions which shall be incorporated into the main control panel to facilitate maintenance and trouble shooting.

- 2. Fan VAV Control
 - a) Variable frequency drives shall be arranged to receive input control signal from temperature control system duct static pressure control.
- 3. Economizer and Refrigeration Control
 - a) Upon a call for mechanical refrigeration from input signal, outside air control damper shall be allowed to modulate towards the open position subject to the unit mixed air enthalpy controller.
 - b) Upon an increase in mixed air enthalpy above set point, outside air control damper shall modulate back to minimum position and allow mechanical refrigeration to be energized in stages.
 - c) Manufacturer shall provide a Dwyer, Model A-306 outdoor static pressure sensor and shall maintain a slightly positive (+.05" building pressure by modulating the relief air dampers toward the open position upon an increase in building static above set point. Provide Dwyer, photo-helic gauge face mounted on the unit panel to provide building static indication and set point adjustment. Relief fan shall be energized by an end switch in ae relief damper actuator. Relief fans Oh units larger than 26 tons shall be provided with inlet vanes in lieu of discharge dampers.
 - d) Damper motors shall be 120 volt type and shall be provided by unit manufacturer.
- 4. Building Automation System Interface
 - a) Provide the units with terminal strips to receive control signal input requirements for the following:
 - 1) Supply fan speed control on VAV systems.
 - 2) System on/off.
 - 3) Heating on/off and stages.
 - 4) Air conditioning on/off and stages.
 - 5) Outside air damper closed (unoccupied and warm-up).
 - b) Coordinate signal requirements with the successful Section 15950 contractor.
 - c) Smoke Shutdown: Provide each unit with factory mounted supply air return air duct smoke detects compete with auxiliary contacts for fire alarm system interface. Detectors

shall be photoelectric type and shall be factory wired to shutdown their respective units and close the outside air dampers upon a smoke condition.

PART 3: INSTALLATION

3.01 GENERAL

- A. Roof Curb: Re-use existing curbs, providing any adapters, transitions and duct and piping modifications as required to connect to existing systems. Secure units to upper curb rail.
- B. Unit Support: Install units level on existing curbs.
- C. Do not operate fan system until filters are in place.

3.02 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust damper linkages for proper damper operation.
- B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.

3.03 SYSTEM START-UP

- A. Provide the services of a factory authorized service representative to provide start-up services.

END OF SECTION

ROOFTOP UNIT SCHEDULE								
UNIT TAG	RTU-2.3							
AREA SERVED	COMMUNITY CENTER							
MANUFACTURER	TRANE							
MODEL NUMBER	YCD420B4							
TYPE	PACKAGE							
NOMINAL CAPACITY (TON)	35							
EER/IEER	10.3/12.5							
MIN OUTSIDE AIR CFM	2400							
SUPPLY FAN (FORWARD CURVE)								
CFM	12000							
ESP/TESP	1.75/2.64							
RPM	761							
BHP/HP	9.99/10.0							
TYPE	BELT							
CLASS (I, II, III, IV)	I							
FILTERS								
TYPE	THROWAWAY							
DEPTH	2"							
EFFICIENCY %	MERV 8							
MEAN APD	0.08"							
GAS HEATING COIL								
CFM	12000							
EAT/LAT	70/107.3							
MBH INPUT/OUTPUT	600/480							
CONTROL STEPS	MODDULATING							
DX COOLING COIL								
CFM	12000							
EAT DB/WB	80/67							
LAT DB/WB	57.2/56.4							
COND. EAT	95.0							
SENSIBLE/TOTAL MBH	300.5/398.6							
REFRIGERANT TYPE	R-410A							
COMPRESSOR								
TYPE	SCROLL							
QUANTITY	2							
CAPACITY CONTROL	5 STEPS							
ECONOMIZER	0-100%							
ELECTRICAL								
MCA	84.08							
V-PH-CY	460/3/60							
STARTER	DIV. 15							
DISCONNECT	DIV. 16							
OPERATING WEIGHT (LBS)	6000							
ACOUSTICS								
	SELF GENERATED NOISE (DB)							
	63	125	250	500	1K	2K	4K	8K
SUPPLY DUCT	87	88	83	85	77	74	70	65
RETURN DUCT	90	88	87	85	86	87	86	85
REMARKS	RE-USE EXISTING ROOF CURBS. PROVIDE UNIT WITH MOTORIZED OA DAMPERS/ DIFF. ENTHALPY ECONOMIZER, POWER EXHAUST AND HAIL GUARDS.							