

MEA No.: 181001

## SECTION 15100 - HVAC - MATERIALS AND EQUIPMENT

## 1.1 GENERAL

- A. All applicable requirements of Section 15000 - HEATING, VENTILATING AND AIR CONDITIONING, GENERAL shall apply to this entire Section and shall have the same force and effect as if fully included herein.
- B. The Contractor shall coordinate installation of all equipment, ductwork, piping, conduit and other work to prevent obstructions, which might interfere with filter removal. Initial installation shall include one complete set of air filters installed by the Contractor. The Contractor shall also furnish one complete set of additional air filters for all filter housings for future installation.

## 1.2 SCOPE

- A. The Contractor shall provide and install all material and equipment specified and shall furnish all appurtenances necessary to properly install the equipment and place it in operation.

## 1.3 MOTORS AND MOTOR STARTERS

- A. Motors shall be high efficiency type built in accordance with NEMA Specifications.
- B. Motors used with variable frequency drives (VFD) shall use high temperature insulation (Class F or H), shall be premium efficiency design and shall have a service factor of 1.15. Motors shall be equipped with grounding rings. Coordinate motor requirements with VFD's specified in the electrical sections of the Specifications.
- C. Where motor starters are required to be provided by the HVAC Contractor by the following paragraphs of these Specifications, the motor starters shall [be as specified in Section 16100 - ELECTRICAL, WIRING SYSTEMS AND DEVICES] [be provided with a control power transformer, a hand-off-automatic switch, and starter coil] even where the starters are supplied with the equipment by the equipment vendor/manufacturer.

## 1.4 VARIABLE FREQUENCY DRIVE (VFD)

- A. Unless otherwise specified, VFDs shall be a combination type VFD motor starter with manual bypass and isolation. The VFD shall have an NEC compliant disconnect device (three pole switch or circuit breaker), bypass and normal overload protection, a Drive-Off-Bypass switch, a Hand-Off-Auto switch and 120 VAC control power transformer.
- B. The AC drive and all associated optional equipment shall be UL listed according to UL 508C Power Conversion Equipment. A UL label shall be attached inside each enclosure as verification. The AC drive shall be designed, constructed and tested in accordance with NEMA, IEEE, ANSI, NEC, VDE and IEC standards.
- C. Alternate control techniques other than pulse width modulated (PWM) are not acceptable.
- D. The AC drive shall have metal oxide varistor (MOV) protection and shall convert the input AC mains power to an adjustable frequency and voltage as defined below.
  - 1. For AC drives rated up to 75 HP, the AC drive manufacturer shall use a six pulse bridge rectifier design with AC line reactors for effective harmonic mitigation. The diode

rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage. The power section shall be insensitive to phase rotation of the AC line.

2. For AC drives rated 100 HP and above, the AC drive manufacturer shall supply an 18-pulse topology using a multiple bridge rectifier design with integral reactor and phase shifting transformer. The 18-pulse configuration shall result in a multiple pulse current waveform that approximates near sinusoidal input current waveform. The power section shall be insensitive to phase rotation of the AC line.
- E. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall use insulated gate bipolar transistors (IGBT) or intelligent power modules (IPM) as required by the current rating of the motor. The VFD shall have one 16-bit microprocessor control logic circuit board for all horsepower ratings.
- F. The AC drive shall be mounted in a Type 1 [Type 12] enclosure with an externally operated disconnect device. VFD's used outdoors shall have weathertight NEMA 4 enclosures. A mechanical interlock shall prevent an operator from opening the AC drive door when the disconnect is in the 'on' position. Another mechanical interlock shall prevent an operator from placing the disconnect in the on position while the AC drive door is open. It shall be possible for authorized personnel to defeat these interlocks. Provisions shall be made for locking all disconnects in the off position with up to three padlocks. Provisions shall be made for accepting a padlock to lock the enclosure door.
- G. Current limiting fuses sized for the motor shall be installed and wired to the AC drive input.
- H. The AC drive shall be sized and matched to the AC motor manufacturer, horsepower, motor full load ampere, motor RPM, motor voltage and motor service factor of 1.15 (i.e., the drive maximum ampere rating shall be greater than or equal to 115 percent of the motor full load amperes).
- I. The AC drive shall be sized to operate a variable torque or constant torque load as required for the application.
- J. The speed range shall be from a minimum speed of 0.5 Hz to a maximum speed of 200 Hz.
- K. The AC drive shall be designed to operate in an ambient temperature from minus ten to +40 degrees C (+26 to 104 degrees F). The maximum relative humidity shall be 95 percent at 40 degrees C, non-condensing. The AC drive shall be rated to operate at altitudes less than or equal to 3,300 feet. For altitudes above 3,300 feet, derate the AC drive by 1.2 percent for every 300 feet. The AC drive shall meet the IEC 68-2 Operational Vibration Specification. The AC drive shall meet IEC 664-1 and NEMA ICS 1 Standards.
- L. The AC drive shall be designed to operate from an input voltage as shown on the Drawings +/- 10 percent. The AC drive shall operate from an input voltage frequency range of 60 Hz +/-two percent. The displacement power factor shall not be less than 0.95 lagging under any speed or load condition. The efficiency of the AC drive at 100 percent speed and load shall not be less than 96 percent.
- M. The torque rated AC drive overcurrent capacity shall be 125 percent for one minute. The output carrier frequency of the AC drive shall be randomly modulated and selectable at 2, 4, or 10 kHz depending on drive rating for low noise operation. No AC drive with an operable carrier frequency above 10 kHz shall be allowed. The AC drive will be able to develop rated motor torque at 0.5 Hz (60 Hz base) in a sensorless flux vector (SVC) mode using a standard induction motor without an encoder feedback signal.

- N. The AC drive shall be UL 508C listed for use on distribution systems with available fault current equal to the upstream protective device rating unless otherwise noted. The AC drive shall have a coordinated short circuit rating designed to UL 508C and NEMA ICS 7.1.09 and listed on the nameplate. The power converter shall be protected against short circuits, between output phases and ground; and the logic and analog outputs.
- O. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function will provide up to five programmable restart attempts. The programmable time delay before restart attempts will range from one second to 600 seconds.
- P. There shall be three skip frequency ranges that can each be programmed with a selectable bandwidth of 2 or 5 Hz. The skip frequencies shall be programmed independently, back-to-back or overlapping.
- Q. The AC drive shall be factory preset to operate the motor load indicated. All programming shall be maintained in non-volatile RAM memory so the program will be maintained when power is removed.
- R. The operator interface terminal will offer the modification of AC drive adjustments via a touch keypad. The display will be a high resolution, LCD backlit screen capable of displaying graphics such as bar graphs as well as six lines of 21 alphanumeric characters. A single keystroke scrolling function shall allow dynamic switching between display variables.
- S. External pilot devices shall be able to be connected to a terminal strip for starting/stopping the AC drive, speed control and displaying operating status. All control inputs and outputs will be software assignable. Two-wire or three-wire control strategy shall be defined within the software. Two-wire control allows automatic restart of the AC drive without operator intervention after a fault or loss of power. Three-wire control required operator intervention to restart the AC drive after a fault or loss of power. The control power for the digital inputs and outputs shall be 24 VDC.
- T. There will be two software assignable, optically isolated analog inputs. The analog inputs will be software selectable and consist of the following configurations: 0-20 mA, 4-20 mA.
- U. There will be four software assignable, optically isolated logic inputs that will be selected and assigned in the software. The selection of assignments shall consist of run/reverse, jog, plus/minus speed (two inputs required), setpoint memory, preset speeds (up to two inputs), auto/manual control, controlled stop, terminal or keypad control, bypass (two inputs required), motor switching and fault reset.
- V. Two voltage free Form C relay output contacts will be provided. One of the contacts will indicate AC drive fault status. The other contact will be user assignable.
- W. The AC drive door mounted control island shall include a power 'on', drive 'run', drive fault light and hand-off-auto selector switch with manual speed potentiometer.
- X. The AC drive shall include IEC rated isolation and bypass contactors complete with thermal overload relay, circuit breaker or molded case switch disconnect interlocked with the door, control power transformer, motor flux decay timer, drive run light, bypass run light and drive/off/bypass switch. The operator shall have full control of the bypass starter operation of the door mounted selector switch.
- Y. Installation shall comply with manufacturer's instructions, drawings and recommendations. The AC drive manufacturer shall provide a factory certified technical representative to supervise the Contractor's installation, testing and startup of the AC drive(s) furnished under this specification.

An on-site training course shall be provided by a representative of the AC drive manufacturer for plant and/or maintenance personnel.

- Z. All disconnect switches downstream of the VFD shall have an auxiliary contact wired to the VFD such that opening the disconnect de-energizes the VFD prior to disconnecting power to the motor.

#### 1.5 VARIABLE REFRIGENRANT FLOW SYSTEM

- A. The HVAC basis of design shall be Daikin VRF as scheduled or approved equal.
- B. Bidders shall provide the minimum system as indicated on drawing, including Heat Recovery or Heat Pump systems as defined by model and family numbers. All systems shall be capable of providing the scheduled capacity at the location of the indoor unit regardless of pipe length. Nominal or catalog capacities will not be accepted.
- C. The system shall consist of Daikin Air Source unit(s), multiple Daikin indoor units, and Daikin VRF System Controls or approved equal.

#### 1.6 QUALITY ASSURANCE

- A. System efficiencies (SEER and HSPF) for units less than 65,000 BTUH shall be certified by AHRI standard 210-240, and shall be published for public review at [www.ahrinet.org](http://www.ahrinet.org). Equipment that is "rated" in accordance with AHRI Standard 210-240, but not published for public review by AHRI shall not be accepted.
- B. System efficiencies (IEER and SCHE) for units greater than 65,000 BTUH shall be certified by AHRI standard 1230, and shall be published for public review at [www.ahrinet.org](http://www.ahrinet.org). Equipment that is "rated" in accordance with AHRI Standard 1230, but not published for public review by AHRI shall not be accepted.
- C. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- D. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- E. Project shall comply with the applicable version of ASHRAE standard 15.
- F. Project shall comply with the applicable version of ASHRAE 90.1
- G. The VRF manufacturing facility shall be registered to ISO 9001 and ISO14001.
- H. All components shall be provided by one manufacturer including but not limited to:
  - Outdoor Units
  - 1. Indoor Units
  - 2. Mode Control Units as required
  - 3. All necessary and applicable controls for the VRF System
  - 4. Factory refrigerant charge for outdoor unit(s) only
  - 5. Factory Y and or T-Branch(s) as required
  - 6. Condensate Lift Pump(s) as shown on the contract documents

7. Refrigerant Ball Valves as shown on the contract documents
8. Service Software

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Installing contractor will take all reasonable and appropriate care to store and handle equipment per the manufacturer's recommendation.

#### 1.8 SUBMITTALS

- A. Installing contractor shall provide the following:
  1. Daikin VRF Guide Specification
  2. Daikin VRF Dimensional Data for all products submitted
  3. Daikin VRF Product Data for all products submitted.
  4. Daikin VRF Select report showing design conditions, total load profile, and actual capacity at actual Indoor Unit location,
  5. Daikin VRF Select Piping and Wiring layout showing estimated piping, wiring sizes, equipment quantities, piping length estimate, and additional refrigerant charge.
  6. Daikin VRF Select Schedule showing the performance for all pieces of equipment.

#### 1.9 INSTALLATION AND OPERATION MANUALS

- A. Owner shall be provided with a complete and comprehensive electronic set of Installation and Operation Manuals.

#### 1.10 QUALIFICATIONS

- A. Manufacturer shall have a minimum of twenty-five (25) years of HVAC experience in the North America market.
- B. Manufacturer to have Local Factory Service within seventy-five (75) miles of jobsite.
- C. The Daikin VRF system shall be installed by a Daikin certified installer with extensive Daikin VRF installation and service training. The mandatory contractor service and install training shall be performed by the manufacturer.

#### 1.11 WARRANTY

- A. The units shall be covered by the manufacturer's standard limited warranty for a period of 12 months from date of installation. If during this period, any part should fail to function properly

due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

- B. The units shall carry an extended manufacturer's parts and compressor warranty for a period of 10 years from date of installation. The following steps shall be taken by the contractor to ensure systems are eligible for extended warranty.
  - 1. System is designed and submitted using the approved application tool (Daikin VRF Select).
  - 2. System installed by a contractor who has successfully completed the Daikin factory training class.
  - 3. Upon completion of installation and prior to final commissioning, contractor shall provide revised piping layout reflecting actual installation conditions to Daikin VRF technician for submittal to Daikin Factory Service Department.
  - 4. Provide a verified and submitted commissioning report to Daikin Factory Service Department.

## 2.1 MANUFACTURERS

- A. Basis of design shall be: Daikin VRF or approved equal.
- B. The following manufacturers shall be allowed to bid as a deductive alternate provided they meet the scheduled performance indicated on the drawings:
  - 1. Trane
  - 2. Mitsubishi

## 2.2 HEAT PUMP AIR SOURCE UNITS

- A. The Daikin VRF Heat Pump Air Source unit (or approved equal) shall be specifically used with Daikin VRF Heat Pump components. The unit electrical power shall be 208/230 volts or 460 volts, 3 phase, 60 hertz as specified. Units shall have weather tight construction for outdoor installation, (outdoor unit).
- B. The Daikin Heat Pump outdoor unit shall be equipped with multiple circuit boards. These boards shall perform all functions necessary for operation. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested.
  - 1. The combination ratio of the nominal indoor cooling capacity versus the nominal outdoor rated cooling capacity shall range from 50% to 130%.
  - 2. Outdoor unit shall have a sound rating no higher than 62/83(Pressure/Power) dB(A).
  - 3. Unit shall have a night quiet setting to reduce nighttime sound levels.
  - 4. All refrigerant lines from the outdoor unit to IDUs (Indoor Units) shall be field insulated with a minimum insulation as referenced in the Daikin VRF IOM (VRF-SVN034A-EN) Table 27, "Pipe insulation selector."
  - 5. The outdoor unit shall have an accumulator.

6. The outdoor unit shall have a high pressure safety switch, fuse, over-current protection and crank case heater.
  7. If the outdoor unit is above the indoor unit, the outdoor unit shall have the ability to operate with a maximum height difference of 361ft. If the indoor unit requirement is greater than 164 ft, contact your local Daikin Sales Office.
  8. If the outdoor unit is below the indoor unit, the outdoor unit shall have the ability to operate with a maximum height difference of 131 ft.
  9. The system shall have a maximum total refrigerant tubing length of 3281ft.
  10. The maximum length between outdoor unit and the furthest indoor units is not to exceed 656 ft (722 equivalent feet).
  11. The maximum height difference between indoor units shall be 164 ft.
  12. The outdoor unit shall be capable of operating in cooling mode from 23°F to 120°F.
  13. The outdoor unit shall be capable of operating in heating mode from 75°F to -13°F ambient temperatures without additional low ambient controls, additional modules, or low ambient accessories.
  14. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
  15. The outdoor units shall provide continuous heating during oil return and the defrost cycle through the use of rotational defrost. (multiple module systems)
  16. Units shall have a snow blower feature to ensure the dispersion of accumulated snow  
The unit casing(s) shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.
- D. The outdoor unit condenser fans shall be furnished with direct drive, variable speed motor(s). All fan motors shall have inherent motor protection, have permanently lubricated bearings. All fan motors shall be mounted for quiet operation. All fans shall be provided with a raised guard to prevent contact with moving parts. The outdoor unit shall have vertical discharge airflow.
  - E. R410A refrigerant shall be required for Daikin VRF outdoor unit systems. Manufacturer shall only provide the refrigerant as required for unit charge. Contractor shall be required to provide additional refrigerant as specified in Daikin VRF Select reports.
  - F. System shall use Polyvinylether (PVE) oil. Due to the increased risk of hydrolysis and formation of acids, Polyolester (POE) oil shall not be acceptable.
  - G. The outdoor condenser coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. The condenser coil shall have Blue Fin anti-corrosion protection as a standard feature. The coil shall be protected with an integral metal guard. The coil fins shall be coated with hydrophilic paints.
  - H. The Daikin VRF Heat Pump outdoor units shall be equipped with inverter driven vapor injection asymmetric scroll compressor(s). The asymmetric design will allow for only one point of contact for the scroll compressor blades resulting in reduced friction, and increased efficiency. Conventional scroll compressors with 2-points of contact will not be allowed due to their inherent inefficiency.

- 1) The outdoor unit compressor shall utilize inverter driven technology to modulate capacity. The compressors shall also utilize advanced technology adaptive sine wave control for reduced harmonics and faster frequency acceleration.
  - 2) The compressor shall be capable of 1/60<sup>th</sup> second advanced micro-control.
  - 3) The outdoor unit compressor shall utilize vapor injection technology which shall increase the mass flow rate of refrigerant, resulting in improved performance for low temperature conditions.
  - 4) The compressor will be equipped with an internal thermal overload protection.
  - 5) The compressor shall be mounted to avoid the transmission of vibrations.
- J. Use 18 AWG, 25pF/ft nom., 60.7  $\Omega$  impedance, braid or foil shielded, twisted pair wire for communications wiring. Splicing of communication wiring shall not be permitted.

## 2.2 4-WAY MINI/ 4-WAY CEILING CASSETTE INDOOR UNITS

- A. The Daikin indoor non-ducted units (or approved equal) are four-way cassette style indoor units that recess into the ceiling grid with an exposed ceiling grille and an integral 2000 step modulating expansion device. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.
- B. The indoor unit shall be a factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, the electronic modulating linear expansion device, control circuit board, and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function. The unit shall be provided with a face mounted infrared receiver for use with a handheld wireless remote controller. The unit shall have an integral return air sensor.
- C. The unit cabinet shall be a space-saving ceiling-recessed cassette.
- D. The indoor fan shall consist of a turbo fan with a single direct drive motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. The indoor fan shall have high, medium, and low fan speeds. The fan speed shall be adjustable by an optional remote controller. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution. If require the cassette shall be capable of closing off one or more vanes to prevent "stray airflow".
- E. Return air shall be filtered by means of a long-life washable permanent filter.
- F. The indoor coil shall be constructed as follows:
  - 1) The indoor coil shall be of nonferrous construction with slit fins on copper tubing.
  - 2) The tubing shall have inner grooves for high efficiency heat exchange.
  - 3) All tube joints shall be brazed with phos-copper or silver alloy.
  - 4) The coils shall be pressure tested at the factory.
  - 5) A condensate pan and drain shall be provided under the coil.
  - 6) The coil fins shall be coated with hydrophilic paints.
  - 7) The factory installed condensate lift mechanism shall be able to raise drain water 29.5 inches water column above the condensate pan.
  - 8) Both refrigerant lines to the indoor units shall be insulated.
- G. Use 18 AWG, 25pF/ft nom., 60.7  $\Omega$  impedance, braid or foil shielded, twisted pair wire for communications wiring. Splicing of communication wiring shall not be permitted.



- H. This unit shall use controls provided by Daikin to perform functions necessary to operate the system. Please refer to Part 3 of this guide specification for details on controllers and other control options.

### 2.3 SLIM DUCT DUCTED INDOOR UNITS

- A. The Daikin indoor slim ducted units (or approved equal) are ducted indoor fan coil designs that mounts above the ceiling. The unit shall have a 2000 step modulating expansion device. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.
- B. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, the electronic modulating linear expansion device, control circuit board, and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. The unit shall be capable of accepting a VRF Duct Signal Receiver (optional) for use with a handheld wireless remote controller. The unit shall have integral return air sensor, integral discharge air sensor, and integral contacts to interface with an external auxiliary heat source.
- C. The unit cabinet shall be a space saving, ceiling-concealed, ducted unit. The cabinet panel shall have provisions for a field installed filtered outside air intake.
- D. The indoor unit fan shall consist of two or three Sirocco fans, direct driven by a single motor. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall have high, medium, and low fan speeds. The fan speed shall be adjustable by an optional remote controller. The airflow may also be adjusted based on static pressure using the Daikin VRF Technician Utility Tool (TUT).
- E. The return air shall be filtered by means of a standard factory installed return air filter. An optional return filter box (rear placement) with high-efficiency filter shall be available for ducted indoor units. If using the optional return filter box, verify the filter/filter box performance is within the bounds of the unit's external pressure performance.
- F. The indoor coil shall be constructed as follows:
  - 1) The indoor coil shall be of nonferrous construction with slit fins on copper tubing.
  - 2) The tubing shall have inner grooves for high efficiency heat exchange.
  - 3) All tube joints shall be brazed with phos-copper or silver alloy.
  - 4) The coils shall be pressure tested at the factory.
  - 5) A condensate pan and drain shall be provided under the coil.
  - 6) The coil fins shall be coated with hydrophilic paints.
  - 7) The optional field installed condensate lift mechanism shall be able to raise drain water 29.5 inches water column above the condensate pan.
  - 8) Both refrigerant lines to the indoor units shall be insulated.
- G. Use 18 AWG, 25pF/ft nom., 60.7  $\Omega$  impedance, braid or foil shielded, twisted pair wire for communications wiring. Splicing of communication wiring shall not be permitted.
- H. This unit shall use controls provided by Daikin to perform functions necessary to operate the system. Please refer to Part 3 of this guide specification for details on controllers and other control options.

### 2.4 CONVERTIBLE AIR HANDLER INDOOR UNITS

- A. The Daikin indoor vertical ducted units (or approved equal) are convertible multi-position indoor air handler designs. The unit shall have a 2000 step modulating expansion device. The AHU electrical power shall be 208-230 volts, 1-phase. Units may use an optional 1-phase or 3-phase electric heater kit. 1-phase units may receive power via the 3-phase heater kit.
- B. The unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, the electronic modulating linear expansion device, sensors, and fan motor. Sensors shall require field termination to the AHU Controller.
- C. The unit shall require an AHU Controller. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. The AHU controller shall interface with the Daikin Wired Controller. The Wired Controller shall be installed in the occupied zone. The AHU controller shall be shipped separately for field installation and termination.
- D. The unit cabinet shall mount up-flow, or horizontal left, and is convertible to horizontal right. Unit shall have an insulated painted galvanized steel cabinet.
- E. The indoor unit shall have a direct driven blower wheel. 2 through 4 tons shall have of a 3-speed, PSC direct drive motor. 5-ton units shall have an ECM direct driven motor. The indoor fan shall be statically and dynamically balanced, and run on a motor with permanently lubricated bearings. The indoor fan shall have high, medium, and low fan speeds.
- F. The return air shall be filtered by a remote field installed filter. Verify the filter performance is within the bounds of the unit's external pressure performance.
- G. The indoor coil shall be constructed as follows:
  - 9) The indoor coil shall be of nonferrous construction with an all-aluminum coil.
  - 10) The coils shall be pressure tested at the factory.
  - 11) A poly carbonate condensate pan and drain shall be provided under the coil.
  - 12) Both refrigerant lines to the indoor units shall be insulated.
- H. Use 18 AWG, 25pF/ft nom., 60.7  $\Omega$  impedance, braid or foil shielded, twisted pair wire for communications wiring. Splicing of communication wiring shall not be permitted.
- I. This unit shall use controls provided by Daikin to perform functions necessary to operate the system. Please refer to Part 3 of this guide specification for details on controllers and other control options.

## 2.5 ACCESSORIES

- A. Y-Joint Kits- are a required component for Daikin VRF-Systems with multiple evaporators or MCU's on the same system. Y-joints shall be provided for liquid, suction, and hot gas fittings as required. Y-joints shall be provided with polystyrene insulation. Y-branches shall facilitate different pipe sizes without having to braze additional fittings. Field fabrication or substitution of non-Daikin Y-Joints shall void warranty. Kits shall be installed per manufacturer guidelines. Requires field installation.
- B. T-Joint Kits – are a required component for Daikin VRF systems capable of operating multiple outdoor modules on a single system, (check catalog(s) for factory approved combinations). The T-Joint shall be provided for liquid, suction, and hot gas fittings as required. T-Joints shall be provided with polystyrene insulation. T-Branches shall facilitate different pipe sizes without having to braze additional fittings. Field fabrication or substitution of non-Daikin T-joints shall void warranty. Kits shall be installed per manufacturer guidelines. Requires field installation.

- C. EEV KITS- the EEV (Electronic Expansion Valve) provides refrigerant management of indoor units. The EEV shall be required for field installation on ceiling suspended (floor) indoor units. Heat Recovery systems shall use the one unit EEV kit. Heat Pump systems may utilize the one, two, or three unit EEV kits. Kits shall be installed per manufacturer guidelines. Requires field installation.
- D. Condensate Drain Pumps shall be provided for field installation as required for efficient condensate management. Condensate pumps shall be capable of 29.5" of lift to allow condensate to reach the closest gravity drain line. Condensate pumps shall include a check valve to prevent water from flowing back into the indoor unit. Pump shall be mounted in the chassis of the indoor unit. Pump shall draw on required power from the associated indoor unit. Requires field installation (Standard factory installed for all ceiling cassettes).
- E. Refrigerant Isolation Ball Valves - shall be provided for field installation as specified by the contract documents. Valves shall utilize a uni-body full port design to minimize leaks and internal pressure drops. Valves shall be rated for 700PSIG, and are offered with an optional factory insulation package. Valves shall be factory tested under pressure. Valves shall require polytetrafluoroethylene (PTFE) seals and gaskets. No synthetic O-rings are allowed. Design shall permit valve operation without removal of seal cap. Valves shall have a temperature operation range of -40°F to 300°F. Valves 5/8" and smaller shall be flare fittings. Valves larger than 5/8" shall be sweat fittings. Valves shall be provided with formed and fitted insulated jacket. Requires field installation.
- F. Simple wired remote controller can be used with all Daikin VRF Indoor Units. Remote shall utilize a multi-function LCD display and shall possess the following functionality:
  - 1) Power on/off setting
  - 2) Mode selection
  - 3) Temperature set point control
  - 4) Fan speed setting
  - 5) On/off timer
  - 6) Controls up to 16 idus
  - 7) Up to 2 simple remotes may be configured as Master Slave for 1 IDU
  - 8) Child lock
  - 9) Filter timer
- G. The VRF Duct Signal Receiver is a wall or ceiling-mounted device that receives signals from the Wireless (Infrared) Remote Control. It re-transmits those signals to an associated concealed VRF Indoor Unit. This allows for use of remote control of concealed indoor units. Requires field installation.
- H. Auxiliary heat contact shall enable the operation of external auxiliary supplemental heat (if scheduled or included).
- I. Standard Cassette Panels shall be required with as indicated for all 1-way, Mini 4-way, and 4-way ceiling cassettes.
- J. Filter Box is an optional return filter box (rear placement) that enables the use of high efficient filters with ducted concealed indoor units. If using the optional return filter box, verify the filter/filter box performance is within the bounds of the unit's external pressure performance. Requires field installation.
- K. Electric Heater Kit allows a Convertible Air Handling Unit (only) to provide supplemental heat with an optional electric resistance heater. The electric heater shall be available in 4KW, 5KW, 8KW, 10KW, 15KW, and 20 KW sizes. Heater kits are available with circuit breaker, pull disconnect, or

lug connections (choose one). Review product IOM (VRF-SVX038A-EN) for specific kit details. Requires field installation.

- L. Single point power entry kit allows a Convertible Air Handling Unit (only) to use single point power if the desired Electric Heater kit is greater than 10 KW. Heaters 10KW and less are single point connection as standard. Requires field installation.
- M. Filter rack allows a Convertible Air Handling Unit (only) comes in three sizes and will accept a 1" filter. Rack is painted to match the Convertible Air handling Unit, and is hinged for easy front filter access. Requires field installation.
- N. Mode Select Switch shall enable the manually override mode control for the VRF HP system. The switch shall set the operating mode as Cool, Heat, or Auto. (For use on heat pump systems only.) Requires field installation.
- O. Hail guards shall protect the air source condenser coil(s) from damaging hail. Requires field installation.
- P. Wind/Snow Prevention Duct. The kits are used in windy or snowy regions to prevent cold gusts of air from interfering with stable operation of the units. They are also for use in snowy regions to prevent snow from accumulating on the units. The kit is recommended when low ambient heating is required. The Wind/Snow prevention kit may require the additional use of the Duct Discharge Kit. Requires field installation.
- Q. Snow Hood/Duct Discharge Kit protects the Air Source VRF Outdoor unit from heavy snowfall. The kit also allows the Air Source VRF unit to be located inside a structure, and duct the condenser discharge air to the exterior of the structure. Requires field installation.

### 3.1 ELECTRICAL CHARACTERISTICS

- A. The Daikin VRF System Network Controls shall operate at 12VDC. Controller power and communications shall be via a common non-polar communications bus.
- B. Control wiring shall be installed in a system daisy chain configuration from the wired remote controller to the indoor unit, to the and to outdoor unit. Control wiring to wired remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
- C. Control wiring for system controllers, and centralized controllers shall be installed in a daisy chain configuration from interface module to interface module, to system controllers, to the power supply.
- D. For communication wiring between ODUs, IDUs, MCU, system controller, and remote controllers use 18 AWG, 25pF/ft nom., 60.7  $\Omega$  impedance, braid or foil shielded, twisted pair wire. Splicing of communication wiring shall not be permitted.
- E. The Daikin VRF SC Web UI shall be capable of being networked with the VRF System Controller TVCTRLTIMD00A0, system controllers for web based control.
- F. Network wiring shall be CAT-5e with RJ-45 connection.

### 3.2 SYSTEM NETWORK CONTROLS

#### VRF-SYSTEM TOUCHSCREEN CONTROLLER

- A. The VRF System Touchscreen shall provide an intuitive, fast and convenient method of centrally operating a Daikin VRF system. The VRF System Touchscreen shall communicate with associated VRF components through a dedicated control network. It can control many comfort and energy-saving settings, including temperature, fan speeds, and operating schedules for up to 128 indoor units, and up to 16 outdoor units. The unit shall be housed in an attractive enclosure suitable for wall-mounting in an office, corridor or utility room.
- B. The System Touchscreen shall feature a 7" Color Capacitive Touch Screen. The User interface shall display operating equipment icons indicating mode status at a glance. All units within a zone shall be managed with one-button control. Unique zone description icons shall make it easy to recognize a zone.
- C. Control shall include but not be limited to the following; On/Off control, temperature set-point, mode settings Auto/Heat/Cool/Auto/Dry/Fan, air-direction adjustment, and local temperature set-point restrictions.
- D. The System Touchscreen shall be capable of setting up to up to 10 unique schedules including exception day setting for holidays, and Daylight Saving Time adjustment.
- E. The System Touchscreen shall be capable of grouping indoor unit in common zones. There may be up to 12 zones. Zones may be individually named.
- F. The System Touchscreen shall provide management of multiple indoor units as 1 unit (Group control). Additionally, the controller shall provide monitoring and control points for Interlocking of external equipment via 2 Binary Inputs and 1 Binary Output.
- G. The System Touchscreen shall provide an alarm/error display, and alarm history.
- H. Security shall be provided by a secure password.
- I. The System Touchscreen shall connect via R1/R2 VRF communications link for monitoring and control of up to 128-total Indoor Units and MCUs, associated with up to 16-outdoor units. Alternately, the system shall connect via F1/F2 VRF communications link for monitoring and control of up to 64-indoor units plus up to 16-MCUs, associated with 1-Outdoor Unit.

#### 4.0 INSTALLATION

- A. System shall be installed in accordance with manufacturer's guidelines.
- B. Installing contractor shall attend and successfully complete the Daikin VRF Installation factory training class. Contractor shall submit certificate of completion as part of project closeout documents.
- C. Installing contractor shall install units to comply with all applicable building codes.
- D. Daikin VRF systems shall be installed in such a way as to permit access for routine maintenance.

#### 4.1 COMMISSIONING

- A. Daikin Factory Technician will support Installing Mechanical Contractor with 2 days of site support for system startup, commissioning, and trouble shooting.
- B. Upon completion of installation and prior to final commissioning, contractor shall provide revised piping layout reflecting actual installation conditions to Daikin VRF technician.

- C. The system shall then be reviewed and commissioned by a Daikin Factory VRF Technician. Contractor shall provide a verified and submitted commissioning report to Daikin Factory Service Department, and to the owner's agent verifying the system has met the requirements for proper installation, and function.
- D. Engage a Daikin Factory Certified VRF Technician to train owner's maintenance personnel to adjust, operate, and maintain units.

## 2.3 AIR FILTERS

- A. Air filters shall be rated in accordance with the ASHRAE Standard Test 52 using atmospheric dust. Filters shall be listed by the Underwriter's Laboratories.
  - 1. Prefilters shall be of the dry disposable pleated type. Filters shall have an average efficiency of 35 percent. Media shall be composed of a non-woven fine fibered media laminated to a rigid backing to hold the pleat formation. Filters shall be encased in a sturdy kraftboard frame. Filters shall be Aeropleat as manufactured by Cambridge Filter Corporation or approved equal.

## 2.4 AIR PURIFICATION SYSTEMS

- A. The air purification system shall consist of a plasma ion generator with bipolar ionization output to reduce space contaminants in accordance with the ASHRAE 62.1 IAQ engineered exception. The system shall be as manufactured by Global Plasma Solutions, or approved equal.
- B. GPS-FC-1 units shall be installed within all new VRF indoor air handlers.
- C. Provide to the owner a portable hand-held ion counter with a calibrated range of 0 to 20,000 ions/cm<sup>3</sup> and an accuracy of  $\pm 25\%$  within the specified range. Ion counter shall have automatic zeroing capability on 10 minute intervals.

## 2.5 FANS

- A. Centrifugal cabinet fans shall have centrifugal steel wheels, galvanized steel fan casing with integral backdraft damper, disconnect switch mounted and wired and perforated metal face grille with extruded aluminum frame where scheduled. Fans shall carry the UL label and be rated in accordance with the AMCA test code. Fans shall be provided with a speed controller. Capacities shall be as indicated on the Drawings. Fans shall be as manufactured by Loren Cook or approved equal with model numbers as scheduled.

## 2.6 ELECTRIC WALL HEATERS

- A. Wall heaters shall have steel finned tubular elements, 18 gauge steel grille with epoxy-polyester powder paint finish, integral thermostat, automatic reset thermal cutout, and totally enclosed fan. Units shall be as scheduled on the Drawings.

## 2.7 VIBRATION TOLERANCES AND VIBRATION ISOLATORS

- A. General: Furnish and install equipment for vibration and balancing requirements.
- B. Vibration Tolerances: Rotating, non-reciprocating equipment shall be balanced both statically and dynamically at factory and at job site after installation. Equipment, when mounted and placed in operation, shall not exceed a self-excited vibration velocity of 0.10-inches per second

when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed.

C. Vibration Isolation

1. Static Deflection: Vibration isolators shall have minimum static deflection as outlined in Equipment Vibration Isolation Schedule, this Section. Equipment supporting structure (Vibration Isolating System) shall not have any natural frequency within plus 20 percent of operating speeds.
2. No metal-to-metal contact shall be permitted between fixed and floating parts.
3. Lateral Motion: Vibration isolation system shall have a maximum lateral motion under equipment startup and shutdown conditions of 1/4-inch. Restrain excess motion by spring type mountings.
4. Connections to equipment shall allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections etc. made to rotating or reciprocating equipment (fans, compressor, etc.) which rest on vibration isolators, shall be isolated from building structure for first fifty pipe diameters or as indicated in the ASHRAE Guide.
5. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.

D. Types of Isolators: Type of isolation, base and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to the following minimum requirements:

1. Pumps and air compressor shall have spring isolator with a minimum static deflection of 0.75-inches.
2. Fans with wheel diameters of 18-inches and less shall have spring isolator with a minimum static deflection of 0.75-inches.
3. Fans with wheel diameters greater than 18-inches shall have spring isolators with a minimum static deflection of 1.5-inches.
4. Floor mounted air handling units shall have spring isolators and a minimum static deflection of 0.75-inches.
5. Suspended air handling units shall have spring isolators and a minimum static deflection of one-inch.
6. Spring type isolators shall be free standing and laterally stable without any housing and complete with 1/4-inch neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.
7. Pads, Washers and Bushings: Pads shall be felt, cork, neoprene waffle, neoprene and steel waffle or reinforced canvas duck and neoprene. Washers and bushings shall be reinforced canvas duck and neoprene.

8. Spring type hangers shall contain a steel spring and 0.3-inch deflection neoprene element in series. Neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit hanger rod to swing through a 300 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.

E. Flexible Connections

1. Flexible Pipe Connections: Shall be provided on suction and discharge piping of all reciprocating and/or rotating mechanical equipment and sized to allow for vibrational displacement of machine. Flexible connectors shall be as manufactured by Flexonics Division, Universal Oil Products Co or approved equal.
2. Flexible Duct Connections: Shall be provided at all connections to air moving units (fan coils, air handlers and fans) and shall be Duro-Dyne or approved equal with 30 ounce Neoprene fabric.

2.8 THERMOSTAT COVERS AND MOUNTING HEIGHT

- A. Provide all new and relocated thermostats with tamper-proof transparent covers and mounting height shall be in accordance with ADA requirements.

END OF SECTION 15100