

**CSI 2004 Format**

<b>Division 23</b>	HEATING VENTILATING AND AIR CONDITIONING
<b>23 81 26</b>	VARIABLE REFRIGERANT FLOW HVAC SYSTEMS
<b>23 81 28</b>	VRF DUCTLESS SPLIT-SYSTEM AIR-CONDITIONING UNITS
<b>23 81 30</b>	BASIS OF DESIGN VRF EQUIPMENT

**CSI 1995 Format**

<b>Section 157 00</b>	DECENTRALIZED HVAC EQUIPMENT
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**Part 01 - General**  
**1.01 Description**

The Heating Ventilation and Air Conditioning system shall be a Variable Refrigerant Flow (VRF) multi-zone capable system.

<V5-230:3>

The HVAC System shall be a heat-pump or heat recovery VRF system with the same SKU. It shall consist of one or multiple outdoor units per refrigerant circuit, one or multiple indoor units, piping, and digital controls. The outdoor unit shall be a 208-230V/3-phase V-V.

</V5-230:3>

<V5-460:3>

The HVAC System shall be a heat-pump or heat recovery VRF system with the same SKU. It shall consist of one or multiple outdoor units per refrigerant circuit, one or multiple indoor units, piping, and digital controls. The outdoor unit shall be a 460V/3-phase V-V.

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<V2-230:3>

The HVAC System shall be a heat-pump VRF system. It shall consist of one or multiple outdoor units per refrigerant circuit, one or multiple indoor units, piping, and digital controls. The outdoor unit shall be a 208-230V/3-phase V-II.

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<V2-460:3>

The HVAC System shall be a heat-pump VRF system. It shall consist of one or multiple outdoor units per refrigerant circuit, one or multiple indoor units, piping, and digital controls. The outdoor unit shall be a 460V/3-phase V-II.

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<VR2-230:3>

The HVAC System shall be a heat-recovery VRF system. It shall consist of one or multiple outdoor units per refrigerant circuit, one or multiple indoor units, one or multiple refrigerant branch unit boxes, piping, and digital controls. The outdoor unit shall be a 208-230V/3-phase VR-II. Each of the indoor units shall be capable of changing its mode (heating, cooling) independently of other indoor units' modes.

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<VR2-460:3>

The HVAC System shall be a heat-recovery VRF system. It shall consist of one or multiple outdoor units per refrigerant circuit, one or multiple indoor units, one or multiple refrigerant branch unit boxes, piping, and digital controls. The outdoor unit shall be a 460V/3-phase VR-II. Each of the indoor units shall be capable of changing its mode (heating, cooling) independently of other indoor units' modes.

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**FUJITSU GENERAL AMERICA, INC.**  
*Airstage VRF CSI Master Specifications Format*

<VR2-230:3>

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</VR2-230:3>

<VR2-460:3>

The HVAC System shall be a heat-recovery VRF system. It shall consist of one or multiple outdoor units per refrigerant circuit, one or multiple indoor units, one or multiple refrigerant branch unit boxes, piping, and digital controls. The outdoor unit shall be a 460V/3-phase VR-II. Each of the indoor units shall be capable of changing its mode (heating, cooling) independently of other indoor units' modes.

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The HVAC System shall be a heat-pump VRF system. It shall consist of one outdoor unit per refrigerant circuit, one or multiple indoor units, piping, and digital controls. The outdoor unit shall be a 208-230V/3-phase J3-Series.

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The HVAC System shall be a heat-pump VRF system. It shall consist of one outdoor unit per refrigerant circuit, one or multiple indoor units, piping, and digital controls. The outdoor unit shall be a 208-230V/1-phase J4-Series.

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#### **1.02 Approved Manufacturers and models**

- A. Fujitsu shall be the Base of Design (BOD) using the Airstage VRF system.

#### **1.03 Quality Assurance**

- A. The VRF system shall be manufactured in facilities registered to follow the International Standard Organization (ISO) ISO 9001 - Quality Management and ISO 14001 - Environmental Management Standards.
- B. All outdoor and indoor units shall be listed under Electrical Testing Laboratories (ETL) and carries the ETL label.
- C. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE Standard 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE Standard 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- E. All wiring shall be in accordance with the National Electric Code (NEC).

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- F. All 3-phase outdoor units must be listed in the Department of Energy (DOE) Compliance certificate Database under "Air Conditioners and Heat Pumps – Variable refrigerant Flow Multi-Split".

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- G. All single-phase outdoor units must be listed in the Department of Energy (DOE) Compliance certificate Database under "Air Conditioners and Heat Pumps – Residential Central".

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#### **1.04 Delivery, Storage, and handling**

All outdoor units, indoor units, controls, and piping components shall be stored and handled according to the manufacturer's recommendation.

**1.05 Warranty**

The outdoor units and indoor units shall be covered by a minimum of (1) year parts and (2) years compressor manufacturer's Limited Standard Warranty. The warranty shall only cover any defects in material or workmanship as long as the VRF system is used for human thermal comfort or other approved applications under normal use and service. Any repaired or replaced component or part shall be warranted for the remainder of the original Standard Limited Warranty period or thirty (30) days after shipment of replacement part, whichever is longer.

The Manufacturer shall offer up to ten (10) year Extended Warranty. The outdoor units and indoor units shall qualify to receive the manufacturer's Extended Warranty when installed according to all of the manufacturer's Qualified System requirements listed:

- a) The system is designed using the VRF manufacturer system design software; and
- b) The system is installed for human thermal comfort or other manufacturer approved applications; and
- c) The system is installed by the VRF manufacturer trained and approved contractor; and
- d) The system is commissioned by the VRF manufacturer certified commissioning agent within 120 days of installation and start-up; and
- e) The commissioning agent shall submit full commissioning report(s) within 21 days of completing commissioning; and
- f) The VRF manufacturer shall issue an Extended Warranty Approval Letter indicating that all reports are complete and without errors.

**1.06 Installer Training**

Variable Refrigerant Flow system manufacturers vary in requirements. Contractor must verify requirements and complete installation training prior to installing the system. The contractor shall comply with the specified manufacturer system installation requirements without change in cost to Owner. Equipment supplier must inspect installation at various stages to ensure proper installation.

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**Part 2 - Products – Outdoor Units**

<V5-230:3>

**2.01 Outdoor Units – Heat-Recovery/Heat Pump 208-230V/3-Phase**

**A. General**

The VRF heat-recovery/heat pump system components; outdoor unit(s), indoor unit(s), refrigerant branch unit(s) and control(s) system shall be made by the same manufacturer. When multiple outdoor units are to connect together, they shall be connected by the manufacturer specified branch kits.

The outdoor units must have the following capabilities:

1. Each outdoor unit shall be capable of providing fan static pressure up to 0.32 in. WG for 6, 8, and 10 Ton units, and 0.44 in. WG for 12, 14, and 16 Ton units, to allow connection of discharge ductwork and to prevent discharge air short-circuiting.
2. Each of the 6, 8, and 10 Ton outdoor units shall have one inverter driven scroll compressor. The 12, 14, and 16 Ton units shall have two inverter driven scroll compressors. The use of other quantities or types of compressors is not allowed.
3. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes.
4. The system must defrost all circuits in an unit simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Multiple condenser systems shall continue to provide heat to the indoor units in heating operation while in the defrost mode.
5. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as high as 150%.
6. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
7. Systems greater than 36 tons shall be split into smaller systems to help comply with refrigerant limitation regulations, such as ASHRAE Standards 15 and 34.
8. The system shall be capable of connecting to 3,280 ft of triple refrigerant piping. Shorter piping length limitation shall not be acceptable.
9. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
10. The outdoor unit shall offer quiet operation option.
11. The outdoor unit shall have separate access door for visibility of error codes and function settings.
12. The refrigerant flow shall be automatically adjusted within the heat exchanger based on airflow balance through the heat exchanger.

**B. Outdoor Temperatures:**

The heat-recovery/heat pump outdoor unit shall be capable of operating in heating mode down to -15°F ambient temperature and cooling or simultaneous heating/cooling mode down to 14°F ambient temperature without any additional low ambient control kits or controls. The selection of an alternate manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.

**C. Compressor:**

1. Each outdoor unit module shall be equipped with inverter driven scroll compressor(s). The use of rotary compressors, and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
3. The compressor shall be equipped with high- and low-pressure overload protection.
4. The compressor modulating capacity shall be between 17% and 100%.

**D. Fan:**

1. Each outdoor unit fan shall be equipped with at least one propeller type fan.
2. The fan motor shall be variable speed DC inverter driven.
3. The fan motors shall be electrically protected.
4. The fan(s) shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan motor shall be factory set to 0 in. WG. In addition, it shall be capable of providing static pressure up to 0.32 in. WG for up to 10 Ton units, and 0.44 in. WG for 12, to 16 Ton units, to allow connection of discharge ductwork and to prevent discharge air short-circuiting.

**E. Coil:**

1. The outdoor unit shall have two outdoor coils. The unit shall be capable of regulating the flow of the refrigerant independently in each coil to improve part load operation. The use of a single outdoor unit coil shall not be acceptable.
2. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
3. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
4. The coil shall be protected with an integral metal guard.

**F. Electrical Power:**

1. The outdoor unit shall be powered by 208-230V/3-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. The outdoor unit shall have built-in protection against single-phasing and reverse-phasing through electrical power.
4. Outdoor unit electronic circuits shall be electrically protected using fuses.

**G. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**H. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.

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**2.02 Outdoor Units – Heat-Recovery/Heat Pump 460V/3-Phase**

**A. General**

The VRF heat-recovery/heat pump system components; outdoor unit(s), indoor unit(s), refrigerant branch unit(s) and control(s) system shall be made by the same manufacturer. When multiple outdoor units are to connect together, they shall be connected by the manufacturer specified branch kits.

The outdoor units must have the following capabilities:

1. Each outdoor unit shall be capable of providing fan static pressure up to 0.32 in. WG for 6, 8, and 10 Ton units, and 0.44 in. WG for 12, 14, and 16 Ton units, to allow connection of discharge ductwork and to prevent discharge air short-circuiting.
2. Each of the 6, 8, and 10 Ton outdoor units shall have one inverter driven scroll compressor. The 12, 14, and 16 Ton units shall have two inverter driven scroll compressors. The use of other quantities or types of compressors is not allowed.
3. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes.
4. The system must defrost all circuits in an unit simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Multiple condenser systems shall continue to provide heat to the indoor units in heating operation while in the defrost mode.
5. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as high as 150%.
6. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
7. Systems greater than 36 tons shall be split into smaller systems to help comply with refrigerant limitation regulations, such as ASHRAE Standards 15 and 34.
8. The system shall be capable of connecting to 3,280 ft of triple refrigerant piping. Shorter piping length limitation shall not be acceptable.
9. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
10. The outdoor unit shall offer quiet operation option.
11. The outdoor unit shall have separate access door for visibility of error codes and function settings.
12. The refrigerant flow shall be automatically adjusted within the heat exchanger based on airflow balance through the heat exchanger.

**B. Outdoor Temperatures:**

The heat-recovery/heat pump outdoor unit shall be capable of operating in heating mode down to -15°F ambient temperature and cooling or simultaneous heating/cooling mode down to 14°F ambient temperature without any additional low ambient control kits or controls. The selection of an alternate manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.

**C. Compressor:**

1. Each outdoor unit module shall be equipped with inverter driven scroll compressor(s). The use of rotary compressors, and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
5. The compressor shall be equipped with high- and low-pressure overload protection.
6. The compressor modulating capacity shall be between 17% and 100%.



**D. Fan:**

1. Each outdoor unit fan shall be equipped with at least one propeller type fan.
2. The fan motor shall be variable speed DC inverter driven.
3. The fan motors shall be electrically protected.
4. The fan(s) shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan motor shall be factory set to 0 in. WG. In addition, it shall be capable of providing static pressure up to 0.32 in. WG for up to 10 Ton units, and 0.44 in. WG for 12, to 16 Ton units, to allow connection of discharge ductwork and to prevent discharge air short-circuiting.

**E. Coil:**

1. The outdoor unit shall have two outdoor coils. The unit shall be capable of regulating the flow of the refrigerant independently in each coil to improve part load operation. The use of a single outdoor unit coil shall not be acceptable.
2. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
3. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
4. The coil shall be protected with an integral metal guard.

**F. Electrical Power:**

1. The outdoor unit shall be powered by 460V/3-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 414 to 506 Voltage range.
3. The outdoor unit shall have built-in protection against single-phasing and reverse-phasing through electrical power.
4. Outdoor unit electronic circuits shall be electrically protected using fuses.

**G. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**H. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.

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**2.03 Outdoor Units – Heat-Pump 208-230V/3-Phase**

**A. General**

The VRF heat-pump system components; outdoor unit(s), indoor unit(s), and control(s) system shall be made by the same manufacturer. If multiple outdoor units are to connect together, they shall be connected by the manufacturer specified branch kits.

The outdoor units must have the following capabilities:

1. Each outdoor unit shall be capable of providing static pressure up to 0.32 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.
2. Each of the outdoor units shall have only one inverter driven twin rotary compressor. The use of multiple compressors or other types of compressors is not allowed.
3. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes after the first oil recovery.
4. The system must defrost all circuits simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Part defrost which may extend the no heating or reduced heating periods shall not be allowed.
5. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
6. Systems greater than 24 tons shall be split into smaller systems to help comply with refrigerant limitation regulations, such as ASHRAE Standards 15 and 34.
7. The system shall be capable of connecting to a minimum of 3,280 ft of paired refrigerant piping. Shorter piping length limitation shall not be acceptable.
8. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
9. The outdoor unit shall offer quiet operation option.
10. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as high as 150%.
11. The following shall be the number of condensers and branch kits used for each size:

<b>Outdoor Model</b>	<b>Branch Kit</b>		
<b>208-230V/3-Phase</b>	<b>Units</b>	<b>Model</b>	<b>Quantity</b>
AOUA72RLBV1	None	-	
AOUA96RLBV1	None	-	
AOUA120RLBV1	None	-	
AOUA144RLBVG1	2	UTP-CX567A	1
AOUA168RLBVG1	2	UTP-CX567A	1
AOUA192RLBVG1	2	UTP-CX567A	1
AOUA216RLBVG1	2	UTP-CX567A	1
AOUA240RLBVG1	2	UTP-CX567A	1
AOUA264RLBVG1	3	UTP-CX567A	2
AOUA288RLBVG1	3	UTP-CX567A	2

**B. Outdoor Temperatures:**

The heat-pump outdoor unit shall be capable of operating in heating mode down to -15°F ambient temperature and cooling mode down to 5°F ambient temperature for single outdoor unit installations and 23°F for multiple outdoor unit installations without any additional low ambient control kits or

controls. The selection of an alternate manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.

**C. Compressor:**

1. Each outdoor unit module shall be equipped with one inverter driven dual rotary compressor. The use of multiple compressors, scroll and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
3. The compressor shall be equipped with high- and low-pressure overload protection.
4. The compressor modulating capacity shall be between 30% and 100%.

**D. Fan:**

1. Each outdoor unit fan shall be equipped with at least one propeller type fan.
2. The fan motor shall be variable speed DC inverter driven.
3. The fan motors shall be electrically protected.
4. The fan(s) shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan motor shall be factory set to 0 in. WG. In addition, it shall be capable of providing static pressure up to 0.32 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.

**E. Coil:**

1. The outdoor unit shall have two outdoor coils. The unit shall be capable of regulating the flow of the refrigerant independently in each coil to improve part load operation. The use of a single outdoor unit coil shall not be acceptable.
2. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
3. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
4. The coil shall be protected with an integral metal guard.

**F. Electrical Power:**

1. The outdoor unit shall be powered by 208-230V/3-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. The outdoor unit shall have built-in protection against single-phasing and reverse-phasing through electrical power.
4. Outdoor unit electronic circuits shall be electrically protected using fuses.

**G. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**H. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.
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<V2-460:3>

**2.04 Outdoor Units – Heat-Pump 460V/3-Phase**

**A. General**

The VRF heat-pump system components; outdoor unit(s), indoor unit(s), and control(s) system shall be made by the same manufacturer. If multiple outdoor units are to connect together, they shall be connected by the manufacturer specified branch kits.

The outdoor units must have the following capabilities:

1. Each outdoor unit shall be capable of providing static pressure up to 0.32 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.
2. Each of the outdoor units shall have only one inverter driven twin rotary compressor. The use of multiple compressors or other types of compressors is not allowed.
3. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes after the first oil recovery.
4. The system must defrost all circuits simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Part defrost which may extend the no heating or reduced heating periods shall not be allowed.
5. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
6. Systems greater than 24 tons shall be split into smaller systems to help comply with refrigerant limitation regulations, such as ASHRAE Standards 15 and 34.
7. The system shall be capable of connecting to a minimum of 3,280 ft of paired refrigerant piping. Shorter piping length limitation shall not be acceptable.
8. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
9. The outdoor unit shall offer quiet operation option.
10. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as high as 150%.
11. The following shall be the number of condensers and branch kits used for each size:

<b>Outdoor Model</b>	<b>Branch Kit</b>		
<b>460V/3-Phase</b>	<b>Units</b>	<b>Model</b>	<b>Quantity</b>
AOUA72RLCV	1	None	-
AOUA96RLCV	1	None	-
AOUA120RLCV	1	None	-
AOUA144RLCVG	2	UTP-CX567A	1
AOUA168RLCVG	2	UTP-CX567A	1
AOUA192RLCVG	2	UTP-CX567A	1
AOUA216RLCVG	2	UTP-CX567A	1
AOUA240RLCVG	2	UTP-CX567A	1
AOUA264RLCVG	3	UTP-CX567A	2
AOUA288RLCVG	3	UTP-CX567A	2

**B. Outdoor Temperatures:**

The heat pump outdoor unit shall be capable of operating in heating mode down to -15°F ambient temperature and cooling mode down to 5°F ambient temperature for single outdoor unit installations and 23°F for multiple outdoor unit installations without any additional low ambient control kits or

controls. The selection of an alternate manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.

**C. Compressor:**

1. Each outdoor unit module shall be equipped with one inverter driven dual rotary compressor. The use of multiple compressors, scroll and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
3. The compressor shall be equipped with high- and low-pressure overload protection.
4. The compressor modulating capacity shall be between 17% and 100%.

**D. Fan:**

1. Each outdoor unit fan shall be equipped with at least one propeller type fan.
2. The fan motor shall be variable speed DC inverter driven.
3. The fan motors shall be electrically protected.
4. The fan(s) shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan motor shall be factory set to 0 in. WG. In addition, it shall be capable of providing static pressure up to 0.32 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.

**E. Coil:**

1. The outdoor unit shall have two outdoor coils. The unit shall be capable of regulating the flow of the refrigerant independently in each coil to improve part load operation. The use of a single outdoor unit coil shall not be acceptable.
2. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
3. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
4. The coil shall be protected with an integral metal guard.

**F. Electrical Power:**

1. The outdoor unit shall be powered by 460V/3-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 414 to 506 Voltage range.
3. The outdoor unit shall have built-in protection against single-phasing and reverse-phasing through electrical power.
4. Outdoor unit electronic circuits shall be electrically protected using fuses.

**G. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**H. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.
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<VR2-230:3>

**2.05 Outdoor Units – Heat-Recovery 208-230V/3-Phase**

**A. General**

The VRF heat-recovery system components; outdoor unit(s), indoor unit(s), refrigerant branch unit(s) and control(s) system shall be made by the same manufacturer. If multiple outdoor units are to connect together, they shall be connected by the manufacturer specified branch kits.

The outdoor units must have the following capabilities:

1. Each outdoor unit shall be capable of providing static pressure up to 0.32 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.
2. Each of the outdoor units shall have only one inverter driven twin rotary compressor. The use of multiple compressors or other types of compressors is not allowed.
3. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes after the first oil recovery.
4. The system must defrost all circuits simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Part defrost which may extend the no heating or reduced heating periods shall not be allowed.
5. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as high as 150%.
6. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
7. Systems greater than 24 tons shall be split into smaller systems to help comply with refrigerant limitation regulations, such as ASHRAE Standards 15 and 34.
8. The system shall be capable of connecting to a minimum of 3,280 ft of triple refrigerant piping. Shorter piping length limitation shall not be acceptable.
9. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
10. The outdoor unit shall offer quiet operation option.
11. The following shall be the number of condensers and branch kits used for each size:

<b>Outdoor Model</b>	<b>Branch Kit</b>		
	<b>Units</b>	<b>Model</b>	<b>Quantity</b>
<b>208-230V/3-Phase</b>			
AOUA72TLBV	1	None	-
AOUA96TLBV	1	None	-
AOUA120TLBV	1	None	-
AOUA144TLBVG	2	UTP-CX567A	1
AOUA168TLBVG	2	UTP-CX567A	1
AOUA192TLBVG	2	UTP-CX567A	1
AOUA216TLBVG	2	UTP-CX567A	1
AOUA240TLBVG	2	UTP-CX567A	1
AOUA264TLBVG	3	UTP-CX567A	2
AOUA288TLBVG	3	UTP-CX567A	2



**B. Outdoor Temperatures:**

The heat-recovery outdoor unit shall be capable of operating in heating mode down to -15°F ambient temperature and cooling or simultaneous heating/cooling mode down to 14°F ambient temperature without any additional low ambient control kits or controls. The selection of an alternate manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.

**C. Compressor:**

1. Each outdoor unit module shall be equipped with one inverter driven dual rotary compressor. The use of multiple compressors, scroll and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
7. The compressor shall be equipped with high- and low-pressure overload protection.
8. The compressor modulating capacity shall be between 17% and 100%.

**D. Fan:**

1. Each outdoor unit fan shall be equipped with at least one propeller type fan.
2. The fan motor shall be variable speed DC inverter driven.
3. The fan motors shall be electrically protected.
4. The fan(s) shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan motor shall be factory set to 0 in. WG. In addition, it shall be capable of providing static pressure up to 0.32 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.

**E. Coil:**

1. The outdoor unit shall have two outdoor coils. The unit shall be capable of regulating the flow of the refrigerant independently in each coil to improve part load operation. The use of a single outdoor unit coil shall not be acceptable.
2. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
3. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
4. The coil shall be protected with an integral metal guard.

**F. Electrical Power:**

1. The outdoor unit shall be powered by 208-230V/3-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. The outdoor unit shall have built-in protection against single-phasing and reverse-phasing through electrical power.
4. Outdoor unit electronic circuits shall be electrically protected using fuses.

**G. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to

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provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**H. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.

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<VR2-460:3>

**2.06 Outdoor Units – Heat-Recovery 460V/3-Phase**

**A. General**

The VRF heat-recovery system components; outdoor unit(s), indoor unit(s), refrigerant branch unit(s) and control(s) system shall be made by the same manufacturer. If multiple outdoor units are to connect together, they shall be connected by the manufacturer specified branch kits.

The outdoor units must have the following capabilities:

1. Each outdoor unit shall be capable of providing static pressure up to 0.32 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.
2. Each of the outdoor units shall have only one inverter driven twin rotary compressor. The use of multiple compressors or other types of compressors is not allowed.
3. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes after the first oil recovery.
4. The system must defrost all circuits simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Part defrost which may extend the no heating or reduced heating periods shall not be allowed.
5. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as high as 150%.
6. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
7. Systems greater than 24 tons shall be split into smaller systems to help comply with refrigerant limitation regulations, such as ASHRAE Standards 15 and 34.
8. The system shall be capable of connecting to a minimum of 3,280 ft of triple refrigerant piping. Shorter piping length limitation shall not be acceptable.
9. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
10. The outdoor unit shall offer quiet operation option.
11. The following shall be the number of condensers and branch kits used for each size:

<b>Outdoor Model</b>	<b>Branch Kit</b>		
<b>460V/3-Phase</b>	<b>Units</b>	<b>Model</b>	<b>Quantity</b>
AOUA72TLCV	1	None	-
AOUA96TLCV	1	None	-
AOUA120TLCV	1	None	-
AOUA144TLCVG	2	UTP-CX567A	1
AOUA168TLCVG	2	UTP-CX567A	1
AOUA192TLCVG	2	UTP-CX567A	1
AOUA216TLCVG	2	UTP-CX567A	1
AOUA240TLCVG	2	UTP-CX567A	1
AOUA264TLCVG	3	UTP-CX567A	2
AOUA288TLCVG	3	UTP-CX567A	2

**B. Outdoor Temperatures:**

The heat-recovery outdoor unit shall be capable of operating in heating mode down to -15°F ambient temperature and cooling or simultaneous heating/cooling mode down to 14°F ambient temperature without any additional low ambient control kits or controls. The selection of an alternate

manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.

**C. Compressor:**

1. Each outdoor unit module shall be equipped with one inverter driven dual rotary compressor. The use of multiple compressors, scroll and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
3. The compressor shall be equipped with high- and low-pressure overload protection.
4. The compressor modulating capacity shall be between 17% and 100%.

**D. Fan:**

1. Each outdoor unit fan shall be equipped with at least one propeller type fan.
2. The fan motor shall be variable speed DC inverter driven.
3. The fan motors shall be electrically protected.
4. The fan(s) shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan motor shall be factory set to 0 in. WG. In addition, it shall be capable of providing static pressure up to 0.32 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.

**E. Coil:**

1. The outdoor unit shall have two outdoor coils. The unit shall be capable of regulating the flow of the refrigerant independently in each coil to improve part load operation. The use of a single outdoor unit coil shall not be acceptable.
2. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
3. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
4. The coil shall be protected with an integral metal guard.

**F. Electrical Power:**

1. The outdoor unit shall be powered by 460V/3-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 414 to 506 Voltage range.
3. The outdoor unit shall have built-in protection against single-phasing and reverse-phasing through electrical power.
4. Outdoor unit electronic circuits shall be electrically protected using fuses.

**G. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**H. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.
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<RBUS>

**2.07 Refrigerant Branch Box -Single**

**A. General**

The Refrigerant Branch Box shall be used to allow indoor units to operate in a heating or cooling mode independent from the rest of the heat-recovery system operating mode. The unit shall be mounted indoors, with access and service clearance provided for each controller. The Refrigerant Branch Box shall be connected to only one indoor unit or to multiple indoor units operating in the same mode. The maximum capacity of the Refrigerant Branch Box shall be equal to or greater than the total indoor units' capacity connected to it.

**B. Unit Cabinet**

1. The unit shall be made of galvanized sheet metal.
2. The unit shall have the flexibility of being mounted with the control box on either side or the top to ease installation.

**C. Piping**

1. The Refrigerant Branch Box shall connect to only two of the three heat-recovery pipes.
2. The indoor unit shall connect to the Refrigerant Branch Box using two pipes only.
3. The Refrigerant Branch Box built-in pipes shall have built-in reducers for each pipe to ease connecting to different piping sizes.

**D. Electrical:**

1. The Refrigerant Branch Box shall be powered by 208-230V/single-phase, 60 Hz.
2. The Refrigerant Branch Box shall be able to operate correctly within the 187 to 253 Voltage range.
3. Refrigerant Branch Box electric circuits shall be electronically protected using fuses.

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**2.08 Multi-Refrigerant Branch Box -Multiple**

**A. General**

The Multi-Refrigerant Branch Box shall be used to allow up to twelve indoor connections to operate in a heating or cooling mode independent from the rest of the heat-recovery system indoor unit operating mode. The unit shall be mounted indoors, with access and service clearance provided for each controller. Each of the Multi-Refrigerant Branch Box connections shall be connected to only one indoor unit or to multiple indoor units operating in the same mode. The maximum capacity of the Multi-Refrigerant Branch Box branch shall be equal to or greater than the total indoor units' capacity connected to it.

**B. Unit Cabinet**

1. The unit shall be made of galvanized sheet metal.

**C. Piping**

1. The Multi-Refrigerant Branch Box shall be able to connect on two sides to all three heat-recovery pipes.
2. The indoor unit shall connect to the Multi-Refrigerant Branch Box using two pipes only.
3. The Multi-Refrigerant Branch Box built-in pipes shall have built-in reducers for each pipe to ease connecting to different piping sizes.
4. The published maximum number of indoor units per branch, maximum capacity index per branch, and minimum number of refrigerant branches, per Multi-Refrigerant Branch Box must be followed for proper system operation.

**D. Electrical:**

1. The Refrigerant Branch Box shall be powered by 208-230V/single-phase, 60 Hz.
2. The Refrigerant Branch Box shall be able to operate correctly within the 187 to 253 Voltage range.
3. Refrigerant Branch Box electric circuits shall be electronically protected using fuses.

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**2.09 Outdoor Units – Heat-Pump 208-230V/3-Phase**

**A. General**

The VRF three-phase double-fan heat-pump system components; outdoor unit(s), indoor unit(s), and control(s) system shall be made by the same manufacturer.

The outdoor units must have the following capabilities:

1. Each of the outdoor units shall have horizontal air discharge without the addition of any hoods or external components.
2. Each outdoor unit shall be capable of providing static pressure up to 0.24 in. WG to allow connection of discharge ductwork and to prevent discharge air short-circuiting.
3. Each of the outdoor units shall have only one inverter driven scroll compressor. The use of multiple compressors or other types of compressors is not allowed.
4. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes after the first oil recovery.
5. The system must defrost all circuits simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Part defrost which may extend the no heating or reduced heating periods shall not be allowed.
6. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
7. The system shall be capable of connecting to a minimum of 1,312 ft of paired refrigerant piping. Shorter piping length limitation shall not be acceptable.
8. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as low as 50% and as high as 150%.
9. The outdoor unit shall be capable of connecting to up to 30 indoor units.
10. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
11. The outdoor unit shall offer quiet operation option.

**B. Outdoor Temperatures:**

The heat-pump outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature and cooling mode down to 23°F ambient temperature without any additional low ambient control kits or controls. 6 and 8Ton capacity units shall be able to operate in cooling mode down to 5°F. The selection of an alternate manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.



**D. Compressor:**

1. Each outdoor unit module shall be equipped with one inverter driven scroll compressor. The use of multiple compressors, and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
3. The compressor shall be equipped with high- and low-pressure overload protection.
4. The compressor modulating capacity shall be between 12.5% and 100%.

**E. Fan:**

1. Each outdoor unit fan shall be equipped with at least one propeller type fan.
2. The fan motor shall be variable speed DC inverter driven.
3. The fan motors shall be electrically protected.
4. The fan(s) shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan blowing shall provide horizontal discharge without the addition of any hoods or external components to help protect fan from snow, ice, and other weather elements.
6. The outdoor unit shall be capable of providing static pressure up to 0.24 in. WG to prevent discharge air short-circuiting and to allow the unit to be installed inside and exhaust air through louvers.

**F. Coil:**

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.

**G. Electrical Power:**

1. The outdoor unit shall be powered by 208-230V/3-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Outdoor unit electronic circuits shall be electrically protected using fuses.

**H. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**I. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.

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<J4D>

## **2.10 Outdoor Units – Heat-Pump Single-Phase Double-Fan**

### **A. General**

The VRF single-phase double-fan heat-pump system components; outdoor unit(s), indoor unit(s), and control(s) system shall be made by the same manufacturer.

The outdoor units must have the following capabilities:

1. Each of the outdoor units shall have only one inverter driven twin rotary compressor. The use of multiple compressors or other types of compressors is not allowed.
2. Each outdoor unit heating efficiency shall be AHRI rated a minimum of 11.4 HSPF for non-ducted applications or shall be AHRI rated a minimum of 10.4 HSPF for ducted applications.
3. Each outdoor unit cooling efficiency shall be AHRI rated a minimum of 18.5 SEER for non-ducted applications or shall be AHRI rated a minimum of 16.5 SEER for ducted applications.
4. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes after the first oil recovery.
5. The system must defrost all circuits simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Part defrost which may extend the no heating or reduced heating periods shall not be allowed.
6. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as high as 150% and as low as 50%.
7. In order to provide safe condensate management, the outdoor unit shall be equipped with a base pan heater that turn the heater On and Off depending on the ambient air temperature. The temperatures for On/Off function of the heater shall be adjustable.
8. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
9. The outdoor unit shall be capable of connecting to up to 15 indoor units.
10. The system shall be capable of connecting to 590 ft of paired refrigerant piping. Shorter piping length limitation shall not be acceptable.
11. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
12. The outdoor unit shall offer quiet operation option.

### **B. Outdoor Temperatures:**

The single-phase heat-pump outdoor unit shall be capable of operating in heating mode down to -15°F ambient temperature and cooling mode down to 23°F ambient temperature for outdoor unit installations without any additional low ambient control kits or controls. The selection of an alternate manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.

### **C. Compressor:**

1. Each outdoor unit module shall be equipped with one inverter driven dual rotary compressor. The use of multiple compressors, scroll and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
3. The compressor modulating capacity shall be between 20% and 100%.

**D. Fan:**

1. Each outdoor unit fan system shall be equipped with two propeller type fans.
2. Each of the fan motors shall be variable speed DC inverter driven.
3. The fan motors shall be electrically protected.
4. The fans shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan blowing shall provide horizontal discharge without the addition of any hoods or external components to help protect fan from snow, ice, and other weather elements.
6. The outdoor unit shall be equipped with dual fans that are independently operated.
7. The outdoor unit shall be capable of providing static pressure up to 0.12 in. WG to prevent discharge air short-circuiting and to allow the unit to be installed inside and exhaust air through louvers.

**E. Coil:**

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.

**F. Electrical Power:**

1. The outdoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Outdoor unit electronic circuits shall be electrically protected using fuses.

**G. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select, and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**H. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.

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## **2.11 Outdoor Units – Heat-Pump Single-Phase Single-Fan**

### **A. General**

The VRF single-phase single-fan heat-pump system components; outdoor unit(s), indoor unit(s), and control(s) system shall be made by the same manufacturer.

The outdoor units must have the following capabilities:

1. Each of the outdoor units shall have only one inverter driven twin rotary compressor. The use of multiple compressors or other types of compressors is not allowed.
2. Each outdoor unit heating efficiency shall be AHRI rated a minimum of 10.9 HSPF for non-ducted applications or shall be AHRI rated a minimum of 10.1 HSPF for ducted applications.
3. Each outdoor unit cooling efficiency shall be AHRI rated a minimum of 18.8 SEER for non-ducted applications or shall be AHRI rated a minimum of 16.9 SEER for ducted applications.
4. The system shall be able to provide heating during oil recovery. Oil recovery operation shall not last more than 6 minutes after the first oil recovery.
5. The system must defrost all circuits simultaneously in order to resume full heating more quickly. Defrost time shall not last more than 15 minutes. Part defrost which may extend the no heating or reduced heating periods shall not be allowed.
6. The system refrigerant circuit shall be capable of having its indoor to outdoor units' connectable capacity ratio as high as 130% and as low as 50%.
7. In order to provide safe condensate management, the outdoor unit shall be equipped with a base pan heater that turn the heater On and Off depending on the ambient air temperature. The temperatures for On/Off function of the heater shall be adjustable.
8. The outdoor unit shall provide refrigerant pressure and temperature safety protection.
9. The outdoor unit shall be capable of connecting to up to 12 indoor units.
10. The system shall be capable of connecting to 262 ft of paired refrigerant piping. Shorter piping length limitation shall not be acceptable.
11. The outdoor unit coil fins shall be coated with a blue corrosion resistance for longer service life.
12. The outdoor unit shall offer quiet operation option.

### **B. Outdoor Temperatures:**

The single-phase heat-pump outdoor unit shall be capable of operating in heating mode down to -15°F ambient temperature and cooling mode down to 23°F ambient temperature for outdoor unit installations without any additional low ambient control kits or controls. The selection of an alternate manufacturer shall deem the contractor responsible for any additional material, cost, and labor to meet low ambient operating condition and performance.

### **C. Compressor:**

1. Each outdoor unit module shall be equipped with one inverter driven dual rotary compressor. The use of multiple compressors, scroll and/or non-inverter driven compressors, which cause inrush current (demand charges) and require larger wire sizing, shall not be allowed.
2. The compressor shall be equipped with automatic thermal overload protection.
4. The compressor modulating capacity shall be between 20% and 100%.

**D. Fan:**

1. Each outdoor unit fan system shall be equipped with one propeller type fan.
2. The fan motor shall be variable speed DC inverter driven.
3. The fan motor shall be electrically protected.
4. The fan shall be enclosed within outdoor unit and shall be protected with metal grille.
5. The fan blowing shall provide horizontal discharge without the addition of any hoods or external components to help protect fan from snow, ice, and other weather elements.
6. The outdoor unit shall be capable of providing static pressure up to 0.1 in. WG to prevent discharge air short-circuiting and to allow the unit to be installed inside and exhaust air through louvers.
7. The outdoor unit shall be equipped with single fan that is independently operated.

**E. Coil:**

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.

**F. Electrical Power:**

1. The outdoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The outdoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Outdoor unit electronic circuits shall be electrically protected using fuses.

**G. Control and Communication:**

1. The outdoor unit shall be controlled by integral microprocessors.
2. The main control board shall have a four-digit seven-segment display along with mode/exit, select, and enter buttons to enter function codes and obtain OU operating data (pressures, temperatures, EEV positions and compressor load details).
3. The outdoor unit shall have a specific function to verify only the number of indoor units connected to the outdoor unit. A second function shall register the indoor units to the outdoor units and verify connected capacity.
4. The control circuit between the outdoor unit(s) and the different indoor units shall be completed using non-polar, 22-AWG, solid-core, twisted-pair, and shielded communication cable to provide total integration of the system. The communication network shall be capable of extending up to a length of 11,800 ft of cable. Shorter cable length capability shall not be acceptable.

**H. Unit Cabinet:**

1. The outdoor unit casing(s) shall be fabricated of painted galvanized steel.

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**Part 03 - Product – Indoor Units**

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**03.01 Indoor Units - Compact Cassette**

**A. General**

The VRF Compact Cassette style indoor unit shall be designed to be recessed into different types of ceilings. The unit shall provide 4-way air distribution away from the unit. The air distribution shall be controlled by electronically controlled louvers. The return air shall be in the center of the unit and shall have a built-in filter. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), high-lift condensate pump, and control circuit board and fan motor. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The cabinet shall be designed to be recessed in a standard suspended ceiling square grid of 2 ft x 2 ft without any alterations.
2. The unit shall have provisions for a field installed filtered outside air intake.
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way airflow using optional air-outlet shutter plates.
4. Each of the louvers shall be individually adjusted using remote controller.

**C. Fan**

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer three (3) speeds, Low, Mid, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit vanes shall have 4 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
6. The indoor unit shall have an adjustable air outlet system offering 4-way, 3-way or 2-way airflow.
7. The indoor unit shall offer optional provisions for outside air intake.

**D. Filter:**

1. Return air shall be filtered by means of a long-life washable filter.

**E. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.

**F. Drainage:**

1. The unit shall be equipped with an integral insulated drain pan and condensate pump.
2. The unit shall be provided with an integral condensate lift mechanism that will be able to raise condensate drain water at least 27 1/2" inches above the bottom of the unit.

**G. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**H. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. The indoor unit shall be equipped with Infrared wireless receiver that is compatible with optional wireless remote controller.
3. The indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error.
4. The indoor unit shall offer outside air intake fan control option.

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**3.02 Indoor Units – Large Cassette**

**A. General**

The VRF Large Cassette style indoor unit shall be designed to be recessed into different types of ceilings. The unit shall provide 4-way air distribution away from the unit. The air distribution shall be controlled by electronically controlled louvers. The return air shall be in the center of the unit and shall have a built-in filter. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), high-lift condensate pump, and control circuit board and fan motor. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The cabinet shall be designed to be recessed in a standard suspended ceiling square grid of 3 ft x 3 ft without any alterations.
2. The unit shall have provisions for a field installed filtered outside air intake.
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way airflow using optional air-outlet shutter plates.
4. Each of the louvers shall be individually adjusted using remote controller.

**C. Fan**

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer three (3) speeds, Low, Med, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit vanes shall have 4 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
6. The indoor unit shall have an adjustable air outlet system offering 4-way, 3-way or 2-way airflow.
7. The indoor unit shall offer optional provisions for outside air intake.

**D. Filter:**

1. Return air shall be filtered by means of a long-life washable filter.

**E. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.

**F. Drainage:**

1. The unit shall be equipped with an integral insulated condensate drain pan and condensate pump.
2. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water at least 33 1/2" inches above the bottom of the unit.



**G. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**H. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. The indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error.
3. The indoor unit shall offer outside air intake fan control option.

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**3.03 Indoor Units – Large Circular Flow Cassette**

**A. General**

The VRF Large Circular Flow Cassette style indoor unit shall be designed to be recessed into different types of ceilings. The unit shall provide 4-way air distribution in 360° away from the unit. The air distribution shall be controlled by electronically controlled louvers. The return air shall be in the center of the unit and shall have a built-in filter. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), high-lift condensate pump, and control circuit board and fan motor. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The cabinet shall be designed to be recessed in a standard suspended ceiling square grid of 3 ft x 3 ft without any alterations.
2. The unit shall have provisions for a field installed filtered outside air intake.
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way airflow using optional air-outlet shutter plates.
4. Each of the louvers shall be individually adjusted using remote controller.

**C. Fan**

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer six (6) speeds, Quiet, Low, Medium-Low, Medium, Medium-High, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit vanes shall have fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
6. The indoor unit shall have an adjustable air outlet system offering 4-way, 3-way or 2-way airflow.
7. The indoor unit shall offer optional provisions for outside air intake.

**D. Filter:**

1. Return air shall be filtered by means of a long-life washable filter.

**E. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.

**F. Drainage:**

1. The unit shall be equipped with an integral insulated condensate drain pan and condensate pump.
2. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water at least 33 1/2" inches above the bottom of the unit.

**G. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**H. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. The indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error.
3. The indoor unit shall offer outside air intake fan control option.

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**3.04 Indoor Units - Slim Ducted**

**A. General**

The VRF Slim Ducted style indoor unit shall be designed to be installed above ceiling or behind walls and shall be connected to ducting system. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), condensate pan, high-lift condensate pump, built-in removable filter, control circuit board and 2 or 3 fans and fan motor. The unit shall be capable of providing static pressure between 0 to 0.36 in. WG. The unit shall be less than 8 in. in height and shall require a ceiling vertical installation space of less than 10 in. The unit shall be suitable for use in plenums. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The unit shall have a low profile to be installed in plenum space of 10 in. or less in height.
2. The indoor unit shall be designed to be installed vertically. In this case, an external separate condensate pump shall be installed.
3. The unit shall have the capability of connecting to return air duct from the back or bottom of the unit.
4. The unit shall have provisions for factory supplied louvers that can be controlled using VRF manufacturer remote.

**C. Fan**

1. The indoor fan shall be an assembly with two or three fans direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The unit shall be factory to a static pressure of 0 in. WG. In addition, the unit shall be capable of providing a static pressure up to 0.36 in. WG.
4. The indoor fan shall offer three (3) speeds, Low, Med, and High.
5. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
6. The unit shall have an auxiliary heat output with function control. The unit shall be capable of operating the auxiliary heat and fan based on ambient set point even when the outdoor unit produces error codes.
7. The unit shall offer the capability of preventing the fan from operating when the temperature is satisfied in heating mode.
8. The indoor unit shall offer provisions for outside air intake.

**D. Filter:**

1. Return air shall be filtered by means of air filter.
2. The filter shall be adaptable to be mounted to the back or bottom of unit.
3. The filter construction shall include a Fungicide agent.

**E. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.

**F. Drainage:**

1. The unit shall be equipped with an integral insulated condensate drain pan and condensate pump.
2. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water at least 33 1/2" inches above the bottom of the unit drain pan.

**G. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**H. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. For systems with required auxiliary heat, the indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error. No substitute to this functionality shall be allowed.
3. The indoor unit shall offer fresh air intake fan control option.

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**3.05 Indoor Units - Med-Static Ducted**

**A. General**

The VRF Med-Static Ducted style indoor unit shall be designed to be installed above ceiling and shall be connected to ducting system. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), condensate pan, control circuit board and 2 fans and fan motor. The unit shall be capable of providing static pressure between 0 to 0.60 in. WG. The unit shall be less than 11 in. in height and shall require a ceiling vertical installation space of less than 11 in. The unit shall be suitable for use in plenums. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The unit shall have a low profile to be installed in plenum space of 11 in or less in height.
2. The unit shall have the capability of connecting to return air duct from the back or bottom of the unit.

**C. Fan**

1. The indoor fan shall be an assembly with two fans that are direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The unit shall be factory to a static pressure of 0 in. WG. In addition, the unit shall be capable of providing a static pressure up to 0.60 in. WG.
4. The indoor fan shall offer three (3) speeds, Low, Med, and High.
5. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
6. The unit shall have an auxiliary heat output with function control. The unit shall be capable of operating the auxiliary heat and fan based on ambient set point even when the outdoor unit produces error codes.
7. The unit shall offer the capability of preventing the fan from operating when the temperature is satisfied in heating mode.
8. The indoor unit shall offer provisions for fresh air intake.

**D. Filter:**

1. Return air shall be filtered by means of air filter.
2. The filter shall be adaptable to be mounted to the back or bottom of unit.
3. The filter construction shall include a Fungicide agent.

**E. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.

**F. Drainage:**

1. The unit shall be equipped with an integral insulated condensate drain pan.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27" inches above the bottom of the unit drain pan.

**G. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**H. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. For systems with required auxiliary heat, the indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error. No substitute to this functionality shall be allowed.
3. The indoor unit shall offer fresh air intake fan control option.

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**3.06 Indoor Units - High-Static Duct 36 to 60 kBTU/h**

**A. General**

The VRF High-Static Ducted style indoor unit shall be designed to be installed above ceiling and shall be connected to ducting system. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), condensate pan, control circuit board and fan motor. The unit shall be capable of providing static pressure between 0.4 to 0.80 in. WG for units 36kBTU/h or smaller and 0.4 to 1.0 in. WG for units 48kBTU/h or greater. The unit shall be suitable for use in plenums. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The unit shall be made of galvanized sheet metal.
2. The unit shall have a fixed return air connection on the back of the unit.

**C. Fan**

1. The indoor fan shall be an assembly with two fans direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The unit shall be factory to a static pressure of 0.40 in. WG. In addition, the unit shall be capable of providing a static pressure up to 1.0 in. WG for units 48kBTU/h or greater. The highest configurable static pressure for 36kBTU/h units or smaller shall be 0.80 in. WG.
4. The indoor fan shall offer three (3) speeds, Low, Med, and High.
5. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
6. The unit shall have an auxiliary heat output with function control. The unit shall be capable of operating the auxiliary heat and fan based on ambient set point even when the outdoor unit produces error codes.
7. The unit shall offer the capability of preventing the fan from operating when the temperature is satisfied in heating mode.
8. The indoor unit shall offer provisions for outside air intake.

**D. Filter:**

1. Return air shall be filtered by means of a field-supplied air filter.

**E. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.

**F. Drainage:**

1. The unit shall be equipped with an integral insulated condensate drain pan.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27" inches above the bottom of the unit drain pan.



**G. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**H. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. For systems with required auxiliary heat, the indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error. No substitute to this functionality shall be allowed.
3. The indoor unit shall offer outside air intake fan control option.

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**3.07 Indoor Units - High-Static Duct 72 and 96 kBTU/h**

**A. General**

The VRF High-Static ducted style indoor unit shall be designed to be installed above ceiling and shall be connected to ducting system. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), condensate pan, control circuit board and fan motor. The unit shall be capable of providing static pressure between 0 to 1.20 in. WG. The unit shall be suitable for use in plenums. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The unit shall be made of galvanized sheet metal.
2. The unit shall have a fixed return air connection on the back of the unit.

**C. Fan**

1. The indoor fan shall be an assembly with two fans direct driven by two separate motors.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer three (3) speeds, Low, Med, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The unit shall have an auxiliary heat output with function control. The unit shall be capable of operating the auxiliary heat and fan based on ambient set point even when the outdoor unit produces error codes.
6. The unit shall offer the capability of preventing the fan from operating when the temperature is satisfied in heating mode.
7. The indoor unit shall offer provisions for outside air intake.

**D. Filter:**

1. Return air shall be filtered by means of an optional field supplied filter.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27" inches above the bottom of the unit drain pan.

**E. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.

**F. Drainage:**

1. The unit shall be equipped with an integral insulated condensate drain pan.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27" inches above the bottom of the unit drain pan.

**G. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**H. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. For systems with required auxiliary heat, the indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error. No substitute to this functionality shall be allowed.
3. The indoor unit shall offer outside air intake fan control option.

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**3.08 Indoor Units – Multi Position Air Handler 12 to 60 kBTU/h**

**A. General**

The VRF Multi Position Air Handling ducted style indoor unit shall be designed to be connected to ducting system. The unit shall be a concealed ducted indoor fan coil that mounts within a mechanical closet or attic with a fixed bottom return and a fixed top discharge supply (in up-flow mounting). Capable of being mounted in 3 positions – Vertical, Horizontal right and Horizontal left. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), insulated condensate pan, control circuit board and fan motor. The unit shall be capable of providing static pressure between 0 to 0.8 in. WG. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

The Multi Position Air handling unit shall be compatible with Airstage VRF heat pump and heat recovery outdoor units. The Indoor unit model numbers shall be: ARUX12TLAV2, ARUX18TLAV2, ARUX24TLAV2, ARUX30TLAV2, ARUX36TLAV2, ARUX48TLAV2 and ARUX60TLAV2.

The system shall perform based on ratings shown in below table under the following conditions:

Cooling — Indoor temperature of 80°F (26.7°C) DB/67°F (19.4°C) WB, and outdoor temperature of 95°F (35°C) DB/75°F (23.9°C) WB.

Heating—Indoor temperature of 70°F (21.1°C) DB/60°F (15.6°C) WB, and outdoor temperature of 47°F (8.3°C) DB/43°F (6.1°C) WB.

Pipe length: 25ft. (7.5m), Height difference: 0ft. (0m) (Outdoor unit – indoor unit).

Model	Cooling (BTU/h)	Heating (BTU/h)
ARUX12TLAV2	12,000	13,500
ARUX18TLAV2	18,000	20,000
ARUX24TLAV2	24,000	27,000
ARUX30TLAV2	30,000	34,000
ARUX36TLAV2	36,000	40,000
ARUX48TLAV2	48,000	54,000
ARUX60TLAV2	60,000	67,000

**B. Unit Cabinet**

1. The unit shall be made of 22 GA painted galvanized steel sheet with insulation.
2. The unit shall have a fixed return air connection on the bottom of the unit.

**C. Fan**

1. The indoor fan shall be an assembly with one blower assembly direct driven by EC motors.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer three (3) speeds, Low, Mid, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The unit shall have an auxiliary heat output with function control. The unit shall be capable of operating the auxiliary heat and fan based on ambient set point even when the outdoor unit produces error codes.
6. The unit shall offer the capability of preventing the fan from operating when the temperature is satisfied in heating mode.
7. The indoor unit shall offer provisions for fresh air intake.

**D. Filter:**

1. Optional filter base can be installed with following models:  
86ET0002 (16" x 20") for Models ARUX12TLAV2, ARUX18TLAV2, ARUX24TLAV2.  
86ET0001 (20" x 20") for Models ARUX30TLAV2, ARUX36TLAV2.  
86ET0003 (20" x 24") for Models ARUX48TLAV2, ARUX60TLAV2.
2. The optional filter base shall include a 1" pleated filter and shall accommodate a 1" or 2" filter

**E. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory up to 500 psi..
6. A condensate pan and drain shall be provided under the coil.

**F. Drainage:**

1. The unit shall be equipped with an integral fully insulated condensate drain pan to protect against side and bottom pan condensation.
2. The unit shall provide two condensate outlets to connect to an external condensate pump and external optional alarm switch.

**G. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**H. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. For systems with required auxiliary heat, the indoor unit shall offer an auxiliary-heat output and functionality. The following functions shall be included in the control logic of auxiliary heat.
  - a. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error. No substitute to this functionality shall be allowed.
  - b. Auxiliary heater control by set point temperature and time intervals.
  - c. Auxiliary heater control during defrost.
  - d. Selection of primary and secondary heat.
  - e. Heat pump lockout based on the outdoor air temperature
  - f. Emergency heat function from within the controller
  - g. Auxiliary heat fan off delay should be able to adjustable from 30 seconds to 1 minute.
3. The control board in the unit shall be capable of connecting to Wi-Fi (LAN) adapters through UART port(CN65) or similar connecting ports.

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**3.09 Indoor Units – Floor Mounted**

**A. General**

The VRF Floor Mount style indoor unit shall be designed to mount vertically on the floor. The unit shall provide air distribution away from the unit. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), and control circuit board and fan motor. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The cabinet shall be designed to be made out of durable plastic and can be installed on the floor or ceiling suspended.
2. Each of the louvers shall be individually adjusted using remote controller.

**C. Fan**

1. The indoor fan shall be an assembly with a high-powered DC fan direct motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer six (6) speeds, Quiet, Low, Lo-Hi, Med, Med-Hi, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

**D. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.
6. A condensate pan and drain shall be provided under the coil.

**E. Drainage:**

1. The unit shall provide a condensate outlet to connect to an external condensate pump.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27” inches above the bottom of the unit drain pan.

**F. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**G. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. The indoor unit shall be equipped with Infrared wireless receiver that is compatible with the optional wireless remote controller.
3. For systems with required auxiliary heat, the indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error. No substitute to this functionality shall be allowed.

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**3.10 Indoor Units – Floor/Ceiling Mounted**

**A. General**

The VRF Floor/Ceiling Mount style indoor unit shall be designed to mount vertically on the floor or be suspended from the ceilings. The unit shall provide swinging air distribution in 2 directions away from the unit. The air distribution shall be controlled by electronically controlled louvers. The louvers shall close when the unit is not in operation. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), and control circuit board and fan motor. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The cabinet shall be designed to be made out of durable plastic and can be installed on the floor or ceiling suspended.
2. Each of the louvers shall be individually adjusted using remote controller.

**C. Fan**

1. The indoor fan shall be an assembly with a high-powered DC fan direct motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer three (3) speeds, Low, Med, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit vanes shall be capable of swinging in two parallel directions to provide extensive and uniform air distribution.

**D. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.
6. A condensate pan and drain shall be provided under the coil.

**E. Drainage:**

1. The unit shall provide a condensate outlet to connect to an external condensate pump.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27" inches above the bottom of the unit drain pan.

**F. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**G. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. The indoor unit shall be equipped with Infrared wireless receiver that is compatible with the optional wireless remote controller.
3. For systems with required auxiliary heat, the indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error. No substitute to this functionality shall be allowed.

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**3.11 Indoor Units - Ceiling Mounted 30 and 36 kBTU/h**

**A. General**

The VRF Ceiling Mount style indoor unit shall be designed to be suspended from the ceilings. The unit shall provide swinging air distribution in 2 directions away from the unit. The air distribution shall be controlled by electronically controlled louvers. The louvers shall close when the unit is not in operation. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), and control circuit board and fan motor. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The cabinet shall be designed to be made out of durable plastic and can be ceiling suspended.
2. The unit shall be less than 10 in. in height.
3. Each of the louvers shall be individually adjusted using remote controller.

**C. Fan**

1. The indoor fan shall be an assembly with a high-powered DC fan direct motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer three (3) speeds, Low, Med, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit vanes shall be capable of swinging in two parallel directions to provide extensive and uniform air distribution.

**D. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.
6. A condensate pan and drain shall be provided under the coil.

**E. Drainage:**

1. The unit shall provide a condensate outlet to connect to an external condensate pump.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27" inches above the bottom of the unit drain pan.

**F. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**G. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. The indoor unit shall be equipped with Infrared wireless receiver that is compatible with the optional wireless remote controller.
3. For systems with required auxiliary heat, the indoor unit shall offer an auxiliary-heat output and functionality. The indoor unit shall offer an option for the auxiliary-heat output to function while outdoor unit has an error. No substitute to this functionality shall be allowed.

</CM>

<CWM>

**3.12 Indoor Units - Compact Wall Mounted 4 to 14 kBTU/h**

**A. General**

The VRF Compact Wall Mounted style indoor unit shall be designed to mount vertically on the wall. The unit shall provide swinging air distribution away from the unit. The air distribution shall be controlled by electronically controlled louvers. The louvers shall close when the unit is not in operation. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), and control circuit board and fan motor. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The cabinet shall be designed to be made out of durable plastic and can be suspended on the wall.
2. Each of the louvers shall be individually adjusted using remote controller.

**C. Fan**

1. The indoor fan shall be an assembly with a high-powered DC fan direct motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer six (6) speeds, Quiet, Low, Lo-Hi, Med, Med-Hi, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit vanes shall be capable of swinging in two parallel directions to provide extensive and uniform air distribution.

**D. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.
6. A condensate pan and drain shall be provided under the coil.

**E. Drainage:**

1. The unit shall provide a condensate outlet to connect to an external condensate pump.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27" inches above the bottom of the unit drain pan.

**F. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**G. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. The indoor unit shall be equipped with Infrared wireless receiver that is compatible with the optional wireless remote controller.

</CWM>

<WM>

**3.13 Indoor Units - Wall Mounted 18 to 36 kBTU/h**

**A. General**

The VRF Wall Mounted style indoor unit shall be designed to mount vertically on the wall. The unit shall provide swinging air distribution in away from the unit. The air distribution shall be controlled by electronically controlled louvers. The louvers shall close when the unit is not in operation. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), and control circuit board, fan motor, and filters. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The cabinet shall be designed to be made out of durable plastic and can be suspended on the wall.
2. Each of the louvers shall be individually adjusted using remote controller.

**C. Fan**

1. The indoor fan shall be an assembly with a high-powered DC fan direct motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall offer six (6) speeds, Quiet, Low, Lo-Hi, Med, Med-Hi, and High.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit vanes shall be capable of swinging in two parallel directions to provide extensive and uniform air distribution.

**D. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.

**E. Drainage:**

1. The unit shall provide a condensate outlet to connect to an external condensate pump.
2. The unit shall have an optional condensate lift mechanism that will be able to raise drain water at least 27" inches above the bottom of the unit drain pan.

**F. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**G. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.
2. The indoor unit shall be equipped with Infrared wireless receiver that is compatible with the optional wireless remote controller.

</WM>



<DOA>

**3.14 Dedicated Outdoor Air Unit (DOA)**

**A. General**

The VRF Dedicated Outdoor Air unit shall be designed to connect to a ducted system. It shall pre-heat and pre-cool the outdoor fresh air before introduction to the indoor space. The unit shall be capable of automatically determining the necessary air-conditioning mode of operation to provide required. Contained within the unit shall be all factory wiring, piping, electronic modulating Electronic Expansion Valve (EEV), condensate pan, control circuit board and fan motor. The unit shall be capable of providing static pressure up to 0.96 in.WG. The unit shall be suitable for use in plenums. The indoor unit shall have an Auto-restart function that allows the unit to resume operation after power interruption.

**B. Unit Cabinet**

1. The unit shall be made of galvanized sheet metal.

**C. Fan**

1. The DOAS fan shall be an assembly with a high-powered DC fan direct motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

**D. Coil:**

1. The indoor coil shall be of nonferrous construction with louvered fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. The coil fins shall have hydrophilic coating.
4. All tube joints shall be brazed with phos-copper or silver alloy.
5. The coils shall be pressure tested at the factory.
6. A condensate pan and drain shall be provided under the coil.

**E. Electrical:**

1. The indoor unit shall be powered by 208-230V/single-phase, 60 Hz.
2. The indoor unit shall be able to operate correctly within the 187 to 253 Voltage range.
3. Indoor unit electric circuits shall be electronically protected using fuses.

**F. Outdoor Temperatures:**

The DOAS unit shall automatically switch between heating and cooling modes. It shall be capable of operating in heating mode from 19°F to 70°F outdoor temperature and in cooling mode from 41°F to 109°F outdoor temperature.

**G. Controls:**

1. This indoor unit shall use controls provided by the specified manufacturer to perform functions necessary to operate the system.

</DOA>

</ID>

<CN>

**Part 04 - Product – Controls and Remotes**

<RNRUZ2>

**4.01 Remote Control – Wired Touch Remote**

**A. General**

The VRF Wired Touch Remote control shall be capable of displaying settings and values and controlling a single group of indoor units. The group shall consist of up to 16 indoor units. The Wired Touch Remote shall be small in size measuring 4-<sup>3</sup>/<sub>4</sub>" x 4-<sup>3</sup>/<sub>4</sub>". The screen shall be equipped with a 3-<sup>3</sup>/<sub>4</sub>" back-lit touch screen. The remote shall be equipped with a temperature sensor to facilitate ambient temperature measurement at the human comfort elevation. The remote shall connect to and be powered by the indoor unit using the manufacturer specified wiring. The remote shall not require any additional controls or equipment to facilitate its operation. The remote shall offer the following features:

1. Languages: English, Chinese, French, German, Spanish, Russian, Polish, Italian, Greek, Portuguese, Turkish and Dutch.
2. Temperature display and settings in Fahrenheit and Celsius.
3. Back-lit touch screen display.
4. Room temperature display.
5. Temperature set point adjustment, fan speed control, and louver control.
6. Room temperature set point range limit settings.
7. Automatic Change over (Heat/Cool) with an adjustable dead band.
8. Modes: Auto, Cool, Heat, Dry, Fan.
9. Economy mode setting.
10. Temperature sensing at the remote or at the indoor unit return air.
11. Setback functionality.
12. Schedule: Weekly or Daily with up to 8 settings per day using On/Off, Set temperature or occupied status.
13. Daylight savings time support.
14. Optimum Start/Stop (Boost/Early shutdown)
15. Security lock.
16. Additional features shall include: display of date and time, defrost, Indoor unit address, and room temperature, and Error history. It shall provide settings for the following features; Auto-Off timer (Sleep Mode), Day-Off mode, Away mode, Clean filter reset, Indoor unit name registration, Anti-freeze setting, Test operation.

</RNRUZ2>

<RNKU>

**4.02 Remote Control – Wired Remote**

**B. General**

The VRF Wired Remote control shall be capable of displaying settings and values and controlling a single group of indoor units. The group shall consist of up to 16 indoor units. The Wired Remote shall be small in size measuring 4-<sup>3</sup>/<sub>4</sub>" x 4-<sup>3</sup>/<sub>4</sub>". The remote shall be equipped with buttons to facilitate its settings and display of information. It shall have a built-in temperature sensor to facilitate ambient temperature measurement at the human comfort elevation. The remote shall connect to and be powered by the indoor unit using the manufacturer specified wiring. The remote shall not require any additional controls or equipment to facilitate its operation. The remote shall offer the following features:

1. Temperature settings in Fahrenheit and Celsius.
2. Modes: Auto, Cool, Heat, Dry, Fan.
3. Temperature set point adjustment, fan speed control, and louver control.
4. Economy mode setting.
5. Temperature Setback Timer.
6. Schedule: Weekly or Daily with up to 4 settings per day using On/Off, Set temperature or occupied status.
7. Temperature sensing at the remote or at the indoor unit return air.
8. Additional features shall include: Clean filter reset, Day-Off Mode, On/Off timer, Test Operation, Error History.

</RNKU>

<RSKU>

**4.03 Remote Control – Simple Wired Remote with Operation Mode**

**A. General**

The VRF Simple Wired Remote with Operation Mode shall be capable of displaying settings and values and controlling a single group of indoor units. The group shall consist of up to 16 indoor units. This remote shall be small in size measuring 3” x 4-3/4”. The screen shall be equipped with a back-lit display. The remote shall be equipped with buttons to facilitate its settings and display of information. The remote shall connect to and be powered by the indoor unit using the manufacturer specified wiring. The remote shall not require any additional controls or equipment to facilitate its operation. The remote shall offer the following features:

1. Temperature settings in Fahrenheit and Celsius.
2. Back-lit display.
3. Automatic Change over (Heat/Cool) with a dead band.
4. Modes: Auto, Cool, Heat, Dry, Fan.
5. Temperature set point adjustment, and fan speed.
6. Temperature sensing at the remote or at the indoor unit return air.
7. Additional features shall include Clean filter reset, Test Operation, Error History.

</RSKU>

<RHKU>

**4.04 Remote Control – Simple Wired Remote without Operation Mode**

**A. General**

The VRF Simple Wired Remote shall be capable of displaying settings and values and controlling a single group of indoor units. The group shall consist of up to 16 indoor units. This remote shall be small in size measuring 3" x 4-3/4". The screen shall be equipped with a back-lit display. The remote shall be equipped with buttons to facilitate its settings and display of information. The remote shall connect to and be powered by the indoor unit using the manufacturer specified wiring. The remote shall not require any additional controls or equipment to facilitate its operation. The remote shall offer the following features:

1. Temperature settings in Fahrenheit and Celsius.
2. Back-lit display.
3. Automatic Change over (Heat/Cool) with a dead band.
4. Temperature set point adjustment, and fan speed.
5. Temperature sensing at the remote or at the indoor unit return air.
6. Additional features shall include Clean filter reset, Error History.

</RHKU>

<LNHU>

**4.05 Remote Control – Wireless Remote**

**A. General**

The VRF Wireless Remote control shall be capable of displaying settings and values and controlling a single group of indoor units. The group shall consist of up to 16 indoor units. This remote shall be designed to be hand-held. It shall use infrared signal to communicate to the indoor unit. The remote shall be equipped with buttons to facilitate its settings and display of information. The remote shall be powered by 2 AAA Batteries. The remote shall require that the indoor unit be equipped with a compatible wireless receiver. No additional controls or equipment are required to facilitate its operation. The remote shall offer the following features:

1. Temperature settings in Fahrenheit and Celsius.
2. On/Off, Sleep, and Program timer
3. Temperature set point adjustment, fan speed control.
4. Operation mode setting.
5. Economy mode setting.
6. Indoor unit address setting.
7. Additional features shall include Current time display, Test Operation.

</LNHU>

<UART>

**4.06 Wi-Fi Interface Module**

**A. General**

The Wi-Fi Interface Module shall be capable of connecting Airstage indoor units to the cloud via the 2.4GHz Wi-Fi band to enable operational control and monitoring of the system using iOS or Android app.

The module shall be powered by 12 V DC with a power consumption of max. 60 mA.

The module should enable the following functions to be performed remote:

1. Equipment start/stop
2. Operation mode
3. Fan control
4. Room temperature and dual heating/cooling setpoints
5. Error code reporting
6. Filter status and reset
7. Over-the-air (OTA) software updates

</UART>

<DTGYZ1>

**4.07 Central Control – Touch Controller with Internet Communication**

**A. General**

The VRF Central Touch Controller shall be capable of viewing and controlling the operation of up to 400 indoor units from up to 16 refrigerant systems. In addition, the controller shall be capable of connecting up to 100 outdoor units. The controller shall be equipped with a 7.5” touch LCD color display. The controller shall be equipped with Ethernet port for TCP/IP network communication over LAN/WAN or the Internet. The controller shall be equipped with USB connection for exporting a variety of reports. No additional remotes, controls or equipment are required to facilitate its operation. The controller shall be powered by an integrated 100 -240VAC 50/60Hz power supply. The controller shall offer the following features:

1. Remote communication over the LAN/WAN or the internet.
2. Email of errors of indoor, outdoor, or touch controller to registered addresses.
3. Export of operation history or error history to USB.
4. Languages: English, Spanish, French, German, Chinese, Polish, and Russian.
5. Temperature settings in Fahrenheit and Celsius.
6. Individual and grouped indoor unit(s) Temperature set point adjustment, fan speed control, louver control, and remote-control temperature set point range limitation.
7. External input for individual and grouped indoor unit(s) On/Off, emergency stop.
8. Up to 20 yearly schedules that can be applied to indoor units or their groups.
9. Registering of indoor units.
10. A minimum of three levels of user security access.
11. Up to 100 operation users and 5 administrative users can be set.
12. Management of remote control(s) individual function limitation.
13. Daylight savings time support.
14. Additional features shall include defrost status display, room temperature, and Error history. It shall provide settings for the following features: Energy Saving Management, Economy mode setting, Day-Off mode, Clean filter reset, Anti-freeze setting, Test operation, Low Noise setting.
15. The controller shall offer an optional Energy Charge Apportionment and Subtenant billing add-on.

</DTGYZ1>



<DCGY>

**4.08 Central Control – Central Controller**

**A. General**

The VRF Central Controller shall be capable of viewing and controlling the operation of up to 100 indoor units from up to 16 refrigerant systems. The controller shall be equipped with a 5” large TFT color display. The controller shall offer several buttons to facilitate control operation. No additional remotes, controls or equipment are required to facilitate its operation. The controller shall be powered by a separate 100 -240VAC 50/60Hz power supply that is included with the controller equipment list. The controller shall offer the following features:

1. Languages: English, Spanish, French, German, Chinese, Polish, and Russian.
2. Temperature settings in Fahrenheit and Celsius.
3. Individual and grouped indoor unit(s) Temperature set point adjustment, fan speed control, louver control, and remote-control temperature set point range limitation.
4. External input for individual and grouped indoor unit(s) On/Off, emergency stop.
5. Up to 20 weekly schedules that can be applied to indoor units or their groups.
6. Backup operation using dipswitches.
7. Display pattern shall automatically adjust from 9 to 100 units per screen based on the number of controlled indoor units.
8. A minimum of two levels of user security access.
9. Management of remote control(s) individual function limitation.
10. Daylight savings time support.
11. Additional features shall include defrost status display, room temperature, and Error history. It shall provide settings for the following features: Economy mode setting, Day-Off mode, Clean filter reset, Anti-freeze setting, Test operation.

</DCGY>

<DCGYZ1>

**4.09 Central Control – Central Remote Controller**

**A. General**

The VRF Central Remote Controller shall be capable of viewing and controlling the operation of up to 100 indoor units in up to 50 groups. The controller shall be equipped with a 7” large backlit TFT color display. The controller shall offer touch panel interface to facilitate control operation. No additional remotes, controls or equipment are required to facilitate its operation. The controller shall be powered by a separate 100 -240VAC 50/60Hz power supply. The controller shall offer the following features:

1. Operation modes: Auto/Cool/Dry/Fan/Heat
2. Various timer setup (on/off/weekly)
3. All settings are accessible from the main screen
4. Batch operation / batch stop signal or emergency stop signal
5. Notification of room temperature outside range through email
6. 12 installed languages

</DCGYZ1>

<APGXZ1>

**4.10 Central Control – System Controller Software**

**A. General**

The VRF System Controller Software shall provide advanced integrated monitoring & control of up to 4 VRF network systems, 1600 indoor units, and 400 outdoor units.

The system controller software shall offer the following features:

1. Possibility to control external devices via Modbus Adapter
2. Annual scheduling, including holidays, for individual control groups
3. Control of Indoor units operating modes, temperature settings/limitations
4. Error messages on display and through email notifications
5. Error messages stored for 12 months
6. Database management with import/export of registration data, layout data, and image data.
7. Electricity Charge Apportionment calculation framework
8. Energy Saving Management with settings/schedules to accommodate usage and seasons
9. Peak Cut Operation to control power consumption and load shedding function
10. Indoor unit rotation operation function within groups
11. Outdoor unit capacity saving function

</APGXZ1>

<ALGXZ1>

**4.11 Central Control – System Controller Software Lite**

**A. General**

The VRF System Controller Software Lite shall provide advanced integrated monitoring & control of up to 1 VRF network system, 400 indoor units, and 100 outdoor units.

The system controller software shall offer the following features:

1. Possibility to control external devices via Modbus Adapter
2. Annual scheduling, including holidays, for individual control groups
3. Control of Indoor units operating modes, temperature settings/limitations
4. Error messages on display and through email notifications
5. Error messages stored for 12 months
6. Database management with import/export of registration data, layout data, and image data.
7. Electricity Charge Apportionment calculation framework
8. Energy Saving Management with settings/schedules to accommodate usage and seasons
9. Peak Cut Operation to control power consumption and load shedding function
10. Indoor unit rotation operation function within groups
11. Outdoor unit capacity saving function

</ALGXZ1>

<VBGX>

**4.12 Central Control – BACnet® Gateway (Hardware)**

**A. General**

The BACnet® Gateway shall be capable of connecting up to 128 indoor units and 32 refrigerant systems to a BMS via BACnet® IP. It shall be powered with 208-240V 50/60Hz single phase, and be compatible with BACnet® (ANSI / ASHRAE-135-2012) application specific controller (B-ASC) and with BACnet®/IP over Ethernet. The BACnet® Gateway shall work in 24 different languages.

</VBGX>

<ABGXZ1>

**4.13 Central Control – BACnet® Gateway (Software)**

**A. General**

The BACnet® Gateway Software shall be capable of connecting up to of 1600 indoor units with 4 VRF network systems (a maximum of 400 indoor units & 100 outdoor units for one network system).

It shall offer Scheduling function, Alarm & Event functions as well as Electricity Change Apportionment functions and also enable connection between a VRF network system to personal computer utilizing a small U10 USB interface.

</ABGXZ1>

<VLGX>

**4.14 Central Control – Network Converter for LONWORKS®**

**A. General**

The Network Converter for LONWORKS® shall be capable of connecting up to 128 indoor units and 100 outdoor units.

</VLGX>

<VMGX>

**4.15 Central Control – MODBUS® Converter**

**A. General**

The MODBUS® Converter shall be capable of connecting up to 128 indoor units and 100 outdoor units. It shall also have the capability to connect up to 9 Converters to one BMS.

</VMGX>



<ASGXZ1>

**4.16 Central Control – Service Tool Software**

**A. General**

The Service Tool Software shall be capable of monitor and analyze VRF systems with up to 400 Indoor Units and 100 Outdoor Units.

The software shall include self-diagnosis function of the refrigeration systems and its sensors and also graphically display the VRF system including operating conditions and values.

The software shall be capable of comparing graphical data trends from two different offline data files.

The software shall have built-in automatic software update.

</ASGXZ1>

<AMGXZ1>

**4.17 Central Control – Web Monitoring Tool**

**A. General**

The Web Monitoring Tool shall be capable of monitor up to 1,600 indoor units in up to 4 VRF systems. and analyze VRF systems with up to 400 Indoor Units and 100 Outdoor Units.

The tool shall offer the following features:

1. Remote trouble shooting of each unit in the system.
2. Automatic system error notifications to multiple locations.
3. Possibility to download and display monitoring data offline.

</AMGXZ1>

</CN>

**Part 5 - Piping:**

Refrigerant piping shall meet ASTM B 280 of the ACR type that is authorized by the manufacturer.

- A. Piping shall be insulated according to the manufacturer and applicable national and local codes.
- B. The piping shall be factory cleaned with both ends capped to protect cleanliness of pipe interiors prior to shipping.
- C. All piping shall be stored according to the manufacturer's instructions.
- D. The piping shall be sized using the manufacturer system design software.
- E. The piping shall be installed according to the manufacturer's installation instructions and national and local code requirements.
- F. All pipe brazing must be done with Dry Nitrogen gas flowing through the piping.
- G. A startup filter drier can be installed with R410A rated isolation ball valves with a valve-regulated bypass connection.
- H. Headers shall be used to connect multiple indoor units.

<V5>

- I. Connecting heat-recovery type outdoor unit(s) refrigeration piping to one/multiple indoor units requires the use of the manufacturer's refrigerant branch box units, separation tubes, ranch kits, and. No alternate piping components are allowed.
- J. The system shall be capable of operation with the outdoor unit being installed higher than the furthest indoor unit by a maximum of 164 ft. The system shall be capable of operation with the outdoor unit being installed below than the furthest indoor unit by a maximum of 131 ft. All piping lengths must be attainable without the need for line size changes.
- K. The system shall be specified to operate with a total refrigerant piping length of up to 3,280 ft. All piping lengths must be attainable without the need for line size changes or traps.
- L. The connection between the outdoor unit and refrigerant branch units shall use 3-pipe refrigerant system design. Use of 2-pipe refrigerant system design shall not be allowed.
- M. Refrigerant branch boxes shall not be equipped with drain piping. The use of refrigerant branch boxes with drain piping shall be prohibited.
- N. The outdoor unit shall have the capability of being piped from front and bottom.

</V5>

<V2>

- I. Connecting the heat-recovery outdoor unit(s) refrigeration piping to one/multiple indoor units requires the use of the manufacturer's refrigerant branch box units, separation tubes, ranch kits, and. No alternate piping components are allowed.
- J. The system shall be capable of operation with the outdoor unit being installed higher than the furthest indoor unit by a maximum of 164 ft. The system shall be capable of operation with the outdoor unit being installed below than the furthest indoor unit by a maximum of 131 ft. All piping lengths must be attainable without the need for line size changes.
- K. The system shall be specified to operate with a total refrigerant piping length of up to 3,280 ft. All piping lengths must be attainable without the need for line size changes or traps.
- L. The connection between the outdoor unit and refrigerant branch units shall use 3-pipe refrigerant system design. Use of 2-pipe refrigerant system design shall not be allowed.
- M. Refrigerant branch boxes shall not be equipped with drain piping. The use of refrigerant branch boxes with drain piping shall be prohibited.
- N. The outdoor unit shall have the capability of being piped from front and bottom.

</V2>

<VR2>

- I. Connecting the heat-recovery outdoor unit(s) refrigeration piping to one/multiple indoor units requires the use of the manufacturer's refrigerant branch box units, separation tubes, ranch kits, and. No alternate piping components are allowed.
- J. The system shall be capable of operation with the outdoor unit being installed higher than the furthest indoor unit by a maximum of 164 ft. The system shall be capable of operation with the outdoor unit being installed below than the furthest indoor unit by a maximum of 131 ft. All piping lengths must be attainable without the need for line size changes.
- K. The system shall be specified to operate with a total refrigerant piping length of up to 3,280 ft. All piping lengths must be attainable without the need for line size changes or traps.
- L. The connection between the outdoor unit and refrigerant branch units shall use 3-pipe refrigerant system design. To maximize system efficiency and reduce piping, the use of 2-pipe refrigerant system design shall not be allowed.
- M. Refrigerant branch boxes shall not be equipped with drain piping. The use of refrigerant branch boxes with drain piping shall be prohibited.
- N. The outdoor unit shall have the capability of being piped from front and bottom.

</VR2>

<J4D>

- I. Connecting the heat-pump outdoor unit(s) refrigeration piping to one/multiple indoor units require(s) the use of the manufacturer's separation tubes and headers. No alternate piping components are allowed.
- J. The system shall be capable of operation with the outdoor unit being installed higher than the furthest indoor unit by a maximum of 164 ft. The system shall be capable of operation with the outdoor unit being installed below the furthest indoor unit by a maximum of 131 ft. All piping lengths must be attainable without the need for line size changes.
- K. The system shall be specified to operate with a total refrigerant piping length of up to 590 ft. All piping lengths must be attainable without the need for line size changes or traps.
- L. The outdoor unit shall have the capability of being piped from the following sides: Rear, front, one side, and bottom.

</J4D>

<J4S>

- I. Connecting the heat-pump outdoor unit(s) refrigeration piping to one/multiple indoor units require(s) the use of the manufacturer's separation tubes and headers. No alternate piping components are allowed.
- J. The system shall be capable of operation with the outdoor unit being installed higher than the furthest indoor unit by a maximum of 98 ft. The system shall be capable of operation with the outdoor unit being installed below the furthest indoor unit by a maximum of 98 ft. All piping lengths must be attainable without the need for line size changes.
- K. The system shall be specified to operate with a total refrigerant piping length of up to 262 ft. All piping lengths must be attainable without the need for line size changes or traps.
- L. The outdoor unit shall have the capability of being piped from the following sides: Rear, front, one side, and bottom.

</J4S>

<COMM>

**Part 6 - Commissioning:**

Each VRF refrigerant system shall be commissioned using the manufacturer's specified procedure and software.

- A. All VRF System Commissioning activities shall be completed by the manufacturer's certified VRF commissioning agent. The certified VRF commissioning agent shall be an employee of the VRF manufacturer or an employee of the manufacturer's VRF distributor or VRF representative.
- B. The installing contractor shall be certified by the manufacturer to install the specified VRF system(s). Upon request, a copy of this certificate shall be presented as part of the VRF equipment submittal process.
- C. Upon proper equipment start up by the contractor, following the manufacturers guidelines and specifications, an employee of the VRF manufacturer shall complete a review of the system performance and complete the following tasks:
  - D. Check and confirm all communication addressing of system components.
  - E. Check and confirm each indoor unit, individually, is properly piped and wired by commanding the indoor unit on, in either heat or cool mode and verifying proper response.
  - F. This process shall be digitally recorded and included as part of the close out documentation.
  - G. Electronically record a minimum of one-hour of operational data per refrigeration system.
  - H. Electronically record selector switch positions on all indoor and outdoor equipment.
  - I. The VRF manufacturer shall retain the electronically recorded data, collected during the start-up and equipment commissioning process, at a designated location within the US for future reference.
  - J. Upon completion of the VRF equipment Commissioning, the VRF manufacturer shall provide a formal report outlining the status of the system in electronic format. Contained within this report shall be copies of all field inspection reports, required action items and status, Manufacturer's design software As-Built, equipment model & serial numbers.
- K. Completion of the Equipment VRF Commissioning process shall verify that the VRF system has been installed per the Engineer's design intent and complies with the VRF manufacturer's engineering and installation specifications related to the used equipment.
- L. Compliance with federal, state, and local codes as well as other authorities having jurisdictions are not part of this process and are the responsibility of the installing contractor.

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