General VRF Product Bulletin

Applying Direct Ventilation Air with VRF and Mini-Split Cassette Units.

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From: Trane Ductless Product Support

Introduction

The purpose of this Application Bulletin is to assist the design professional with designing fresh air applications for cassette style VRF and mini-split indoor units.

This Application Bulletin is for informational purposes only. Unless noted in this document, the information is not a recommendation of any specific methodology or product. Trane is not responsible for issues that may arise due to ducting outside air directly to a VRF or mini-split indoor unit, (IDU).

Trane does not make any claims of compliance with local codes, and or professional standards. This document is not intended to provide commentary for either. The design professional is encouraged to separately review both the applicable ASHRAE Standards, and the codes with jurisdiction.

(Anyone may preview, (at no cost), or purchase ASHRAE Standards 62.2, and 62.1 by visiting www.ASHRAE.org, along with many other standards commonly referenced in building codes.)

Affected Units

The determination described in this Application Bulletin is applicable to Trane VRF cassettes and C-Series Mini-Split products manufactured for sale by North America Trane. This Application Bulletin may, or may not apply to other products manufactured by Trane, or product sold in other regions.

Discussion

Efforts to improve the air quality of occupied spaces may require the introduction of ventilation air to the space. Towards this end ASHRAE has developed Standards 62.1 and 62.2 to discuss proper ventilation requirements. Many local codes have adopted these standards, and mandate the various minimum ventilation rates as specified for different applications. In order to comply with these local codes, the designer may desire to deliver ventilation air directly to a desired space. This document will discuss the advantages and disadvantages of the most common strategies for distributing ventilation air.

Per the *2016 ASHRAE Handbook HVAC Systems and Equipment (I-P Edition) – Chapter 18, Variable Refrigerant Flow*, there are three common strategies for delivering ventilation air. They are:

- Direct Method
- Integrated Method
- Decoupled Method

Figure 1 Direct Method

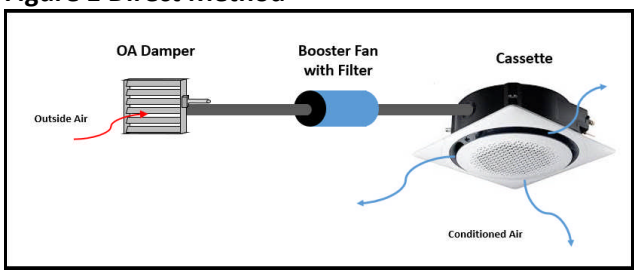


Figure 2 Integrated Method

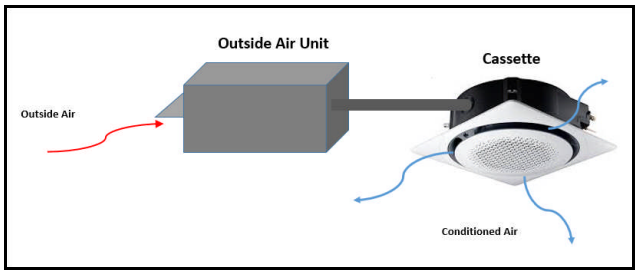
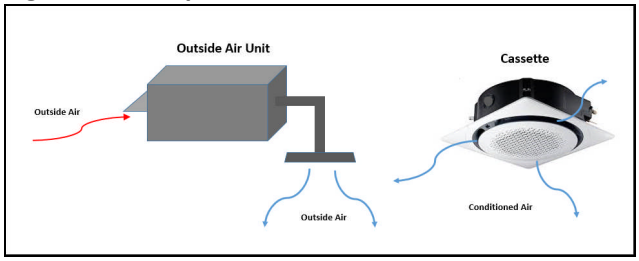


Figure 3 Decoupled Method



Direct Method

The Direct Method, (Figure 1) requires ducting of ventilation air directly to each VRF or Mini-Split IDU return. The air is not preconditioned, and requires the VRF or Mini-Split system to address all dehumidification, and cooling/heating loads. This method is used with cassette and ducted style units only. The direct method is not recommended except for milder dry climates.

The primary advantage of this solution is simple system design. However, per ASHRAE, when designing for VRF, *"the minimum supply air temperature,"* (outside air), *"from the ventilation system should be 59°F to 63°F, and sufficient mixing should factored in to enable effective coil performance."*[1] ASHRAE further states, *"ventilation requirements must be treated with caution where outdoor air could increase humidity levels to an unacceptable level in the space."*[2]

1, 2 - From the 2016 ASHRAE Handbook HVAC Systems and Equipment (I-P Edition) – Chapter 18, Variable Refrigerant Flow, page 18.12.

The concerns with supplying humid ventilation air include but are not limited to:

1. Temperatures exceeding minimums may result in high space relative humidity leading to condensation developing on the face of the indoor units, and other surfaces.
2. Possible failure to comply with ASHRAE 62.1. (*Check local adoption*.)
3. May disrupt the balance of the mechanical equipment.
4. May create conditions conducive for microbial growth.
5. Possible decreased workplace productivity due to health related absenteeism, (ie. sick building syndrome).
6. Possible decreased workplace productivity due to uncomfortable space conditions.

Additional Direct Method concerns include:

1. A pre-filter, and auxiliary booster fan are required.
2. The pre-filtration may not be adequate to comply with local building codes.
1. The amount of ventilation air may be limited by the IDUs capacity to accept the air. The designer must ensure the acceptable limits satisfy the local building code. (*See Tables below*.)
3. The mixed OA and return air will render the IDU mounted return air temperature sensor ineffective. A separate remote temp space temperature sensor is required to read the space temperature.
4. The ventilation air will increase the building load requirements. A larger outdoor unit is required to compensate for the additional load.
5. The VRF IDU fan should run continuously.
6. An interlocked ventilation damper and booster fan is recommended to prevent infiltration when the VRF or mini-split system IDU fan is off.
7. Requires cassette or ducted style indoor units.

Integrated Method

The Integrated Method, (Figure 2) provides outside air that is preconditioned, and filtered by a mechanical means. The air is ducted directly to the return of the VRF IDU units. This method is used with cassette and ducted style units. The integrated method is often used when unconditioned outside air is not acceptable.

The advantages of the integrated method are the ability to temper, and or possibly control the humidity and temperature of the ventilation air. The designer may also transfer a portion of the building load to the outdoor unit. This may result in smaller condensing units.

The disadvantages with this design are:

2. The mixed OA and return air will render the IDU mounted return air temperature sensor ineffective. This requires a separate remote temp space temperature sensor to read the space temperature.
3. The fans for the VRF indoor units, must run continuously
4. The amount of ventilation air may be limited by the IDUs capacity to accept the air. The designer must ensure the acceptable limits satisfy the local building code. (*See Tables below*.)
5. Depending on the ductwork design, an auxiliary booster may still be required.
6. The VRF IDU fan should run continuously.
7. An interlocked outside air unit is recommended to prevent infiltration when the VRF or mini-split system IDU fan is off.

Decoupled Method

The Decoupled method is suitable for any climate or condition. The decoupled method is the preferred method to provide ventilation air to VRF or mini-split systems.

The decoupled method, (Figure 3), provides for 100% conditioning of the pre-filtered ventilation air. The air is dehumidified to a dew point less than the space conditions. The unit is not ducted to the VRF IDUs. This allows the IDU fans to cycle based on space conditions. This also provides the designer the flexibility to address more stringent conditions, and or provide a more cost effective ventilation distribution.

When using the decoupled method the designer has the option to provide ventilation air at “coil” conditions, (example: 55^{o}F discharge air temp), or “room neutral” condition (example 74^{o}F discharge air temp).

When the unit is provided at coil conditions, the outside air unit will transfer some of the sensible load from the VRF system to the outdoor air unit. The removal of a portion of the sensible may provide additional reductions in the size of the VRF outdoor unit. However, the designer must be

cautious. To protect against high head conditions, VRF, and mini split systems lockout heat based on a factory set OA ambient temperature. If the outdoor unit locks out heat, the IDU will not be able to reheat the ventilation air. This may create occupant comfort issues during the shoulder seasons if the indoor unit is required to reheat the air.

When the air is provided as neutral air, the delivered air does not alter the thermal condition of the space, (72~74°F DB.) The VRF or mini-split system is only sized to maintain occupant comfort this is preferred with systems that require simultaneous heating and cooling, as the VRF IDU does not need to reheat the ventilation air. *(Note: The designer is encouraged to review local codes to ensure compliance.)*

Determination

When using the Direct, or Integrated Method, the amount of air that may be provided to the space is dependent on the VRF IDU. If using the Direct Method, a separate booster fan and filter, is required to deliver the airflow to the space. If using the Integrated Method, the outdoor unit will provide filtering, and the supply fan. However, if the supply fan is inadequate, a booster fan is required.

Mini, and 4-Way Cassette Fresh Air Intakes

The following illustrations are intended to assist the designer in locating the Fresh Air Intakes for a Mini, and 4-Way Cassette. As shown in Figure 4, using a sharp knife remove the exterior Fresh Air Intake, (red circle). **Do not cut the foam insulation,** only remove the outside plastic ring. Next, as shown in figure 5, trim the underside of the cassette chassis insulation, (red rectangle). This is visible by removing the cassette pane. Finally, carefully attach field provided duct work with field provided screws, (blue circles). Care must be taken to prevent stripping the screw locations. Use duct sealer on the connection as required.

Figure 4 Mini and 4-Way Cassette and Knockout Locations

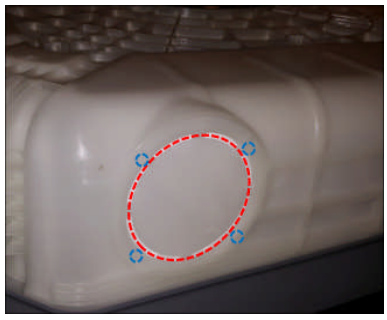
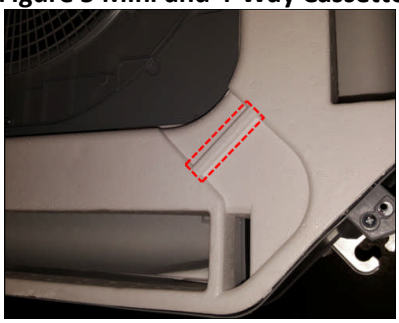


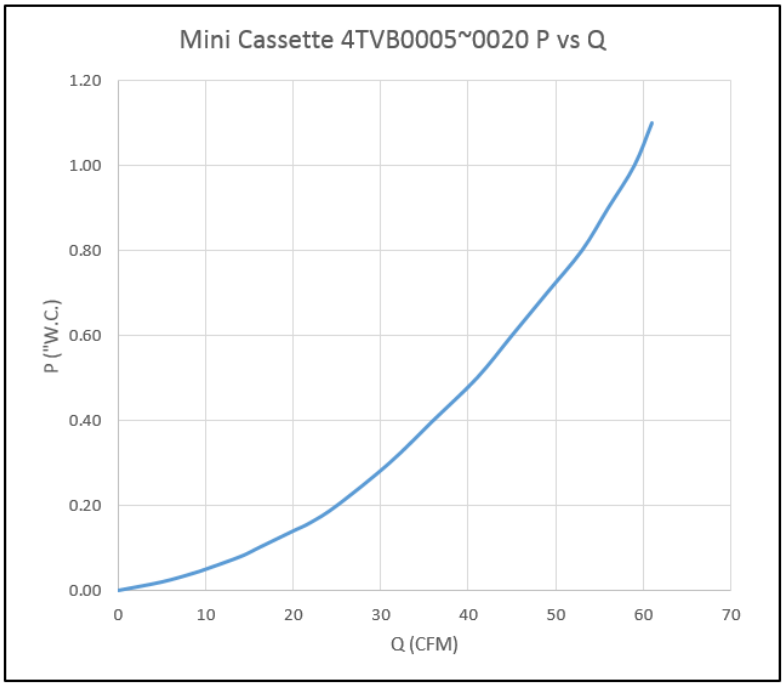
Figure 5 Mini and 4-Way Cassette Internal Knockout Location



Tables 1, 2, and 3, are provided to help the designer estimate the amount of ventilation air that may be delivered to the space via the factory provided cassette fresh air knockout. P is the static pressure that must be supplied at the fresh air inlet, in order to produce desired CFM, Q, at the return of the IDU. Please design the fan accordingly.

Table 1 Trane Mini-4-way Cassette Ventilation Rates

Mini Cassette 4TVB0005~0020	
P ("W.C.)	**Q (CFM)**
0.00	0
0.02	5
0.04	9
0.05	10
0.08	14
0.10	16
0.12	18
0.14	20
0.16	22
0.20	25
0.30	31
0.40	36
0.50	41
0.60	45
0.70	49
0.80	53
0.90	56
1.00	59
1.10	61

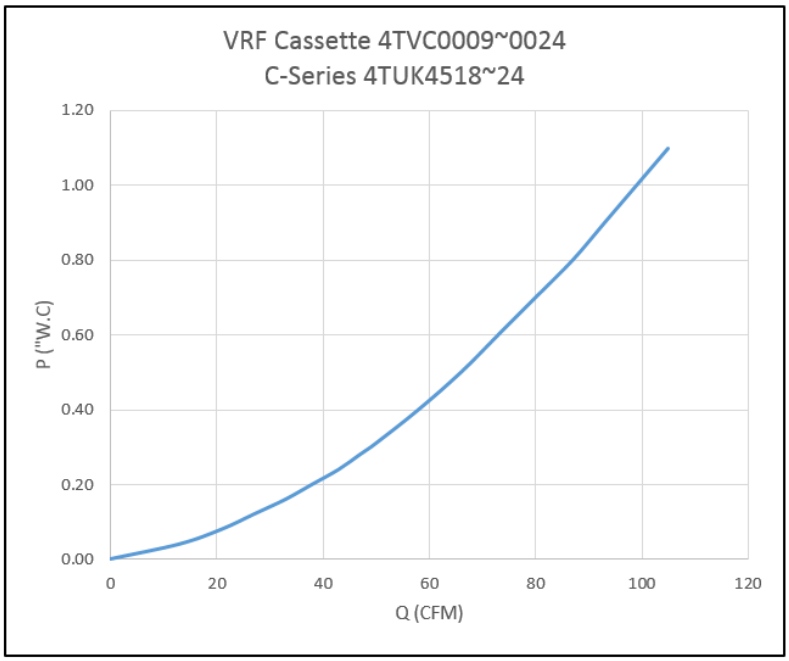


P= Ductwork static pressure at the cassette.

Q= CFM at cassette return.

Table 2 Trane Small Tonnage 4-way Cassette Ventilation Rates

VRF Cassette 4TVC0009~0024 C-Series 4MUC4518~24	
P ("W.C.)	**Q (CFM)**
0.00	0
0.04	13
0.08	21
0.12	27
0.16	33
0.20	38
0.24	43
0.28	47
0.31	50
0.40	58
0.50	66
0.60	73
0.70	80
0.80	87
0.90	93
1.00	99
1.10	105

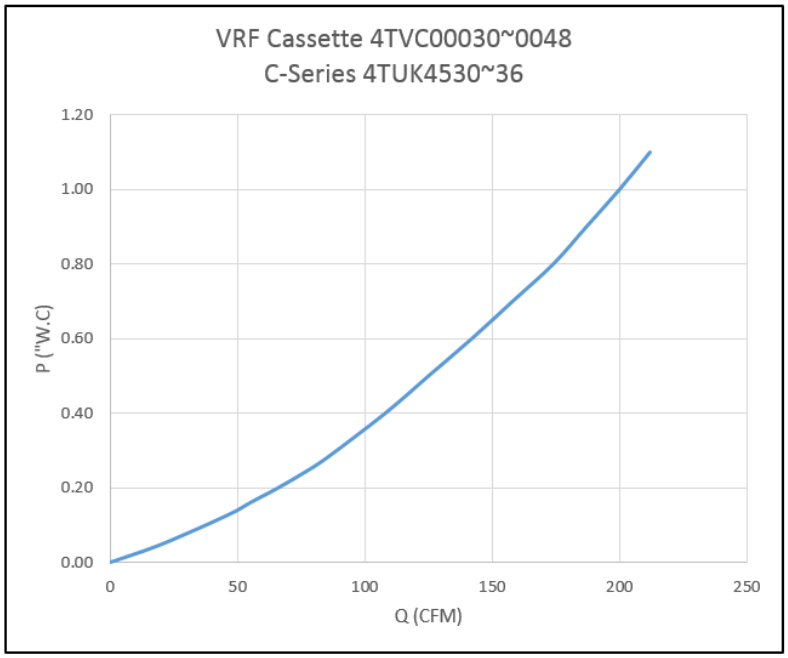


P= Ductwork static pressure at the cassette.

Q= CFM at cassette return.

Table 3 Trane Large Tonnage 4-way Cassette Ventilation Rates

VRF Cassette 4TVC00030~0048 C-Series 4MUC4530~36	
P ("W.C.)	**Q (CFM)**
0.00	0
0.04	17
0.08	31
0.12	44
0.14	50
0.16	55
0.20	66
0.24	76
0.28	85
0.40	108
0.50	125
0.60	142
0.70	158
0.80	174
0.90	187
1.00	200
1.10	212



P= Ductwork static pressure at the cassette.

Q= CFM at cassette return.

Circular Cassette Fresh Air Intakes
The following illustrations are intended to assist the designer in locating the "Fresh Air Intakes" for a circular cassette.

As shown in Figures 6, using a sharp knife remove the exterior Fresh Air Intake, (red circle). **Do not cut the foam insulation,** only remove the outside plastic ring. Next, as shown in Figure 7, remove the cassette panel, and fan bell mouth from the cassette body. With the fan bell separated, use a sharp knife to remove the interior Fresh Air knockout, (red rectangle). With the bell mouth still removed, a second interior knock is now visible. Remove the second interior Fresh Air knockout, taking care to not damage the insulation, (red rectangle). Reassemble the cassette. Carefully attach field provided duct work with screws, (blue circles). Care must be taken to prevent stripping the screw locations. Use duct sealer as required.

Figure 6 Circular Cassette External Knockout Locations

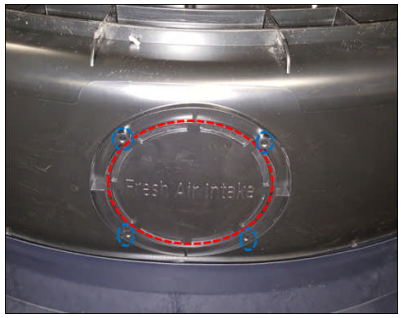
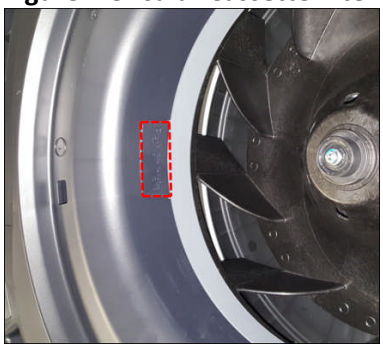


Figure 7 Circular Cassette Internal Knockout Locations



Tables 4, and 5 are provided to help the designer estimate the amount of ventilation air that is delivered to the space via the factory provided Fresh Air knockout in the VRF Circular Cassette. P is the static pressure the must be supplied at the fresh air inlet, in order to produce desired CFM, Q at the return of the IDU. Please design the fan accordingly.

Table 4 Trane Small Tonnage Circular Cassette Ventilation Rates

VRF Circular 4TVS0030~0048 C-Series 4MUS4530~36	
P ("W.C.)	**Q (CFM)**
0.000	0
0.010	13
0.012	15
0.017	19
0.023	22
0.029	25
0.037	28

P= Ductwork static pressure at the cassette.

Q= CFM at cassette return.

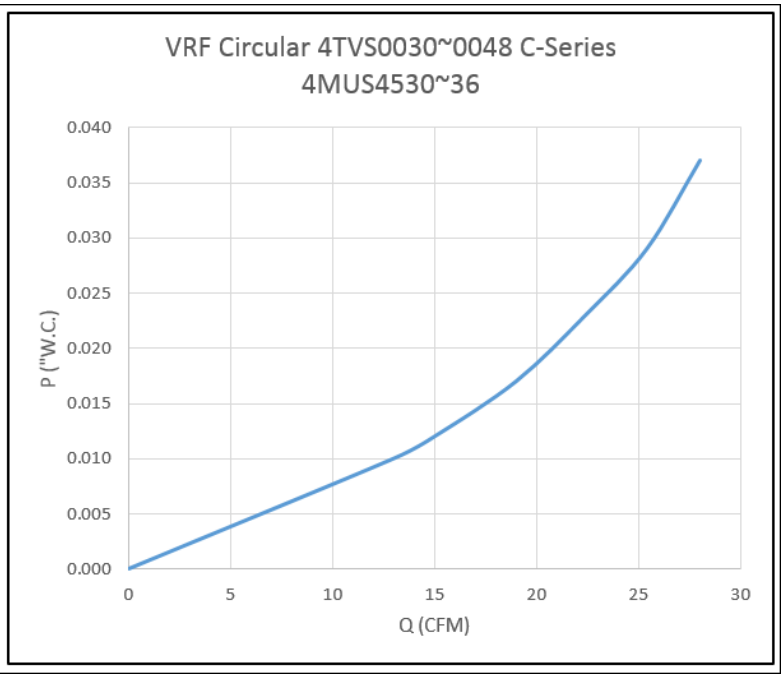
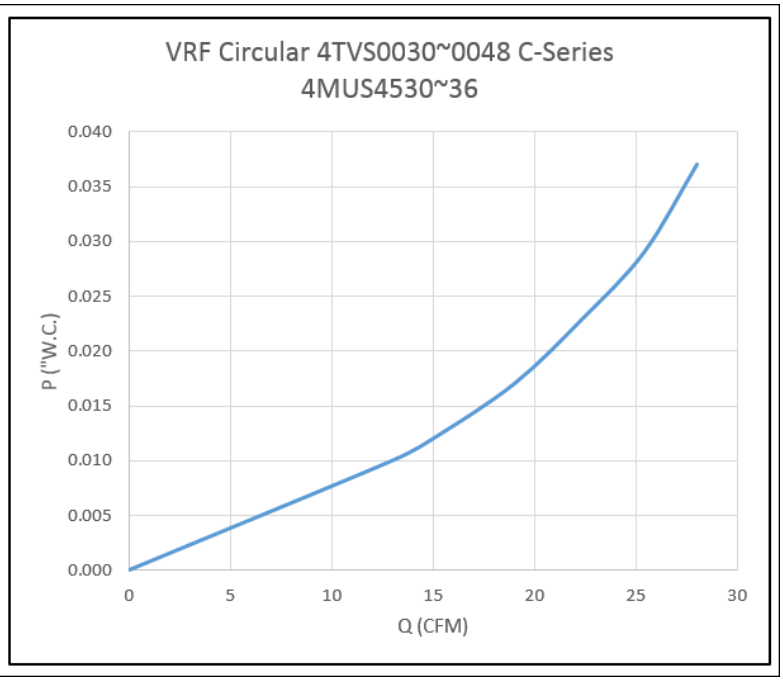


Table 5 Trane Large Tonnage Circular Cassette Ventilation Rates

VRF Circular 4TVS0030~0048 C-Series 4MUS4530~36	
P ("W.C.)	**Q (CFM)**
0.000	0
0.010	13
0.012	15
0.017	19
0.023	22
0.029	25
0.037	28

P= Ductwork static pressure at the cassette.

Q= CFM at cassette return.



Questions

This document is intended to discuss common industry strategies for delivering ventilation air with VRF indoor units. This document is not valid for any other purpose. Unless noted in this document, the information is not a recommendation of any specific methodology or product. Trane is not responsible for issues that may arise due to ducting outside air directly to a VRF indoor unit. The design professional is encouraged to separately review both the applicable ASHRAE Standards, and or codes for the project.

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