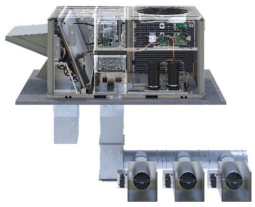

TRANE A2L Packaged Rooftop Multiple Zone VAV System User Manual

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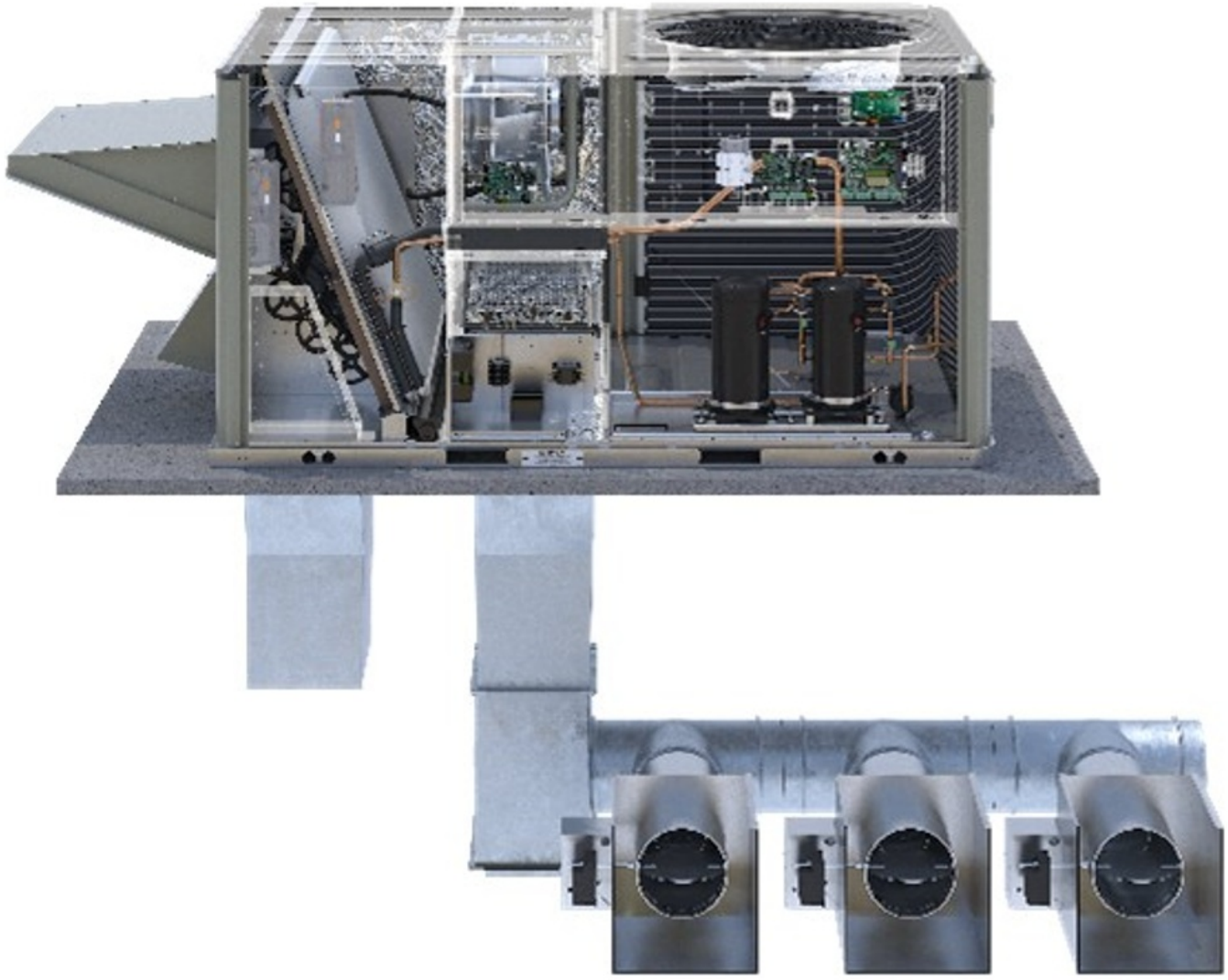

Contents

Multiple Zone VAV Packaged Rooftop Systems

The following informational material is abridged material from the Trane document APP-APM001F-EN Applications Engineering Manual Refrigeration Systems and Machinery Rooms Application Considerations for Compliance with ASHRAE® Standard 15- 2022. It is strongly recommended any user of this document also review the source material for additional clarifications, givens, and commentary.

When using an A2L refrigerant the product safety code UL 60335-2-40 mandates the circulating fan must provide a minimum \CFM as prescribed by the code. Additionally, Standard 15 states that if the unit has more than 4 pounds of refrigerant, and is ducted, the system must have a leak detection system listed with the equipment.

A packaged rooftop system is an example of a high probability system as there is a high probability the refrigerant may enter the occupied space. When designing high probability systems, the occupied space must be of sufficient “volume” to safely diffuse and dilute the refrigerant. This volume is refrigerant dependent and is known as the \Effective Dispersal Volume Charge (EDVC). The EDVC is determined by the space volume available to disperse a refrigerant leak. Dilution is the solution!

Standard 15 may provide more than one EDVC compliance path. The designer may use one or all of the approved EDVC compliance paths. For the purposes of brevity, it is not possible to discuss all examples. Therefore, this document only focuses on the simplest approach. Please see Trane document APP-APM001F-EN for additional approaches.

Example: Packaged (DX) Rooftop Multiple Zone VAV System Serving a “Commercial” Occupancy with an A2L Refrigerant

Givens

A 20-ton (70-kW), packaged, direct-expansion (DX) rooftop unit with variable-airflow control serves a small office building (Figure 1). The rooftop unit consists of two 10-ton (35-kW) independent refrigeration circuits. The refrigerant is R-454B (A2L) and has a factory refrigerant installed detector. Each occupied space is served by a VAV terminal unit, with minimum airflow setpoints higher than 10 percent of design supply airflow. A free return interstitial ceiling plenum provides the return-air path to the rooftop unit. The supply ductwork is located in the ceiling plenum.

The occupancy classification is “commercial” (Focc = 1.0), and this system is categorized as a “high probability” system. Please see Trane document APP-APM001F-EN for further discussion on classification.

This is an example of “connected spaces” via a ducted air distribution system. The standard discusses ducted air distribution in Section 7.2.3.3.

Figure 1. Example office building served by a packaged DX rooftop VAV system.

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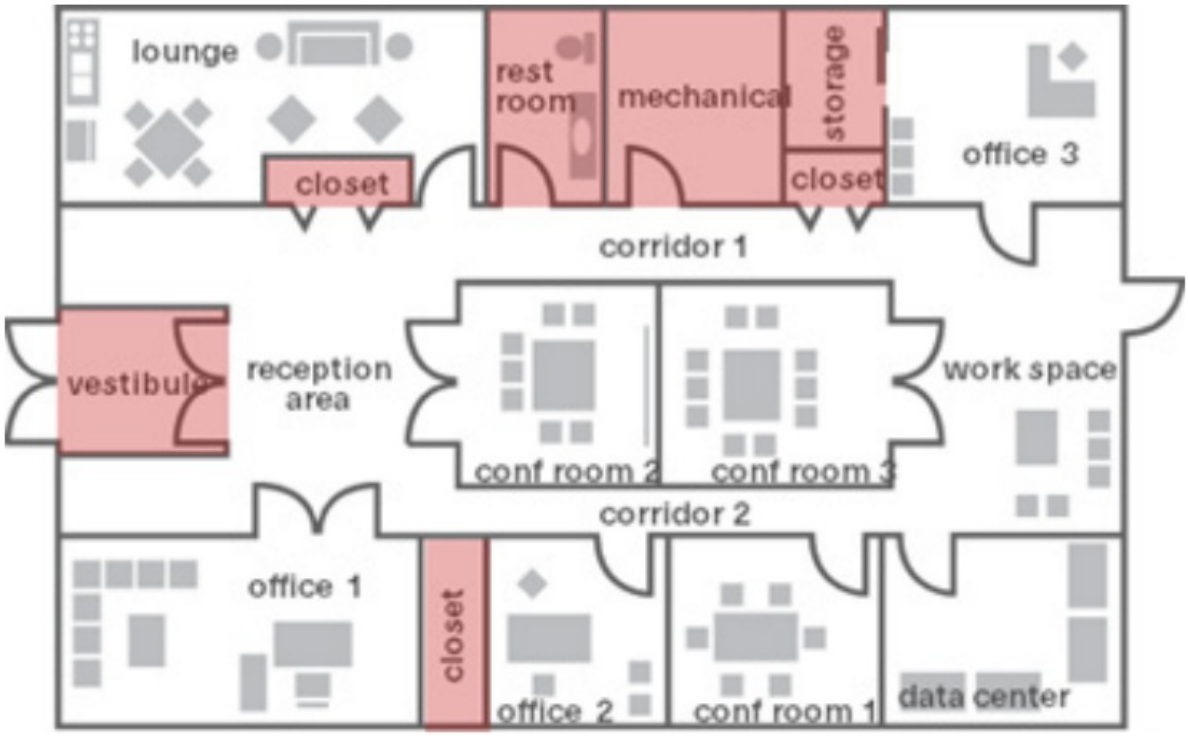

Table 1. Example office building served by the rooftop VAV system.

Occupied Space	Volume of Space, ft3	Veff, ft3
Office 2	2695	
Conf Room 1	3144	
Conf Room 2	3327	
Data Center	3593	
Conf Room 3	3826	
Office 3	3992	
Office 1	5389	61,072
Lounge	7319	
Reception	8383	
Corridor 1	2146	
Corridor 2	2146	
Workspace	6387	
Ceiling Plenum	8725	

As explained in the application manual, when calculating the effective dispersal volume (Veff) of the connected spaces in this example, include the following:

- The volume is the sum of all spaces served by the common supply and return ductwork, since the VAV dampers in this example do not close below 10 percent of design supply airflow whenever the supply fan is operating. Further the standard states we may ignore duct openings that only close in an emergency.
- The volume of the supply and return ductwork may be included. However, we are not allowed to double dip. In this example this volume should be ignored as both the supply and return ductwork is routed through a ceiling plenum, and the ceiling plenum is used as part of the return air path.
- The volume of the interstitial ceiling plenum may be used as it is part of the return-air path in this example.

but exclude the following:

- The volumes of the mechanical room, storage room, and closets since these spaces are not served by the rooftop unit or the return-air plenum and can be closed (isolated) from the source of the refrigerant leak by a door.
- The volumes of the vestibule and restroom since they are conditioned by transfer air only.

For this example (Table 1), the effective dispersal volume (Veff) of the connected spaces is calculated to be 61,072ft^3

Solution

As this system uses a Group A2L refrigerant:

The rooftop unit consists of two 10-ton independent refrigeration circuits, each of \which contains 10.2 lb of R-454B refrigerant. Per Section 7.3.4.2, the releasable refrigerant charge (mrel) is the largest refrigerant charge in an independent circuit—which is 10.2 lb in this case.

Standard 34 lists R-454B as Group A2L refrigerant with an LFL equal to 18.5 lb/1000 ft3 or 0.0185 lb/ft3.

Since this is a high-probability system used for human comfort, the use of a Group A2L refrigerant means that the requirements of Section 7.6 apply. The rooftop unit in the example includes a refrigerant detector—that complies with the requirements of Section 7.6.2.4—to initiate air circulation in the event that a leak is detected. Therefore, per Section 7.6.1.1, the EDVC is calculated to be 565 lb:

EDVC = 0.0185 lb/ft 3 × 61,072 ft 3 × 0.5 × 1.0 = 565 lb

For this example, the releasable refrigerant charge mrel = 10.2 lb. This is much lower than the EDVC, so this system complies with the limit prescribed by Section 7.6.1.

Please refer to Trane document APPAPM001F-EN for more details.

ASHRAE Standard 15 is under continuous maintenance, the requirements can change frequently. This content is based on the 2022 published version.

Systems with air circulation

If the system has either continuous air circulation (except during short periods for maintenance or service) or air circulation that is initiated by a refrigerant detector that complies with Section 7.6.2.4, the EDVC is calculated as follows (Section 7.6.1.1):

EDVC = LFL × Veff × CF × Focc

where, **EDVC** = effective dispersal volume charge, lb (kg)

Veff = effective dispersal volume per Sections 7.2.1 through 7.2.3, ft3(m3)
LFL = lower flammability limit of the refrigerant, lb/ft3(kg/m3)*
CF = concentration factor = 0.5
Focc = occupancy adjustment factor (0.5 for institutional; 1.0 for all others)

***Note** that the values tabulated in ASHRAE Standard 34 are in units of lb/1000 ft ^{3} and g/m^3 , so be sure to convert to the correct units when using this formula.

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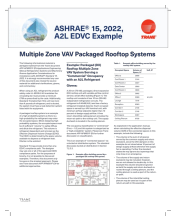
environments through a broad portfolio of heating, ventilating and air conditioning systems and controls, services, parts and supply. For more information, please visit **trane.com** or **tranetechnologies.com**.

Documents / Resources

	**TRANE A2L Packaged Rooftop Multiple Zone VAV System** [pdf] User Manual A2L Packaged Rooftop Multiple Zone VAV System, A2L, Packaged Rooftop Multiple Zone VAV System, Multiple Zone VAV System, Zone VAV System

References

- User Manual