engineering bulletin

ASHRAE® Standard 15-2022 A2L EDVC Example

TRANE®

Packaged Rooftop Single-Zone VAV System

The following abridged material is from Trane application manual APP-APM001*-EN, *Refrigeration Systems and Machinery Rooms: Application Considerations for Compliance with ASHRAE® Standard 15-2022*. It is strongly recommended that any user of this document also reviews the source material for additional clarifications, givens, and commentary.

A packaged rooftop system is classified by Standard 15 as a "high-probability" system, since leaked refrigerant has a high probability of entering the occupied space. When designing a high-probability system, the occupied space must be of sufficient "volume" to safely disperse and dilute any leaked refrigerant. Dilution is the solution! The maximum allowable refrigerant charge, known as the Effective Dispersal Volume Charge (EDVC), is calculated using the volume available to disperse the leaked refrigerant, and depends on the refrigerant's safety group classification.

Standard 15 may provide more than one approach for complying with the EDVC. The designer may use one or a combination of several of these approaches. For the purposes of brevity, it is not possible to discuss all possible approaches, so this document only focuses on the simplest approach. Refer to Trane application manual APP-APM001*-EN for additional approaches.

Because ASHRAE Standard 15 is under continuous maintenance, the requirements can change frequently. This document is based on the 2022 published version. Refer to the ASHRAE web site for the most current version of the standard, including any published addenda and errata.

Example: Packaged (DX) Rooftop Single-Zone VAV System Serving a "Public Assembly" Occupancy with an A2L Refrigerant

Given: A 5-ton, packaged, direct-expansion (DX) rooftop unit serves a 1000-ft^2 classroom in a K-12 school building, with a 10-ft ceiling height. The rooftop unit consists of a single refrigeration circuit with R-454B (A2L) refrigerant .

Supply air is ducted to four diffusers located throughout the classroom, while return air passes through a ceiling-mounted grille into a 1.5-ft tall free return interstitial ceiling plenum before traveling through a short section of return ductwork into the rooftop unit. The supply ductwork is located in the ceiling plenum.

Per Standard 15, the occupancy classification is "public assembly" (F_{occ} = 1.0) and this system is categorized as a "high probability" system

Solution (A2L refrigerant): This is an example of "connected spaces" via a ducted air distribution system (per Section 7.2.3.3). When calculating the effective dispersal volume (V_{eff}) of the connected spaces in this example, include the following:

- The volume of the classroom, which is 10,000 ft^3.
- The volume of the supply ductwork. However, for this example, this volume should be ignored as the ductwork is routed through the ceiling plenum, which is used as part of the return-air path.
- The volume of the interstitial ceiling plenum, which is 1500 ft^3, since it is part of the return-air path in this example.

...but exclude the following:

- The volume of the restroom that is attached to this classroom, since it is not served by the supply ductwork or the return-air plenum and can be closed (isolated) from the source of the refrigerant leak by a door.

For this example, the effective dispersal volume (V_{eff}) of the connected spaces is 11,500 ft^3.

The 5-ton rooftop unit consists of a single 5-ton refrigeration circuit, containing 5.1 lb of R-454B refrigerant. Per Section 7.3.4.1, the releasable refrigerant charge (m_{rel}) is the entire charge of 5.1 lb.

Standard 34 lists R-454B as Group A2L refrigerant with an LFL of 18.5 lb/1000 ft^3 or 0.0185 lb/ft^3.

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.

This refrigeration system is ducted, and m_{rel} is greater than 4 lb, so Section 7.6.2.3 requires that it be equipped with a leak detection system that is listed with the equipment. The rooftop unit in this example includes a refrigerant detector—which complies with 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 106 lb:

EDVC = 0.0185 lb/ft^3 × 11,500 ft^3 × 0.5 × 1.0 = 106 lb

For this example, the releasable refrigerant charge (m_{rel} = 5.1 lb) is lower than the EDVC, so this system complies with the limit prescribed by Section 7.6.1.

Refer to the Trane application manual APP-APM001*-EN for more details.

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 (per Section 7.6.1.1):

$$\mathbf{EDVC = LFL \times V_{eff} \times CF \times F_{occ}}$$

where,

EDVC = effective dispersal volume charge, lb (kg)

$\mathbf{V_{eff}}$ = effective dispersal volume per Sections 7.2.1 through 7.2.3, ft^3 (m^3)

LFL = lower flammability limit of the refrigerant, lb/ft^3 (kg/m^3)*

CF = concentration factor = 0.5

$\mathbf{F_{occ}}$ = 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.

When air circulation is used to disperse leaked refrigerant, the UL product safety standard (UL 60335-2-40) prescribes the minimum circulation air flow rate.

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