engineering bulletin

ASHRAE® Standard 15-2022 A2L EDVC Example

TRANE®

Single-Zone DX Split 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 DX split 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: Single-Zone DX Split System Serving a "Commercial" Occupancy with an A2L Refrigerant

Given: A 7.5-ton, direct-expansion (DX) split system unit serves a 2625-ft^2 commercial office space, with a 10-ft ceiling height. The split system consists of a single refrigeration circuit with R-454B (A2L) refrigerant.

Supply air is ducted from the indoor air-handling unit (AHU) to four diffusers located throughout the office space, while return air passes through a ceiling-mounted grille into a 1.5-ft tall free-return interstitial ceiling plenum before traveling down through a short section of return ductwork to the AHU. The supply ductwork is located in this ceiling plenum.

The air-cooled condensing unit is located on the roof. The interconnecting refrigerant piping drops down 2 ft into the interstitial ceiling plenum, runs 35 ft horizontally, and then drops down 10 ft to the AHU in the mechanical space. The liquid line is 1/2 in. and the suction line is 1 1/8 in. The total linear length of each refrigerant line is 47 ft.

The refigerant piping has been leak tested in accordance with Section 9.13 of the standard. Therefore, per Section 7.2.3.1.1, areas of the building that contain only continuous sections of refrigerant piping, or that contain only joints and connections that have been leak tested in accordance with the standard, do not need to be considered in the calculations of effective dispersal volume.

Per Standard 15, the occupancy classification is "commercial" (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 office space, which is 26,250 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 3,937 ft^3, since it is part of the return-air path in this example.

...but exclude the following:

- The volume of any restrooms or closets attached to this office space, since they are 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 30,187 ft^3.

TRANE TECHNOLOGIES

The 7.5-ton split system consists of a single refrigeration circuit. The manufacturer's installation manual lists the refrigerant charge as 10.6 lb of R-454B, and states that this includes the first 25 ft of refrigerant piping. So we must account for the charge in the additional 22 ft of piping, which will be added in the field. Per the product application guide, this will require an additional top-off charge of 1.3 lb, resulting in a total refrigerant charge equal to 11.9 lb. Per Section 7.3.4.1, the releasable refrigerant charge (m_{rel}) is the entire charge of 11.9 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 AHU in this example includes a refrigerant detector—which 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 279 lb:

$$EDVC = 0.0185 \text{ lb/ft}^3 \times 30{,}187 \text{ ft}^3 \times 0.5 \times 1.0 = 279 \text{ lb}$$

For this example, the releasable refrigerant charge (m_{rel} = 11.9 lb) is lower than the EDVC, so this system complies with the limit prescribed by Section 7.6.1.

Per Section 7.2.3.1.1, areas of the building that contain only continuous sections of refrigerant piping, or that contain only joints and connections that have been leak tested in accordance with Section 9.13 of the standard, do not need to be considered in the calculations of effective dispersal volume.

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.

SS-PRB004B-EN
December 2023