

Understanding UL 60335-2-40 Refrigerant Detector Requirements

In support of the Kigali Amendment to the Montreal Protocol and the Paris Climate Agreement and to promote efforts to reduce global warming, a coalition of state governors has formed the US Climate Alliance. The Alliance's goal is to demonstrate leadership on this issue through the advancement of responsible climate change legislation. A critical area of focus for the Alliance has been the reduction of greenhouse gas emissions, such as traditional hydrofluorocarbon (HFC) refrigerants, to the atmosphere.

Several states have introduced measures curtailing use of these products, such as the California Air Resources Board (CARB) proposing a Global Warming Potential (GWP) limit of 750 starting January 1, 2023, for HVAC products, and January 1, 2024, for chillers, as well as additional requirements for refrigeration systems to go into effect in 2021. In response to these state government regulations, manufacturers are developing systems to use lower GWP refrigerant alternatives. The challenge in deploying alternatives to traditional HVAC/R refrigerants is that these lower GWP refrigerants typically exhibit more flammable properties than refrigerants designated as ASHRAE A1.

The air conditioning and refrigeration industry has been actively working to address this issue since 2006 by developing a new classification of refrigerants, known as A2L, to meet the lower GWP challenge. While having slightly higher flammability characteristics as compared to traditional A1 refrigerants, A2Ls are much harder to ignite and are much less flammable than A3 hydrocarbon

refrigerants, such as R290 (propane). A binational (U.S. and Canada) consensus group was formed to update the product safety and application standards to allow for the safe use of these more environmental friendly refrigerants within HVAC systems. For many existing air conditioning products that use R-410A, the most promising lower GWP alternatives include R-32 and R-454B, which are ASHRAE A2L classified.

The current updates

UL 60335-2-40 3rd Edition is an ANSI/SCC approved standard covering electrical heat pumps, air-conditioners and dehumidifiers. Further, it is a binational standard (U.S. and Canada) that is based on the international IEC 60335-2-40 standard. IEC 60335-2-40 is currently being used as the basis for the design, evaluation, testing and certification of HVAC equipment using Low GWP refrigerants in places like Europe. Overall, UL 60335-2-40 has adopted more conservative safety requirements than the IEC standard to address the unique product usage of the North American market.

One of the risks associated with UL 60335-2-40 equipment is refrigerant leakage. An integral component of the equipment to mitigate this risk is a refrigerant leak detection system. Refrigerant leak detectors that sense loss of pressure are required for all systems in the occupied space exceeding a prescribed refrigerant charge limit, which typically consists of approximately four pounds of refrigerant for most permanently installed applications.



How UL is making an impact

Refrigerant leak detection systems have been in use by the HVAC/R industry for decades — in areas such as machine rooms and supermarkets — for a majority of all refrigerants currently in use. While technology exists today to meet the new specifications outlined in UL 60335-2-40, HVAC equipment manufacturers are actively working with sensor manufacturers to determine the optimal balance of properties for their system designs while also integrating all the safety requirements defined for a full detector package. Further research (e.g., AHRTI-9014 Sensor Assessment Project Review) is being conducted to enhance this process, further enabling manufacturers to complete their work before CARB's proposed January 1, 2023, effective date for implementing lower global warming potential refrigerants in air conditioning systems.

Refrigerant leak detection systems are required to have both sensors and control logic electronics that activate the evaporator fan and use circulated air to quickly disperse and dilute refrigerant in the event of a leak. This is intended to prevent the formation of refrigerant concentrations.

In addition, UL 60335-2-40 requires that refrigerant charge limits be based on the minimum occupied volume of the room where the equipment is expected to be used. This charge limit requirement also includes a safety factor of four to ensure any leaked refrigerant is diluted to well below the lower flammability limit (LFL), based on room size. UL 60335-2-40 also requires appliances to be free of potential internal ignition sources to mitigate the risk of fire due to a leak.

Requirements for refrigerant leak detection systems

1. Indicating type detectors are required to be factory installed by the manufacturer with sensors optimally located to detect any leaks.
2. Refrigerant leak detector sensor set point is factory set and sealed with no field adjustment permitted. Routine factory inspections are conducted by UL as part of the listing requirements. Detector markings identify the manufacturer and refrigerants used.
3. The leak detection system is required to activate at a maximum concentration of < 25% of the LFL of the refrigerant being used in the equipment. This 4-times safety factor helps ensure flammable concentrations are not reached.
4. Detectors turn on available mitigation devices such as circulation fans.
5. Self-test protocols run every hour to ensure proper operation and function. In the event of detector failure, the circulation fans activate and maintain a required airflow to prevent flammable concentrations from forming. This fail-safe mode is maintained until the detector is replaced.
6. Detector software is considered part of a Protective Electronic Circuit. Robustness, functionality and reliability of this circuit is determined in accordance with clause 19 of UL 60335-2-40 which includes the requirements in UL 60335-1 or UL 60730.
7. The sensor shall not be subject to poisoning due to common household and workplace contaminants that shall not damage the sensor or produce false alarms or nuisance trips per Annex LL of UL 60335-2-40.
8. These systems are required to pass testing designed to address long term stability, vibration, range and setpoint verification, and response time per Annex LL of UL 60335-2-40.
9. If the detector has a defined life and requires replacement after a given period, the detection system shall initiate the mitigation requirements in Annex GG and LL of UL 60335-2-40.

Specific information regarding the most recent changes to UL 60335-2-40 are available at www.UL.com/Standards

To learn more about how UL is helping keep the environment safe, contact us at HVACInfo@UL.com or visit UL.com/lowGWP.



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