



# **WITHDRAWN: Refrigerant Safety in HVAC Systems**

**An Online Continuing Education Course for Engineers**

**Course Number: HV-4022**

**Credit: 4 Hours / 4 PDH / 4 CPD**

# Refrigerant Safety in HVAC Systems

A. Bhatia, Mechanical Engineer

## Introduction

Maintaining a safe work environment is essential inside the heating, ventilation, and air conditioning (HVAC) machinery rooms housing chillers as well in occupied areas having direct expansion (DX) type refrigeration equipment including packaged units or variable refrigerant flow (VRF) type air conditioning. The failure to monitor these areas properly for leaking refrigerant gases can lead to accidents with deadly consequences.

Refrigerant hazards may be related to several aspects, in that they may:

- be stored at high pressure
- displace oxygen when released in the air
- have toxicological effects
- be flammable
- have dangerous decomposition products

At least one of these characteristics applies to any refrigerant, and for that reason, a variety of precautions must be followed to ensure against injury to persons and damage to property.

To advise users on the way the refrigerants shall be handled or used, the American Society of Heating Refrigerant and Air conditioning Engineers (ASHRAE) provide safety guidelines through standards 15 and 34.

- ASHRAE 34, Designation and Safety Classification of Refrigerants, describes a simple means of referring to common refrigerants instead of using the chemical name, formula, or trade name. It also assigns safety classification to refrigerants based on toxicity and flammability data.

- ASHRAE 15, Safety Standard for Refrigeration Systems, sets forth the procedures for safe design, construction, installation, and operation of refrigerating systems.

In this course, we will discuss a set of minimum requirements to keep personnel safe while working inside machinery rooms containing refrigerants. We will also discuss the design requirements for the occupied areas containing Variable Refrigerant Flow (VRF) systems.

# Contents

## **CHAPTER 1 - Refrigerants Safety**

- 1.0. Risks with Refrigerants
- 1.1 Health and Safety
- 1.2 Toxicological effects
- 1.3 Refrigerant Flammability
- 1.4 Decomposed Products
- 1.5 Environmental Effects

## **CHAPTER 2 - Refrigerants Types, Designation, And Numbering**

- 2.0 Refrigerant Types
- 2.1 Choice of Refrigerants
- 2.2 ODP and high GWP refrigerants
- 2.3 Designation of Refrigerants (ASHRAE 34)
- 2.4 Refrigerant Designation
- 2.5 Refrigerant Numbering

## **CHAPTER 3 - Safety & Hazardous Classification of Refrigerants**

- 3.0 Safety Classification of Refrigerants
- 3.1 Toxicity Classification
- 3.2 Flammability Classification
- 3.3 Occupancy Classification (ASHRAE Standard 15)
- 3.4 Refrigeration System Classification

## **CHAPTER 4 - Variable Refrigerant Flow (VRF) Systems**

- 4.0 VRF Systems
- 4.1 Refrigerant Concentration Limit (RCL)

4.2 Calculations

4.3 Design Process

## **CHAPTER 5 - ASHRAE Standard 15 - Refrigerant Machinery Rooms**

5.0 Refrigerating Machinery Room

5.1 Refrigeration System Placement

5.2 Ventilation

5.3 Refrigerant Monitoring

5.4 Machinery Room Special Requirements

5.5 Combustion and Open Flame Devices

5.6 Pressure-Relief Protection

5.7 Purge Discharge

5.8 General Safety Requirements

5.9 Operation and Field Testing

# Chapter 1 - Refrigerant Safety

## Risks With Refrigerants

Refrigerants used in refrigeration and air conditioning systems must be handled, stored, and used properly to avoid potential hazards. Most refrigerants have low boiling points and present dangers of frostbite and eye damage. Refrigerant liquids with higher boiling points can cause respiratory and skin irritation. The common risks include toxicity, flammability, asphyxiation, and physical hazards.

The refrigerant gasses, primarily chlorofluorocarbons (CFC) and Hydrochlorofluorocarbons (HCFCs), have also been linked to the depletion of the Ozone layer in the stratosphere. The ozone layer is often referred to as a protective layer because it absorbs and scatters ultraviolet light from the sun, preventing some of the harmful ultraviolet light from reaching the earth's surface. Ozone depletion is a global concern and is associated with multiple health and environmental concerns, including skin cancers, damage to crops, the threat to animal life, and global warming.

In the United States, the Environmental Protection Agency (EPA) has set strict standards for regulating and monitoring a refrigerant leak. The Montreal Protocol and Kyoto Protocols were both created to establish similar environmental standards internationally. These regulations include protocols for repairing refrigerant leaks or disposing of systems within a certain timeframe.

## Health and Safety

A hazard in refrigeration and air conditioning equipment and systems is present when there is an uncontrolled, unexpected release of refrigerant from the system. The health and safety issues related to refrigerants may be attributed to several aspects and include the following:

### High-Pressure Fluids

Most refrigerants are stored under pressure since they would be a gas at atmospheric pressure. A sudden release of pressure can cause personal injury and property damage

by propelling a cylinder or rupture of a part. Refrigerant cylinders, tubing, hoses, system components would fail at some elevated pressures without safety provisions.

### **Frostbite**

When liquid refrigerant is suddenly released from high pressure to atmospheric pressure, the liquid refrigerant will flash and boil to vapor. Naturally, the temperature of the refrigerant will drop quickly to the boiling point, and the refrigerant will quickly absorb heat from whatever it is touching. If the refrigerant is touching skin, it can cause frostbite.

### **Oxygen displacement**

Most refrigerants are denser than air, which means these will deplete oxygen levels if released due to any failure. Since most refrigerants are odorless, occupants may become asphyxiated before they realize the problem. The rooms below ground, seated areas, and enclosed spaces are more susceptible to this problem as the refrigerant will settle down.

It is worth noting that within the field of refrigeration and air conditioning, there have been more fatalities associated with oxygen displacement than with any other aspect. Good ventilation must be provided to prevent concentrations of the vapor could accumulate. This means fans to circulate the air at floor-level: the low density of the vapor means it will rise and accumulate in areas where refrigerants could have settled. This should be carried out in order to determine what is needed.

### **Toxicological effects**

All refrigerants have some toxicity, but the level of toxicity becomes meaningful only when the concentration is specified. Some fluids are more toxic than others are dangerous only when the concentration is high. If exposure is long. Exposure to refrigerant can result in loss of concentration, arrhythmia, and other fatal symptoms. If inhaled, medical help must be sought urgently.

*To view the remainder of the course material and to take the quiz for PDH credit, you must purchase the course.*

*Close this window and click "Add to cart" on the product page.*