FESHM 5035: MECHANICAL REFRIGERATION SYSTEMS

Revision History

Author	Description of Change	Revision Date
Dave Pushka	Update of chapter 5035 to address changes in applicable national standards for small commercially produced chillers.	Revision 2 11 January 2022
Dave Pushka	Five-year review of chapter 5035. Release Chapter 5035 using new FESHM template. Significant changes to the scope intended to streamline the documentation requirement for commercially produced packaged refrigeration systems where the manufactures do not explicitly indicate compliance with ASHRAE 15	Revision 1 07-March-2019

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1.0 INTRODUCTION

Mechanical refrigeration systems such as chillers, air conditioners, and heat pumps containing pressurized refrigerants pose a potential hazard to equipment and personnel from explosion, fire, and suffocation. This chapter specifies the procedures to be followed in the design, construction, installation and operation of refrigeration systems which fall under the scope of this chapter. Additional procedures are included for commercially produced, purchased units. Consult FESHM 8081 Refrigeration Management for requirements on refrigerant inventory reporting.

2.0 SCOPE

This chapter applies to all mechanical refrigeration systems falling under the scope of ANSI/ASHRAE 15, UL 471, EN 61010, IEC 61010 or UL 61010 except the following small units are excluded: reach-in refrigerators and freezers, window installed air conditioners, mobile laboratory chillers, and other units with Group A1 refrigerant (per ASHRAE 15 Table 1) inventory less than three (3) lbs. Also excluded are cryogenic systems of any size using a fluid whose normal boiling point is less than -150C (These are covered by another FESHM chapter). This chapter applies to items on the Fermilab Batavia site and to leased spaces.

3.0 DEFINITIONS

Engineering Note - A written analysis demonstrating that a refrigeration system installation satisfies the requirements of this chapter.

Exceptional Refrigeration System: A mechanical refrigeration system using a refrigerant other that a refrigerant in Group A1 which cannot meet the requirements of this chapter and therefore requires a Director's exception.

Qualified Person: A person who, by possession of a recognized degree or certificate of professional standing, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

Definitions for refrigeration system terminology are included in ANSI/ASHRAE 15 Safety Standard for Refrigeration Systems

Large refrigeration systems: Cooling capacities greater than 100,000 BTU / hour (29,300 Watts) at temperatures at or above 32 F (0 C).

Small refrigeration systems: Cooling capacities up to 100,000 BTU / hour (29,300 Watts) at temperatures at or above 32 F (0 C).

4.0 SPECIAL RESPONSIBILITIES

The Division/Section Head

The Division/Section head who controls the area in which the mechanical refrigeration system is being operated is responsible for carrying out the requirements of this chapter. The division/section head or their designee shall:

1. Arrange for the review of the Engineering Note by a qualified person.
2. Certify system compliance with this chapter by signing the Engineering Note via Teamcenter standard workflow process.
3. File the original Engineering Note in Teamcenter and apply standard workflow review process.
4. Maintain an open, current file on all refrigeration systems located in their areas of responsibility.

The ES&H Section

The ES&H Section shall audit the Divisions/Sections on their compliance to this chapter.

The Mechanical Safety Subcommittee

The Mechanical Safety Subcommittee (MSS) shall serve the Division/Section heads and ES&H Section in a consulting capacity on all refrigeration system matters.

5.0 REQUIREMENTS

1. For large mechanical refrigeration systems, the design, construction, installation, and operation must meet all requirements of the ANSI/ASHRAE 15 revision current at the initiation of the system's specification.
    a. Where industry does not provide a ANSI/ASHRAE 15 compliant mechanical refrigeration system, the mechanical safety committee shall act as the authority having jurisdiction (AHJ) and will specify the engineering note content needed to show conformance with the ASHRAE 15. Notes shall include, as a minimum the topics shown in section 8.0 of this chapter.
    b. A signed engineering note by an individual deemed qualified by the appropriate division/section head must demonstrate compliance to ANSI/ASHRAE 15 or as deemed required by the AHJ.
2. For small, commercially produced refrigeration systems used as delivered from the manufacturer and which are built to and marked in accordance with any of the following industry standards:
    a. UL 471 Commercial Refrigerators and Freezers

b. UL 61010 Safety requirements for electrical equipment for measurement, control, and laboratory use

i. UL 61010 / EN 61010 / IEC 61010 Part 1: General Requirements and

ii. UL 61010 / EN 61010 / IEC 61010 Part 2-011: Particular requirements for refrigerating equipment

3. The refrigerant type and quantity need to be collected and sent to the refrigerant manager as defined in FESHM 8081.

6.0 EXCLUSIONS FOR REQUIREMENTS OF OTHER FESHM CHAPTERS

Purchased mechanical refrigeration units and skids in compliance with and marked in accordance with ANSI/ASHRAE 15, UL 471, or UL 61010-2-011 comply by virtue with the intent of other ES&H Chapters.

1. ASHRAE 15, and UL 471, require ASME BPV code-stamped pressure vessels. These vessels do not require engineering notes per FESHM 5031 Pressure Vessels nor Fermilab's silver conformance sticker,
2. Relief valves on the refrigeration equipment are exempt from the requirements of FESHM 5031.4 Inspection and Testing of Relief Systems.
3. ASHRAE 15, UL 471, and EN 61010-2-011 / IEC 61010-2-011 / UL 61010-2-011 require that refrigeration piping conform to specific requirements. Refrigeration piping that is part of the procured refrigeration equipment is exempt from demonstration of compliance to FESHM 5031.1 Piping Systems. (Piping connected to/from the refrigeration equipment is not exempted.)
4. ASHRAE 15, and UL 471, include installation requirements that address oxygen deficiency, flammability, and toxicity concerns of leaking refrigerants. Installation requirements shall be addressed by the requirements of this chapter and therefore demonstration of compliance to FESHM 4240 Oxygen Deficiency Hazards and 6020.3 Storage and Use of Flammable Gases at Physics Experiments is exempted.

7.0 PROCEDURE FOR PACKAGED REFRIGERATION UNITS WHICH DO NOT EXPLICITLY INDICATE COMPLIANCE WITH ASHRAE 15, UL 471, or UL 61010-2-011

Mechanical refrigeration units and skids which are not in compliance or marked in accordance with ANSI/ASHRAE 15, UL 471, or EN 61010-2-011 / IEC 61010-2-011 / UL 61010-2-011 must have an engineering note prepared which includes:

1. Documentation of code-stamp for any vessel which falls under the scope of the ASME BPVC. These vessels do not require engineering notes per FESHM 5031 Pressure Vessels nor the silver conformance sticker.

2. Documentation that any relief valves are sufficiently sized. Relief valves on the refrigeration equipment are exempt from the requirements of FESHM 5031.4 Inspection and Testing of Relief Systems.
3. Documentation that refrigeration piping meets ASME B31.5 requirements
4. Documentation that the flammability, ODH and toxicity concerns of leaking refrigerants from the system meet ASHRAE 15, or UL 471 requirements. Installation requirements shall be addressed by the requirements of this chapter and therefore demonstration of compliance to FESHM 4240 Oxygen Deficiency Hazards and 6020.3 Storage and Use of Flammable Gases at Physics Experiments is exempted.

8.0 PROCEDURES

1. *Preparation of Engineering Note:* An Engineering Note shall be prepared by a qualified person for all mechanical refrigeration systems in the scope of this chapter. Essential elements of the engineering note are listed in the Appendix. Its purpose is to allow a reviewer to verify compliance to ANSI/ASHRAE 15, UL 471, or UL 61010-2-011 and other FESHM Chapters. The Engineering Note shall include documentation from vendors that certifies refrigeration equipment complies with ANSI/ASHRAE 15, UL 471, or UL 61010-2-011. The Note shall also demonstrate that ANSI/ASHRAE 15, UL 471, or UL 61010-2-011 installation-specific requirements have been met by Fermilab and subcontractors involved in the installation. The engineering note author is responsible for performing or arranging to be performed the initial inspection.
2. *Review of Engineering Note:* All Mechanical Refrigeration Engineering Notes shall be reviewed by an independent, qualified reviewer for concurrence to this chapter. The reviewer shall be from a group not reporting to the preparer of the Engineering Note or his supervisor.
3. *Exceptional refrigeration systems:* Exceptional installations require the approval of the Laboratory Director or their designee. The need for such exceptions is to be minimized by adherence to the provisions of this chapter. Exceptions are to be identified and submitted to the Director for review as early in the design process as possible. These exceptions shall only be allowed after the Director has assured himself that sound engineering practices will be followed and the installation is safe. The ES&H Section shall maintain copies of exceptions for the Director. The director's approval is documented by signing the engineering note and approving in a Teamcenter workflow.
4. *Amendment of Engineering Note:* Any subsequent changes in refrigerants, capacity, etc., which effects safety or merits documentation, requires an amendment to the original Engineering Note. This amendment shall be reviewed in the same manner as the original Note.
5. *Mechanical Refrigeration System marking:* After signed approval of the engineering note, the Each system shall be permanently marked with the Teamcenter engineering note number. The Teamcenter number shall also be recorded in the engineering note.
6. *Records:* Approved engineering notes shall be filed in Teamcenter and released. Division approver and reviewers shall use the Teamcenter review and release process.

9.0 TECHNICAL APPENDIX A - Engineering Note Essential Elements

For all refrigeration systems, include this information as a minimum:

1. Cover sheet identifying title, author, reviewer, and approver. Director's signature shall also be included for an Exceptional Refrigeration System.
2. Identify physical location, division responsible for the equipment, system's unique identifying number.
3. Append memo or letter from manufacturer, photo of conformance label, etc. which demonstrates that purchased refrigeration equipment complies with one of the referenced standards.
4. Equipment Manufacturer
5. Equipment serial number(s)
6. Chilling capacity,
7. Total mass (pounds or kg) of refrigerant
8. Refrigerant type (e.g. R134)
9. Refrigerant class or Group per ASHRAE 15 (circle one): A1, A2, A3, B1, B2, B3

For large refrigeration systems, include this additional information:

10. Occupancy Class (circle one):
    Institutional / Public Assembly / Residential / Commercial / Industrial /Mixed:
    If mixed, specify:
11. Describe and demonstrate compliance with ASHRAE 15 Installation Requirements, including:
    a. Equipment location, room specifications
    b. Room ventilation
    c. Refrigeration monitor
    d. Relief valve vent lines
12. Demonstrate in this engineering note or reference a different note that the space where the equipment is located has an ODH class 0 rating.
13. Demonstrate in this engineering note or reference a different note that any vessels included in the equipment comply with FESHM 5031 Pressure vessels.
14. Demonstrate in this engineering note or reference a different note that piping connecting to/from equipment complies with FESHM 5031.1 Piping