



Designation: **D 6065 – 9600**

## **Standard Practice for Handling, Transportation, and Storage of HFC-227ea 1,1,1,2,3,3,3-Heptafluoropropane (CF<sub>3</sub>CHF<sub>2</sub>)<sup>1</sup>**

This standard is issued under the fixed designation D 6065; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

### **1. Scope**

1.1 This practice covers guidance and direction to suppliers, reclaimers, purchasers, and users in the handling, transportation, and storage of HFC-227ea.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### **2. Referenced Documents**

2.1 *ASTM Standards:*

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<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D-26 on Halogenated Organic Solvents and Fire Extinguishing Agents and is the direct responsibility of Subcommittee D26.09 on Fire Extinguishing Agents.

Current edition approved Dec. 10, 1996; 2000. Published February 1997; May 2000. Originally published as D 6065 – 96. Last previous edition D 6065 – 96.

D 6064 Specification for HFC-227ea, 1,1,1,2,3,3,3-Heptafluoropropane (CF<sub>3</sub>CHFCF<sub>3</sub>)<sup>2</sup>

2.2 *Military Standards:*

DLAR No. 4145.25 Storage and Handling of Compressed Gases and Liquids in Cylinders, and of Cylinders<sup>3</sup>

2.3 *CGA Standards:*

No. C-1 Methods for Hydrostatic Testing of Compressed Gas Cylinders<sup>4</sup>

No. C-4 American National Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained<sup>4</sup>

No. C-6 Standards for Visual Inspection of Steel Compressed Gas Cylinders<sup>4</sup>

No. P-1 Safe Handling of Compressed Gases in Containers<sup>4</sup>

No. SB-1 Hazards of Refilling Compressed Refrigerant (Halogenated Hydrocarbon) Gas Cylinders<sup>4</sup>

No. SB-5 Hazards of Reusing Disposable Refrigerant (Halogenated Hydrocarbon) Gas Cylinders<sup>4</sup>

No. SB-18 Use of Refrigerant (Halogenated Hydrocarbons) Recovery Cylinders<sup>4</sup>

2.4 *U.S. Government Standards:*

Code of Federal Regulations (CFR) Title 40, Part 82.106<sup>5</sup>

Code of Federal Regulations (CFR) Title 49, Part 173, U.S. Department of Transportation (DOT) Specifications, Shippers-General Requirements for Shipping and Packagings<sup>5</sup>

Code of Federal Regulations (CFR) Title 49, Part 178, U.S. DOT Specifications, Specifications for Packagings<sup>5</sup>

2.5 *UL Standard:*

UL 2083<sup>6</sup>

### 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *containers*—storage vessels for HFC-227ea.

3.1.2 *cylinders*—containers of HFC-227ea.

3.1.3 *HFC-227ea*<sup>7</sup>—1,1,1,2,3,3,3-Heptafluoropropane; a compound used to inert or suppress a fire or explosion hazard.

3.1.4 *insulated*—placed in an isolated situation to protect and prevent the transfer of damage.

### 4. Significance and Use

4.1 This practice provides requirements for the handling, transportation, and storage of HFC-227ea encountered in distribution through both commercial and military channels. It is intended to ensure that HFC-227ea is handled, transported, and stored in such a way that its physical property virtues are not degraded. Transport may be by various means, such as, but not limited to, highway, rail, water, and air.

### 5. Practice

5.1 Personnel shall be trained in Title 49 CFR, Part 172, Subpart H, to ensure safe handling, loading, unloading, storing, and transporting of material.

5.2 *Handling:*

5.2.1 Handling shall be in accordance with Section 5 of DLAR 4145.25.

5.2.1.1 Personnel who handle or store, or both, cylinders of HFC-227ea shall be trained properly to recognize and identify the characteristics of the product and the proper methods of safely handling full, partially full, and empty cylinders.

5.2.2 All HFC-227ea transfers between storage containers and recycling processes shall be performed by personnel trained in handling procedures.

5.2.2.1 Facility personnel must be trained in applicable Title 49 CFR, Parts 173 and 178, and the CGA documents referenced in 2.3.

~~5.2.3 HFC-227ea recycling and transfer processes shall be in conjunction with the equipment requirements of UL 2083.~~

~~5.2.4 HFC-227ea handling shall be in nonsmoking, heater-free, ventilated areas to preclude product accumulation. Provisions shall be made to ensure that service areas limit HFC-227ea concentrations do not exceed 180.5 % for 1 min and 0.18 % for 8 h.~~

5.2.5~~4~~ Cylinders shall not be overfilled. The liquid portion of the liquefied gases must not completely fill the container's internal volume at any temperature up to and including 130°F (54°C). The maximum permitted filling density for pure HFC-227ea shall be 79 lb/ft<sup>3</sup> (1265 kg/m<sup>3</sup>). The maximum permitted filling density for HFC-227ea super pressurized with nitrogen to ~~360~~ 600 psig (25.8 bar) at 70°F (21°C) shall be 72 lb/ft<sup>3</sup> (1153 kg/m<sup>3</sup>). The maximum filling density for HFC-227ea super pressurized with nitrogen to 600 psig (42.4 bar) at 70°F shall be ~~72~~ 68 lb/ft<sup>3</sup>. Filling density requirements are specified in Title 49 CFR, 173.304 and Title 49 CFR, 173.305.

<sup>2</sup> Annual Book of ASTM Standards, Vol 15.05.

<sup>3</sup> Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

<sup>4</sup> Available from Compressed Gas Association.

<sup>5</sup> Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20036.

<sup>6</sup> Available from Underwriters Laboratories.

<sup>7</sup> FM-200® is a registered trademark for HFC-227ea manufactured by Great Lakes Chemical Corp., West Lafayette, IN.

5.2.65 Handling of materials should be done in a manner that prevents contamination or comingling of halocarbons other than of HFC-227ea.

5.2.76 Cylinders shall be free of dirt and contamination that would contribute to or would cause deterioration of product during shipment or storage. Precautions should be taken to prevent the entry of oil, water, or any other foreign matter into containers. Unique coatings or preservatives applied prior to shipment to protect the containers are not considered contamination.

**5.3 Transportation:**

5.3.1 Transportation shall be as specified in accordance with DOT regulations of Title 49 CFR.

5.3.1.1 Shipment of materials between collectors, recyclers, and reclaimers should be within approved DOT guidelines for Class 2, Division 2.2, regulated materials. Any further provisions for special transportation or packaging should be agreed upon between the collectors, recyclers, and reclaimers.

5.3.1.2 The minimum design pressure requirements shall be as indicated in Title 49 CFR, Part 173.301. The pressure inside the container at 70°F (21°C) shall not exceed the service pressure for which the container is marked. The pressure inside the container at 130°F (54°C) shall not exceed ¾ times the service pressure for which the container is marked. Fig. 1 illustrates the effect of temperature on cylinders filled with HFC-227ea. Fig. 2 and Fig. 3 illustrate the effect of temperature on mixtures of HFC-227ea and nitrogen for the cases of HFC-227ea superpressurized at 70°F with nitrogen to a total pressure of 360 psig (25.8 bar) and 600 psig (42.4 bar), respectively.

5.3.2 Transportation shall be by suitable vehicles to preclude cylinder damage by excessive mechanical vibration, shock, freezing, or deleterious high temperatures throughout the entire transport route.

5.3.2.1 Should cylinders be expected to be subjected to unacceptable transport conditions, the cylinders should be placed under insulated conditions.

5.3.3 Compressed gas cylinder permanent marking requirements shall be as specified under Part 178 of Title 49 CFR and must be maintained in legible condition as required by Part 173 of Title 49 CFR. Warning labels shall be affixed to cylinders conforming to requirements of Part 82.106 of Title 40 CFR.

**5.4 Storage:**

5.4.1 Storage shall be in accordance with Section 5 DLAR 4145.25, in qualified cylinders in accordance with Title 49 CFR, Parts 173 and 178.

5.4.2 Cylinders should be stored in areas that will protect vessels from physical and environmental damage and tampering from unauthorized personnel.

5.4.2.1 Facilities should be of construction and orientation so that safety requirements are fulfilled for the storage of pressurized cylinders.

5.4.3 Storage cylinders shall be fitted with pressure release mechanisms to limit vessel pressure to not more than the rated

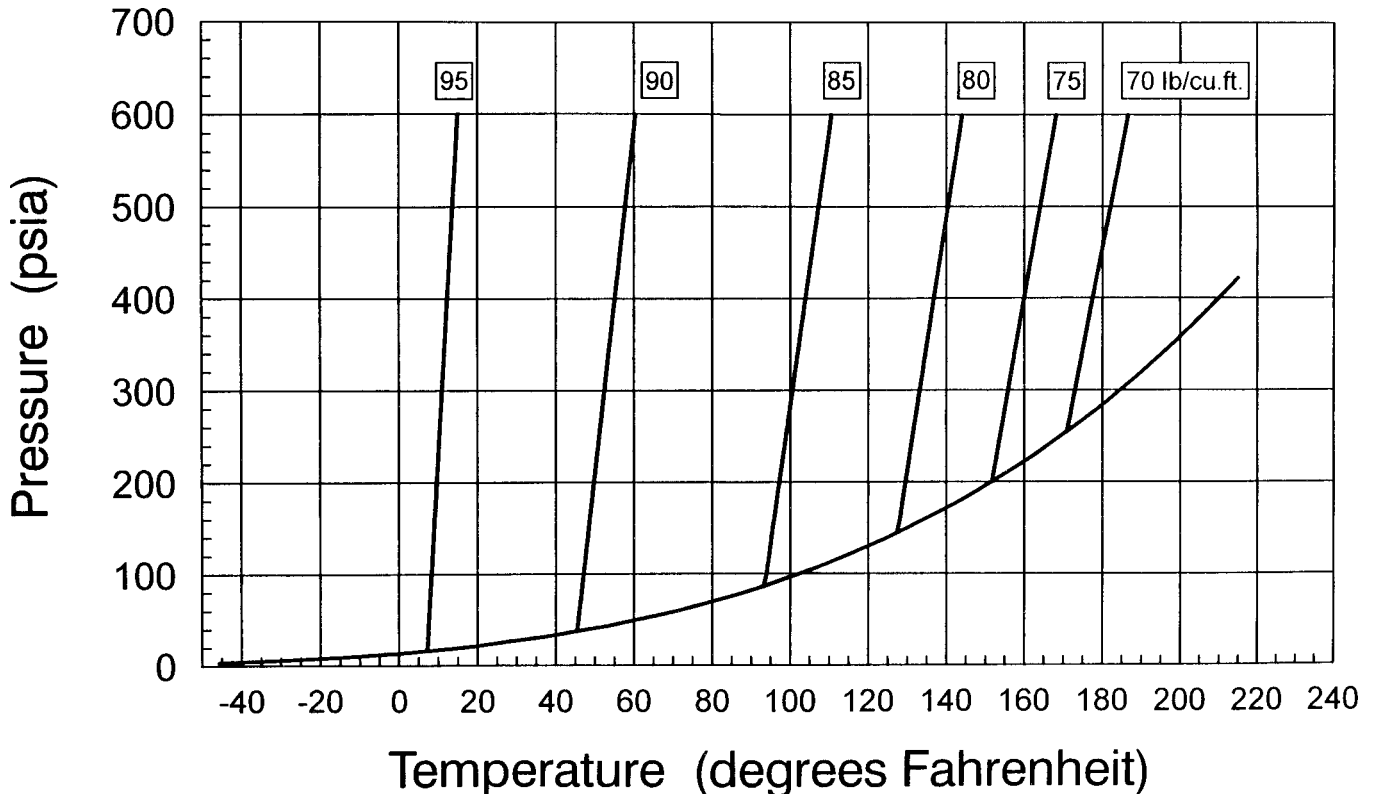


FIG. 1 HFC-227ea Isometric Diagram

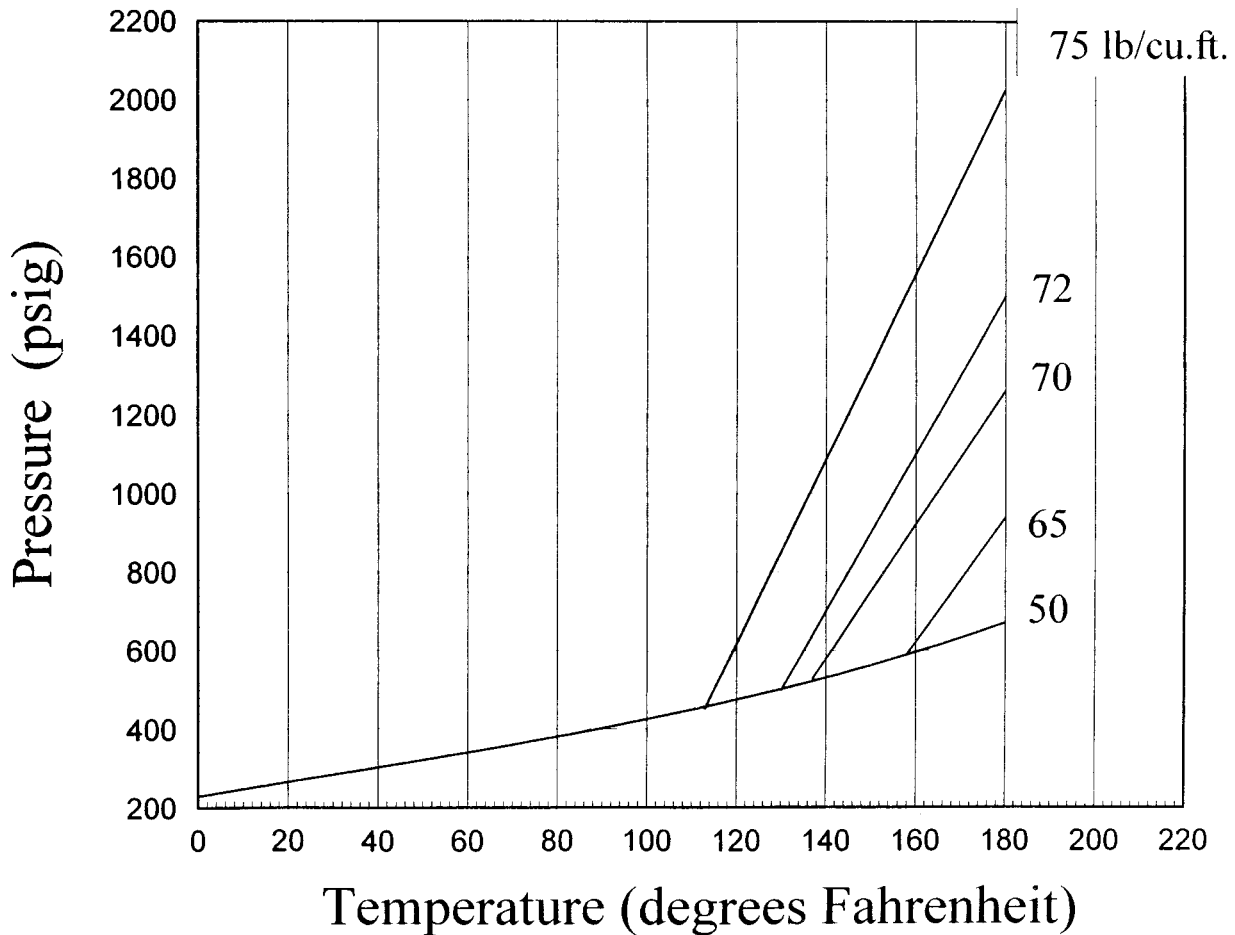


FIG. 2 Isometric Diagram HFC-227ea Pressurized to 360 psig (25.8 bar) With Nitrogen at 70°F (21°C)

working pressure of the HFC-227ea container in use at any particular time.

5.4.3.1 Periodic hydrostatic testing and reinspection of cylinders used for recycled HFC-227ea shall comply with Title 49 CFR, Part 173.34.

5.4.4 Containers shall be clearly marked and labeled to identify whether the HFC-227ea contained does or does not conform to this specification.

5.4.5 Insulation shall be placed on pallets or shoring, and provisions should be made to prevent excessive shock or thermal fluctuations to cylinders.

5.4.6 Cylinders shall be stored in a manner that will prevent contamination from external sources.

5.4.6.1 If HFC-227ea meeting the standards of this specification is stored in the same area as material not meeting this requirement, storage shall be segregated or clearly identifiable as not being similar.

## 6. Inspection

6.1 HFC-227ea that is reclaimed using approved HFC-227ea reclamation systems may be released for reissue, provided test examination to validate the material to specification is fulfilled.

6.1.1 Reclaimed HFC-227ea that cannot be proven to comply with this specification shall not be reissued. The material will be processed by environmentally safe methods until conformance to product standard is achieved.

## 7. Keywords

7.1  $CF_3CH_2CF_3$ ; compressed gas; cylinders; explosion suppressant; fire suppressant; FM-200®; handling; heptafluoropropane; 1,1,1,2,3,3,3-heptafluoropropane; HFC-227ea; reclamation; recovery; recycling; storage; transport

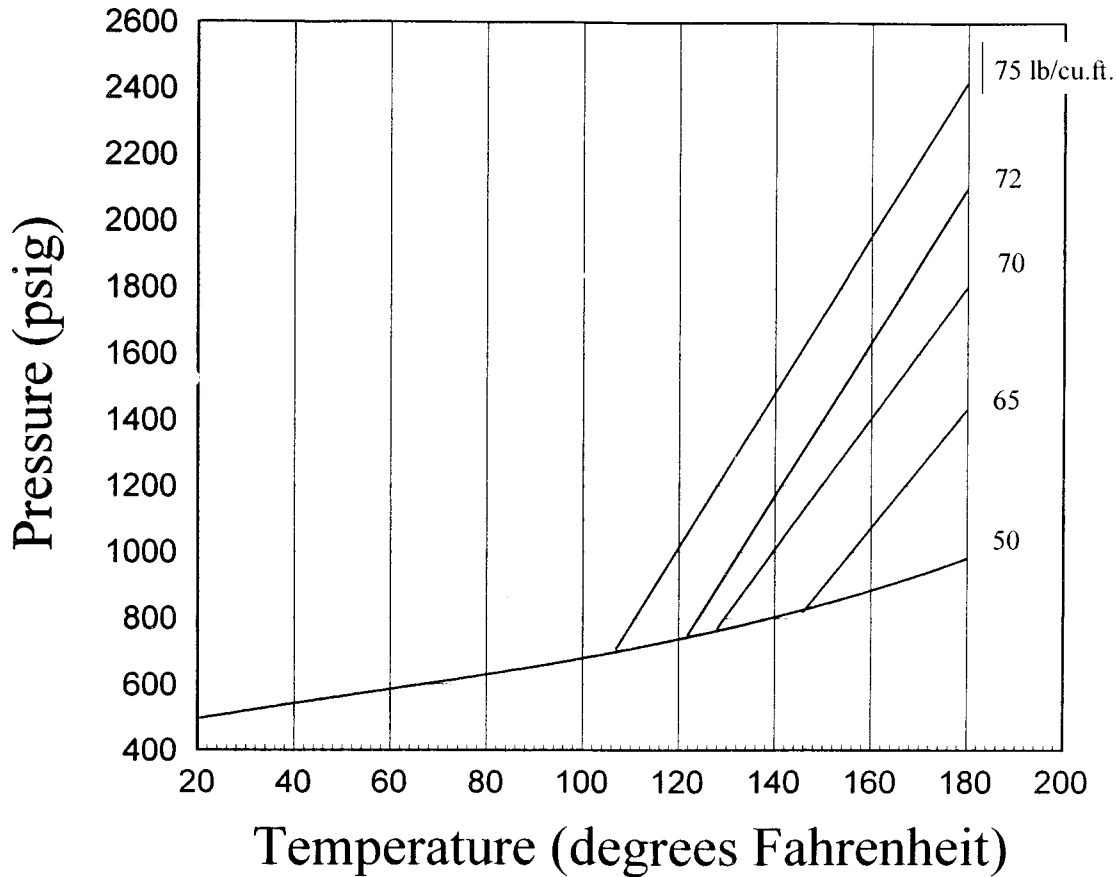


FIG. 3 Isometric Diagram HFC-227ea Pressurized to 600 psig (42.4 bar) With Nitrogen at 70°F (21°C)

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