

AHRI Guideline K

**2015 Guideline for
Containers for Recovered Non-
flammable Fluorocarbon
Refrigerants**



**AIR-CONDITIONING, HEATING,
& REFRIGERATION INSTITUTE**

we make life better™

2111 Wilson Boulevard, Suite 500
Arlington, VA 22201, USA
www.ahrinet.org
PH 703.524.8800
FX 703.562.1942

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Note:

This guideline supersedes AHRI Guideline K-2009.

TABLE OF CONTENTS

SECTION	PAGE
Section 1. Purpose.....	1
Section 2. Scope.....	1
Section 3. Definitions.....	1
Section 4. Containers	2
Section 5. Responsibility of Owner	2
Section 6. Labels and Markings.....	3
Section 7. Filling Procedures	4
Section 8. Transportation.....	5

APPENDICES

Appendix A. References - Normative	6
Appendix B. References - Informative.....	6
Appendix C. Service Pressures for Selected Non-flammable Fluorocarbon Refrigerant Recovery Cylinders - Informative	7

TABLES FOR APPENDICES

Table C1. Service Pressures for Selected Non-flammable Fluorocarbon Refrigerant Recovery Cylinders	7
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CONTAINERS FOR RECOVERED NON-FLAMMABLE FLUOROCARBON REFRIGERANTS

Section 1. Purpose

1.1 *Purpose.* Recovery, recycling and Reclamation of certain non-flammable fluorocarbon refrigerants will prevent unnecessary release of these compounds. For practical and safety reasons, there is a need for containers designed and identified specifically for these uses. This document is intended as a recommended guide of good practice to be used on a voluntary basis by all who supply, use, store or transport these containers. In certain instances, this document sets forth federal requirements as of the date of publication hereof. This document is not intended to be an exhaustive listing of all such requirements. Applicable federal, state, and local requirements should be reviewed.

1.1.1 *Intent.* This guideline is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors, and users.

1.1.2 *Review and Amendment.* This guideline is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope.* This guideline applies to cylinders with a maximum Service Pressure of 400 psig and ton tanks with a maximum Service Pressure of 500 psig for the receipt, storage and transportation of Recovered Non-flammable Fluorocarbon Refrigerants.

Where this guideline mentions regulations that are mandated by the United States Federal Government, the reference to the Federal regulation is provided.

2.2 *Exclusions.* This guideline does not apply to American Society of Mechanical Engineers (ASME) pressure vessels for on-site recovery and storage that are not U.S. Department of Transportation (DOT) approved for transportation of non-flammable fluorocarbon refrigerants.

Section 3. Definitions

All terms in this document shall follow the standard industry definitions in the current edition of ASHRAE Terminology website (<https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology>) unless otherwise defined in this section.

3.1 *Reclamation.* To reprocess refrigerant to new product specifications, by means which may include distillation. Chemical analysis of the refrigerant will be required to determine that appropriate product specifications are met. This term usually implies the use of processes or procedures available only at a reprocessing or manufacturing facility.

3.2 *Recovered Non-flammable Fluorocarbon Refrigerant.* Refrigerant that has been removed from a system for the purpose of storage, recycling, Reclamation or transportation.

3.3 *Service Pressure.* The rated pressure marked on the cylinder or ton tank.

3.4 *Special Permit Cylinder.* A cylinder that has been authorized by the DOT to be manufactured outside the scope of existing DOT regulations but in accordance with the requirements specified by DOT in a special permit. The requirements in the special permit may include design, composition, manufacture, testing, marking, and transportation criteria as well as special provisions.

Section 4. Containers

- 4.1** *Cylinders for Recovered Non-flammable Fluorocarbon Refrigerants as Referenced in Appendix C.*
- 4.1.1** Federal law requires that cylinders comply with United States DOT packaging requirements, in accordance with CFR Title 49, or as specified in an applicable Special Permit as provided by the cylinder manufacturer.
- Note: Federal law 49 U.S.C. 5124 forbids the transportation of DOT Specification 39 (see CFR Title 49) non-reusable/non-refillable cylinders, if refilled. Non-refillable cylinders meeting DOT Specification 39 should not be refilled or reused for any reason due to risk of serious personal injury.
- 4.1.2** Valve outlet connections should comply with Compressed Gas Association Publication V-1.
- 4.1.3** Pressure relief devices are required to comply with Compressed Gas Association Publication S-1.1.
- 4.1.4** Valves used for vapor and/or liquid withdrawal should be clearly identified and marked.
- 4.2** *Ton Tanks for Recovered Non-flammable Fluorocarbon Refrigerants as Referenced in Appendix C.*
- 4.2.1** Federal law requires that ton tanks comply with United States DOT specification 106A500X or 110A500W as detailed in 49 CFR Part 179, Subpart E
- 4.2.2** Valve outlet connections should comply with Compressed Gas Association Publication V-1.
- 4.2.3** Federal law, CFR Title 49, requires that pressure relief devices comply with CGA Publication S-1.1.
- 4.3** *Containers for Recovered Non-flammable Fluorocarbon Refrigerants R-11, R-113, and R-123.*
- 4.3.1** DOT Specifications require that steel drums comply with UN Specification 1A1, as per 49 CFR Part 178, Subpart L.
- 4.3.2** Containers that originally contained new refrigerant R-11, R-113, or R-123 (excluding those originally used for cleaning agents) may be used, provided the following conditions are met:
- 4.3.2.1** The drums should be inspected internally and externally and found to be clean and free of dents, bulges, holes, cracks, rust, pits, creases or other structural weaknesses.
- 4.3.2.2** Closure devices, including gaskets, should be in such condition that they comply, in all respects, with the original requirements for the drum.
- 4.3.2.3** Drums that originally contained refrigerant R-11, R-113, or R-123 should be made to comply with Section 6.6.3. Previous labels and markings should be removed and be replaced with new labels and markings per Section 6.4.

Section 5. Responsibility of Owner

This section applies only to cylinders and ton tanks, not drums, because drums are not compressed gas containers. See applicable definitions in 49 CFR Part 171, Subpart A.

- 5.1** *Cylinder Filling.* Only the owner may fill his/her containers or grant permission for some other party to fill them.
- 5.1.1** Responsibility to assure that the service pressure rating of the cylinder or ton tank is appropriate for the material being recovered rests with the filler. Different refrigerants require different minimum Service Pressures, as per Appendix C.

5.2 Cylinder/Ton Tank Retesting. Federal law requires that refillable cylinders used to recover refrigerant must be inspected and hydrostatically tested a minimum of once every five years in accordance with 49 CFR Part 180, Subpart C or as specified in an applicable Special Permit as provided by the manufacturer of the cylinder. Testing by visual inspection alone is not permitted (See 49 CFR Part 180, Subpart C).

Responsibility to assure the cylinder or ton tank is within the test date rests with the filler even if the filler is not the owner of the container. Per 49 CFR Part 180, Subpart C, no cylinder is permitted to be filled with a hazardous material and offered for transportation in commerce unless that cylinder has been successfully requalified and marked in accordance with DOT requirements. Per 49 CFR Part 180, Subpart F no ton tank is permitted to be filled with a hazardous material and offered for transportation in commerce unless that ton tank has been successfully requalified and marked in accordance with DOT requirements.

Section 6. Labels and Markings

6.1 DOT Requirements. Specific container labeling and marking requirements apply for all DOT-regulated hazardous materials. Instructions as noted in Sections 6.1.1 and 6.1.2 apply to non-flammable fluorocarbon recovered refrigerants.

Note: R-11 in drum quantities is not a DOT-regulated hazardous material. When in bulk packaging of 5,000 lbs. or more, it is subject to DOT regulation as a hazardous substance. R-113 and R-123, in any quantity, are not DOT regulated hazardous materials.

6.1.1 Labeling. Federal law requires that each non-flammable gas cylinder display a DOT diamond (square-on-point) "non-flammable gas" label. The 4" x 4" green diamond shaped label may be printed on a tag and securely attached to the cylinder's valve protection cap prior to shipment. Ton tanks require two DOT non-flammable gas labels, one on each end.

6.1.2 Marking. Federal law requires that each container of a regulated material be marked with a DOT proper shipping name and an appropriate UN identification number as specified in DOT CFR Title 49, Part 172 Subpart D. Consignee's or consignor's name and address is required to be shown on each container. Refer to CFR Title 49 for details of marking requirements.

6.2 EPA Labeling Requirements.

6.2.1 Each cylinder, ton tank, or drum containing a recovered refrigerant designated by the U.S. Environmental Protection Agency as a Class I (CFC) or Class II (HCFC) substance in the Clean Air Act is required to display a warning statement indicating that the product(s) inside the cylinder or drum harms the earth's ozone layer.

The warning statement is as follows per 40 CFR Part 82, Subpart E:

WARNING: Contains (insert name of substance) which harms public health and environment by destroying ozone in the upper atmosphere.

6.2.2 The chemical name of the substance may be abbreviated in the warning statement. For example, R-134a may be substituted for 1,1,1,2-Tetrafluoroethane.

6.3 Fill Weight.

6.3.1 The gross weight should be marked on each cylinder and ton tank. Maximum allowable gross weight should be determined as follows:

$$\text{Maximum allowable gross cylinder weight} = (0.8 \cdot \text{WC} \cdot \text{SG}) + \text{TW} \quad 1$$

Where:

- SG = Specific gravity of the refrigerant recovered at 77°F
- TW = Tare weight of the recovery cylinder, lb
- WC = Water capacity of the recovery cylinder, lb

6.4 *Product Labeling and Marking.*

6.4.1 Each container should display a precautionary label prepared in accordance with OSHA HCS 1910.1200. Federal law requires that this label include:

6.4.1.1 Product identifier

6.4.2.2 Signal word

6.4.2.3 Hazard statements

6.4.2.4 Pictograms

6.4.2.5 Precautionary statements

6.4.2.6 Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party

6.4.2 Federal law requires that cylinders and ton tanks be marked in accordance with 49 CFR Part 172, Subpart D.

6.4.3 Printing on labels should be clear and legible.

6.5 *User Information.* Each container should be labeled with the filler's name, address and date filled.

6.6 *Color.* Following are examples of coloring schemes for various recovery containers. Depending upon the provider of the recovery container, the actual shading of the color may vary. However, the use of the color yellow as specified below will identify the container as a recovery vessel.

6.6.1 Cylinders with non-removable collars:

The body should be gray. The collar should be yellow.

6.6.2 Cylinders with removable caps:

The body should be gray. The shoulder and the cap should be yellow.

6.6.3 Drums:

The drum should be gray. The top head should be yellow.

6.6.4 Ton tanks:

The body should be gray. The ends and chimes should be yellow.

Section 7. Filling Procedures

Important: Do not mix refrigerants when filling containers.

7.1 *Cylinders and Ton Tanks.*

7.1.1 Per DOT requirements, do not fill if the present date is more than five years past the test date on the container. No person may fill a cylinder overdue for periodic re-qualification with a hazardous material and then offer it for transportation. The prohibition against offering a cylinder for transportation that is overdue for periodic re-qualification does not apply to a cylinder filled prior to the re-qualification due date. See 49 CFR Part 173, Subpart G.

The test date will be stamped on the shoulder or collar of 4BA and 4BW cylinders; on the valve end chime of 106A and 110A ton tanks; and per the cylinder manufacturer's design on Special Permit Cylinders. For each cylinder or ton tank, the test date marking will appear as follows:

A1
9 06X
32

Note: This indicates the cylinder was re-tested in September of 2006 by re-tester number A132. X represents the 5 year volumetric expansion test (the Effective Date for the additional markings (e.g. X) was 9/2006).

7.1.2 Cylinders and ton tanks should be continuously weighed during filling to ensure user safety. The maximum allowable gross weight should never be exceeded.

7.1.3 Cylinders and ton tanks should be checked for leakage prior to shipment. Federal law per 49 CFR Part 173, Subpart G requires that leaking cylinders and ton tanks not be shipped and be immediately evacuated into acceptable cylinders or ton tanks.

7.2 *Drums.*

7.2.1 Recovered refrigerant R-11, R-113, or R-123 should be placed into a new drum or a drum that previously contained new refrigerant R-11, R-113, or R-123, respectively.

7.2.2 Drums should be continuously weighed during filling to ensure user safety. Drums should be filled to allow a vapor space equal to at least 10% of the drum height between the top of the liquid and the bottom of the drum top.

7.2.3 Drums should be sealed by wrench-tightening the closure devices until the gaskets are firmly seated and the closure is confirmed not to leak.

7.2.4 Drums should be checked for leakage prior to shipment. In accordance with 49 CFR Part 173, Subpart B, leaking drums must not be shipped and must be immediately transferred into acceptable containers.

Section 8. Transportation

8.1 *Local Regulations.* Per federal regulations in 49 CFR Part 173, Subpart G, the shipper of recovered refrigerant is responsible to determine if there are any state or local regulations restricting transportation, such as classifying recovered refrigerant and oil mixtures as hazardous waste. As of the date of publication hereof, the U.S. Environmental Protection Agency does not classify these materials as hazardous waste.

8.2 *Shipping Papers.* Per 49 CFR Part 172, Subpart C, the shipper is required to properly fill out the shipping papers when returning the recovered refrigerant. The shipping papers always contain:

8.2.1 The quantity and type of container

8.2.2 The total gross weight of recovered refrigerants, lb

8.2.3 For DOT hazardous materials, the shipping descriptions always include the following, in sequence:

8.2.3.1 The UN identification number, for example: "UN 1018"

8.2.3.2 The DOT proper shipping name, for example: Refrigerant Gas R-22

8.2.3.3 The DOT hazard class, for example: "2.2"

8.2.4 For material not regulated by DOT as a hazardous material, the words "Not Regulated as a Hazardous Material by DOT" are recommended.

APPENDIX A. REFERENCES - NORMATIVE

A1 Listed here are all standards, handbooks, and other publications essential to the formation and implementation of the standard. All references in this appendix are considered as part of this guideline.

None.

APPENDIX B. REFERENCES - INFORMATIVE

B1 Listed here are standards, handbooks, and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the guideline.

B1.1 ASHRAE Terminology, <https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology>, 2015, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A.

B1.2 CGA Publication V-1-2013, *Compressed Gas Cylinder Valve Outlet and Inlet Connections*, 2013, Compressed Gas Association, 14501 George Carter Way, Suite 103, Chantilly, VA 20151-2923, U.S.A.

B1.3 CGA Pamphlet S-1.1, *Pressure Relief Device Standard Part 1 - Cylinders for Compressed Gases*, 2011, Compressed Gas Association, Inc., 14501 George Carter Way, Suite 103, Chantilly, VA 20151-2923, U.S.A.

B2 For information on cylinder tank testing:

B2.1 U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, 1200 New Jersey Ave., S.E., Washington, DC 20590 U.S.A.

B3 For information on Code of Federal Regulations Title 49:

B3.1 Superintendent of Documents, Government Printing Office, Washington, DC 20401 U.S.A., (202) 512-1800

B3.2 Code of Federal Regulations, <http://www.ecfr.gov/cgi-bin/ECFR?page=browse>, 2015, United States Government Publishing Office, 710 North Capitol Street N.W. Washington, DC 20403 U.S.A.

B4 For information on Occupational Safety & Health Administration Hazard Communication Standard 1910.1200:

B4.1 U.S. Department of Labor, Occupational Safety & Health Administration, 200 Constitution Ave, NW, Washington, DC 20210, 800-321-6742.

APPENDIX C. SERVICE PRESSURES FOR SELECTED NON-FLAMMABLE FLUOROCARBON REFRIGERANT RECOVERY CYLINDERS – INFORMATIVE

Table C1. Service Pressures for Selected Non-flammable Fluorocarbon Refrigerant Recovery Cylinders			
Refrigerants	Vapor Pressure at 131°F, psig	Vapor Pressure at 70°F, psig	Minimum Required Cylinder Service Pressure, psig ^{1,2,3}
R-11	24.8	N/A	225
R-12	183.0	70.1	225
R-22	300.8	121.4	241
R-113	4.0	N/A	225
R-114	59.3	12.6	225
R-115	253.6	103.2	225
R-123	21.1	N/A	225
R-124	113.1	34.3	225
R-125	397.1	164.9	318
R-134a	201.6	70.8	225
R-141b	16.2	N/A	225
R-218	248.5	98.1	225
R-227ea	136.2	43.5	225
R-236fa	82.5	19.8	225
R-245fa	43.3	3.8	225
R-401A	223.2	85.7	225
R-401B	236.1	91.7	225
R-402A	382.6	161.4	306
R-402B	356.9	149.5	285
R-403A	344.8	146.0	276
R-403B	364.1	155.9	291
R-404A	360.1	148.8	288
R-405A	214.9	82.9	225
R-407A	360.2	147.6	288
R-407B	379.3	156.7	303
R-407C	342.8	139.3	274
R-407D	293.3	116.0	235
R-407E	331.5	133.9	265
R-408A	333.3	137.3	267
R-409A	227.2	89.1	225
R-409B	238.6	94.1	225
R-410A	484.0	201.1	387
R-410B	480.6	199.7	384
R-414A	212.4	82.6	225
R-414B	213.4	82.8	225
R-416A	177.9	62.0	225
R-417A	284.0	112.6	227
R-420A	190.2	66.5	225
R-421A	303.3	121.3	243

R-421B	360.4	148.3	288
R-422A	365.6	151.5	292
R-422B	303.2	122.1	243
R-422C	358.4	148.0	287
R-422D	323.2	131.7	259
R-423A	183.4	63.7	225
R-424A	289.8	115.5	232
R-425A	281.1	110.4	225
R-426A	211.6	76.3	225
R-427A	300.7	113.7	241
R-500	220.1	85.3	225
R-502	323.5	135.3	259
R-507A	368.4	152.5	295
R-509A	378.0	161.1	302

Notes:

1. Per Title 49 of the Code of Federal Regulations (CFR) 173.301a (c), the pressure in the container at 70°F must not exceed the Service Pressure for which the container is marked or designated.
2. Per CFR Title 49, Section 173.301a (d), the pressure in the container at 131°F shall not exceed 5/4 times the Service Pressure.
3. The minimum Service Pressure for a DOT 4BA or DOT 4BW cylinder is 225 psig per CFR Title 49, Sections 178.51 and 178.61. Special Permit Cylinders should conform to CFR Title 49, Section 178.71 except as detailed in the Special Permit.

N/A - Not Applicable.