

# 1999 STANDARD for

# SPECIFICATION FOR FLUOROCARBON REFRIGERANTS

Standard 700



**IMPORTANT**

***SAFETY RECOMMENDATIONS***

It is strongly recommended that the product be designed, constructed, assembled and installed in accordance with nationally recognized safety requirements appropriate for products covered by this standard.

ARI, as a manufacturers' trade association, uses its best efforts to develop standards employing state-of-the-art and accepted industry practices. However, ARI does not certify or guarantee safety of any products, components or systems designed, tested, rated, installed or operated in accordance with these standards or that any tests conducted under its standards will be non-hazardous or free from risk.

This standard supersedes ARI Standard 700-95.

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# SPECIFICATION FOR FLUOROCARBON REFRIGERANTS

## Section 1. Purpose

**1.1 Purpose.** The purpose of this standard is to establish purity specifications and specify the associated methods of testing for acceptability of fluorocarbon refrigerants regardless of source (new, reclaimed and/or repackaged) for use in new and existing refrigeration and air-conditioning products within the scope of ARI.

**1.1.1 Intent.** This standard is intended for the guidance of the industry including manufacturers, refrigerant reclaimers, repackagers, distributors, installers, servicemen, contractors and users.

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

## Section 2. Scope

**2.1 Scope.** This standard specifies acceptable levels of contaminants (purity requirements) for fluorocarbon refrigerants regardless of source and lists acceptable test methods. These refrigerants are: R-11; R-12; R-13; R-22; R-23; R-32; R-113; R-114; R-123; R-124; R-125; R-134a; R-143a; R-401A; R-401B; R-402A; R-402B; R-403A; R-403B; R-404A; R-405A; R-406A; R-407A; R-407B; R-407C; R-407D; R-407E; R-408A; R-409A; R-409B; R-410A; R-410B; R-411A; R-411B; R-412A; R-413A; R-500; R-502; R-503; R-507A; R-508A; R-508B; and R-509A as referenced in the ANSI/ASHRAE Standard 34.

## Section 3. Definitions

**3.1 Definitions.** All terms in this document will follow the standard industry definitions established in the current edition of ASHRAE Terminology of Heating, Ventilation, Air-Conditioning and Refrigeration, unless otherwise defined in this section.

**3.2 "Shall," "Should," "Recommended," or "It Is Recommended."** "Shall," "should," "recommended," or "it is recommended" shall be interpreted as follows:

**3.2.1 Shall.** Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

**3.2.2 Should, Recommended, or It is Recommended.** "Should", "recommended", or "it is recommended" is used to indicate provisions which are not mandatory but which are desirable as good practice.

## Section 4. Characterization of Refrigerants and Contaminants

**4.1 Characterization.** Characterization of refrigerants and contaminants addressed are listed in the following general classifications:

### 4.1.1 Identification.

- a. Gas Chromatography
- b. Boiling point and boiling point range

### 4.1.2 Contaminants.

- a. Water
- b. Chloride
- c. Acidity
- d. High boiling residue
- e. Particulates/solids
- f. Non-condensables
- g. Volatile impurities including other refrigerants

## Section 5. Sampling and Summary of Test Procedures

**5.1 Referee Test.** The referee test methods for the various contaminants are summarized in the following paragraphs. Detailed test procedures are included in *Appendix C to ARI Standard 700*. If alternative test methods are employed, the user must be able to demonstrate that they produce results at least equivalent to the specified referee method.

## 5.2 Refrigerant Sampling.

**5.2.1 Sampling Precautions.** Special precautions should be taken to assure that representative samples are obtained for analysis. Sampling shall be done by qualified personnel following accepted sampling and safety procedures.

**5.2.2 Cylinder Preparation.** Place a clean, empty sample cylinder with the valve open in an oven at 230°F [110°C] for one hour. Remove it from the oven while hot, immediately connect to an evacuation system and evacuate to less than 1000 microns [56 kPa]. Close the valve and allow it to cool. Weigh the empty cylinder.

**5.2.3 Gas Phase Sample.** A gas phase sample shall be obtained for determining the non-condensables. The source temperature shall be measured and recorded at the time the sample is taken. Since non-condensable gases, if present, will concentrate in the vapor phase of the refrigerant, care must be exercised to eliminate introduction of either air or liquid phase refrigerant during the sample transfer. Since R-11, R-113, and R-123 have normal boiling points at or above room temperature, non-condensable determination is not required for these refrigerants.

**5.2.4 Liquid Phase Sample.** A liquid phase sample is required for all tests listed in this standard except the test for non-condensables.

**5.2.4.1 Liquid Sampling.** Accurate analysis requires that the sample container be filled to at least 60% by volume, however under no circumstances should the cylinder be filled to more than 80% by volume. This can be accomplished by weighing the empty cylinder and then the cylinder with refrigerant. When the desired amount of refrigerant has been collected, close the valve(s) and disconnect the sample cylinder immediately.

NOTE: Care should be taken to insure that all connections and transfer lines are dry and evacuated to avoid contaminating the sample.

**5.2.4.2 Record Weight.** Check the sample cylinder for leaks and record the gross weight.

## 5.3 Refrigerant Identification.

**5.3.1 Primary Method.** The primary method shall be gas chromatography (GC) as described in *Appendix C to*

*ARI Standard 700*. The chromatogram of the sample shall be compared to known standards.

**5.3.2 Alternative Method.** Determination of the boiling point and boiling point range is an acceptable alternative test method which can be used to characterize refrigerants. The test method shall be that described in the Federal Specification for "Fluorocarbon Refrigerants," BB-F-1421-B, section 4.4.3.

## 5.4 Water Content.

**5.4.1 Method.** The Coulometric Karl Fischer Titration shall be the primary test method for determining the water content of refrigerants. This method is described in *Appendix C to ARI Standard 700*. This method can be used for refrigerants that are either a liquid or a gas at room temperature. For all refrigerants, the sample for water analysis shall be taken from the liquid phase of the container to be tested. Proper operation of the analytical method requires special equipment and an experienced operator.

The precision and accuracy of the results are excellent if proper sampling and handling procedures are followed.

**5.4.2 Limits.** The value for water content shall be expressed as parts per million by weight and shall not exceed the maximum specified (see Tables 1A, 1B, and 1C).

## 5.5 Chloride.

**5.5.1 Method.** The refrigerant shall be tested for chloride as an indication of the presence of hydrochloric acid and/or metal chlorides. The recommended procedure is intended for use with new or reclaimed refrigerants. Significant amounts of oil can interfere with the test results.

The test method shall be that described in *Appendix C to ARI Standard 700*. The test will show noticeable turbidity at chloride levels of about 3 ppm or greater by weight.

**5.5.2 Limits.** The results of the test shall not exhibit any sign of turbidity. Report the results as "pass" or "fail."

## 5.6 Acidity.

**5.6.1 Method.** The acidity test uses the titration principle to detect any compound that is soluble in water and ionizes as an acid. The test method shall be that described in *Appendix C to ARI Standard 700*. This test may not be suitable for determination of high molecular weight organic acids; however these acids will be found in the high boiling residue test outlined in 5.7. The test requires a 100 to 120 gram sample and has a detection limit of 0.1 ppm by weight calculated as HCl.

**5.6.2 Limits.** The maximum permissible acidity is 1 ppm by weight as HCl.

## 5.7 High Boiling Residue.

**5.7.1 Method.** High boiling residue shall be determined by measuring the residue from a standard volume of refrigerant after evaporation. The refrigerant sample shall be evaporated at room temperature or at 113°F [45°C] for all refrigerants, except R-113 which shall be evaporated at 140°F [60°C], using a Goetz bulb as specified in *Appendix C to ARI Standard 700*. Oils and/or organic acids will be captured by this method. An alternative gravimetric method is described in *Appendix C to ARI Standard 700*.

**5.7.2 Limits.** The value for high boiling residue shall be expressed as a percentage by volume and shall not exceed the maximum percent specified (see Tables 1A, 1B, and 1C).

## 5.8 Particulates and Solids.

**5.8.1 Method.** A measured amount of sample is evaporated from a Goetz bulb under controlled temperature conditions. The particulates/solids shall be determined by visual examination of the Goetz bulb prior to the evaporation of refrigerant. For details of this test method, refer to Part 3 of *Appendix C to ARI Standard 700*.

**5.8.2 Limits.** Visual presence of dirt, rust or other particulate contamination is reported as "fail."

## 5.9 Non-Condensables.

**5.9.1 Method.** A vapor phase sample shall be used for determination of non-condensables. Non-condensable gases consist primarily of air accumulated in the vapor phase of refrigerants. The solubility of air in the refrigerants liquid phase is extremely low and air is not significant as a liquid phase contaminant. The presence of non-condensable gases may reflect poor quality control in transferring refrigerants to storage tanks and cylinders.

The test method shall be gas chromatography with a thermal conductivity detector as described in *Appendix C to ARI Standard 700*.

**5.9.2 Limits.** The maximum level of non-condensables in the vapor phase of a refrigerant in a container shall not exceed 1.5% by volume at 75°F [23.9°C] (see Tables 1A, 1B, and 1C).

## 5.10 Volatile Impurities Including Other Refrigerants.

**5.10.1 Method.** The amount of volatile impurities including other refrigerants in the subject refrigerant shall be determined by gas chromatography as described in *Appendix C to ARI Standard 700*.

**5.10.2 Limits.** The subject refrigerant shall not contain more than 0.5% by weight of volatile impurities including other refrigerants (see Tables 1A, 1B, and 1C).

## Section 6. Reporting Procedure

**6.1 Reporting Procedure.** The source (manufacturer, reclaimer or repackager) of the packaged refrigerant shall be identified. The refrigerant shall be identified by its accepted refrigerant number and/or its chemical name. Maximum allowable levels of contaminants are shown in Tables 1A, 1B, and 1C. Test results shall be tabulated in a similar manner.

## Section 7. Voluntary Conformance

**7.1 Conformance.** Conformance to this standard is voluntary. However, any refrigerant specified as meeting these requirements shall meet all of the requirements given in this standard.

Table 1A. Characteristics of Single Component Refrigerants and their Maximum Allowable Levels of Contaminants

	Reporting Units	Reference (Subclause)	R-11	R-12	R-13	R-22	R-23	R-32	R-113	R-114	R-123	R-124	R-125	R-134a	R-143a
<i>CHARACTERISTICS*</i> :															
Boiling Point*	°C @ 101.3 kPa	---	23.8	-29.8	-81.4	-40.8	-82.1	-51.7	47.6	3.8	27.9	-11.0	-48.5	-26.2	-47.0
	°F @ 14.7 PSIA	---	74.9	-21.6	-114.6	-41.4	-115.7	-61.1	117.6	38.8	82.6	-12.2	-55.3	-15.1	-52.6
Boiling Point Range*	°C	---	0.3	0.3	0.5	0.3	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	°F		0.5	0.5	0.9	0.5	0.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Critical Temperature*	°C		198.0	111.8	28.8	96.2	25.6	78.1	214.1	145.7	183.7	122.3	66.3	101.2	72.9
	°F		388.4	233.2	83.8	205.2	78.1	172.8	417.4	294.2	362.7	252.1	151.3	214.1	163.2
Isomer Content	% by weight	---	N/A	N/A	N/A	N/A	N/A	N/A	0-1	0-30	0-8	0-5	N/A	0-0.5	0-0.01
Isomer									R-113a	R-114a	R-123a	R-124a		R-134	R-143
<i>VAPOR PHASE CONTAMINANTS</i> :															
Air and other noncondensables	% by volume	5.9	N/A**	1.5	1.5	1.5	1.5	1.5	N/A**	1.5	N/A**	1.5	1.5	1.5	1.5
<i>LIQUID PHASE CONTAMINANTS</i> :															
Water	ppm by weight	5.4	20	10	10	10	10	10	20	10	20	10	10	10	10
Volatile impurities including other refrigerants	% by weight	5.10	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
High boiling residue	% by volume	5.7	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Particulates/solids	Visually clean to pass	5.8	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass
Acidity	ppm by weight (as HCl)	5.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chloride***	No visible turbidity	5.5	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

\* Boiling points, boiling point ranges, and critical temperatures, although not required, are provided for informational purposes.

\*\* Since R-11, R-13, and R-123 have normal boiling points at or above room temperature, non-condensable determinations are not required for these refrigerants.

\*\*\* Recognized chloride level for pass/fail is about 3ppm.

N/A – Not Applicable

Table 1B. Characteristics of Zeotropic Blends (400 Series Refrigerants) and their Maximum Allowable Levels of Contaminants

	Reporting Units	Reference (Subclause)	R-401A	R-401B	R-402A	R-402B	R-403A	R-403B
<i>CHARACTERISTICS*</i> :								
Refrigerant Components			R-22/152a/ 124	R-22/152a/ 124	R-125/290/ 22	R-125/290/ 22	R-290/22/ 218	R-290/22/ 218
Nominal Comp, weight%			53/13/34	61/11/28	60/2/38	38/2/60	5/75/20	5/56/39
Allowable Comp, weight%			51.54/11.5- 13.5/33-35	59.63/9.5- 11.5/27-29	58.62/1.3/ 36-40	36.40/1.3/ 58-62	3.5.2/73-77/ 18-22	3-5.2/54-58/ 37-41
Boiling Point*	°C @ 101.3 kPa °F @ 14.7 PSIA	---	-33.2 to -27.8 -27.7 to -18.1	-34.7 to -29.6 -30.4 to -21.2	-48.2 to -47.7 -54.8 to -53.9	-47.4 to -45.0 -53.3 to -49.0	-50 to -48.7 -58 to -55.7	-50.6 to -49.3 -59.1 to -56.8
Boiling Point Range*	°C °F	---	5.4 9.6	5.1 9.2	0.5 0.9	2.4 4.3	1.3 2.3	1.3 2.3
Critical Temperature*	°C °F		108.0 226.4	106.1 223.0	75.5 167.9	82.6 180.7	93.3 199.9	90.0 194.0
<i>VAPOR PHASE CONTAMINANTS:</i>								
Air and other noncondensables	% by volume	5.9	1.5	1.5	1.5	1.5	1.5	1.5
<i>LIQUID PHASE CONTAMINANTS:</i>								
Water	ppm by weight	5.4	10	10	10	10	10	10
Volatile impurities including other refrigerants	% by weight	5.10	0.5	0.5	0.5	0.5	0.5	0.5
High boiling residue	% by volume	5.7	0.01	0.01	0.01	0.01	0.01	0.01
Particulates/solids	Visually clean to pass	5.8	pass	pass	pass	pass	pass	pass
Acidity	ppm by weight (as HCl)	5.6	1.0	1.0	1.0	1.0	1.0	1.0
Chloride**	No visible turbidity	5.5	pass	pass	pass	pass	pass	pass

\* Boiling points, boiling point ranges, and critical temperatures, although not required, are provided for informational purposes.

\*\* Recognized chloride level for pass/fail is about 3ppm.

Shaded columns denote refrigerants for which some analytical methods are not available.



Table 1B (continued). Characteristics of Zeotropic Blends (400 Series Refrigerants) and their Maximum Allowable Levels of Contaminants

	Reporting Units	Reference (Subclause)	R-404A	R-405A	R-406A	R-407A	R-407B	R-407C
<i>CHARACTERISTICS*</i> :								
Refrigerant Components			R-125/143a/ 134a	R-22/152a/ 142b/C318	R-22/600a/ 142b	R-32/125/ 134a	R-32/125/134a/ 134a	R-32/125/ 134a
Nominal Comp, weight%			44/52/4	45/7/5/42.5	55/4/41	20/40/40	10/70/20	23/25/52
Allowable Comp, weight%			42-46/51-53/ 2-6	43-47/6-8/4.5- 6.5/40.5-44.5	53-57/3-5/ 40-42	19-21/38-42/ 38-42	9-11/68-72/ 18-22	22-24/23-27/ 50-54
Boiling Point*	°C @ 101.3 kPa °F @ 14.7 PSIA	---	-46.1 to -45.4 -51.0 to -49.8	-34.0 to -21.9 -29.2 to -7.4	-36.0 to -26.1 -32.7 to -15.0	-45.5 to -38.9 -49.9 to -38.1	-47.3 to -42.9 -53.1 to -45.2	-43.6 to -36.6 -46.4 to -33.9
Boiling Point Range*	°C °F	---	0.7 1.2	12.1 21.8	9.9 17.7	6.6 11.8	4.4 7.9	7.0 13.4
Critical Temperature*	°C °F		72.1 161.7	106.1 223.0	114.5 238.1	82.8 181.0	75.8 168.4	86.7 188.1
<i>VAPOR PHASE CONTAMINANTS:</i>								
Air and other nonecondensables	% by volume	5.9	1.5	1.5	1.5	1.5	1.5	1.5
<i>LIQUID PHASE CONTAMINANTS:</i>								
Water	ppm by weight	5.4	10	10	10	10	10	10
Volatile impurities including other refrigerants	% by weight	5.10	0.5	0.5	0.5	0.5	0.5	0.5
High boiling residue	% by volume	5.7	0.01	0.01	0.01	0.01	0.01	0.01
Particulates/solids	Visually clean to pass	5.8	pass	pass	pass	pass	pass	pass
Acidity	ppm by weight (as HCl)	5.6	1.0	1.0	1.0	1.0	1.0	1.0
Chloride**	No visible turbidity	5.5	pass	pass	pass	pass	pass	pass

\* Boiling points, boiling point ranges, and critical temperatures, although not required, are provided for informational purposes.

\*\* Recognized chloride level for pass/fail is about 3 ppm.

Shaded columns denote refrigerants for which some analytical methods are not available.

Table 1B (continued). Characteristics of Zeotropic Blends (400 Series Refrigerants) and their Maximum Allowable Levels of Contaminants

	Reporting Units	Reference (Subclause)	R-407D	R-407E	R-408A	R-409A	R-409B	R-410A
<i>CHARACTERISTICS*:</i>								
Refrigerant Components			R-32/125/ 134a	R-32/125/ 134a	R-125/143a/ 22	R-22/124/ 142b	R-22/124/142b	R-32/125
Nominal Comp, weight%			15/15/70	25/15/60	7/46/47	60/25/15	65/25/10	50/50
Allowable Comp, weight%			13-17/13-17/ 68-72	23-25/13-17/58- 62	5-9/45-47/ 45-49	58-62/23-27/ 14-16	63-67/23-27/ 9-11	48.5-50.5/ 49.4-51.5
Boiling Point*	°C @ 101.3 kPa °F @ 14.7 PSIA	---	-39.8 to -33.1 -39.6 to -27.6	-43.1 to -35.1 -45.6 to -31.2	-44.9 to -44.4 -48.8 to -47.9	-35.8 to -27.9 -32.4 to -18.2	-36.6 to -29.6 -33.8 to -21.3	-51.2 to -51.1 -60.2 to -60.0
Boiling Point Range*	°C °F	---	6.7 12.0	8.0 14.4	0.5 0.9	7.9 14.2	7.0 12.5	0.1 0.2
Critical Temperature*	°C °F		91.2 196.2	88.2 190.8	83.5 182.3	107.0 224.6	116.0 240.8	72.5 162.5
<i>VAPOR PHASE CONTAMINANTS:</i>								
Air and other noncondensables	% by volume	5.9	1.5	1.5	1.5	1.5	1.5	1.5
<i>LIQUID PHASE CONTAMINANTS:</i>								
Water	ppm by weight	5.4	10	10	10	10	10	10
Volatile impurities including other refrigerants	% by weight	5.10	0.5	0.5	0.5	0.5	0.5	0.5
High boiling residue	% by volume	5.7	0.01	0.01	0.01	0.01	0.01	0.01
Particulates/solids	Visually clean to pass	5.8	pass	pass	pass	pass	pass	pass
Acidity	ppm by weight (as HCl)	5.6	1.0	1.0	1.0	1.0	1.0	1.0
Chloride**	No visible turbidity	5.5	pass	pass	pass	pass	pass	pass

\* Boiling points, boiling point ranges, and critical temperatures, although not required, are provided for informational purposes.

\*\* Recognized chloride level for pass/fail is about 3ppm.

**Table 1B (continued). Characteristics of Zeotropic Blends (400 Series Refrigerants) and their Maximum Allowable Levels of Contaminants**

	Reporting Units	Reference (Subclause)	R-410B	R-411A	R-411B	R-412A	R-413A
<i>CHARACTERISTICS*</i> :							
Refrigerant Components			R-32/125	R-1270/22/ 152a	R-1270/22/ 152a	R-22/218/ 142b	R-218/134a/ 600a
Nominal Comp. weight%			45/55	1.5/87.5/11.0	3/94/3	70/5/25	9/88/3
Allowable Comp. weight%			44-46/54-56	0.5-1.5/87.5- 89.5/10-11	2-3/94-96/ 2-3	68-72/3-7/ 24-26	8-10/86-90/ 2-3
Boiling Point*	°C @ 101.3 kPa °F @ 14.7 PSIA	---	-51.3 to -51.2 -60.3 to -60.2	-39.4 to -38.6 -38.9 to -37.5	-41.6 to -40.9 -42.9 to -41.6	-40.1 to -32.0 -40.2 to -25.6	-33.2 to -28.1 -27.7 to -18.6
Boiling Point Range*	°C °F	---	0.1 0.1	0.8 1.4	0.7 1.3	8.1 14.6	5.1 9.1
Critical Temperature*	°C °F		71.0 159.9	98.6 209.5	96.5 205.7	104.8 220.6	103.5 218.3
<i>VAPOR PHASE CONTAMINANTS:</i>							
Air and other noncondensables	% by volume	5.9	1.5	1.5	1.5	1.5	1.5
<i>LIQUID PHASE CONTAMINANTS:</i>							
Water	ppm by weight	5.4	10	10	10	10	10
Volatile impurities including other refrigerants	% by weight	5.10	0.5	0.5	0.5	0.5	0.5
High boiling residue	% by volume	5.7	0.01	0.01	0.01	0.01	0.01
Particulates/solids	Visually clean to pass	5.8	pass	pass	pass	pass	pass
Acidity	ppm by weight (as HCl)	5.6	1.0	1.0	1.0	1.0	1.0
Chloride**	No visible turbidity	5.5	pass	pass	pass	pass	pass

\* Boiling points, boiling point ranges, and critical temperatures, although not required, are provided for informational purposes.

\*\* Recognized chloride level for pass/fail is about 3ppm.

Shaded columns denote refrigerants for which some analytical methods are not available.

Table 1C. Characteristics of Azeotropic Blends (500 Series Refrigerants) and their Maximum Allowable Levels of Contaminants

	Reporting Units	Reference (Subclause)	R-500	R-502	R-503	R-507A	R-508A	R-508B	R-509A
<i>CHARACTERISTICS*</i> :									
Refrigerant Components									
Nominal Comp. weight%			73.8/26.2	48.8/51.2	40.1/59.9	50/50	39/61	46/54	44/56
Allowable Comp. weight%			72.8-74.8/ 25.2-27.2	44.8-52.8/ 47.2-55.2	39-41/59-61	49-51/49-51	37-41/59-63	45-47/53-55	42-46/56-60
Boiling Point*	°C @ 101.3 kPa	---	-33.4	-45.4	-88.7	-46.7	-86.4	-88.3	-47.7
	°F @ 14.7 PSIA	---	-28.1	-49.7	-127.7	-52.1	-123.5	-126.9	-53.9
Boiling Point Range*	°C	---	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	°F		0.9	0.9	0.9	0.9	0.9	0.9	0.9
Critical Temperature*	°C		104.3	82.2	19.5	70.8	13.5	14.0	86.9
	°F		219.7	180.0	67.1	159.4	56.3	57.2	188.3
<i>VAPOR PHASE CONTAMINANTS:</i>									
Air and other nonecondensables	% by volume	5.9	1.5	1.5	1.5	1.5	1.5	1.5	1.5
<i>LIQUID PHASE CONTAMINANTS:</i>									
Water	ppm by weight	5.4	10	10	10	10	10	10	10
Volatile impurities including other refrigerants	% by weight	5.10	0.5	0.5	0.5	0.5	0.5	0.5	0.5
High boiling residue	% by volume	5.7	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Particulates/solids	Visually clean to pass	5.8	pass	pass	pass	pass	pass	pass	pass
Acidity	ppm by weight (as HCl)	5.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chloride**	No visible turbidity	5.5	pass	pass	pass	pass	pass	pass	pass

\* Boiling points, boiling point ranges, and critical temperatures, although not required, are provided for informational purposes.

\*\* Recognized chloride level for pass/fail is about ppm.

## 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 standard.

**A1.1** *ANSI/ASHRAE Standard 34-1997 and ANSI/ASHRAE Standard 34-1997 Addenda, Number Designation and Safety Classification of Refrigerants*, 1997, American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers, 11 West 42<sup>nd</sup> Street, New York, NY 10036, U.S.A./1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

**A.1.2** *Appendix C Analytical Procedures to ARI Standard 700-99, Specification for Fluorocarbon Refrigerants*, Air-Conditioning and Refrigeration Institute, 1999, 4301 North Fairfax Drive, Suite 425, Arlington, VA 22203; U.S.A.

**A.1.3** *ASHRAE Terminology of Heating, Ventilating, Air Conditioning and Refrigeration*, American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2<sup>nd</sup> Edition, 1992, 1791 Tullie Circle N.E., Atlanta, GA 30329-2305; U.S.A.

## 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 standard.

**B1.1** Federal Specification for *Fluorocarbon Refrigerants, BB-F-1421-B*, dated March 5, 1982, Office of the Federal Register, National Archives and Records Administration, 1982, 800 North Capitol Street, N.W., Washington, D.C. 20402; U.S.A.