

# THREE IMPORTANT QUESTIONS TO ANSWER ON ALTERNATIVE REFRIGERANTS

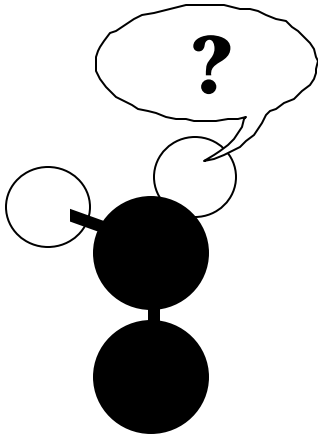


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## THREE IMPORTANT QUESTIONS TO ANSWER ON ALTERNATIVE REFRIGERANTS

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The marketing hype continues on “alternative refrigerants”. Driven by the Montreal Protocol and Federal laws like the U.S. Clean Air Act, the market potential for replacement or alternative refrigerants is an opportunity for an array of chemical companies to promote the “drop-in answer to your refrigerant needs”. Unfortunately the public is being tasked with finding the right answer to their particular needs, and they are becoming increasingly confused by the advertisements and misleading promotions.

If the general public were well versed in chemistry, perhaps the alternative refrigerant choices would be easier to sort. However, most of the people who are faced with these choices are not chemists, but auto mechanics, service technicians, facility managers, property managers, engineers and numerous other professions who are addressing a mechanical device that uses refrigerants. Even environmentalists have been misled by the alternative refrigerant choices.

The following three questions should be considered to properly determine the best application of alternative refrigerants. They will help to sort the hype from good information.

### **1. *Has the refrigerant been approved under the Environment Protection Agency (EPA), Significant New Alternatives Policy (SNAP)?***

The EPA evaluates, approves, limits, or disapproves all alternative refrigerants in U.S. Applications. This evaluation includes the refrigerants ozone depleting potential, global warming potential, flammability and toxicity along with application limits. The SNAP program does not however approve or disapprove the performance or compatibility in a refrigeration system. Approval under the SNAP program is critical as those alternatives found unacceptable or violation of conditions or use of listed refrigerants is a violation of the U.S. Clean Air Act and may be subject to a \$25,000 (U.S.) fine and up to five years in jail.

Producers of alternative refrigerants must submit information to the EPA SNAP program 90 days prior to marketing the product. After 90 days, if EPA has not had the opportunity to review the refrigerant, it may be sold and used. However, if after EPA review, the refrigerant is not approved for use or limited in application, owners may be stuck with an inventory or application that cannot be used legally. Under the Clean Air Act SNAP program, sale of any refrigerant is not restricted, however use can be legally restricted. The SNAP program can be accessed on the internet under the address: [www.epa.gov/ozone/title6/snap/snap/snapfact.html](http://www.epa.gov/ozone/title6/snap/snap/snapfact.html).

EPA administers the Clean Air Act by using industry standards for the recovery, recycling and reclamation of refrigerants. These standards are based on such organizations as the Society of

Automotive Engineers (SAE), the Air-Conditioning and Refrigeration Institute (ARI) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

## 2. *Has the refrigerant been recognized by industry standards?*

Most advertisements on the “drop-in refrigerants” use trade names and designations along with promotional information that does not include the makeup of the refrigerant especially in the case of blended refrigerants. EPA along with the industry rely on the standards set forth by such organizations as SAE, ARI and ASHRAE to classify refrigerants for use. Not only do these standards provide limits on recovery, recycling and reclamation, but also on flammability and toxicity, along with proper application. See fig. #1 for reference.

SAFETY GROUP Per ASHRAE 34 ( with examples shown )		
High Flammability	<b>A3</b>	<b>B3</b>
Low Flammability	<b>A2</b> R-406a	<b>B2</b> R-717
No Flame Propagation	<b>A1</b> R-11, R-134a, R-410a	<b>B1</b> R-123
	Lower Toxicity	Higher Toxicity

Fig. # 1

Standard ASHRAE 34, Number Designation and Safety Classification of Refrigerants provides a uniform rating of refrigerants for toxicity and flammability and also assigns refrigerant numbers (e.g. R-11, R-12, R-22, R-134a). Standard ASHRAE 15, Safety Code For Mechanical Refrigeration Rooms establishes safe practices in designing and installing equipment.

These standards provide factual data to sort out the marketing hype. Under ASHRAE 34, refrigerants assigned a number will also be listed as to flammability and toxicity. Flammability is tested according to the American Society of

Testing Materials (ASTM) E-681 and the refrigerant is assigned to one of three categories: 1 - no flame propagation; 2 - low flammability or 3 - high flammability.

For example, under ASHRAE 34, HFC-134a is classified in group 1, no flame propagation, because it is not flammable at any concentration in air at atmospheric pressure. On the other hand alternative refrigerants referred to as hydrocarbons ignite at concentrations as low as 2% by volume and are assigned to group 3. There are also two classifications for toxicity, “A” or “B”. The “A” designates lower toxicity and the “B” higher toxicity. These designations are applied with the numbers (e.g. A1, B1) to provide the complete safety classification as noted in fig. #1. For example: CFC-11, 12 and HFC-134a are classified A1, no flame propagation, lower toxicity, HCFC-123 is assigned B1, no flame propagation, higher toxicity.

Blended refrigerants are assigned dual classifications, the first represents the safety classification for the refrigerant blend as it is purchased while the second represents the worst case that could be encountered if the components should separate during operation or during a leak. For example, R-410a (HFC32/125, 50%/50%) has been assigned a A1/A1, designation - no flame propagation, lower toxicity. Those blended refrigerants that contain hydrocarbons or other flammable components may have two different ratings depending on the potential for flammability during applications. For example: R-406a HCFC-22/isobutane 600a/HCFC-142b, 55%/4%/41% is classified as a A1/A2, non-flammable as originally formulated, but could become flammable in application, such as a leak. Under ASHRAE Standard 15, this refrigerant would have to be applied per the worst condition A2. As a result under ASHRAE 15 Safety Code, R-406a would not be allowed for comfort cooling applications.

The assignment of an ASHRAE refrigerant designation has other benefits in that the number serves as a generic reference to the refrigerant rather than a manufacturer's trade name. For example, R-134a is sold by Dupont under the brand name SUVA MP. Allied Signal refers to R-134a as Genetron 134a. In both cases, R-134a is the same.

Other industrial standards produced by the Air-Conditioning and Refrigeration Institute (ARI) provide guidance and in some cases are adopted by law. For example, ARI 700-93 is Specifications For Fluorocarbon and Other Refrigerants. Reclaimed refrigerants both in motor vehicles and stationary/commercial sectors must meet the requirements of ARI Standard 700 under the Clean Air Act Section 608. ARI Standard 700 specifies acceptable levels of refrigerant purity for fluorocarbon refrigerants. EPA is also considering an update to the Clean Air Act to incorporate another industry publication: Industry Recycling Guide (IRG-2). IRG-2 still refers to ARI 700 as the purity level standard.

Two other standards that should be reviewed are ASHRAE Guideline "K" Containers For Recovered Fluorocarbon Refrigerants and Guideline "N", Assignment Of Refrigerant Container Colors. All refrigerants are assigned a container color so that when in stock they can easily be distinguished from other type. For example, HFC-134a in cylinders is designated by light blue(sky). Guideline K is important as it references the proper markings that should be labeled on all refrigerant containers along with reference to Department of Transportation requirements for refrigerant containers.

### **3. *Has the original equipment manufacturer approved the new refrigerant for use in that particular application?***

Technically there are no "drop-in" refrigerants. Some come close, but there is always a compromise.

People considering the use of an alternative refrigerant should always consult with the original equipment manufacturer. As refrigerant is the blood of the equipment, the analogy applies; if a person's blood type was changed during a transfusion, the patient could die.

Material compatibility, compressor displacement, pressure, flow control, heat exchanger type and other application considerations must be thoroughly reviewed and tested. Results of not having an approved refrigerant application can result in problems from voided warranties to critical demise of the equipment.

For example, Refrigerant R-410a (Azeotrope of HFC-32 & 125, produced by Allied Signal, AZ20) is an excellent replacement for HCFC-22. The key word being "replacement". However, this refrigerant is not a drop-in for all HCFC-22 existing equipment. One reason is pressure. For example, at 100° F (327.8c), HCFC-22 is at 195.9 psig( 1350.7 kPa ) R-410a at 100° F (37.8c) is at 320.5 psig. ( 2209.8 kPa ). 61% higher pressure than HCFC-22.

### **Consult your original equipment manufacture for alternative refrigerant application!**

Three critical questions that should be applied to any alternative refrigerant. The answers will sort through the advertising hype and provide factual data.

**Remember "There are no drop-in refrigerants, only alternatives"**

**ASHRAE Number Assignments For Refrigerant Blends And Compounds**  
 (\*Pending approval at time of article publication)

ASHRAE 34 Number	Manufacturer's Name	Components	Composition Weight %	Safety Group*	Replaces Refrigerant	Container Color	Class** Number
22	Allied Signal, Dupont, Others	True Compound	CHF <sub>2</sub> CL	A1	--	Light Green	11
123	Dupont	True Compound	C <sub>2</sub> HF <sub>3</sub> CL <sub>2</sub>	B2	--	Light Blue-Gray	1
134a	Dupont, Allied Signal, ICI, Others	True Compound	C <sub>2</sub> H <sub>2</sub> F <sub>4</sub>	A1	--	Light Blue	11
236fa	(EPA) R-236fa	True Compound	100	A1	--	--	--
245fa	Allied Signal Genetron 245fa	True Compound	100	A1	R-123	--	--
401A	Dupont MP 39	R-22 R-152a R-124	53/13/3	A1/A1	R-12	Light Purple	11
401B	Dupont MP66	R-22 R-152a R-124	61/11/28	A1/A1	R-12	Yellow-Brown	11
401C	Dupont MP52	R-22 R-152a R-124	33/15/52	A1/A1	R-12	Blue-Green	11
402A	Dupont HP80	R-125 R-290 R-22	60/2/38	A1/A1	R-502	Light Brown	111
402B	Dupont HP81	R-125 R-290 R-22	38/2/60	A1/A1	R-502	Green-Brown	111
403A	Rone-Poulenc 69S	R-290 R-22 R-218	5/75/20	A1/A1	R-502	--	--
403B	Rone-Poulenc 69L	R-290 R-22 R-218	5/56/39	A1/A1			
404A	Dupont HP62	R-125 R-143a R-134a	44/52/4	A1/A1	R-502	Orange	111
405A	Greencool G2015	R-22 R-152a R-142b R-C318	45/7/5.5/42.5	Withdrawn by ASHRAE	R-12	--	--
406A	Monroe Air Tech GHG-12	R-22 R-600a R-142b	55/4/41	A1/A2	R-12	--	--
407A	ICI Klea 60	R-32 R-125 R-134a	20/40/40	A1/A1	R-22	Lime-Green	111
407B	ICI Klea 61	R-32 R-125 R-134a	10/70/20	A1/A1	R-22	Cream	111

407C	Dupont AC9000/ICI Klea 66	R-32 R-125 R-134a	23/25/52	A1/A1	R-22	Medium-Brown	111
407D	ICI Klea	R-32 R-125 R-134a	15/15/70	A1/A1			
407E	ICI Klea	R-32 R-125 R-134a	25/15/60	A1/A1			
408A	Atochem FX 10	R-125 R-143a R-22	7/46/47	A1/A1	R-502	Medium-Purple	111
409A	Atochem FX 56	R-22 R-124 R-142b	60/25/15	A1/A1	R-12	Medium-Brown	11
409B	Atochem FX 57	R-22 R-124 R-142b	65/25/10	A1/A1			
410A	Allied Signal AZ20	R-32 R-125	50/50	A1/A1			
410B	Dupont AC 9100	R-32 R-125	45/55	A1/A1	R-22	Maroon	111
411A	Greencool G2018A	R-1270 R-22 R-152a	1.5/87.5/11	A1/A2	R-22	--	--
411B	Greencool G2018B	R-1270 R-22 R-152a	3/94/3	A1/A2	R-502	--	--
*411C	Greencool G2018C	R-1270 R-22 R-152a	3.0/95.5/1.5	A1/A1	--	--	--
412A	ICI Arcton TP5R	R-22 R-218 R-142b	70/5/25	A1/A2	--	--	--
413A	Rhone-Poulenc Isceon 49	R-218 R-134a R-600a	9/88/3	A1/A2	--	--	--
*414A	Peoples Welding Supply GHG-X4	R-22 R-124 R-600a R-142b	51.0/28.5/4.0/1 6.5	A1/A1			
*414B	ICOR International Inc.HOT SHOT	R-22 R-124 R-600a R-142b	50.0/39/1.5/ 9.5	A1/A1			
*416A	Intercool Energy FRIGC FR-12	R-124 R-134a R-600	39.5/59/1.5	A1/A1	--	--	--
507A	Allied Signal AZ50	R-125 R-143a	50/50	A1	R502/22	Blue-Green	111
508A	ICI Klea 5R3	R-23 R-116 R-123	39/61	A1	R-503	--	--

508B	DuPont SUVA 95	R-116	46/54	A1/A1			
509A	ICI Arcton TP5R2	R-22 R-218	44/56	A1	--	--	--

\*Safety Group per ASHRAE-34  
A1 = Low toxicity, Non-flammable  
A2 = Low toxicity, Flammable  
B2 = Higher toxicity, Non flammable  
B2 = Higher toxicity, Non flammable

\*\*Class 1: boiling point .68F. Packaged in drums  
Class II: low pressure Title 49 CRF,  
Normally in cylinders <260 psig  
Class III: high pressure, compressed  
gas per Title 49 CFR min. press.  
cylinder <260 psig  
Class IV: flammable refrigerants

Note: R-405A previously classified  
A1/A1. Safety classification removed  
due to lack of toxicity data on R-C318.

## ESSENTIAL REFERENCES

Guideline Standards	
ASHRAE 34-1992:	Number designation and safety classification of refrigerants
ASHRAE 15-1994:	Safety code for mechanical refrigeration
ARI 740-93:	Performance of refrigerant recovery, recycling, and/or reclaiming equipment
ARI 700-93:	Specifications for fluorocarbon refrigerants
ASHRAE Guideline "K": refrigerants	Containers for recovered fluorocarbon
ASHRAE Guideline "N":	Assignment of refrigerant container colors
U.S. EPA Guidelines & Law:	Clean Air Act; final ruling of Section 608 of CAA; dated May 14, 1993; EPA Section 114 Letter; EPA Action Guidelines
<p>Air Conditioning and Refrigeration Institute (ARI)  4301 North Fairfax Drive, Suite 425, Arlington, VA 22203  Phone: (703) 524-8800 Fax: (703) 528-3816</p> <p>American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)  1791 Tullie Circle, NE, Atlanta, GA 30329  Phone: (404) 636-8400 Fax: (404) 321-5478</p> <p>U.S. Environmental Protection Agency (U.S. EPA)</p>	

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