Solstice® yf Refrigerant

User Guide – Asia-Pacific

Honeywell

Honeywell

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April, 2014

Honeywell Solstice® yf Refrigerant User Guide – Asia-Pacific

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General Information

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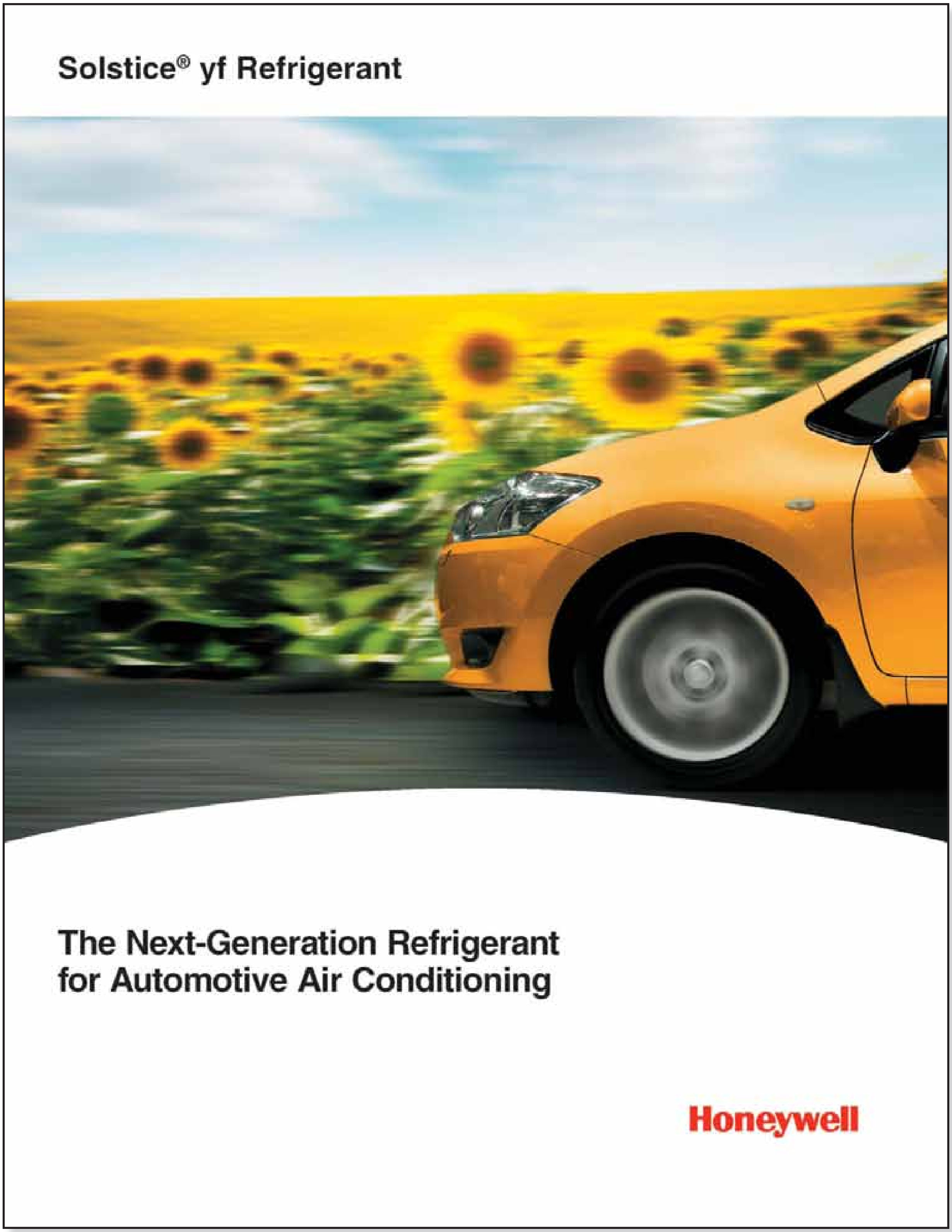
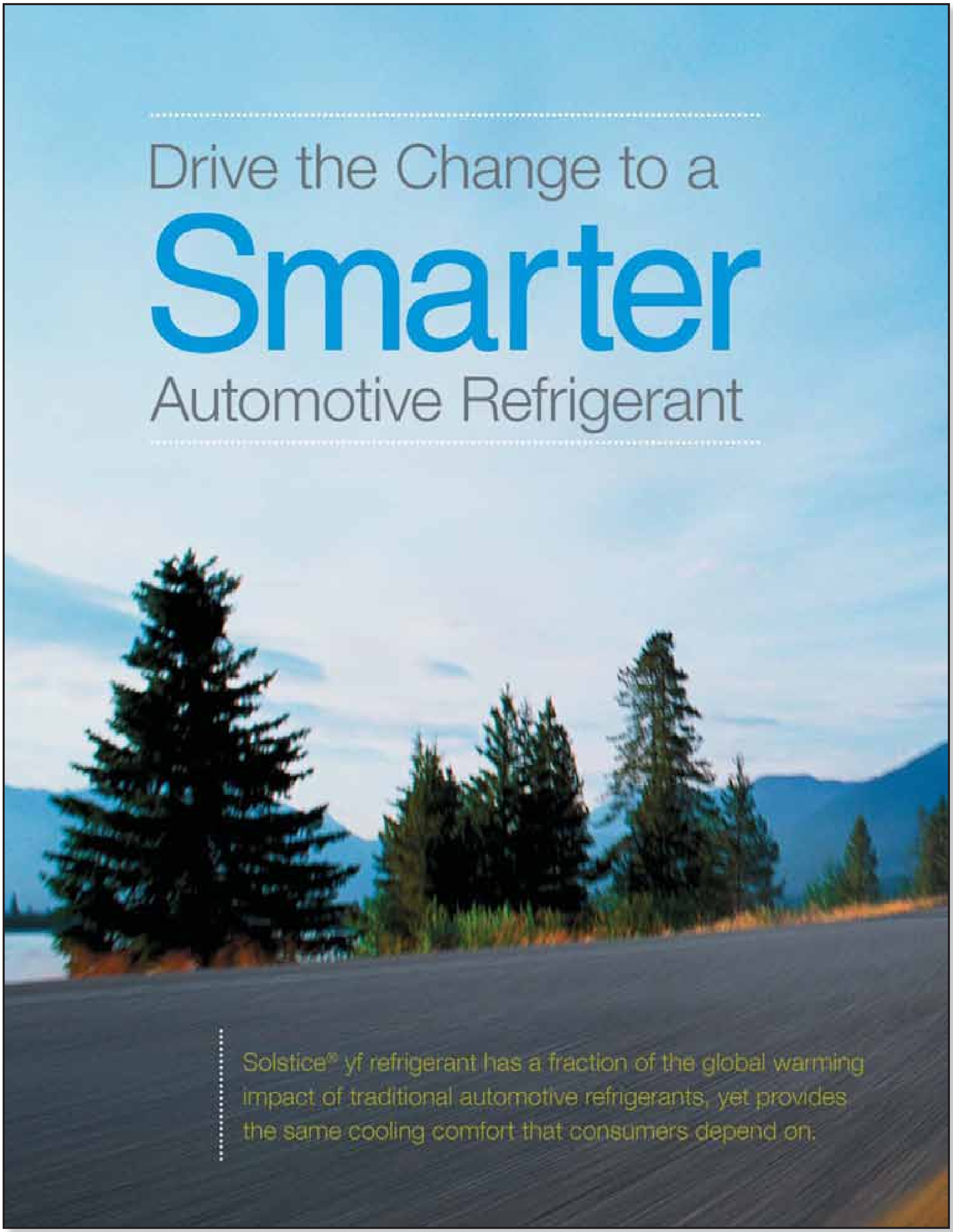
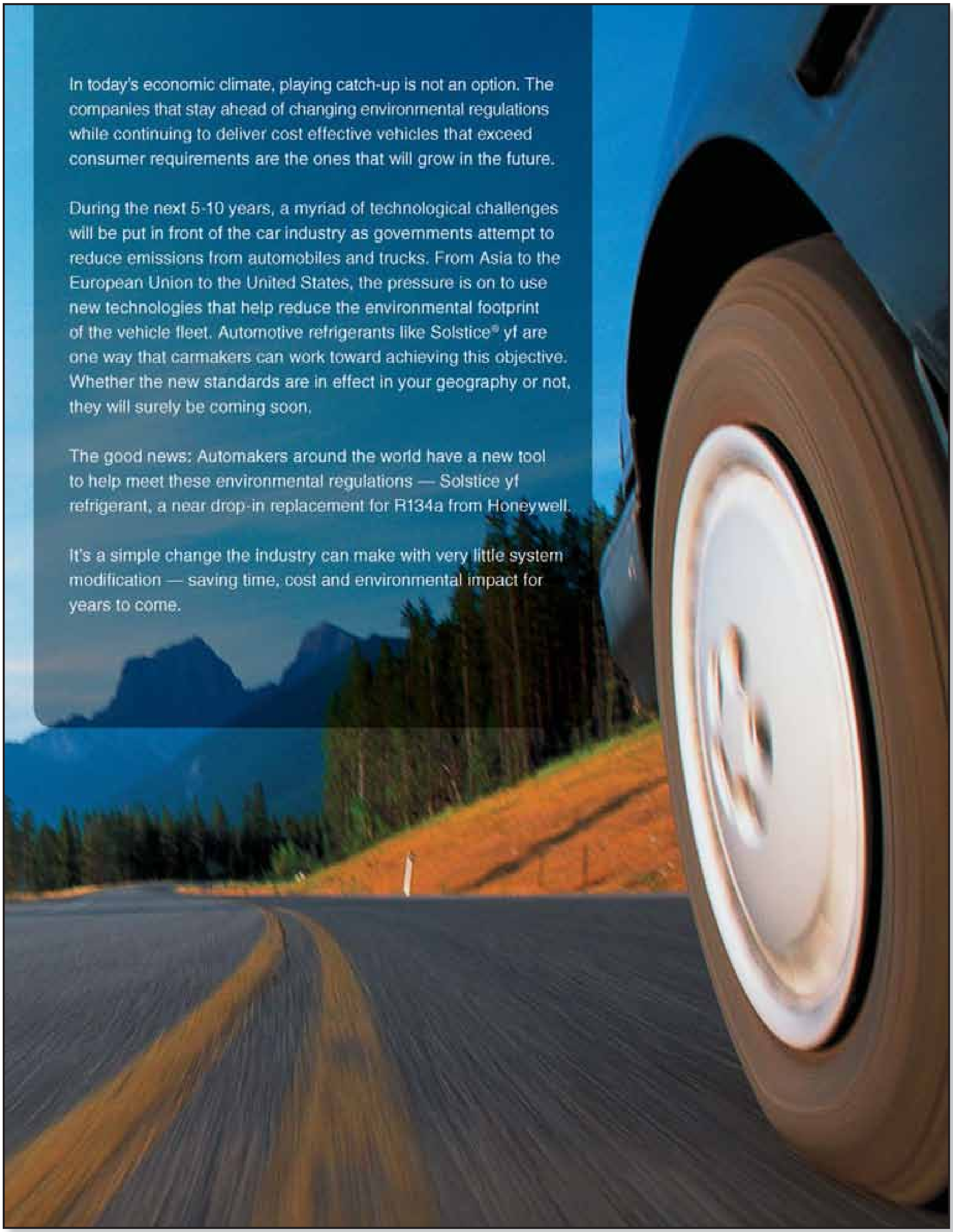


Solstice® yf Refrigerant

The Next-Generation Refrigerant
for Automotive Air Conditioning

Honeywell


Drive the Change to a
Smarter
Automotive Refrigerant
Solstice® yf refrigerant has a fraction of the global warming impact of traditional automotive refrigerants, yet provides the same cooling comfort that consumers depend on.

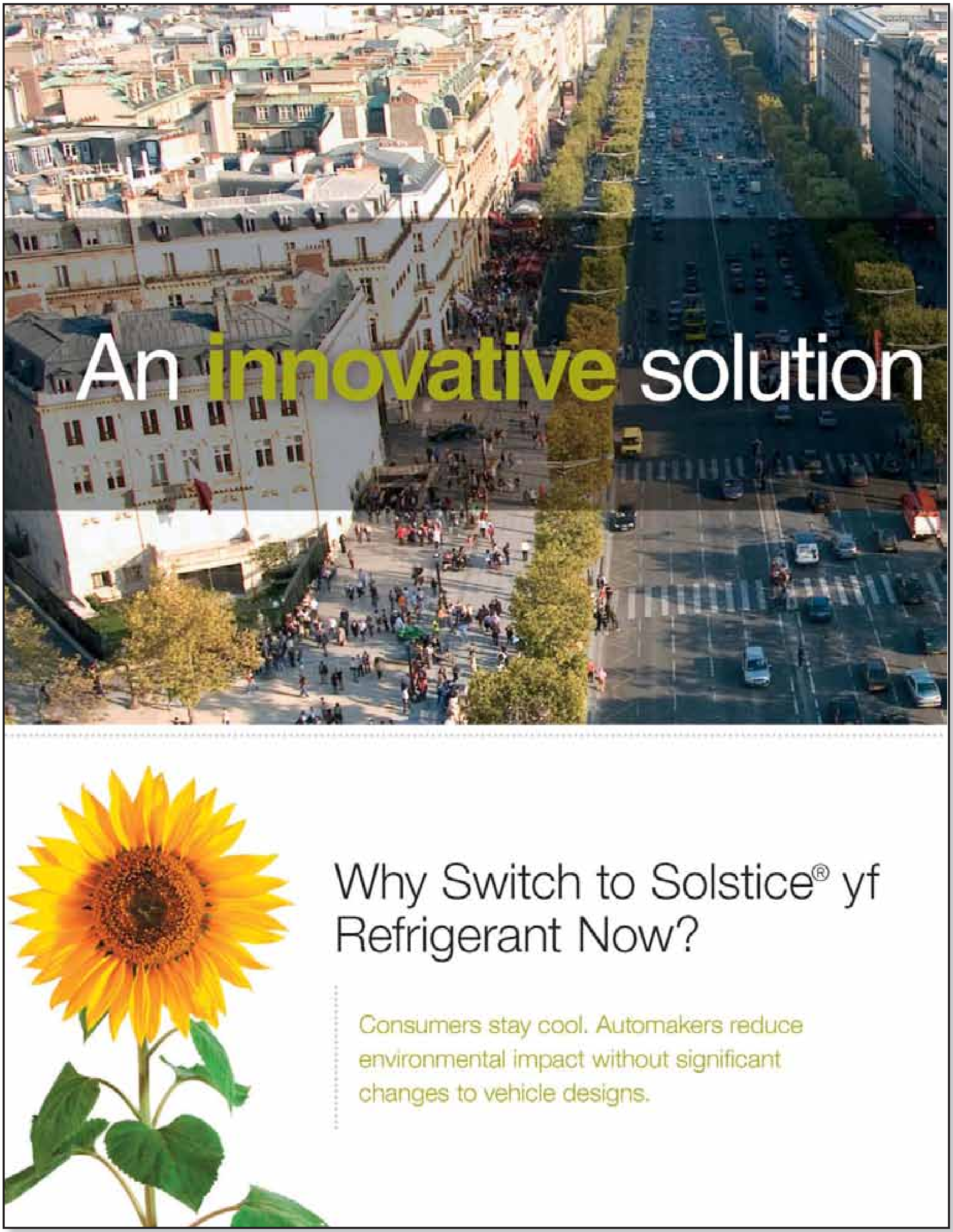


In today's economic climate, playing catch-up is not an option. The companies that stay ahead of changing environmental regulations while continuing to deliver cost effective vehicles that exceed consumer requirements are the ones that will grow in the future.

During the next 5-10 years, a myriad of technological challenges will be put in front of the car industry as governments attempt to reduce emissions from automobiles and trucks. From Asia to the European Union to the United States, the pressure is on to use new technologies that help reduce the environmental footprint of the vehicle fleet. Automotive refrigerants like Solstice® yf are one way that carmakers can work toward achieving this objective. Whether the new standards are in effect in your geography or not, they will surely be coming soon.

The good news: Automakers around the world have a new tool to help meet these environmental regulations — Solstice yf refrigerant, a near drop-in replacement for R134a from Honeywell.

It's a simple change the industry can make with very little system modification — saving time, cost and environmental impact for years to come.


An innovative solution
Why Switch to Solstice® yf Refrigerant Now?
Consumers stay cool. Automakers reduce environmental impact without significant changes to vehicle designs.

Excellent Cooling Performance

- **Just as effective.** Honeywell Solstice® yf refrigerant is as effective as HFC-134a and offers comparable cooling performance in all climates.
- **More energy efficient.** Air conditioning systems using Solstice yf refrigerant are generally more energy efficient than competing technologies.

Low Environmental Impact

- **Surpasses new EU standards.** Honeywell Solstice yf refrigerant doesn't just meet the new standard; it significantly surpasses it. With a global warming potential (GWP) of less than 1, it's 99.3% lower than the EU's Mobile Air Conditioning (MAC) Directive requires* and 99.9% lower than R134a.
- **Reduces fuel consumption and emissions.** Vehicles equipped with Solstice yf refrigerant use less fuel and produce 20% to 30% fewer emissions than the CO_2 alternative, shrinking their carbon footprint even more.

99.9 percent lower **global warming potential** than R134a

*The EU's MAC Directive requires new vehicles to use refrigerants with a global warming potential (GWP) below 150.


Up to 30 percent
fewer emissions
than CO_2

Lower Cost In-Use

- **Solstice® yf is easily integrated into vehicle systems.** Little or no redesign is required. In many cases the AC system hardware costs after converting to Solstice yf are the same as they were before.

Low Implementation Cost

- **Near drop-in replacement.** In most cases, Solstice yf refrigerant is a direct replacement for currently used materials.
- **Single global solution.** The performance characteristics of Solstice yf refrigerant make it well suited to comply with current and future regulations around the world, so automakers have the supply chain benefit of one global solution. In some regions, Solstice yf can help automakers achieve tough future fuel mileage regulations by allowing them to receive tailpipe credits in return for transitioning in advance of any refrigerant-specific use regulations.

Easy Serviceability

- **Similar components.** Parts used in A/C systems running Solstice yf refrigerant are identical or similar to those used in today's HFC-134a systems.

Proven Safety

- **Tested and approved.** Solstice yf refrigerant has been verified as safe to use in automobiles through extensive third-party testing, including tests performed by the Society of Automotive Engineers and crash testing conducted by automakers.
- **Safe and easy to use, handle and store.** Unlike many of today's alternatives, Solstice yf has low flammability and toxicity, is noncorrosive and operates at pressures that repair technicians are already familiar with.

Strong Reputation

- **Backed by Honeywell.** Like all of our products, Honeywell Solstice yf refrigerant comes with the confidence of a brand the industry trusts to meet its requirements with quality innovations.
- **Training and support.** Ask about our customer support and training options to help you make a smooth transition.

**The EU's MAC Directive requires new vehicles to use refrigerants with a global warming potential (GWP) below 150.*

Ready to Learn More?

With Solstice yf refrigerant, you sacrifice nothing – yet there's a lot to gain. Visit **www.1234facts.com** for more information about the benefits of implementing Solstice yf refrigerant now. Product literature, MSDS and technical specifications are also available at www.honeywell-refrigerants.com.

Honeywell | Solstice yf refrigerant. Good for auto manufacturers, great for the planet.

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www.honeywell-refrigerants.com

RESPONSIBLE CARE®

January 2014

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Solstice® yf refrigerant

Solstice® yf refrigerant		• Developed for auto air conditioning • Low global warming potential • Comprehensively tested • Reliable • Cost-efficient
	HFO	Describes an organic fluorine compound called hydrofluoroolefin
	1234	Stands for a specific compound: First Number = Number of double bonds Second Number = Number of carbon atoms minus one Third Number = Number of hydrogen atoms plus one Fourth Number = Number of fluorine atoms
	yf	Denominates the specific isomer (position of the fluorine atoms)
MAC Directive		Starting in January 2011, all new vehicle types must have an air conditioning refrigerant with a global warming potential (GWP) below 150. From 2017 on, this will apply to all new vehicles. This is based on the MAC Directive (2006/40/EG), passed in July 2006.
Development		Honeywell and DuPont, in a joint development agreement, have developed a new low global warming potential refrigerant to replace R134a. They are commercializing the product separately. Honeywell is selling the product under the brand name Solstice™ yf refrigerant.
Environmental		Solstice yf refrigerant has a GWP of <1. It significantly exceeds the mandate of the MAC Directive (GWP below 150), by 99.3%.
Approval		Solstice yf refrigerant can be used in Europe, Japan, Korea, Canada and the U.S. along with other countries. Solstice yf refrigerant is registered under the EU chemical regulation REACH (Registration, Evaluation, Authorization and Restriction of Chemicals). Solstice yf refrigerant is also included in the U.S. E.P.A.'s SNAP Program (Significant New Alternatives Policy). With this program, the EPA evaluates new and improved substances that replace ozone-depleting substances.
Time of Implementation		Car manufacturers will receive the product according to their commitments.

Solstice® yf Refrigerant Fact Sheet

Quantity	About 600 grams in modern air conditioning equipment; refill in automotive lifecycle, if necessary.
Scientific Studies	Honeywell ensures that all products undergo intense testing both internally and externally, especially during the development phase. SAE International – the international Society of Automotive Engineers with about 133,000 engineers and technicians – has tested Solstice yf refrigerant for five years in their Cooperative Research Program. Eighteen international, independent scientific institutions and 15 international car manufacturers and component suppliers have participated in this program. These industry participants include: Audi, BMW, Chrysler, Daimler, Fiat, Ford/Volvo, GM/Opel, Honda, Porsche, PSA, Renault, Jaguar/Land Rover, Toyota and VW, as well as Conti Tech, Delphi, Denso, DuPont, Freudenberg, Goodyear, Maflow, Valeo and Visteon. SAE has stated that Solstice yf refrigerant is safe for use in automobiles.
Crash Tests	Automotive manufacturers and component suppliers have tested Solstice yf refrigerant in detail during the SAE Cooperative Research Program. They have modern testing facilities and broad experience in conducting these tests. Two examples: 1. An automobile OEM performed a crash test with Solstice yf refrigerant at 65 km/h (in accordance with EuroNCAP Protocol). The result was no fire. 2. A separate OEM conducted a crash test with Solstice yf refrigerant in an automobile at 56 km/h (in accordance to ECE 94). The engine had been running for a long time and was particularly hot. Again, there was no fire.
Safety	Note: now there are two classes under 1272/2008: Category Criteria 1. Gases, which at 20 °C and a standard pressure of 101.3 kPa: (a) are ignitable when in a mixture of 13% or less by volume in air; or (b) have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit. 2. Gases, other than those of Category 1, which, at 20 °C and a standard pressure of 101.3 kPa, have a flammable range while mixed in air. Class 1 is Extremely flammable and Class 2 is flammable. Tests under real-life conditions have shown that the product does not ignite on surfaces up to 800 °C. The auto ignition temperature is established using a test protocol set at 405 °C.
Additional Resources	Additional Safety information for Solstice® yf refrigerant (R-1234yf) can be found at **www.honeywellmsds.com**. **www.1234facts.com** has the latest industry information regarding Solstice® yf.

February 2014

Guidelines for Use and Handling of Solstice® yf

Solstice® yf can be described as being "mildly flammable" as measured by standard methodology. This descriptor is used to characterize the flammability in simplistic terms; however, properties such as minimum ignition energy, heat of combustion, and the burning velocity are assessed in order to arrive at such a descriptor. These measured properties, when applied to the laboratory setting, can be useful in determining if laboratory or apparatus modification should be considered. Measurement of Solstice yf flammability properties indicates that a typical static discharge will not have sufficient energy to ignite Solstice yf. Available data appears below.

Upper Flammability Limit [Vol. % in air] (21°C, ASTM E681-01)	12.3
Lower Flammability Limit [Vol. % in air] (21°C, ASTM E681-01)	6.2
Minimum Ignition Energy [mJ at 20 $C and 1 atm] (In-house method. Tests conducted in 12 liter flask to minimize wall quenching effects)	5000-10000
Autoignition Temperature [°C] (EC Physico/Chemical Test A15, Measured by Chilworth Technology, UK)	405
Heat of Combustion [MJ/kg] per ASHRAE Standard 34 (Stoichiometric composition 7.73% in air)	11.8
Fundamental burning velocity [cm/s] (per ISO 817, Measured by AIST, Japan)	1.5
Minimum Ignition Current (per IEC 79-3, 3rd ed., 1990; measured by UL)	No ignition*
Minimum Ignition Current Ratio (per IEC 79-3, 3rd ed., 1990; measured by UL)	>>1

*Unable to obtain ignition for any current level or test gas mixture when using calibration circuit or spark plug box. After no ignition was obtained using the calibration circuit, attempts were made to obtain ignition using a spark plug.

Risk assessment and risk minimization in facilities typically requires evaluation on a case-by-case basis since the outfitting of individual facilities may vary from one another in many ways. To assist the end-user in assessing and minimizing risk in association with the use of Solstice yf, a number of general guidelines can be applied.

GENERAL GUIDELINES

Read the Solstice yf Material Safety Data Sheet before beginning work with the material.

Refrigerant with Air

- Fire or explosion may result if vapor-in-air concentrations are within the flammable range and an ignition source of adequate energy level is available.
- Avoid mixing Solstice yf with air, oxygen or other oxidizers at pressures above atmospheric pressure.

Cylinder Storage

- Smoking should not be allowed in storage or handling areas as a general rule. Smoking should be prohibited in storage, handling and servicing areas where Solstice yf is used.
- Do not store Solstice yf cylinders near sources of open flames, ignition sources or at temperatures exceeding 50°C.
- Store cylinders in a cool, well-ventilated area with low risk of fire and out of direct sunlight. Ensure that cylinders are properly strapped into place; avoid dropping, denting or mechanically abusing containers.
- Protect cylinders from moisture and rusting during storage.

Contact with Hot-surfaces/High Energy/Ignition Sources

- Avoid contacting Solstice yf with white-hot or red-hot surfaces.
- Do not locate apparatus that produce ignition sources in proximity to air-conditioning systems, air-conditioning system test rigs, equipment or storage vessels that contains Solstice yf.
- Air-conditioning systems, test rigs, and service equipment should not incorporate components or devices that can generate discharges.
- Devices that generate sparks may need to be isolated, purged with inert gas (to minimize the probability of attaining concentration in air that are within the flammable range), or relocated.
  - Note that DC motors that use brushes will have potential for continuous spark generation. A fan that uses such a DC motor may have to be isolated, replaced with a non-sparking one, or purged with an inert gas such as nitrogen or with adequate air flow to minimize the quantity of refrigerant within the flammable range. If nitrogen inerting is used, route the exiting nitrogen gas to a local exhaust if practical, otherwise, the adjacent work environment may

also have to be monitored for oxygen level so that an acceptable breathing atmosphere is maintained.

- As spark energy data may not readily be available, electrical contactors, switches, relays, and other electrical or electronic devices capable of generating a spark that are located in proximity to probable leak sites should be subject to risk evaluation.

- Electrical equipment in and adjacent to the refrigerant charging and storage locations should be electrically classified according to applicable codes and regulations.
  - A typical 0.5 KVA 3-phase transformer with a 6-cycle breaker feeding shop utilization equipment can generate over 450,000 mJ before opening.
- In cases where NFPA 497 *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas 2008 Edition* can be applied, the following guidance is available:
  - *Note that Solstice yf is classified as Group D or Group IIA (per NFPA 497): the autoignition temperature of 405 °C is consistent with use of a T2 temperature class per the National Electric Code (NFPA-70).*
  - Electrical equipment within 5 feet of the charging location and within 3 feet above grade and 25 ft horizontally should be Class I, Division 2, Group D (Class I, Zone 2, Group IIA).
  - In pits or other below grade servicing areas, above which the refrigerant could be charged or within 25 ft of charging locations, mechanical ventilation should be provided with a pickup no more than 12 inches above the lowest level and the electrical equipment within the pit should be Class I, Division 2, Group D (Class I, Zone 2, Group IIA).
  - In unoccupied, non-ventilated pits within 25 ft of charging locations, the electrical equipment within the pit should be Class I, Division 1, Group D (Class I, Zone 1, Group IIA).
- Due to large energy capacity and circuit amperage, there is also a potential for ignition from the electric power source for hybrid vehicles. As a matter of general safety, isolation techniques or other suitable methods should be used to prevent battery and power system sparks/arcs. In areas where processes, procedures or upset conditions such as leaks have the potential to generate flammable Solstice yf vapor-in-air concentrations in proximity to hybrid vehicle electric power sources, isolation and/or ventilation should be used.

Service Areas

- Solstice yf is a heavier-than-air gas. Depending on the quantity released in air, the material can travel a considerable distance to a low-lying ignition point.
- Solstice yf can collect in floor pits. There is potential for asphyxiation in floor pits or confined spaces. Use adequate ventilation in these areas. Monitoring/measuring oxygen levels or refrigerant vapor-in-air concentrations prior to entry into floor pits or confined spaces is recommended. Note that applicable regulations may require measurement and/or monitoring of oxygen level in confined spaces as part of dictated confined space entry procedures.
- Refrigerant charging should be performed away from open flames or high energy ignition sources.
- Provide mechanical ventilation at filling zones and storage areas or other locations where leakage is probable. It should be determined if existing local ventilation is adequate for other operating and storage areas. The ventilation rate should prevent vapor–air concentrations from exceeding 25% of the LFL. For example, NFPA 497 *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas 2008 Edition* defines adequate ventilation as a ventilation rate that affords either 6 air changes per hour, or 1 cfm per sq.ft. of floor area (0.3m^3/min per m^2 of floor area), or other similar criteria that prevent the accumulation of significant quantities of vapor–air concentrations from exceeding 25% of the LFL.
- Refrigerant leak detection equipment that provides continuous numerical vapor-in-air measurement provides a means for personnel to respond to a leak in a timely fashion. A detection level of 25% of the lower flammability limit is acceptable. Infrared leak detection devices capable of detecting R134a at levels of 1,000 ppm in air or lower are commonly available; typically, these may also be used. Performance may vary depending on device configuration. Consult the leak detection equipment manufacturer for additional information.
- In the event of a leak, air flow will tend to disperse leaked refrigerant and may be beneficial in reducing local concentrations. Exhaust ventilation can be used to reduce vapor-in-air concentrations. The aim should be to maintain concentrations below the lower flammability limit. For example, in a calorimeter room, it may be best to leave the room air circulating (room air handler "ON") to disperse leaked refrigerant rather than shutting off room air flow. Note: This assumes that the charge is smaller than the amount needed to reach the 25% of the LFL in a well mixed room.

- In the event of a leak, nearby electrical contactors, electric controls, or other electric devices may create an undesirable spark in the affected area if the devices are shut off locally. In accordance with good engineering practices, interrupt power to systems and devices at a location that is removed (remote) from the environment where the leak is. Whenever possible, create a "zero demand" signal to electrical or electronic devices, for example, adjust a servo-controlled relay serving electric resistance heaters to eliminate demand. This is preferred to opening local contacts.
- Maintenance or construction work that can produce sparks, electrical arcs, or open flames must be performed in compliance with all applicable regulations pertaining to hot work. Welding, flame cutting, grinding, or other operations that can create an ignition source, must be carried out in compliance with applicable hot work procedures and permits.

Additional good engineering safety practices:

Customer should perform their own

fire & safety review
building code review
fire alarm systems
smoke detection systems
suppression systems
Fire extinguishers
egress procedures
fire separation systems
emergency response procedures
emergency lighting

Common considerations for Solstice yf product handling & plant implementation

Tank Truck (ISO) Unloading

1. Is the unloading area in good condition for safe operation?
2. During inclement weather, should any additional safety precautions be considered?
3. Is grounding cable available and free of corrosion or damage for delivery trailer?
4. Is the electrical receptacle properly located within 25 ft (7.5 m) by 3 ft (1 m) high radius and properly rated (Group D)?
5. What ype of electrical receptacle is available (i.e. Hubbell, Four Prong, male, female, amperage, etc)?
6. Is the receptacle equipped with an electrical switch disconnect?
7. Is the bulkhead designed for impact (crash posts installed, anchored) and located more than 15 feet from the bulk storage tank?
8. Is the liquid line equipped with an Emergency Shutoff Valve (ESV) or Backflow Check valve?
9. Is the vapor line equipped with an Emergency Shutoff Valve (ESV)?
10. Can the Emergency Shutoff Valves be actuated nearby and remotely?
11. Will Emergency Shutoff Valves be automatically activated by fire (e.g. fusible link shut off valves)?
12. Do fill lines and/or hoses have caps and/or plugs in place?
13. Are all lines identified?

Bulk Storage Tank

Tank needs to be designed, installed and operated according to appropriate regulations and laws!

1. Is tank design pressure adequate?
2. Is the area free of combustibles?
3. Is the area fenced or protected from vandalism?
4. Is the tank adequately grounded?
5. Is the grounding free of corrosion?

6. Is the grounding checked periodically?
7. Are all electrical switches, lighting etc. rated appropriately?
8. Are pump motors rated appropriately?
9. Are all elastomeric parts (seals, gaskets, etc.) compatible with the product?
10. Are the tank supports fireproofed (cement, etc.)?
11. Is the tank properly labeled?
12. Is a tank label visible?
13. Does instrumentation (level gauge, pressure gauge, etc.) appear to be in good condition?
14. Is the tank exterior free of corrosion?

Piping

1. Is the piping free of any signs of exterior surface corrosion?
2. Are all gasketing and valve internal materials compatible?
3. Is piping and other equipment grounded? (Piping systems with large filter elements can develop significant static charge separation. Generally, piping systems should be grounded unless an engineering evaluation determines that it is not needed.)
4. Is grounding free of corrosion?
5. Is piping adequately supported?
6. Is valving designed to avoid trapping liquid between valves?
7. Is piping protected from impact?
8. Is piping leak checked on a regular basis?
9. Is piping labeled to identify contents?
10. Is piping inside the building constructed with a minimum of valves, fittings, etc.?
11. Is the diameter of the piping inside the building the minimum size required?
12. Are block valves provided at both ends of the pipeline to isolate a leak?

Cylinder Storage Area

1. Is the cylinder(s) stored on a rack or firm foundation, i.e. concrete pad?
2. Is the storage area protected from excessive heat and adverse weather conditions?
3. Is the area fenced or protected from vandalism?
4. Are all electrical switches, lighting, etc. rated appropriately?
5. Is the area properly labeled as to contents?
6. Are the cylinders stored upright?

Personnel Training

1. Do personnel know product hazards and have access to MSDS's?
2. Are personnel trained to handle flammables?
3. Is there a written emergency response plan?
4. Does each person know his/her responsibility in case of an emergency and is properly trained?
5. Does maintenance personnel know what materials of construction are compatible with Solstice yf?

Find out more

For more information...

Honeywell Refrigerants
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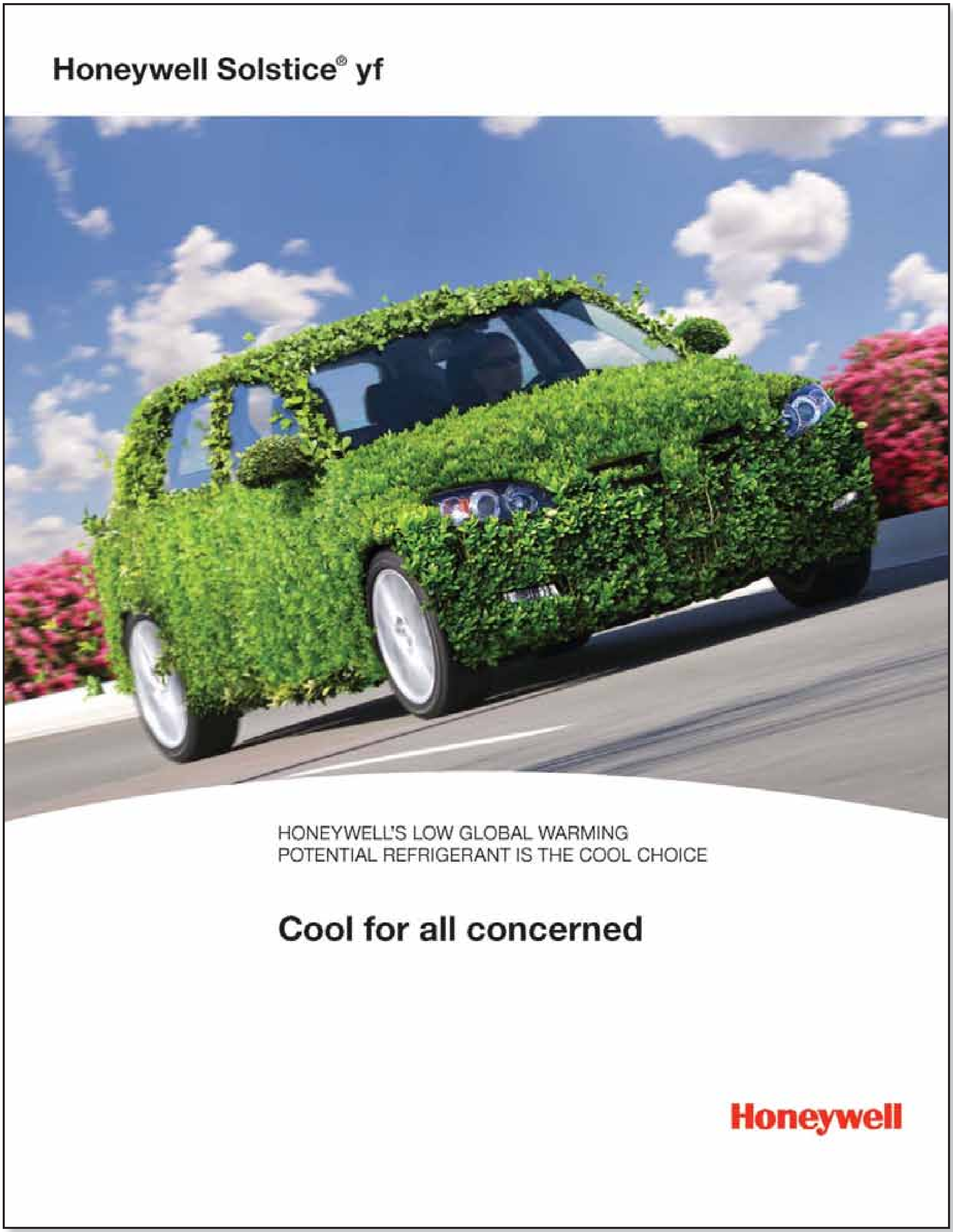
www.honeywell.com

Honeywell

Honeywell Solstice® yf Refrigerant MSDS:

CLICK HERE For more information www.1234facts.com/msds


Honeywell Solstice® yf
HONEYWELL'S LOW GLOBAL WARMING
POTENTIAL REFRIGERANT IS THE COOL CHOICE
Cool for all concerned
Honeywell

Solstice® yf – A Green Solution to a Global Challenge

Introduction

Starting in 2011, automakers must meet the EU's MAC Directive, which prohibits the use of refrigerants with a global warming potential (GWP) higher than 150 in new vehicle types.

This Directive requires a globally-compliant replacement for R134a refrigerant. Honeywell worked for many years and invested substantial resources to solve the challenge of finding a replacement for R134a refrigerant. Honeywell's solution, called Solstice® yf, is a drop-in or near drop-in replacement for R134a.

Automobile air conditioning systems using Honeywell Solstice yf are also more energy efficient than those using CO_2, particularly at higher ambient temperatures; automobiles equipped with Solstice yf will use less fuel and emit fewer greenhouse gases than the CO_2 alternative, which further increases the environmental benefit and reduces the carbon footprint.

Solstice yf is safe and easily integrated into current systems. As a near drop-in replacement, or even a drop-in replacement in certain cases, it requires virtually no alterations to current equipment. So it's easy to use and enables automakers to meet new regulations.

Cool for the Environment

Solstice yf has an atmospheric lifetime of only 11 days – compared to 13 years for R134a and more than 500 years for carbon dioxide. Unlike HFCs and CFCs, which take decades to decompose, Solstice yf does not persist in the atmosphere. Quite simply, automobiles using highly energy-efficient Solstice yf refrigerant will use less fuel and produce fewer emissions than many of the existing alternatives.

Verified as Safe

Solstice® yf has been verified as safe to use in automobiles through extensive third-party testing, including tests performed by the Society of Automotive Engineers and crash testing conducted by automakers. Today, Solstice yf is the refrigerant of choice in automotive air-conditioning.

Highly Compatible and Easy to Implement

Because the pressure and performance of Solstice yf is so similar to R134a it can be used as a replacement for R134a with little or no reengineering of automotive systems. This enables automakers to comply with the new EU regulations quickly and cost-effectively.

Solstice yf Physical Properties

Component	
Chemical name	2,3,3,3-Tetrafluoro-prop-1-ene
Molecular formula	CF3CF=CH2
Molecular weight (g/gmol)	114
Boiling point at 101.3 kPa (°C)	-29.45
Freezing point at 101.3 kPa (°C)	-150
Vapour density at boiling point (kg/m3)	5.98
Liquid density (kg/m3)	1092
Liquid heat capacity at 25°C (kJ/kg·°K)	1.392
Vapour heat capacity at 25°C (kJ/kg·°K)	1.053
Heat of vaporization at boiling point (kJ/kg)	180.1
Vapour Pressure at 25°C (kPa)	683
Liquid thermal conductivity at 25°C (W/m·°K)	0.064
Vapour thermal conductivity at 25°C (W/m·°K)	0.014
Liquid viscosity at 25°C (µPa·sec)	155.4
Vapour viscosity at 25°C (µPa·sec)	12.3
Solubility of HFO-1234yf in water (wt.%)	0.020
Solubility of water in HFO-1234yf (wt.%)	0.025
Ozone Depletion Potential (ODP-R11=1)	0

Pressure/Temperature Table

Temperature	Pressure
(°C)	(kPa)
-40	63.
-35	79
-30	99
-25	123
-20	151
-15	184
-10	222
-5	266
0	316
5	373
10	438
15	510
20	592
25	683
30	784
35	895
40	1018
45	1154
50	1302
55	1464
60	1642
65	1834
70	2044

Compatibility with Plastics and Elastomers

The table below provides a summary of materials compatibility data derived from tests performed by Honeywell and other global organizations. Since there are many different grades and formulations of these materials, we recommend that compatibility testing be performed on the specific grade of materials under consideration when designing new systems. This data should be used only as a guide to the compatibility of materials with Solstice yf. The rankings in the table should be used with caution since they constitute judgments based on limited samplings. Customers are advised to consult with the manufacturer or conduct further independent testing.

Material	Rating
HNBR	S
Polyester	Su
Nylon	S
Epoxy	S
Polyimide	S
Neoprene	S
HNBR	S
EPDM	S
Silicone	S
Butyl Rubber (IIR)	Su
Polyvinylidene Fluoride and copolymer of Vinylidene Fluoride and Hexafluoropropylene	U

S: Suitable, Su: Suitable with some exceptions, U: Unsuitable

Other Refrigeration and Air-Conditioning Applications

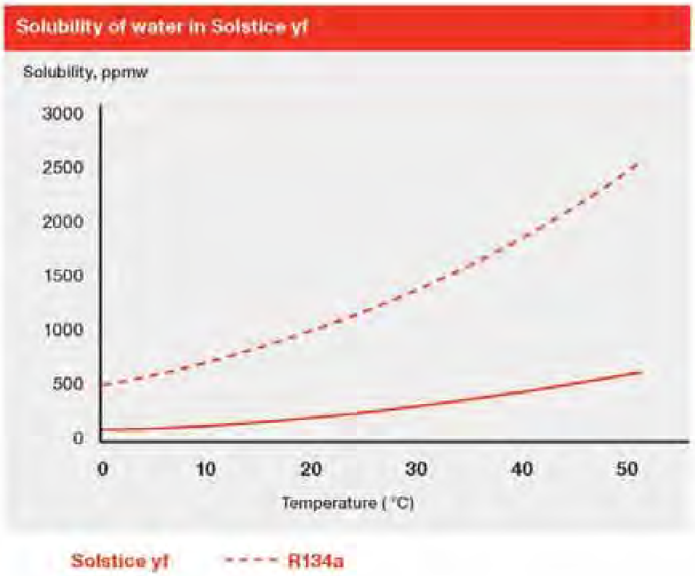
Solstice® yf has been developed for a number of applications beyond automotive air conditioning. These include supermarket cases, walk-in coolers, residential refrigerators and chillers. Generally, there are a few compressor design changes necessary to optimize the performance of Solstice yf in these applications, so once again it brings considerable benefit with easy implementation.

Easy Serviceability

The parts and components used in Solstice yf systems are identical or similar to those used in R134a systems — both use flexible hoses to connect components. These parts are mass-produced in high volumes worldwide and widely available at reasonable prices. This makes systems repair and assembly easy and inexpensive.

Solubility of Water in Solstice yf

The solubility of water in Solstice yf is shown in the graph below. It is lower than that of R134a.



Lubricants

Solstice yf performs well when used with polyalkylene glycol (PAG) and with polyol ester lubricants. Most automotive original equipment manufacturers have chosen specific PAG lubricants for their systems. For non-automotive applications, most compressor manufacturers recommend specific polyol ester lubricants. Users should check with the equipment manufacturer for the recommended lubricants for their system.

Toxicity

Solstice® yf has undergone extensive toxicity testing, and has been found to be safe for use in its intended applications. It is also registered in the EU under REACH in the +1000 MT tonnage band. Consult the Material Safety Data Sheet (MSDS) before using Solstice yf.

Flammability

According to ASHRAE Standard 34, Solstice yf is classified in safety group A2L. This means it is in the lower segment of the mildly flammable refrigerants. Its flammability characteristics are shown in the table below:

Flame Limits – ASTM E681-01 at 21 °C	Rating
LFL (Vol% in Air)	6.2
UFL (Vol% in Air)	12.3
Minimum Ignition Energy (mJ)	> 5000
Auto ignition temperature °C	405
Heat of Combustion (kJ/g)	9.5
Burning Velocity (cm/s)	1.5

Solstice yf has undergone extensive application-specific flammability tests and risk assessment by the SAE CRP1234. Based on these results, the sponsors of the SAE CRP1234 have concluded that it can be used as a global replacement refrigerant in automobile air conditioning.

Leak Detection

Leak detectors can be used to pinpoint leaks or to monitor an entire room on a continual basis. Leak detection is important for refrigerant conservation, equipment protection and performance, reduction of emissions, and protection of those coming into contact with the system. Customers should check with equipment manufacturers for appropriate detector equipment.

Storage & Handling – Bulk & Cylinder

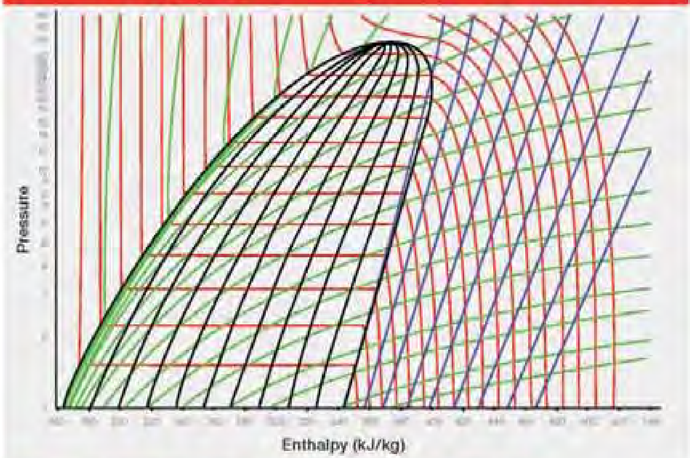
Solstice® yf cylinders must be clearly marked and stored in a cool, dry and properly ventilated area away from heat, flames, corrosive chemicals, fumes and explosives — and be otherwise protected from damage. Under no circumstances should an empty cylinder be refilled with anything other than virgin product. Once empty, the cylinder valve should be properly closed and the valve cap replaced. Empty cylinders should be returned to a Honeywell distributor.

Cylinders containing Solstice yf should be kept out of direct sunlight, especially in warm weather. Liquid Solstice yf expands significantly when heated, reducing the amount of vapor space left in the cylinder. Once the cylinder becomes liquid-full, any further rise in temperature can cause it to rupture or explode, potentially resulting in severe damage and injury. A cylinder should never be allowed to get warmer than 50°C.

Vessels, containers, transfer lines, pumps and other equipment used with Solstice yf should not be exposed to high-temperature sources until they have been thoroughly cleaned and found free of vapors or liquid. Cylinders should never be exposed to welding, brazing or open flames. When possible, maintenance or cleaning of equipment should be performed without entering the vessel. If a tank or any confined space must be entered, then formal confined space entry procedures must be followed. These procedures require that a fully qualified work team be used and a confined space entry form be completed.

Honeywell's Low Global Warming Potential refrigerant is an innovative solution tackling the challenge of climate change while providing superior performance. The business has a wide variety of offerings for the refrigeration industry in general. For more information and to download product literature, please go to www.honeywell-refrigerants.com.

Pressure-Enthalpy Diagram Solstice yf



Reference State: h=200kJ/kg, s=1.00 kJ/kg -K sat. liq at 0°C

Disclaimer

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Our commitments:

+ The safety of our employees
+ The quality of our products
+ Being responsible stewards for the protection of the environment, the communities in which we operate and our customers

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Honeywell

Guidelines for Use and Handling of Solstice® yf

This brochure provides selected properties information for Solstice® yf including thermodynamic data, transport properties, and flammability characteristics.

Solstice yf was originally developed as a low global warming potential replacement for R134a in the automobile air-conditioning application. Because of its desirable environmental properties, along with other factors, it is being investigated in a number of stationary applications as well.

Flammability

Solstice yf can be described as being "mildly flammable" as measured by standard methodology.

This descriptor is used to characterize the flammability in simplistic terms; however, properties such as minimum ignition energy, heat of combustion, and the burning velocity are assessed in order to arrive at such a descriptor. Measurement of Solstice yf flammability properties indicates that a typical static discharge will not have sufficient energy to ignite Solstice yf. Available data appears below.

Upper Flammability Limit [Vol. % in air] (21°C, ASTM E681-01)	12.3
Lower Flammability Limit [Vol. % in air] (21°C, ASTM E681-01)	6.2
Minimum Ignition Energy [mJ at 20 şC and 1 atm] (In-house method. Tests conducted in 12 liter flask to minimize wall quenching effects)	5000-10000
Autoignition Temperature [°C] (EC Physico/Chemical Test A15, Measured by Chilworth Technology, UK)	405
Heat of Combustion [MJ/kg] per ASHRAE Standard 34 (Stoichiometric composition 7.73% in air)	11.8
Fundamental burning velocity [cm/s] (per ISO 817, Measured by AIST, Japan)	1.5
Minimum Ignition Current (per IEC 79-3, 3rd ed., 1990; measured by UL)	No ignition*
Minimum Ignition Current Ratio (per IEC 79-3, 3rd ed., 1990; measured by UL)	>>1

Unable to obtain ignition for any current level of test gas mixture when using calibration circuit or spark plug box. After no ignition was obtained using the calibration circuit, attempts were made to obtain ignition using a spark plug.

It is recommended that risk assessment and risk minimization for use of Solstice yf in facilities and applications should be conducted prior to use.

Selected Physical Properties

Chemical Name	2,3,3,3-Tetrafluoroprop-1-ene
Molecular Formula	CH_2CFCF3
Molecular Weight	114
% Volatiles by Volume	100
Water Solubility (in Solstice yf, ppm by mass)	200
ASHRAE Safety Group Classification	A2L

Solstice® yf Properties and Materials Compatibility

English Units

Boiling Point (°F) @ 1atm	-21
Freezing Point (°F)	Not available
CriticalTemperature (°F)	202.5
Critical Pressure (psia)	490.6
Critical Density (lb/ft³)	29.7
Vapor Density @ 20°C, 1 atm (lb/ft³)	0.303
Liquid Density (lb/ft³)	68.2
Liquid Heat Capacity (Btu/lb °F)	0.33
Vapor Heat Capacity @ constant pressure, 1atm (Btu/lb °F)	0.22
Heat of Vaporization at 1 atm (Btu/lb)	77.53
Vapor Pressure at 77°F (psia)	99
Liquid Thermal Conductivity (Btu/hr-ft °F)	0.0368
Vapor Thermal Conductivity (Btu/hr-ft °F)	0.008
Liquid Viscosity (lb/ft-hr)	0.38
Vapor Viscosity (lb/ft-hr)	0.03

Standard International Units

Boiling Point [°C] @ 1.01 bar	-29.5
Freezing Point[°C] @1.01 bar	Not available
Critical Temperature [°C]	94.7
Critical Pressure[bar]	33.8
Critical Density [kg/m³]	475.6
Vapor Density @ 20°C, 1 atm [kg/m³]	4.79
Liquid Density [kg/m³]	1091.9
Liquid Heat Capacity [kJ/kg K]	1.39
Vapor Heat Capacity @ constant pressure, 1.01 bar [kJ/kg K]	0.91
Heat of Vaporization at 1 atm [kJ/kg]	180.25
Vapor Pressure at 25°C [bar]	6.83
Liquid Thermal Conductivity [mW/m-K]	63.59
Vapor Thermal Conductivity [mW/m K]	13.97
Liquid Viscosity [µPa-s]	155.5
Vapor Viscosity [µPa-s]	12.3

Flame Limits measured at ambient temperature and pressure using ASTM E681-85 with electrically heated match ignition, spark ignition and fused wire ignition; ambient air. All measurements at 77°F (25 °C) unless otherwise noted.

Thermodynamic & Transport Data – SI Units (reference state: IIR)

Temperature °C	Pressure kPa	Density kg/m³ Liquid	Density kg/m³ Vapor	Enthalpy kJ/kg Liquid	Enthalpy kJ/kg Vapor	Entropy kJ/kg•K Liquid	Entropy kJ/kg•K Vapor	cp kJ/kg•K Liquid	cp kJ/kg•K Vapor	cv kJ/kg•K Liquid	cv kJ/kg•K Vapor
-40	62.4	1291.9	3.7945	151.1	336.6	0.8074	6031	1.16	0.78	0.78	0.69
-38	68.7	1286.5	4.1519	153.4	337.9	0.8173	1.6020	1.16	0.78	0.79	0.70
-36	75.5	1281.0	4.5353	155.7	339.3	0.8272	1.6011	1.17	0.79	0.79	0.70
-34	82.8	1275.6	4.946	158.1	340.6	0.8370	1.6003	1.18	0.80	0.80	0.71
-32	90.6	1270.1	5.3856	160.4	342.0	0.8468	1.5996	1.18	0.80	0.80	0.71
-30	99.1	1264.5	5.8553	162.8	343.3	0.8566	1.5990	1.19	0.81	0.81	0.72
-28	108.1	1259.0	6.3566	165.2	344.7	0.8663	1.5984	1.19	0.82	0.81	0.72
-26	117.8	1253.4	6.8911	167.6	346.0	0.8760	1.5980	1.20	0.83	0.81	0.73
-24	128.1	1247.7	7.4602	170.0	347.4	0.8857	1.5976	1.21	0.83	0.82	0.74
-22	139.2	1242.0	8.0658	172.4	348.7	0.8954	1.5973	1.21	0.84	0.82	0.74
-20	150.9	1236.3	8.7093	174.9	350.1	0.9050	1.5970	1.22	0.85	0.83	0.75
-18	163.4	1230.5	9.3925	177.3	351.4	0.9146	1.5968	1.23	0.85	0.83	0.75
-16	176.8	1224.7	10.117	179.8	352.7	0.9242	1.5967	1.23	0.86	0.84	0.76
-14	190.9	1218.8	10.885	182.3	354.1	0.9338	1.5967	1.24	0.87	0.84	0.76
-12	205.9	1212.9	11.699	184.8	355.4	0.9433	1.5967	1.25	0.88	0.84	0.77
-10	221.8	1207.0	12.559	187.3	356.7	0.9528	1.5968	1.25	0.88	0.85	0.77
-8	238.6	1200.9	13.469	189.8	358.0	0.9623	1.5969	1.26	0.89	0.85	0.78
-6	256.4	1194.9	14.431	192.3	359.4	0.9717	1.5970	1.27	0.90	0.86	0.79
-4	275.1	1188.7	15.446	194.9	360.7	0.9812	1.5973	1.27	0.91	0.86	0.79
-2	295.0	1182.5	16.517	197.4	362.0	0.9906	1.5975	1.28	0.92	0.86	0.80
0	315.8	1176.3	17.647	200.0	363.3	1.0000	1.5978	1.29	0.93	0.87	0.80
2	337.8	1170.0	18.837	202.6	364.6	1.0094	1.5981	1.30	0.93	0.87	0.81
4	360.9	1163.6	20.092	205.2	365.9	1.0187	1.5985	1.30	0.94	0.87	0.81
6	385.2	1157.2	21.413	207.8	367.2	1.0281	1.5989	1.31	0.95	0.88	0.82
8	410.8	1150.6	22.804	210.5	368.4	1.0374	1.5993	1.32	0.96	0.88	0.83
10	437.5	1144.0	24.267	213.1	369.7	1.0467	1.5998	1.33	0.97	0.89	0.83
12	465.6	1137.4	25.807	215.8	371.0	1.0560	1.6003	1.34	0.98	0.89	0.84
14	495.0	1130.6	27.425	218.5	372.2	1.0653	1.6008	1.34	0.99	0.89	0.84
16	525.8	1123.8	29.127	221.2	373.5	1.0746	1.6013	1.35	1.00	0.90	0.85
18	558.0	1116.9	30.916	223.9	374.7	1.0838	1.6018	1.36	1.01	0.90	0.85
20	591.7	1109.9	32.796	226.6	375.9	1.0931	1.6024	1.37	1.02	0.90	0.86
22	626.9	1102.8	34.772	229.3	377.1	1.1023	1.6029	1.38	1.04	0.91	0.87
24	663.6	1095.5	36.848	232.1	378.3	1.1115	1.6034	1.39	1.05	0.91	0.87
26	701.9	1088.2	39.029	234.9	379.5	1.1208	1.6040	1.40	1.06	0.91	0.88
28	741.9	1080.8	41.321	237.7	380.6	1.1300	1.6045	1.41	1.07	0.92	0.88
30	783.5	1073.3	43.729	240.5	381.8	1.1392	1.6051	1.42	1.09	0.92	0.89
32	826.9	1065.7	46.26	243.4	382.9	1.1484	1.6056	1.43	1.10	0.92	0.90
34	872.0	1057.9	48.92	246.2	384.0	1.1576	1.6061	1.44	1.12	0.93	0.90
36	918.9	1050.0	51.717	249.1	385.1	1.1668	1.6066	1.45	1.13	0.93	0.91
38	967.7	1042.0	54.658	252.0	386.1	1.1759	1.6071	1.46	1.15	0.93	0.92
40	1018.4	1033.8	57.753	254.9	387.2	1.1851	1.6075	1.47	1.17	0.94	0.92
42	1071.1	1025.5	61.01	257.8	388.2	1.1943	1.6079	1.49	1.19	0.94	0.93
44	1125.7	1017.0	64.44	260.8	389.2	1.2035	1.6083	1.50	1.21	0.94	0.94
46	1182.5	1008.3	68.053	263.8	390.1	1.2128	1.6087	1.51	1.23	0.95	0.94
48	1241.3	999.4	71.863	266.8	391.1	1.2220	1.6089	1.53	1.25	0.95	0.95
50	1302.3	990.4	75.884	269.9	392.0	1.2312	1.6092	1.55	1.28	0.96	0.96
52	1365.6	981.1	80.13	272.9	392.9	1.2405	1.6094	1.57	1.30	0.96	0.97
54	1431.1	971.6	84.619	276.0	393.7	1.2498	1.6095	1.59	1.33	0.96	0.97
56	1498.9	961.8	89.371	279.2	394.5	1.2592	1.6095	1.61	1.37	0.97	0.98
58	1569.2	951.7	94.407	282.3	395.2	1.2685	1.6095	1.63	1.40	0.97	0.99
60	1641.9	941.3	99.754	285.5	395.9	1.2779	1.6093	1.66	1.44	0.97	1.00
62	1717.1	930.6	105.44	288.8	396.6	1.2874	1.6091	1.68	1.49	0.98	1.01
64	1794.9	919.5	111.5	292.1	397.2	1.2969	1.6087	1.72	1.53	0.98	1.01
66	1875.4	907.9	117.96	295.4	397.7	1.3065	1.6082	1.75	1.59	0.98	1.02
68	1958.6	895.8	124.89	298.8	398.2	1.3162	1.6076	1.79	1.65	0.99	1.03
70	2044.5	883.2	132.33	302.2	398.6	1.3260	1.6068	1.84	1.72	0.99	1.04

Thermodynamic & Transport Data – SI Units (reference state: IIR)

Temperature °C	Pressure kPa	Speed of Sound m/s Liquid	Speed of Sound m/s Vapor	Thermal Conductivity mW/m•K Liquid	Thermal Conductivity mW/m•K Vapor	Viscosity μPa•s Liquid	Viscosity μPa•s Vapor	Surface Tension mN/m Liquid
-40	62.4	735.9	133.7	85.5	8.5	358.5	9.5	15.2
-38	68.7	726.7	134.0	84.8	8.7	347.8	9.6	14.8
-36	75.5	717.5	134.2	84.1	8.8	337.6	9.7	14.5
-34	82.8	708.4	134.4	83.3	9.0	327.9	9.8	14.2
-32	90.6	699.4	134.7	82.6	9.1	318.5	9.9	13.9
-30	99.1	690.4	134.9	81.9	9.3	309.6	9.9	13.6
-28	108.1	681.4	135.0	81.2	9.4	301.0	10.0	13.3
-26	117.8	672.5	135.2	80.5	9.6	292.8	10.1	13.0
-24	128.1	663.6	135.4	79.8	9.7	284.9	10.2	12.7
-22	139.2	654.8	135.5	79.1	9.9	277.3	10.3	12.5
-20	150.9	646.0	135.6	78.4	10.0	269.9	10.3	12.2
-18	163.4	637.2	135.7	77.7	10.2	262.9	10.4	11.9
-16	176.8	628.5	135.7	77.0	10.3	256.1	10.5	11.6
-14	190.9	619.7	135.8	76.3	10.5	249.6	10.6	11.3
-12	205.9	611.0	135.8	75.6	10.7	243.2	10.7	11.0
-10	221.8	602.4	135.8	74.9	10.8	237.1	10.7	10.7
-8	238.6	593.7	135.8	74.3	11.0	231.2	10.8	10.5
-6	256.4	585.1	135.7	73.6	11.2	225.5	10.9	10.2
-4	275.1	576.4	135.6	72.9	11.3	220.0	11.0	9.9
-2	295.0	567.8	135.5	72.3	11.5	214.6	11.1	9.6
0	315.8	559.2	135.4	71.6	11.7	209.4	11.2	9.4
2	337.8	550.6	135.2	70.9	11.8	204.4	11.2	9.1
4	360.9	542.0	135.1	70.3	12.0	199.5	11.3	8.8
6	385.2	533.4	134.8	69.6	12.2	194.7	11.4	8.6
8	410.8	524.8	134.6	69.0	12.4	190.1	11.5	8.3
10	437.5	516.2	134.3	68.3	12.5	185.6	11.6	8.0
12	465.6	507.5	134.1	67.7	12.7	181.3	11.7	7.8
14	495.0	498.9	133.7	67.1	12.9	177.0	11.8	7.5
16	525.8	490.3	133.4	66.4	13.1	172.9	11.9	7.3
18	558.0	481.6	133.0	65.8	13.3	168.8	11.9	7.0
20	591.7	472.9	132.6	65.2	13.5	164.9	12.0	6.8
22	626.9	464.2	132.1	64.5	13.7	161.1	12.1	6.5
24	663.6	455.5	131.7	63.9	13.9	157.3	12.2	6.3
26	701.9	446.8	131.1	63.3	14.1	153.6	12.3	6.0
28	741.9	438.1	130.6	62.7	14.3	150.0	12.4	5.8
30	783.5	429.3	130.0	62.0	14.5	146.5	12.6	5.6
32	826.9	420.5	129.4	61.4	14.7	143.1	12.7	5.3
34	872.0	411.7	128.8	60.8	14.9	139.7	12.8	5.1
36	918.9	402.9	128.1	60.2	15.1	136.4	12.9	4.9
38	967.7	394.1	127.3	59.6	15.4	133.2	13.0	4.6
40	1018.4	385.2	126.6	59.0	15.6	130.0	13.2	4.4
42	1071.1	376.4	125.7	58.4	15.8	126.9	13.3	4.2
44	1125.7	367.4	124.9	57.8	16.1	123.8	13.4	4.0
46	1182.5	358.5	124.0	57.2	16.3	120.8	13.6	3.8
48	1241.3	349.4	123.1	56.6	16.6	117.8	13.7	3.6
50	1302.3	340.3	122.1	56.1	16.9	114.9	13.9	3.4
52	1365.6	331.1	121.0	55.5	17.2	112.0	14.0	3.2
54	1431.1	321.8	120.0	54.9	17.5	109.1	14.2	3.0
56	1498.9	312.3	118.8	54.4	17.8	106.3	14.4	2.8
58	1569.2	302.6	117.6	53.8	18.1	103.5	14.6	2.6
60	1641.9	292.7	116.4	53.3	18.5	100.8	14.8	2.4
62	1717.1	282.6	115.1	52.8	18.9	98.0	15.0	2.2
64	1794.9	272.3	113.7	52.3	19.3	95.3	15.3	2.0
66	1875.4	261.8	112.3	51.8	19.7	92.5	15.5	1.8
68	1958.6	251.0	110.8	51.3	20.2	89.8	15.8	1.7
70	2044.5	240.0	109.3	50.9	20.8	87.1	16.1	1.5

Thermodynamic and Transport Data – English Units (reference state: ASHRAE)

Temperature °F	Pressure psia	Density lb_m/ft^3 Liquid	Density lb_m/ft^3 Vapor	Enthalpy Btu/lb_m Liquid	Enthalpy Btu/lb_m Vapor	Entropy $Btu/lb_m \cdot F$ Liquid	Entropy $Btu/lb_m \cdot F$ Vapor	c_p $Btu/lb_m \cdot F$ Liquid	c_p $Btu/lb_m \cdot F$ Vapor	cv $Btu/lb_m \cdot F$ Liquid	cv $Btu/lb_m \cdot F$ Vapor
-40	9.0	80.65	0.2369	0.00	79.81	0.0000	0.1902	0.28	0.19	0.19	0.17
-35	10.3	80.18	0.2683	1.39	80.61	0.0033	0.1898	0.28	0.19	0.19	0.17
-30	11.8	79.71	0.3029	2.79	81.42	0.0066	0.1896	0.28	0.19	0.19	0.17
-25	13.3	79.23	0.3410	4.20	82.23	0.0098	0.1893	0.28	0.19	0.19	0.17
-20	15.1	78.75	0.3827	5.62	83.03	0.0131	0.1891	0.28	0.19	0.19	0.17
-15	17.0	78.26	0.4283	7.05	83.84	0.0163	0.1890	0.29	0.20	0.19	0.17
-10	19.1	77.77	0.4781	8.50	84.64	0.0195	0.1888	0.29	0.20	0.20	0.18
-5	21.4	77.28	0.5323	9.95	85.44	0.0227	0.1887	0.29	0.20	0.20	0.18
0	23.9	76.78	0.5913	11.41	86.24	0.0259	0.1887	0.29	0.20	0.20	0.18
5	26.6	76.27	0.6552	12.89	87.04	0.0291	0.1887	0.30	0.21	0.20	0.18
10	29.6	75.76	0.7245	14.37	87.84	0.0322	0.1887	0.30	0.21	0.20	0.18
15	32.8	75.24	0.7995	15.87	88.63	0.0354	0.1887	0.30	0.21	0.20	0.19
20	36.3	74.72	0.8805	17.38	89.42	0.0385	0.1887	0.30	0.21	0.20	0.19
25	40.1	74.19	0.9679	18.90	90.21	0.0417	0.1888	0.30	0.22	0.21	0.19
30	44.1	73.65	1.0620	20.43	90.99	0.0448	0.1889	0.31	0.22	0.21	0.19
35	48.5	73.11	1.1633	21.98	91.77	0.0479	0.1890	0.31	0.22	0.21	0.19
40	53.1	72.55	1.2723	23.54	92.54	0.0510	0.1891	0.31	0.23	0.21	0.19
45	58.1	71.99	1.3893	25.11	93.30	0.0541	0.1892	0.31	0.23	0.21	0.20
50	63.5	71.42	1.5150	26.69	94.06	0.0572	0.1894	0.32	0.23	0.21	0.20
55	69.2	70.84	1.6498	28.28	94.81	0.0603	0.1896	0.32	0.24	0.21	0.20
60	75.3	70.25	1.7943	29.89	95.55	0.0634	0.1897	0.32	0.24	0.21	0.20
65	81.7	69.65	1.9492	31.51	96.29	0.0664	0.1899	0.33	0.24	0.22	0.20
70	88.6	69.04	2.1152	33.15	97.01	0.0695	0.1901	0.33	0.25	0.22	0.21
75	95.9	68.42	2.2930	34.80	97.72	0.0726	0.1903	0.33	0.25	0.22	0.21
80	103.7	67.78	2.4834	36.46	98.42	0.0756	0.1904	0.33	0.25	0.22	0.21
85	111.9	67.14	2.6874	38.14	99.11	0.0787	0.1906	0.34	0.26	0.22	0.21
90	120.6	66.47	2.9060	39.84	99.78	0.0817	0.1908	0.34	0.26	0.22	0.21
95	129.8	65.80	3.1402	41.55	100.44	0.0848	0.1910	0.34	0.27	0.22	0.22
100	139.6	65.10	3.3914	43.28	101.07	0.0878	0.1911	0.35	0.27	0.22	0.22
105	149.8	64.39	3.6608	45.02	101.70	0.0909	0.1913	0.35	0.28	0.22	0.22
110	160.6	63.67	3.9502	46.78	102.30	0.0940	0.1914	0.36	0.29	0.23	0.22
115	172.0	62.92	4.2613	48.57	102.87	0.0970	0.1915	0.36	0.29	0.23	0.23
120	183.9	62.14	4.5962	50.37	103.43	0.1001	0.1916	0.37	0.30	0.23	0.23
125	196.5	61.35	4.9572	52.20	103.96	0.1032	0.1917	0.37	0.31	0.23	0.23
130	209.7	60.52	5.3471	54.05	104.45	0.1062	0.1917	0.38	0.32	0.23	0.23
135	223.6	59.66	5.7692	55.94	104.92	0.1093	0.1917	0.39	0.33	0.23	0.24
140	238.1	58.77	6.2274	57.85	105.34	0.1125	0.1917	0.40	0.34	0.23	0.24
145	253.4	57.83	6.7265	59.79	105.73	0.1156	0.1916	0.41	0.36	0.23	0.24
150	269.4	56.84	7.2722	61.77	106.06	0.1188	0.1914	0.42	0.38	0.23	0.24

Thermodynamic and Transport Data – English Units (reference state: ASHRAE)

Temperature °C	Pressure psia	Speed of Sound ft/s Liquid	Speed of Sound ft/s Vapor	Thermal Conductivity Btu/hr;ft•°F Liquid	Thermal Conductivity Btu/hr;ft•°F Vapor	Viscosity lb_m/ft•hr Liquid	Viscosity lb_m/ft•hr Vapor	Surface Tension dyne/cm Liquid
-40	9.0	2414.3	438.6	0.0494	0.0049	0.87	0.0231	15.2
-35	10.3	2372.4	439.8	0.0489	0.0050	0.83	0.0234	14.7
-30	11.8	2330.8	440.9	0.0483	0.0052	0.80	0.0236	14.3
-25	13.3	2289.6	441.9	0.0477	0.0053	0.77	0.0239	13.9
-20	15.1	2248.7	442.8	0.0471	0.0054	0.74	0.0242	13.5
-15	17.0	2208.0	443.6	0.0465	0.0055	0.71	0.0244	13.1
-10	19.1	2167.6	444.2	0.0460	0.0056	0.68	0.0247	12.7
-5	21.4	2127.4	444.7	0.0454	0.0058	0.66	0.0250	12.2
0	23.9	2087.4	445.1	0.0449	0.0059	0.63	0.0252	11.8
5	26.6	2047.5	445.4	0.0443	0.0060	0.61	0.0255	11.4
10	29.6	2007.9	445.5	0.0438	0.0062	0.59	0.0258	11.1
15	32.8	1968.4	445.4	0.0432	0.0063	0.57	0.0260	10.7
20	36.3	1928.9	445.3	0.0427	0.0064	0.55	0.0263	10.3
25	40.1	1889.6	444.9	0.0421	0.0066	0.53	0.0266	9.9
30	44.1	1850.3	444.4	0.0416	0.0067	0.51	0.0269	9.5
35	48.5	1811.1	443.8	0.0411	0.0068	0.50	0.0271	9.1
40	53.1	1771.9	442.9	0.0406	0.0070	0.48	0.0274	8.8
45	58.1	1732.7	441.9	0.0400	0.0071	0.46	0.0277	8.4
50	63.5	1693.4	440.8	0.0395	0.0073	0.45	0.0280	8.0
55	69.2	1654.1	439.4	0.0390	0.0074	0.43	0.0283	7.7
60	75.3	1614.8	437.9	0.0385	0.0075	0.42	0.0286	7.3
65	81.7	1575.3	436.1	0.0380	0.0077	0.41	0.0289	7.0
70	88.6	1535.8	434.2	0.0375	0.0079	0.39	0.0293	6.6
75	95.9	1496.1	432.0	0.0370	0.0080	0.38	0.0296	6.3
80	103.7	1456.3	429.7	0.0365	0.0082	0.37	0.0299	6.0
85	111.9	1416.4	427.1	0.0360	0.0083	0.36	0.0303	5.6
90	120.6	1376.4	424.3	0.0355	0.0085	0.35	0.0307	5.3
95	129.8	1336.4	421.3	0.0350	0.0087	0.33	0.0311	5.0
100	139.6	1296.2	418.0	0.0345	0.0089	0.32	0.0315	4.7
105	149.8	1255.8	414.5	0.0340	0.0090	0.31	0.0319	4.4
110	160.6	1215.3	410.7	0.0335	0.0092	0.30	0.0324	4.1
115	172.0	1174.4	406.6	0.0331	0.0094	0.29	0.0328	3.8
120	183.9	1133.2	402.3	0.0326	0.0097	0.28	0.0334	3.5
125	196.5	1091.4	397.7	0.0321	0.0099	0.27	0.0339	3.2
130	209.7	1048.7	392.7	0.0317	0.0101	0.26	0.0345	2.9
135	223.6	1005.1	387.5	0.0312	0.0104	0.25	0.0351	2.6
140	238.1	960.4	381.9	0.0308	0.0107	0.24	0.0358	2.4
145	253.4	914.2	375.9	0.0304	0.0110	0.23	0.0366	2.1
150	269.4	866.6	369.5	0.0300	0.0113	0.23	0.0375	1.9

Materials Compatibility

A number of plastics and elastomers were evaluated for compability with Solstice yf. The information below can serve as a guide to identification of compatible classes of plastics and elastomers. Performance of plastics and elastomers can vary considerably with formulation and conditions of use. Materials should be evaluated at the conditions associated with the intended application before adopting use of a particular material, especially in the case of production components.

Plastics

	Rating	24-hr Post Weight Change, %	Physical Change
Polyester	1	4.4	0
Nylon	1	-1.5	1
Epoxy	1	0.3	1
Polyethylene Terephthalate	1	2.0	0
Polyimide	0	0.2	0

0 = best when weight gain < 1 and physical change = 0
1 = borderline when weight gain > 1 and < 10 and/ or physical change up to 2
2 = incompatible when weight gain > 10 an d/or physical change = 2

Elastomers

	Rating	24-hr Post Linear Swell, %	24 -hr Post Weight Change, %	24 -hr Post Change in Hardness
Neoprene WRT	0	0.0	-0 .3	1 .0
HNBR	0	1.6	5 .5	-7. 0
NBR	0	-1.2	-0 .7	4 .4
EPDM	0	-0.5	-0 .6	4 .4
Silicone	1	-0.5	2 .5	-14 .5
Butyl Rubber	0	-1.6	-1 .9	0 .5

0 = less than 10% weight gain and less than 10% linear swell and <10 hardness u nit change
1 = >10% weight gain or >10% linear swell or >10 hardness unit change
2 = 10% weight gain an d >10% linear swell and >10 hardness u nit change

Other Elastomer Information

SAE Cooperative Research Program (CRP) has studied hose permeability and O-ring compatibility using samples from a number of commercial suppliers. Sample s were exposed to HFO-1234yf/modified ND-8 (PA G) lubricant. Most samples were within target parameters after exposure. Formulations of the following elastomer types having acceptable performance should be commercially available:

EPDM
HNBR
Neoprene
Butylrubber
Chlorobutyl rubber
Polyamide elastomer

Honeywell Refrigerants
101 Columbia Road
Morristown, NJ 07962-1053
1-800-631-8138
www.honeywell.com

Honeywell

Solstice® yf Refrigerant (R-1234yf)

Packaging Range: *Asia-Pacific (excluding Japan)*

Honeywell

4.5kg and 11.3kg Disposable Cylinders*

4.5kg and 11.3kg Returnable Cylinders

Valve

1 Valve
Invert for liquid
CGA166 Outlet Connection

Specifications

	4.5kg Disposable	11.3kg Disposable	4.5 kg Returnable	11.3 kg Returnable
Full Cylinder SKU	10616573	10616086	10617229	10624446
Certification	US DOT 39	US DOT 39	DOT 4BA	DOT 4BA
Unit Dimensions	191mm x 363mm (D x H)	241mm x 427mm (D x H)	221mm x 343mm (D x H)	234mm x 518mm (D x H)
Gross Weight, Approximate	6.1kg	14.1kg	9.5kg	19.9kg

ISO Container

45.3kg Returnable Cylinder

100kg Returnable Cylinder

794kg Returnable Cylinder

Specifications

	45.3kg Returnable Cylinder	100kg Returnable Cylinder	794kg Returnable Cylinder
Full Cylinder SKU	10616554	10616555	10605532
Certification	DOT 4BW	DOT 4BW	DOT 110A800W
Unit Dimensions	254mm x 1370mm (D x H)	406mm x 1097mm (D x H)	767mm x 2070mm (DxL)
Gross Weight, Approximate	76.5kg	164.5kg	1440kg

Specifications

	ISO Container
Full Cylinder	10581428
Gross Weight, Approximate	23,000 kg
Net Gas per ISO Container	15,000 kg
Certification	US DOT / UN / IMDG
Unit Dimensions	6M x 2.5M x 2.6M (LxWxH)

** Disposable Cylinder can not be used in Australia or South Korea*
Note: Cylinder images not to scale

Solstice® yf Refrigerent Packaging Guide (Asia excluding Japan)

Packaging Range: *Asia-Pacific (excluding Japan)*

Valve for 4.5kg and 11.3kg

1 Valve with 2 hand wheels
Red = Liquid
Blue = Gas

Valve for 45.3kg and 100kg

1 Valve with 2 hand wheels
Red = Liquid
Blue = Gas

Valve for 794kg Returnable

1 Liquid Valve, Red hand wheel

1 Gas Valve, Blue hand wheel

Outlet Connection

CGA 166, left-handed threads
0.500 inch (12.7 mm) connection
ACME, 16 threads per inch

Outlet Connection

CGA 670, Left-handed threads
1.030 inch (26.2 mm) connection
NGO, 14 threads per inch

Features

- Liquid and vapor phase
- Embedded anti-filling valve
- Anti-tamper protection
- Dedicated connections and colors

Solstice yf Refrigerant Specification	
Assay (minimum weight %)	99.50
Moisture (maximum weight %)	0.0020
Non-volatile residue (maximum volume %)	0.0100
Acidity (maximum weight % as HCl)	0.0001
Non-condensable gases in vapor phase (maximum volume %)	1.50
Appearance	Clear and colorless
Particulates and solids	Visually clean

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Ratchadapisek Road, Huay Khwang
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Phone: 662-693 3099 ext 700

Learn More
www.honeywell-refrigerants.com

Australia
Honeywell Polymers (Australia) Pty Limited
Ground Floor
71 Queens Road
Melbourne Victoria 3004
Phone: 61-03-9529 1411

Honeywell

Solstice® yf Refrigerent Packaging Guide (Japan)

Honeywell

Solstice® yf Refrigerant (R-1234yf)

Packaging Range: *Japan*

5kg, 10kg, 50kg, 100kg Returnable Cylinder

Specifications

	5kg Returnable Cylinder	10kg Returnable Cylinder	50kg Returnable Cylinder	100kg Returnable Cylinder
Full Cylinder SKU	10629483	10629484	106294825	10629486
Certification	KHK	KHK	KHK	KHK
Unit Dimensions	220mm x 354mm (D x H)	250mm x 453mm (D x H)	275mm x 1209mm (D x H)	366mm x 1300mm (D x H)
Gross Weight, Approximate	11.5kg	18.5kg	76.5kg	141.5kg

ISO Container

Specifications

	ISO Container
Full Cylinder	10581428
Gross Weight, Approximate	23,000 kg
Net Gas per ISO Container	15,000 kg
Certification	US DOT / UN / IMDG
Unit Dimensions	6M x 2.5M x 2.6M (LxWxH)

Note: Cylinder images not to scale

Solstice® yf Refrigerent Packaging Guide (Japan)

Packaging Range: *Japan*

Valve for 5kg and 10 kg

1 Valve with 2 hand wheels
Red = Liquid
Blue = Gas

Valve for 50kg and 100kg

1 Valve with 2 hand wheels
Red = Liquid
Blue = Gas

Outlet Connection

CGA 166, left handed threads
0.500 inch (12.7 mm) connection
ACME, 16 threads per inch

CGA 670, Left handed threads
1.030 inch (26.2 mm) connection
NGO, 14 threads per inch

Features

- Liquid and vapor phase
- Embedded anti-filling valve
- Anti-tamper protection
- Dedicated connections and colors

Solstice yf Refrigerant Specification	
Assay (minimum weight %)	99.50
Moisture (maximum weight %)	0.0020
Non-volatile residue (maximum volume %)	0.0100
Acidity (maximum weight % as HCl)	0.0001
Non-condensable gases in vapor phase (maximum volume %)	1.50
Appearance	Clear and colorless
Particulates and solids	Visually clean

Honeywell Fluorine Products
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RESPONSIBLE CARE®

March 2014 Version 4

Honeywell

Table of Contents

Part 2
Customer Process and Procedures

2

Flow Chart

Driver arrives at facility

Step 1 - Check In

Driver - report in at gate.

Site traffic control - instructs where and how to park on the weight scale

Step 2 - Full Weight

Driver - Weigh per the site specific procedures and obtain full weight ticket

Step 3 - Fill Station

Driver - Proceed to designated fill station and verify product and paper work with authorized customer employee

Step 4 - Unload Authorization

Site authorized employee - Verify receiving tank has unfilled capacity to receive the full load and proper tank is being unloaded into.

Step 5 - Connect Hose and Valve Alignment

Driver - Follow delivery connection procedure.

Customer Employee - Opens Valves to the tank for unloading to proceed

Step 6 - Unload

Driver - Open proper valves on the delivery vessel to unload and start the pump

Step 7 - Disconnect

Customer - verify unload complete (tank level rise)

Driver - Stop Pump, align valves, disconnect and store hoses

Step 8 - Scale Out

Driver - Obtain “light weight”, Calculate Net Weight Delivered

Customer - Confirm values

Delivery Complete

Driver Departs

1. RECEIVING LOADED ISO TANKS

1.1 Reception

a. Truck arrives at gate and is admitted by traffic control

1.2 ISO Weight (Full)

a. Receiving facility performs daily scale procedures prior to weighing ISO

b. Park ISO chassis and tractor on the scale per receiving facilities direction

c. Weigh ISO and receive the “full weight” value from the customer’s facility

1.3 Product and Documentation Verification

a. Receiving facility will verify all shipping documents such as:

- Bill of Lading (BOL)
- Certificate of Analysis (COA)
- Consignment Note (CMR)

b. Facility contact checks the scale weight verses the BOL weight and notifies Honeywell of any discrepancies > +/- 5%.

Immediately notify Honeywell of any abnormalities using the STOP procedure as outlined in procedure Honeywell STOP Procedure and provide supporting documentation such as digital photos.

2. VERIFICATION AND HANDOVER OF DOCUMENTATION

2.1 Driver parks the ISO tank at the unloading spot/station per site personnel instructions

2.2 Driver presents the shipping paperwork to the sites authorized unloading contact

2.3 Facility contact verifies the product paperwork ensuring that the product listed matches product entered into the scale and what was scheduled for delivery

Immediately notify Honeywell of any abnormalities using the STOP procedure as outlined in procedure Honeywell STOP Procedure and provide supporting documentation such as digital photos.

3. UNLOADING AND SCALE OUT

3.1 Facility primary contact instructs driver where to hook up to unload

3.2 Driver connects the appropriate liquid and vapor hoses to the unload station

3.3 Driver unloads the contents of the ISO

3.4 Driver safely disconnects and stores the hoses at the facilities location or on the delivery vessel.

3.5 Driver proceeds to the facility scale for “light weight” scale reading

4. HEEL WEIGHT CHECK

4.1 ISO Weight (Light)

a. Park ISO chassis and tractor on the scale per receiving facilities direction

b. Weigh ISO and receive the “light weight” value from the customer’s facility

c. Driver shares light weight with the receiving, tank farm or traffic department contact (should be the same contact that received the full weight for comparison to the Bill Of Lading).

4.2 “Complete” offload verification

a. Utilizing the following math, ensure a “normal” heel is all that remains in the ISO.

- Full Weight – Light Weight = Net Weight Delivered
- (Light Weight / Full Weight) x 100 = % Heel Remaining

b. Driver shares the Net Weight Delivered and the % Heel Remaining with the receiving tank farm or traffic department contact.

c. The % Heel Remaining should be less than 5%

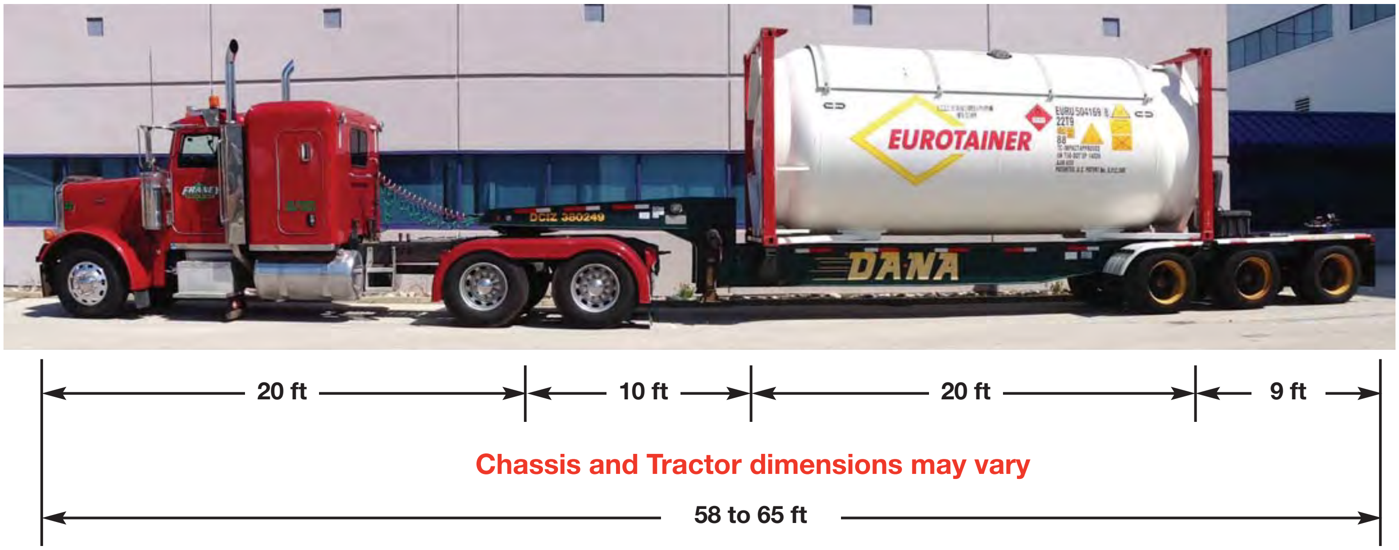
d. If more than 5% remains, use the STOP process

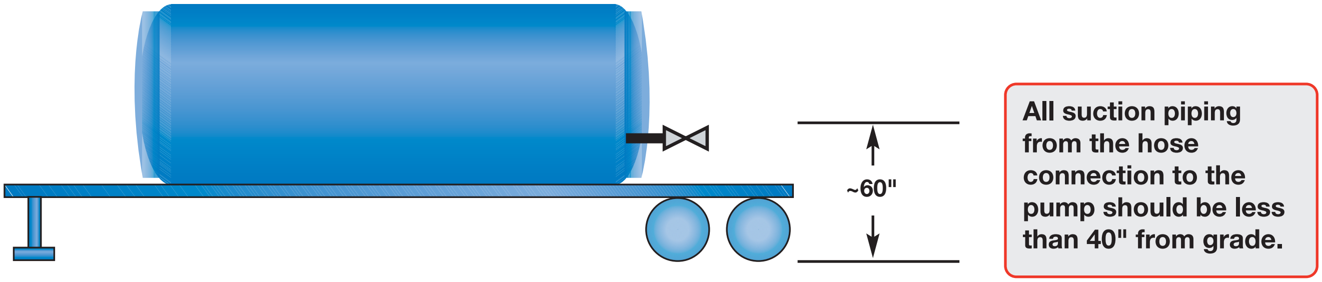
Immediately notify Honeywell of any abnormalities using the STOP procedure as outlined in procedure Honeywell STOP Procedure and provide supporting documentation such as scale tickets or digital photos.

EXAMPLE:

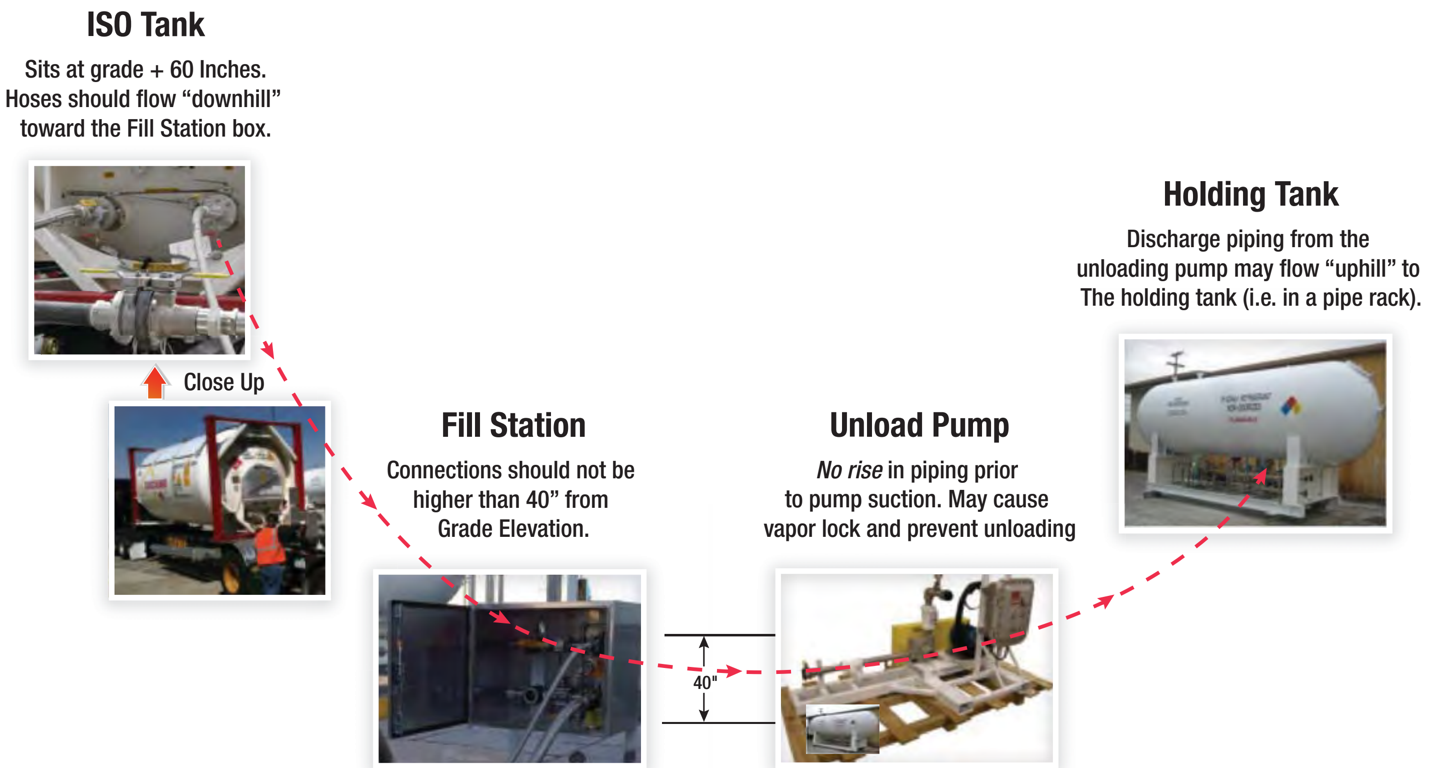
Full Weight		Light Weight		Net Weight Delivered
30,000 lbs	minus	1,500 lbs	equals	28,500 lbs
Light Weight		Full Weight		% Heel Remaining
1,500 lbs	divide	30,000 lbs	multiply 100 equals	5%

Approximate ISO Dimensions





Typical R-1234yf Pump and Unloading Configuration



Prepare Tank and Equipment For Initial Offload

PRIOR TO THE FIRST LOAD BEING DELIVERED TAKE THE FOLLOWING STEPS TO PREPARE THE TANK:

1. Pressure test
   a. Pressure up with Nitrogen to 90% of the lowest pressure rated piece of equipment in the system. (Note: This could change with each system so no specific pressure is recommended)
   b. Monitor the system for a minimum of 24 hours to ensure no pressure loss has occurred on the system.
   c. If loss of pressure occurs, leak check joints, flanges, fittings etc with soap and water

   Note: fluctuations in ambient temperature change may cause pressure increase/decrease. A steady decrease is the sign of a leak. Open all Valves and connections to get a true SYSTEM tightness.

2. Nitrogen Purge (this could be accomplished by releasing the nitrogen used to pressure test through all the “bleed” valves on the tank and associated piping).

   Note: It is recommended that Step 1 and this step occur two to three times. This will help to “drive” a lot of the moisture out of the low lying points and joints and make the next step easier to accomplish.

3. Pull vacuum down to 2,000 microns (measured at the tank, not at the pump)
   a. When the vacuum pump is shut down or valved off, the vacuum at the tank should hold for a minimum of 60 minutes.
   b. In good conditions (warm days and nights) this process could take 1 to 2 days. This is vacuum pump size dependant, must use a 12 cfm or larger vacuum pump.

      Caution: If a total of a liter of water is present in the system, this time could go as long as 3 days and up to a week (depending on ambient temperature), step 2 will help prevent this from occurring

      Caution: If water is present, or during winter, it may be necessary to use a heater with insulating blankets and a tent tarp to elevate the tank temperature and drive off water and/or frost. The fittings and pipes also need to be heated or the water will just move to the coldest portions.

Flow Chart

Stage transport vessel at an approved location

Step 1 – Confirm Analytical

Site Quality Department – Verifies that the material is within specification or accepts based on HON COA

Step 2 – Confirm Available Capacity

Site Operations – Verifies that the receiving vessel can safely hold the contents of the delivered vessel

Step 3 – Ensure Safety Policies are followed

Driver / Unloader – Utilize the appropriate PPE for unloading 1234yf and ensure all equipment is properly grounded prior to unloading

Step 4 – Visual Inspection

Driver / Unloader – Ensure all hoses are free of contamination and are in safe working condition

- Within Test date
- No Visible damage

Step 5 – Prepare Hoses and Equipment

Site Operations – If dedicated hoses and equipment are not utilized, prepare equipment to eliminate contamination

Step 6 – Unload Product

Driver / Unloader - Verify correct flow path and unload vessel completely

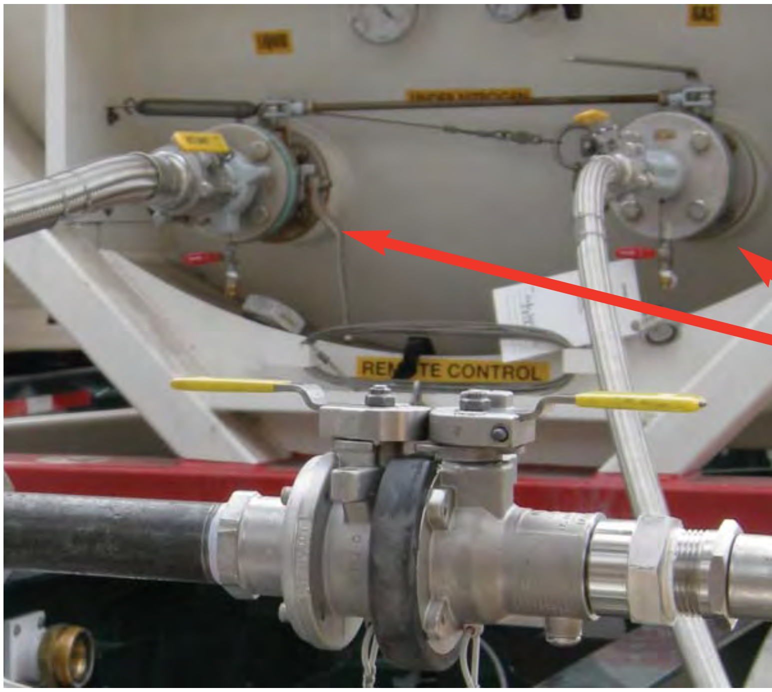
Step 7 – Recover Hoses

Driver / Unloader – Recover all hoses and equipment to minimize loss.

Disconnect Hoses and store properly for next delivery.

OFFLOADING INTO A FIXED BULK STORAGE ASSET

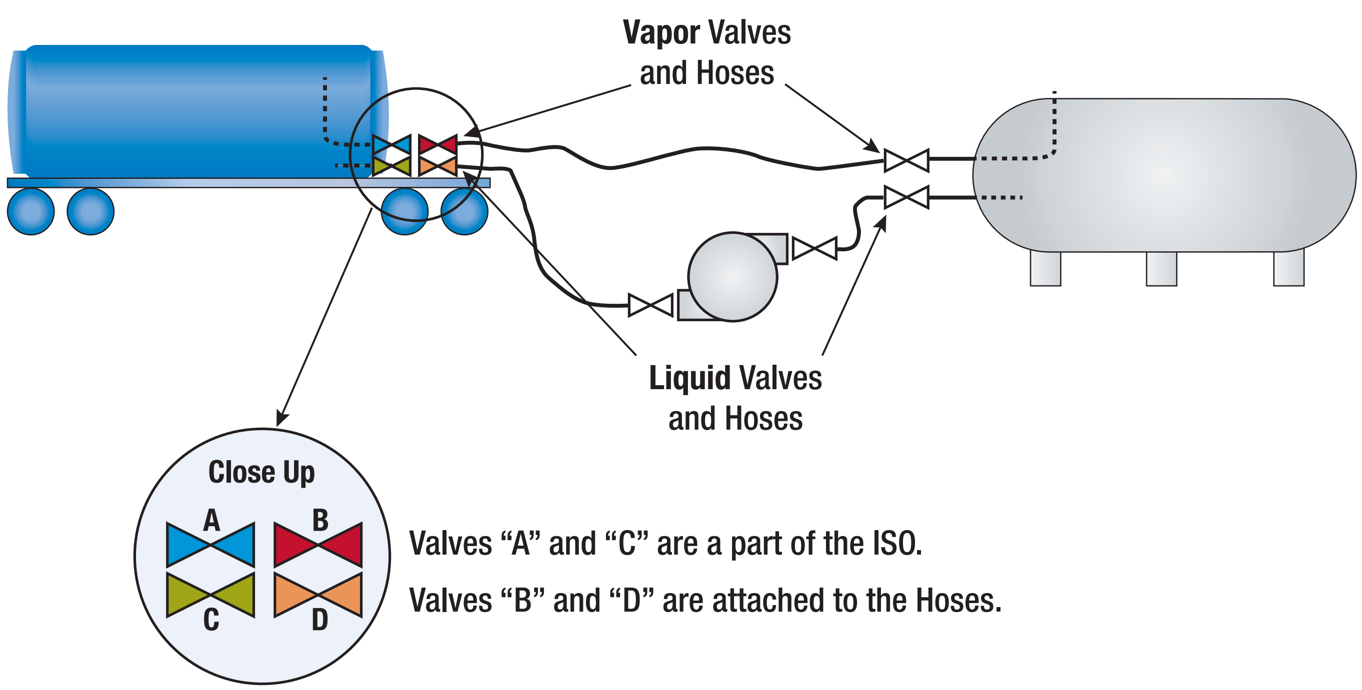
1. Verify that a COA is included in the shipping paperwork. The COA certification date may not be greater than 90 days old.
2. Verify that the fixed bulk storage asset has sufficient available space to receive the full contents of the ISO. Fixed bulk storage assets should not be filled above 85% of their total capacity
3. Ensure site personnel are informed/trained in the handling of refrigerants are wearing all required PPE
4. Position the ISO in the designated area for 1234yf transfers. If this area is not marked appropriately, STOP and seek guidance from the responsible Health and Safety professional on site.
5. Check grounding equipment is in good working order, free of abrasions, gouges, kinks or any line breaks
6. Ground the ISO tank, transfer pump and fixed bulk storage asset
7. Under ideal conditions the hoses used will be as short as possible to minimize the opportunity for introduction of non condensable gases and moisture into the transfer lines and tanks.
8. Visually inspect hoses to ensure they are safe for use, check for:
   a. Fraying
   b. Gouges
   c. Kinks
   d. Any other defects
9. Hoses and pumps should be stored indoors or in a covered area to prevent accumulation of moisture; pump should have caps applied over hose connection points
10. Visually inspect each connection to ensure moisture is not present. If present, manually remove with a clean, dry cloth
11. Connect the couplings to the liquid line of the ISO tank
12. Connect the hose from the coupling to the pump
13. Ideally the hoses and pump should be dedicated for specific product usage. To prepare the hose:
   a. Connect all hoses, valve, couplings etc.
   b. Ensure the valves going into the bulk storage tank are closed
   c. Leave the internal valves and the manual valves for the ISO closed
   d. Connect to a vacuum source to the point shown below and pull to 2 mbar, holding for 1 minute
   e. hoses have been completely evacuated, close valves and disconnect vacuum source
14. Close (ensure that) the bleed valve used to pull the vacuum is closed
15. Open the valve(s) from the ISO tank vapor line to the fill box
16. Open the valve(s) from the ISO tank liquid line to the fill box
17. Open the valve(s) for the vapor line to the bulk tank starting inside the fill box
18. Open the valve(s) for the liquid line through the pump to the bulk tank starting inside the fill box
19. Turn on the pump
20. Using a hand held gas leak detector, frequently monitor the pump, bulk tank, all lines and connections for leaks
21. Offload the appropriate contents of the ISO tank. A partial offload may be requested only when the bulk tank is installed on a scale or other means of estimating offload amount are present
22. Stop the pump
23. Close the bulk storage liquid fill valves – do not disconnect the hoses (leave the vapor line to the storage open)
24. Close the internal valve and valves “B” and “C” shown below
25. Begin hose recovery procedures to minimize and/or prevent product loss:
   a. Connect the suction of recovery pump to the liquid sample valve, pictured below as a vacuum connection valve, on the liquid discharge line of the ISO
   b. Connect the discharge of the recover pump to the vapor sample valve, pictured below as a vacuum connection valve, on the vapor equalization line of the ISO
   c. Open both sample valves



Vacuum can be pulled at these connection ports for the liquid and the vapor hoses.

d. Verify flow of product, should be pulling product out of the liquid hoses from the liquid fill line on the storage, through the pump and back into the vapor side of the ISO. See diagram below for the proper valve arrangement.
   - Valve C is Closed
   - Valve D is Open
   - Valve B is Closed
   - Valve A is Open
e. Open the valves for the recovery pump
f. Engage the pump to recover the product
g. Recover product to 3mbar of total pressure on the recovery pump
h. Close all valves
i. Disconnect all piping and equipment
j. Close all valves, Disconnect all piping and equipment

Offloading into a Fixed Bulk Storage Asset



DISCLAIMER

Although all statements and information contained herein are believed to be accurate and reliable, they are presented without guarantee or warranty of any kind, expressed or implied. Information provided herein does not relieve the user from the responsibility of carrying out its own tests and experiments, and the user assumes all risks and liability for use of the information and results obtained. Statements or suggestions concerning the use of materials and processes are made without representation or warranty that any such use is free of patent infringement and are not recommendations to infringe on any patents. The user should not assume that all toxicity data and safety measures are indicated herein or that other measures may not be required.

Flow Chart

Issue Identified

Applies to anything from a Safety Concern to incorrect paper work

Step 1 – STOP

Be aware of your surroundings from abnormal conditions or inappropriate actions and STOP once identified.

Step 2 – Identify Potential Solutions

Where appropriate, use your expertise and knowledge to identify potential solutions.

Step 3 – Implement Corrective Actions

Where the solutions are within your job responsibilities, implement the corrective actions to bring the issue back into standard. If not see next step.

Step 4 – Escalate to Supervisor

Do not extend solutions beyond your area of control, escalate to the next level of management, communicate potential solutions and ask for assistance to implement

Step 5 – Update Standards to prevent future issues

Where appropriate implement corrective actions to eliminate all future occurrences of the abnormal condition or action.

Safety Bulletin - STOP

USING THE “STOP” PROCESS IS AN EXPECTATION OF EMPLOYEES, TOLLERS AND DISTRIBUTORS

Response Time Standards

Step	Total	Person Escalating the Question	Person Providing the Response
30 min	30 min	**Staff:** Identify the root cause and apply the solution. If a solution is not available within 30 minutes or support required, inform next level support.	Not applicable
60 min	90 min	**Maintenance:** **Production Manager:** **Plant Manager:** **Safety Manager:** Identify the root cause. If cause not identifiable in 60 minutes or support needed, escalate.	Present the root cause preferably along with the solution to the person originally escalating the question within 60 minutes.
2 hr	3.5 hr	**Honeywell Supply Chain:** Identify the root cause. If cause not identifiable in 60 minutes or support needed, escalate.	Present the root cause preferably along with the solution to the person originally escalating the question within 2 hours.
	>3.5 hr	**Honeywell Leadership:** Identify the root cause utilizing all available assets until identified and a solution created.	Not applicable

TRUE EMERGENCIES should be handled using local emergency response, not the STOP Process

Instructions for Returning Empty Cylinders to JAPAN

PRODUCT : Solstice yf (R-1234yf) in 45.3kg/100kg cylinder

1. RETURNS PROCESS (PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1.1 Customer/Distributor informs Honeywell Country office once cylinders are ready for return providing following information - product name, order #, cylinder # or no. of cylinders, packaging and collection date via email to Honeywell. ** The empty cylinders will need to be palletized **in standing position** when returning to Honeywell plant.

1.2 Customer/Distributor and its appointed forwarder will ensure the returnables are **properly blocked and braced**. Kindly note that charges/penalties incurred due to improper blocking and bracing will be borne by Customer/Distributor.

1.3 Unless otherwise specified, all return shipments must be booked on Honeywell contracted carrier(s). In the event a non-contracted carrier is used, Customer/Distributor will bear for the freight difference.

1.4 Cust/Dist to quote Honeywell contract number when booking vessel. Please obtain list of Honeywell's Carrier Contract #s from Honeywell office. Customer/Distributor informs Honeywell office **via email** on the shipment booking advice.

1.5 Customer/Distributor e-mails a copy of the Booking Advise and Commercial Invoice to Consignee **2 days prior to cut off**. filed with the relevant authorities.

1.6 Customer/Distributor ensures its appointed fowarder adheres to Honeywell's return instructions complete with proper paperwork and declaration filed with the relevant authorities.

1.7 Customer/Distributor emails a complete set of shipping documents to Honeywell office within **3 working days** after vessel sailing.

1.8 Honeywell office checks shipping documents and email documents to respective parties (see docs distribution instructions below).

2. DOCUMENTS REQUIRED

Customer/Distributor will provide following documents to Honeywell Office :

2.1 Express Bill of Lading/Seaway Bill

2.2 Proforma Invoice and Packing list

2.3 Declaration of Dangerous Goods for Multimodal Transport

2.4 List of cylinder#

A. Consignee :

Honeywell Japan Inc.
PMT Fluorine Products
New Pier Takeshiba South Tower 20F
1-16-1, Kaigan Minato-ku,
105-0022 Japan
Attn: Toshiko Otsu
Phone: 81-3-6730-7095, Fax:81-3-6730-7221

Notify Party:

NRS CORPORATION
8th Floor, Hitotsubashi-Kowa Building 3-7-1
Kanda Nishikicho Chiyoda-ku,
Tokyo Tokyo 101-0054 Japan
TEL: 81-3-5281-8180 FAX: 81-3-5281-1855

B. Express Bill of Lading/Seaway Bill should show :

Description of Goods :
- Name of Chemical Residue [Indicate both Product Name & Chemical Name - refer "Haz. Mat. Sheet]
- IMDG Class and UN number
- Quantity of each package type

Port of Loading	Port of Discharge	Place of Delivery
Carrier's Convenience	Tokyo, Japan	

Freight : Freight Collect (unless otherwise specified)
** Please arrange the shipment by FCL.

C. Proforma Invoice should show :

1) Consignee name
2) Description of Goods as stated in the BL
3) Value of Packages (Nominal value/ 45.3kg: US$115.00 & 100kg: US$659.85 each)
4) Invoice to add clause "No commercial value. Value for customs clearance purposes only."

3. DOCUMENTS DISTRIBUTION

Email complete set of shipping docs to :

3.1 Notify Party (see above)

3.2 Respective Honeywell offices

- SC (Mariko.Ishikawa: mariko.ishikawa@honeywell.com) and Logistics (Toshiko Otsu: toshiko.otsu@honeywell.com)

Note : Please contact Honeywell office if you need assistance in the Returns. Exception to this instruction requires the approval of Honeywell Regional Supply Chain team.

Flow Chart

Driver arrives at facility

Step 1 - Check In

Driver - report in at gate.

Site traffic control - instructs where to park at a fork truck accessible receiving bay

Step 2 - Verify Shipping Documents

Site traffic control – Check Bill of Lading, Certificate of Analysis, Quantities, etc…

Step 3 - Unload Cylinders

Site authorized employee – Using site safety procedures, secure the truck and unload the truck.

Driver – Comply with all site safety standards regarding the 3rd party truck management (shut down the truck, hand over the keys, etc.)

Step 4 - Visual Inspection

Customer Employee – Inspect jugs and cylinders while offloading for:

- Obvious signs of leakage
- Damage to cylinders

Step 5 - Damage Notification

Driver & Site Employee's – Utilizing the HON STOP procedure, notify Honeywell of any abnormalities

Step 6 - Confirm Receipt

Customer – verify quantity received matches delivery paperwork

Step 7 - QA/QC

Customer – CoA is accepted or analysis is preformed as appropriate

Utilizing the HON STOP procedure, notify Honeywell of any abnormalities

RECEIVING FULL CYLINDERS

1. Truck arrives on site and reports to traffic control
2. Product and Documentation Verification
   a. Customer employee - begins filling out the proper site receiving documentation
   b. Customer employee - physically verifies the following:
   - The presence of all required paperwork:
     - Bill of Lading (BOL)
     - Consignment Note (CMR)
     - Certificate of Analysis (COA)
   - A two way product match:
     - The labels and tags located on the cylinders
     - The product on the paper work match
3. Offload truck and store tanks in designated areas. While offloading, watch for obvious signs of leaking or tank damage

   Immediately notify Honeywell of any abnormalities using the STOP procedure as outlined in procedure Honeywell STOP Procedure and provide supporting documentation such as digital photos.

4. Net weight is received by the warehouse
5. CoA review or analysis is performed by the quality department as appropriate

   Immediately notify Honeywell of any abnormalities using the STOP procedure as outlined in procedure Honeywell STOP Procedure and provide supporting documentation such as digital photos.

Flow Chart

Step 1 - Ensure Proper Valve Alignment

Close Valves at ends of the system.

Open **ALL** other valves in the system

↓

Step 2 - Pressure Test with Nitrogen

Use Dry Nitrogen to pressure test the entire system up to 90% of the lowest Relieve Valve set point

↓

Step 3 - Purge Nitrogen and Moisture vapor

Purge the nitrogen from all the low point bleeds and end points to "push" the moisture out of the system

↓

Step 4 - Vacuum Evacuate the System

Pull vacuum on the entire system, down to at least 2,000 microns.

↓

Step 5 - Repeat for a total of three cycles

Hold the vacuum on the third and final evacuation

Note: Cycle 2 and 3 require less nitrogen for purge step.

1. PRESSURE TEST AND EVACUATION PROCESS

Perform pressure tests and evacuation procedures on all lines and equipment that will contain R1234yf.

For all steps ensure that all auxiliary equipment utilized in this procedure, including connections and hoses, are rated for greater than 500 psig and certified to hold a 500 micron Hg vacuum.

1.1 Pressure test

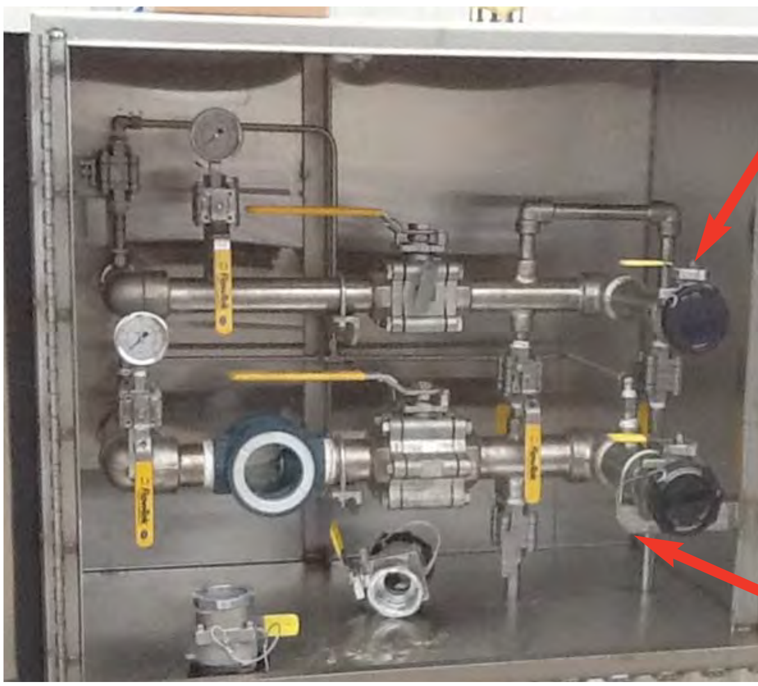
a. Ensure that you have enough nitrogen on site to pressure up the entire system, this could take at least 4 "cylinder banks" of nitrogen per testing cycle
b. Make certain ALL valves are open to the lines and equipment to be tested.

Some valves may be air operated and may even need a signal from a panel to open the valve. It is important to ensure all valves are in the open position.

There are a lot of valves on the bottom of the tank to open, be sure to get them all. You can use the pressure gauges to monitor pressures. There should also be bleed points to relieve the pressure during the purge step(s).

c. Pressure test the entire system to 10% less than the lowest rated relief valve setting in the system with dry nitrogen.

Primary Tank RV will typically be located on top of the tank. There may be other RV's in the system.



The fill box, pictured here, is a good place to connect the nitrogen bank and the recommend location for pulling vacuum. Use the hose provided and connect to the 1" vapor Epsilon fitting. The other hose end can be fitted with a connection for the nitrogen bank or vacuum pump.

NOTE: Do not use the 2" liquid connection for vacuum, the flow check will prevent the vacuum flow path.

d. Perform leak test on lines and equipment using leak detection solution (Cal Blu is recommended).
e. If necessary, repair leaking lines and equipment.
f. Repeat steps 2-4 until no leaks are detected.
g. Hold N2 pressure for one hour. Residual moisture contained in the system will evaporate into the nitrogen during this period. Compressed air should not be used for leak checking, you will adding moisture to the vessel and will significantly extend evacuation time. Honeywell does not recommend using compressed air.
h. Once the lines and equipment are deemed to be leak free continue to the next step.

1.2 Purge Nitrogen through the low point bleeds and ends of the system

a. Open the valves at the ends of the system (Fill Box and Assembly Line) and under the holding tank. Pay particular attention to open the low points in the system, especially under the holding tank.
   - This could be a loud process

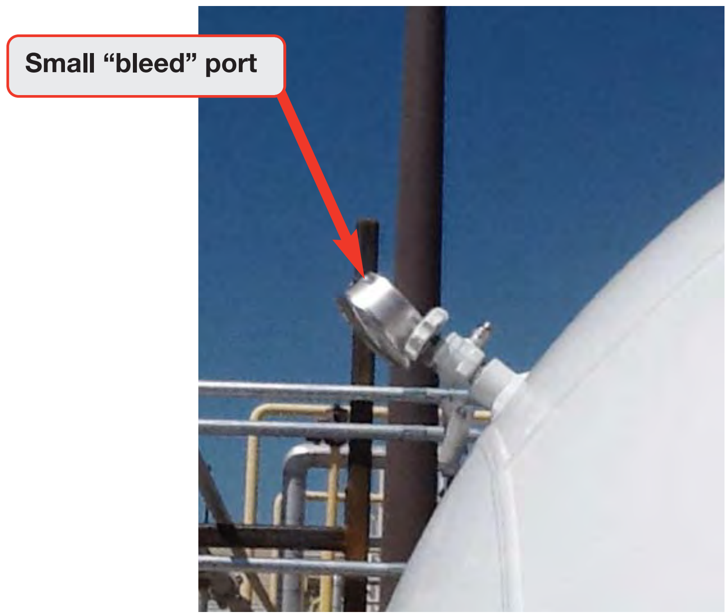
b. Monitor a pressure gauge on the system once the gauges read 50 to 100 PSIG, begin to close the valves at the end of the lines working toward the holding tank.

c. Continue to bleed the nitrogen in the system down to a slight positive pressure on the system, 5 to 10 psig.

1.3 Evacuate lines and equipment to less than 2,000 microns

a. Utilize an adequately sized vacuum pump to evacuate the system. Remember the tank is typically 6,500 gallon capacity and the systems normally have a lot of piping to be evacuated.

While a smaller vacuum pump(s) can be used , we recommend at least one 80 SCFM vacuum pump to pull down the system (shown below). This size pump should pull down the entire system in 4-6 hours. If it takes longer than 6 hours, you probably have a leak in the system (a valve open to atmosphere, loose hose connections and small bleeds like the one behind this pressure gauge are likely leak sources) or residual water in the tank.



b. Hook up the vacuum pump to the vapor line at the fill box and pull vacuum on the entire system.

c. Ensure that the entire system is open from the fill box to the end of the line inside the assembly plant.
d. Pull vacuum until 2,000 microns vacuum is attained and continue evacuating for two hours. Residual water will vaporize during evacuation to below 2000 microns.

We recommend a digital Micrometer that should be connected to a bleed port under the tank, not at the vacuum pump. The micrometer pictured is capable of reading high readings approx. 75,000 microns. Most meters will not start reading until the system is less than 12,000 microns.

e. Shut down the vacuum pump and close off the valve at the fill box "locking in" the vacuum
f. The system should hold less than 2,000 microns for one to two hours.
   - If the lines and equipment do not pass the vacuum check (step F), look for possible sources of leaks at all connections, including welds, hoses, valves, etc. Likely sources of leak points are hoses and connections, ensure the vacuum pump(s) and hose(s) are isolated from the system being tested.
   - If the evacuation pressure plateaus or slows significantly you may have free water in the tank. Add insulating blankets and start heating the tank to drive off water or frost. Once the tank and lines are above freezing, break the vacuum with dry nitrogen and start evacuation over.

1.4 Repeat all steps above **two** (2) more times to ensure the system is ready to charge.

1.5 On the third and final evacuation, keep the system under vacuum until the unloading of the 1234yf product takes place. Vapor form the 1234yf ISO will be used to break the vacuum during the initial unloading.

1.6 If the tank initial fill is to be postponed/delayed, Honeywell recommends filling with +30 psig of dry nitrogen (NOT compressed air) until Commissioning takes place.

a. Vacuum will have to be pulled down to 2,000 microns and held for one to two hours prior to filling with Solstice 1234yf.

The entire process could take 3-6 days to complete

Checklist for Commissioning Tank for Initial Unloading

	Yes	No	Initial
Piping installed completely from the Fill Box to the Fill Station inside the Assembly Plant (Ensure Scope of Work was completed)			
Ensure tank is properly marked with Chemical Name, HMIS ratings, etc.			
Valve Closed at filling station cabinet inside Assembly Plant			
All Valves Open "walking back" to 1234yf Holding Tank discharge pump			
All Valves Open under the 1234yf Holding Tank			

- Pay careful attention to air accuted valves
- Pay careful attention to any control valves
- You may have to activate the control pannel
- You may have to activate the Emergency Shut Down system

Ensure one Relief Valves (RV's) is in the open position			
Document the Set Pressure on the RV			
All Valves Open "walking back" to the skid pump (the liquid unload line)			
All Valves Open " walking back" to the fill box (the vapor equalize line)			
ISO Delivery Scheduled, Please indicate the date for the ISO delivery			
Complete Pressure Test and Evacuation Procedure (SOP NA-1234yf-2.8)			

- Purchase or ensure the site has Nitrogen for pressure testing
- Rent or ensure that you have the proper vacuum pump to evacuate
- Rent or ensure that you have hoses and connections
- This proces may take 3 to 6 days (Initial when cycle step is complete)

Pressure test preformed (at 10% less than RV set points)			
Pressure test held for 1 hour minimum			
Nitrogen Purged through low points and ends of the piping system			
Vacuum (measured at the 1234yf holding tank) reached 2000 microns			
Vacuum (measured at the 1234yf holding tank) held 2000 microns for 2 hours			

Contractor Preforming work Signature: ______________________________

Customer Accepting work Signature: ______________________________

Hold vacuum (and equipment) until ISO arrives for unloading			
Vacuum (measured at the 1234yf holding tank) held 2000 microns for 2 hours			

Table of Contents

Part 3
Quality and Analytical Information

3

Honeywell

Customer Specification No. CS Solstice® 1234yf-1 Rev. 4 T

Honeywell Solstice® 1234yf

(Automotive Grade)

Alternate Name(s):	**R-1234yf**
Chemical Formula:	CH_2CFCF_3
CAS Number:	754-12-1

Parameter	**Limit**[1]	**Test Method**
2,3,3,3-Tetrafluoroprop-1-ene	99.5% (w/w), min.	RDAM-618 Rev. 1
Moisture	20 ppm (w/w), max.	Solstice-1234yf-52
Acidity as HCl	1 ppm (w/w) as HCl, max.	Solstice-1234yf-2
Non-volatile residue	100 ppm (v/v), max.	Solstice-1234yf-6
Particulates and Solids	Visually clean to pass	Visual Inspection
Density @25°C	1.08 to 1.10 Kg/L	Solstice-1234yf-50
Non-condensable gases in vapor phase @25°C	1.5% (v/v) max.	Solstice-1234yf-8
Appearance (clear, colorless liquefied gas)	Visual to pass test	Visual Inspection
Impurities: Maximum Quantity in Liquid Phase Detected by This Method		
(E) 1,3,3,3-Tetrafluoroprop-1-ene, 1234ze(E)	1,000 ppm (w/w), max.	RDAM-618 Rev 1.
(Z) 1,2,3,3,3 Pentafluoroprop-1-ene, 1225ye(Z)	150 ppm (w/w), max.	RDAM-618 Rev. 1
Total unspecified unsaturated compounds	40 ppm (w/w), max.	RDAM-618 Rev. 1
Total organic impurities	5,000 ppm (w/w), max.	RDAM-618 Rev. 1

[1] All analyses shall be performed on the liquid phase of the sample, unless noted otherwise.

Approved by: Doris Weber Date: 08/22/12

Coordinator of Specifications
Fluorine Products

Specification History:
CS Solstice™ 1234yf Rev. 4, revised 08/22/12. Added parameter for (E) 1,3,3,3-Tetrafluoroprop-1-ene,1234ze(E).
CS Solstice™ 1234yf Rev. 3, revised 12/13/11. Revised Spec due to Name Change from HFO-1234yf to Solstice™ 1234yf.
CS HFO-1234yf -1 Rev 2, revised 04/28/10. Revised GC method. The method RDAM-618T has been revised and is now RDAM-618 Rev. 1.
CS HFO-1234yf -1 Rev 1, revised 02/17/10. Removed Chlorides parameter. Removed limit for Acidity as HCl, mg KOH/gm.
New, issued 07/16/09.

This is a *Controlled Document* when embossed as follows: **Honeywell - CONTROLLED DOCUMENT.**
Page 1 of 1

Honeywell
Distributor Location

Street Address
City, State, Zip, Country
Phone: +XX XXX-XXX-XXXX

Master Lot Number:
Packaged Lot Number:
Customer: *if applicable*

Delivery Date:
Packaged Date:
Order Number: *if applicable*

Honeywell
Solstice® yf Refrigerant
2,3,3,3-Tetrafluoroprop-1-ene
(Automotive Grade)
Certificate Of Analysis

	Specification	Results
Purity	99.5 wt.% min	Pass
1225yeZ	150 ppm by wt. max	Pass
1234zeE	500 ppm by wt. max	Pass
Other unsaturates (total)	40 ppm by wt. max	Pass
Moisture	20 ppm by wt. max	Pass
Acidity	1 ppm by wt. max	Pass
Residue	100 ppm by v/v max	Pass
Non Condensible Gases	1.5 Vol. % max	Pass
Appearance	Clear, Colorless	Pass
Particles or Solids	Visually Clean	Pass

SAMPLE

Certified by__________________________
Laboratory Analyst

The test results herein reported represent the analysis regularly performed in accordance with our documented quality control programs.

Section 3.1 - Certificate of Analysis (Sample)

Honeywell

Certificate of Conformity

Honeywell Fluorine Products
430 Li Bing Road
Zhang Jiang Hi-Tech Park
Pudong New Area
Shanghai 201203, China

Lot Number	: JPT130805
Packing	: Returnable Cylinder
Packing Number	: ARB-1224, ARB-1207, ARB-1173, KRQ-0150, KRQ-0111, KRG-5634, KRG-5576

HONEYWELL Solstice® 1234yf
(Automotive Grade)

Alternate Name(s):	R-1234yf
Chemical Formula:	CH_2CFCF_3
CAS Number:	754-12-1

PROPERTIES	SPECIFICATIONS
Purity	99.5 % (w/w), min.
Moisture	20 ppm (w/w), max.
Non-condensable gases in vapor phase @25°C	1.5 % (v/v), max.
Acidity as HCl	1 ppm (w/w) max.
High volatile residue	100 ppm (w/w) max.

FILLING DATE: 08/05/2013, 11/11/2013

CROSS REFERENCE TO CERTIFICATE OF ANALYSIS: DCIU5527630 (Source ISO Container Number)

Laboratory Equipment Recommendation for HFO Refrigerants QA/QC Analyses

This document describes the recommended equipment needed for HFO Refrigerants QA/QC analyses procedures. The details of the laboratory layout, wiring and plumbing designs as well as gas supply and chemical reagents are not included in this document.

1. SAMPLING CYLINDERS , QTY: VARY

1.1 Stainless steel, carbon steel or Aluminum cylinders, which are certified for refrigerant service and have pressure rating greater than 15 bar with relief valve, should be used.

1.2 The internal volume should be more than 300 mL but less than 1 L (300 mL < Volume < 1000 mL). for gas and vapor sampling cylinders. Qty: 4-6

1.3 The internal volume should be 1L for ISO sample retaining cylinders. QTY:12-14

2. LARGE DRYING OVEN, QTY:1

2.1 Internal depth should be larger than sampling cylinder length and diameter.

2.2 Temperature control range: room temperature to 200 °C

3. VACUUM PUMP, QTY:1

3.1 The maximum vacuum should be 29.5 inches of Hg (10 torr) or better.

3.2 Free air displacement at 1 aatmosphere should be greater than 2 CFM or 60 L/min.

4. CYLINDER PREPARATION MANIFOLD, QTY: 1

4.1 The manifold should have two or more sampling cylinder inlet connections.

4.2 The manifold should have a minimum of one Helium supply port, and one vacuum port.

4.3 The manifold should have one Pressure-Vacuum gauge, 30” Hg vacuum to 30 PSIG (-100 to 200 kPa gauge), this gauge may be dial or electronic.

5. GC SYSTEM, QTY: 1

5.1 Assay determination using traditional GC system

a. Equipped with a flame ionization detector (FID)

b. Chromatography data system: Capable of electronic integration and processing the chromatographic data.

c. Gas chromatographic column: 1% SP-1000, 60/80 Carbopack B column. 24 ft, 1/8” Stainless steel column or equivalent.

d. Gas inject syringe (2 mL) or auto injection valve with sampling loop (1mL)

5.2 Non- condensable gas analysis using traditional GC system

a. Equipped with a thermal conductivity detector (TCD), and capable of oven temperature programming.

b. Chromatography data system: Capable of electronic integration and processing the chromatographic data.

c. Gas chromatographic column (Packed): Poropak QS, 80-100 mesh 6ft, 1/8” Stainless steel column, or equivalent.

d. Gas inject syringe (2 mL) or auto gas injection valve with sampling loop (1mL)

6. KARL FISCHER ANALYZER, QTY:1

6.1 KF coulometric titration system (contains a removable drying tube for venting refrigerant, anode and cathode solutions, septum, and water vaporizer)

6.2 Drierite, 20-40 mesh

6.3 Desiccator, containing Drierite

6.4 Needle attachment assembly for cylinder sampling. Please refer to AHRI standard 700-2006, 2008 appendix C, Part 2

7. SCALES, QTY: VARY

7.1 op loading scale 4000g with 0.1g resolution, Qty:1
7.2 Analytical scale, 320g with 0.1mg resolution, Qty:1

8. GENERAL LAB GLASSWARE AND SUPPLIES, QTY: VARY

8.1 Gas Dispersion tube, polyethylene, Qty:1
8.2 Hot plate with stir, Qty:1
8.3 Amber-glass bottle, 300 mL, for Silver Nitrate solution, Qty:1
8.4 Assorted graduated cylinders
8.5 Assorted beakers
8.6 Assorted volumetric flasks
8.7 Deionized water supply system

Revised: v101, Jim Tu, 10/16/2012 – modify required GC equipments to matching current method.

Honeywell International, Inc.
Performance Materials and Technologies
Buffalo Research Laboratory
Buffalo, New York 14210
716-827-6245

Sampling Cylinder Preparation for HFO Refrigerants QA/QC Analyses

Material:	HFO Refrigerants
Analyte:	Sampling Cylinder Preparation for HFO Refrigerants QA/QC Analyses
Technique:	Vacuum and Purge
Specific Method:	HFO-Refrigerants-1
Supersedes:	None
Also Required:	None

PURPOSE

To describe sampling cylinder preparation procedure for HFO Refrigerants QA/QC analyses.

SCOPE

All cylinders used for sampling HFO Refrigerants analyses should be prepared per this procedure. Procedure written for 50 c.c. to 1 liter sampling cylinders.

SAFETY

1. HFO Refrigerants is a compressed liquefied gas which becomes very cold as it volatilizes. See MSDS.
2. Please review the all materials' MSDS. Wear safety glasses and safety shoes at all time.

This method may involve the use of hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

EQUIPMENT

1. Large drying oven controlled at 50°C
2. Vacuum pump, capable of achieving 29.5 in Hg of vacuum (1600 Pa abs. or 12 Torr)
3. Helium, industrial grade, feeding pressure 35 PSIA (240 kPa abs.)
4. Preparation manifold with pressure (0-30 PSIA, 0-200 kPa abs.) and vacuum gauge
5. Preferred solvent: Solstice™ 1233zd
6. Alternative Solvents: methylene chloride, acetone or hexane, reagent grade
7. Graduated cylinder, 100mL
8. Balance

PROCEDURE

Preparation of new sampling cylinders for HFO Refrigerants service

1. Inspect new sampling cylinder for any rust, water and/or oil residue. Clean any visible contaminations.
2. Place sample cylinder in the oven at 50°C, with valves completely open, for no less than one hour.
3. Remove cylinder from the oven and connect cylinder to the preparation manifold.

4. Evacuate cylinder to at least 29.5 in.Hg of vacuum (1600 Pa abs. or 12 Torr) for 20 minutes.
5. Shut off vacuum, fill the cylinder with helium to 25 PSIA (175 kPa abs.), and then close the cylinder valve for 5 minutes.
6. Open cylinder valve and evacuate cylinder to at least 29.5 in.Hg of vacuum (1600 Pa abs. or 12 Torr) for 10 minutes.
7. Repeat steps 5 and 6 two more times.
8. Close cylinder valves, and the cylinder is ready for sampling.

Preparation of used sampling cylinders for HFO Refrigerants service

1. Connect cylinder to the preparation manifold.
2. Vent residual HFO Refrigerants from the cylinder to ambient pressure.
3. Evacuate cylinder to at least - 29.5 in.Hg of vacuum (1600 Pa abs. or 12 Torr) for 3 minutes.
4. Shut off vacuum, fill the cylinder with Helium to 25 PSIA (175 kPa abs.), and then close the cylinder valve for 30 seconds.
5. Open cylinder valve and evacuate cylinder to at least - 29.5 in.Hg of vacuum (1600 Pa abs. or 12 Torr) for 1 minute.
6. Repeat steps 4 and 5 two more times.
7. Close cylinder valves, and the cylinder is ready for sampling.

Contaminated sampling cylinders cleaning procedures

* This section is for the contaminated new sampling cylinders and for used sampling cylinders are contaminated with oil residues during the service.

[Use Solstice™ Performance Fluid (1233zd) – preferred solvent]
**The following steps are the cleaning procedures for using Solstice™ Performance Fluid (1233zd) (preferred).

1. Connect the sampling cylinder valve to 1233zd container with clean fittings and tubings.
2. Open the sampling cylinder valve, and then fill the cylinder with about 32 grams of 1233zd solvent (~25 mL of 1233zd).
3. Close sampling cylinder valve, and detach the cylinder from 1233zd container.
4. Carefully swirl the cylinder to rinse the cylinder interior wall for 30-60 seconds.
5. Carefully empty the 1233zd from the sampling cylinder to a waste container.
   a. The cylinder will have built up vapor pressure. Open the cylinder valve carefully.
   b. Position the sampling cylinder upside-down to help 1233zd liquid flow out from the cylinder.
6. Repeat steps 1 - 5 three more times so total of approximately 100 mL of 1233zd solvent is used for rinsing the cylinder.
7. Disassemble the cylinder valve, and then inspect the cylinder for any visible oil residue. If any oil residue is still visible, reinstall the cylinder valve, and then repeat steps 1 - 5 one more time. If the oil residue is still visible, discard the cylinder.
8. Reassemble the cylinder valve per cylinder/valve manufacturer procedures.
9. Evacuate cylinder to at least 29.5 in.Hg of vacuum (1600 Pa abs. or 12 Torr) for 5 minutes.
10. Shut off vacuum, fill the cylinder with helium to 25 PSIA (175 kPa abs.), and then close the cylinder valve. Check for leak around the cylinder valve.
11. Open cylinder valve and evacuate cylinder to at least -29.5 in.Hg of vacuum (1600 Pa abs. or 12 Torr) for 5 minutes.
12. Fill the cylinder with helium to ambient pressure.
13. Disconnect the cylinder from the manifold with cylinder valve completely opened. Place the cylinder in the 50°C oven for no less than one hour.
14. Prepare the cleaned cylinder as NEW sampling cylinder for service.

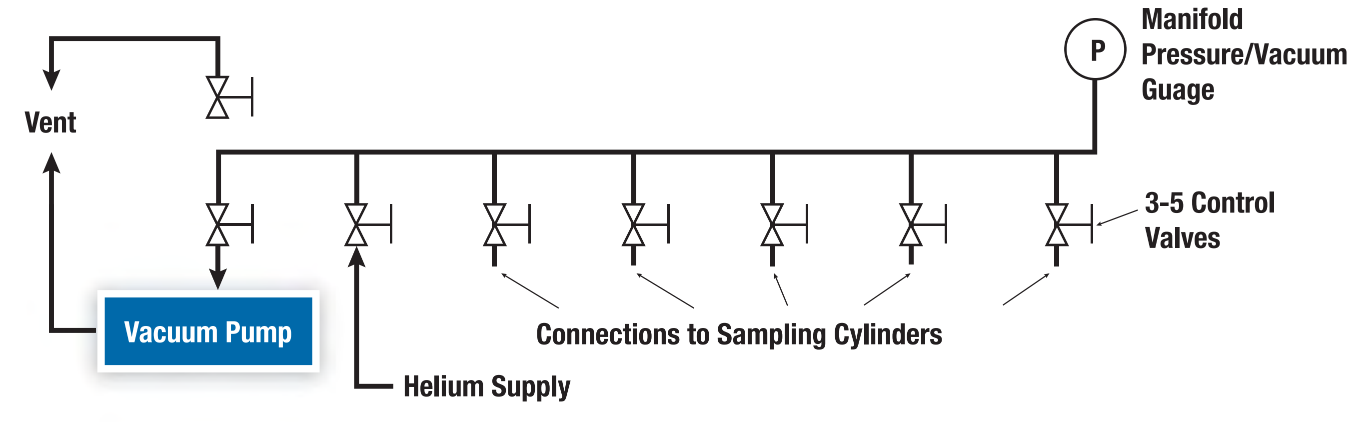
[Use Alternative Solvents]

*** The following steps are the cleaning procedures for using alternative solvents, such as methylene chloride, acetone or hexane.

1. Disassemble the cylinder value from the contaminated cylinder per cylinder/valve manufacturer procedures.
2. Fill the cylinder with 25 mL of solvent.
3. Carefully swirl the cylinder to rinse the cylinder interior wall for 30-60 seconds.
4. Pour alternative solvents from the cylinder to a waste container.
5. Repeat steps 2 - 4 three more times so total of ~100 mL of solvent is used for rinsing the cylinder.
6. Inspect the cylinder for any visible oil residue. If any oil residue is still visible, repeat steps 2 - 4 three more times. If the oil residue is still visible, discard the cylinder.
7. Reassemble the cylinder valve per cylinder/valve manufacturer procedures.
8. Evacuate cylinder to at least 29.5 in.Hg of vacuum (1600 Pa abs. or 12 Torr) for 5 minutes.
9. Shut off vacuum, fill the cylinder with helium to 25 PSIA (175 kPa abs.), and then close the cylinder valve. Check for leak around the cylinder valve.
10. Open cylinder valve and evacuate cylinder to at least 29.5 in.Hg of vacuum (1600 Pa abs. or 12 Torr) for 5 minutes.
11. Fill the cylinder with helium to ambient pressure.
12. Disconnect the cylinder from the manifold with cylinder valve completely opened. Place the cylinder in the 50°C oven for no less than one hour.
13. Prepare the cleaned cylinder as NEW sampling cylinder for service.

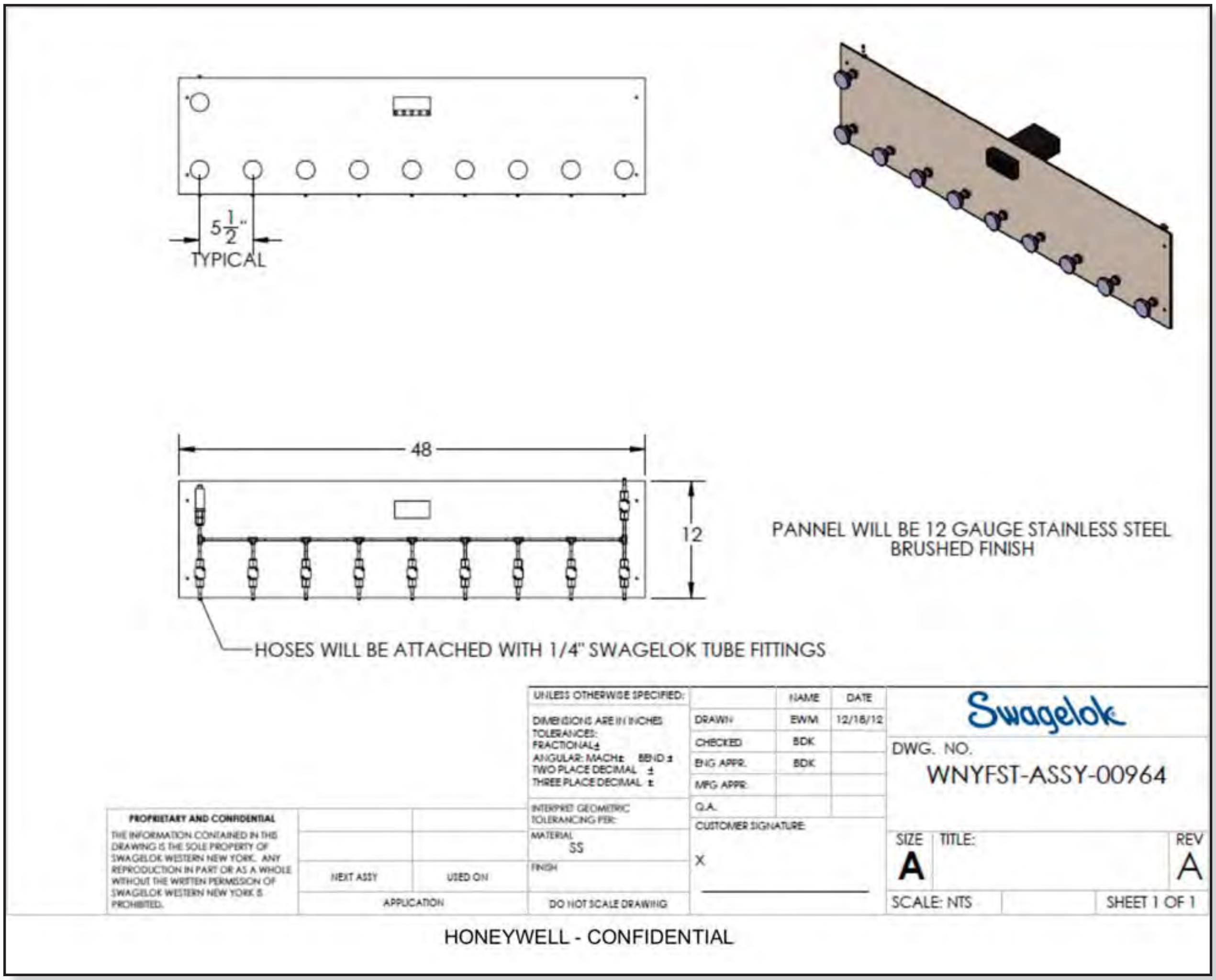
Written by; Jim Tu
Date: April 17, 2012
Date: Sep. 21, 2012, Revised by: Jim Tu, Revision on changing 1234yf to HFO Refrigerants and added cleaning procedures for contaminated cylinders.
Date: Nov. 12, 2012, Revised by: Jim Tu, Revision on adding 1233zd as preferred solvent. Added Acetone and Hexane as alternative solvents.
Date: Nov 14, 2012, Revised by: Jim Tu, Added metric units and modified procedure description texts for clarification. Corrected the oven temperature in equipment section.
Approved by: John L. Welch
Date: April 17, 2012

Sampling Cylinder Preparation Rack Schematic



1. **VACUUM PUMP**
   - 1.2 Capable of achieving 29.5 in Hg of vacuum (1600 Pa abs. or 12 Torr) or better
   - 1.1 Free air displacement at 1 atmosphere should be greater than 2 CFM or 60 L/min
2. **HELIUM, INDUSTRIAL GRADE, FEEDING PRESSURE 35 PSIA (240 KPA ABS.)**
3. **PRESSURE/VACUUM (0-30 PSIA, 0-200 KPA ABS.) GAUGE**

Sampling Manifold Design from Swagelok



Sampling manifold design from Swagelok

1. VACUUM PUMP IS NOT INCLUDED IN THE DESIGN.

2. SIX CYLINDER CONNECTIONS, ONE HELIUM, ONE NITROGEN AND ONE VACUUM PORT.

3. WELDED MANIFOLD WITH VCR FITTINGS.

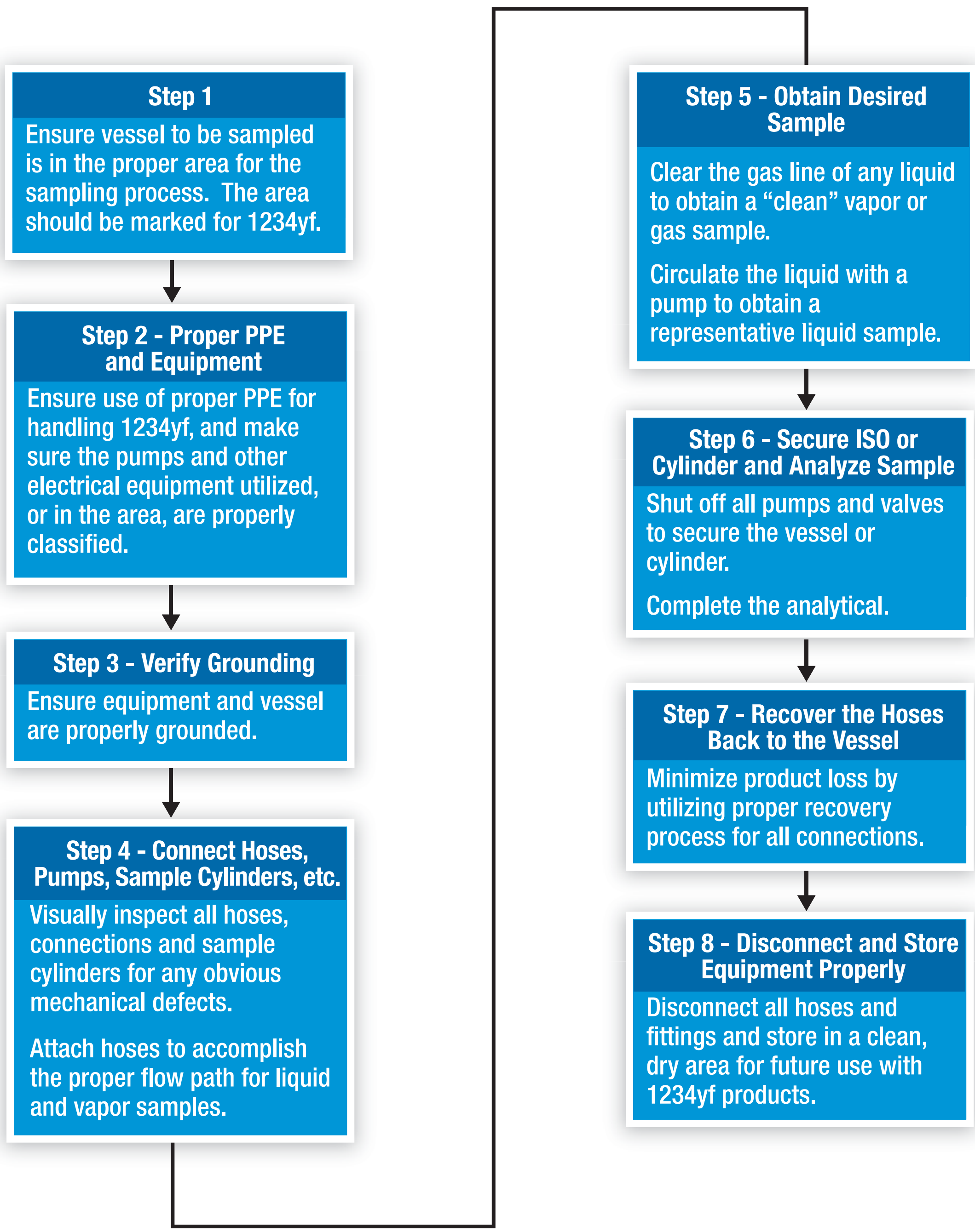
4. PARTS NUMBER

4.1 Valves: SS-4BK-VCR (Swaglok)

4.2 Pressure transducer: PX309-200AI (OMEGA ENGINEERING, Inc.)
- 0-200 PSIA
- 4-20 mA output
- 2 wire cable internal excitation pressure transducer

4.3 Digital meter : DP25B-E ((OMEGA ENGINEERING, Inc.)
- 4 digits meter
- Resolution: 0.1 PSIA

Flow Chart


Step 1
Ensure vessel to be sampled is in the proper area for the sampling process. The area should be marked for 1234yf.
Step 2 - Proper PPE and Equipment
Ensure use of proper PPE for handling 1234yf, and make sure the pumps and other electrical equipment utilized, or in the area, are properly classified.
Step 3 - Verify Grounding
Ensure equipment and vessel are properly grounded.
Step 4 - Connect Hoses, Pumps, Sample Cylinders, etc.
Visually inspect all hoses, connections and sample cylinders for any obvious mechanical defects.
Attach hoses to accomplish the proper flow path for liquid and vapor samples.
Step 5 - Obtain Desired Sample
Clear the gas line of any liquid to obtain a “clean” vapor or gas sample.
Circulate the liquid with a pump to obtain a representative liquid sample.
Step 6 - Secure ISO or Cylinder and Analyze Sample
Shut off all pumps and valves to secure the vessel or cylinder.
Complete the analytical.
Step 7 - Recover the Hoses Back to the Vessel
Minimize product loss by utilizing proper recovery process for all connections.
Step 8 - Disconnect and Store Equipment Properly
Disconnect all hoses and fittings and store in a clean, dry area for future use with 1234yf products.

Collecting Samples from ISOs and Cylinders

1. EQUIPMENT REQUIRED

1.1 Sample bottles must meet the following specifications:

a. Valves: All materials must be compatible with 1234yf per the compatibility matrix
b. Pressure Rating: The bottle must have a minimum pressure rating of 18 bar or 260 PSI
c. Acceptable Bottle Composition:
  - Stainless Steel
  - Aluminum
  - Carbon Steel

1.2 Gas Leak Detectors are needed for this procedure:

a. Should be portable, hand held devices
b. Must be calibrated for 1234yf

2. ISO TANKS

2.1 Vapor Sample

a. Ensure site personnel are wearing all PPE required for handling 1234yf.
b. Inspect the area to ensure the presence of only properly certified equipment. Remove any spark generating device from the immediate sampling area.
c. Position the ISO in the designated area for safely handling R1234yf. If the area is not marked to handle 1234yf, STOP immediately and consult the onsite HS&E professional.
d. Visually inspect hoses to ensure that they are safe for use. Check for
  - Fraying
  - Gouges
  - Kinks
  - Any other defects
e. Pump preparation: Ideally the pump should be dedicated for specific product usage.
  - Connect all hoses, valve, couplings etc., except the connection, to the liquid phase
  - Open the valves from the gas phase to the liquid phase to purge the pump
  - Connect the hose of the pump to the liquid phase
  - Open all valves
  - “Bump” start and immediately stop the pump until all liquid is out of the gas phase
  - Stop the pump
  - Close all valves and disconnect the pump
f. Take a sample from the gas phase by using a flow-through cylinder.
  - Connect the sample hose to the vapor line
  - Connect the other end of the hose to a flow through cylinder
  - Open the valves to the flow through cylinder and purge for 10 seconds
  - Close the valves of the flow-through cylinder, farthest away from the ISO first and then moving toward the ISO.

2.2 Liquid phase samples

a. Connect the gas phase line to the discharge of the properly certified pump.
b. Connect the liquid phase line to the suction of the pump.
c. Leaving the valves to the ISO closed, pull a slight vacuum on the hoses and the pump to remove any air introduced to the system during the hose connections.
d. Open the valve to the liquid line, through the pump and into the vapor side of the ISO.
e. Continue to vent air until the gas monitor detects the presence of gas.
f. Turn on the pump.

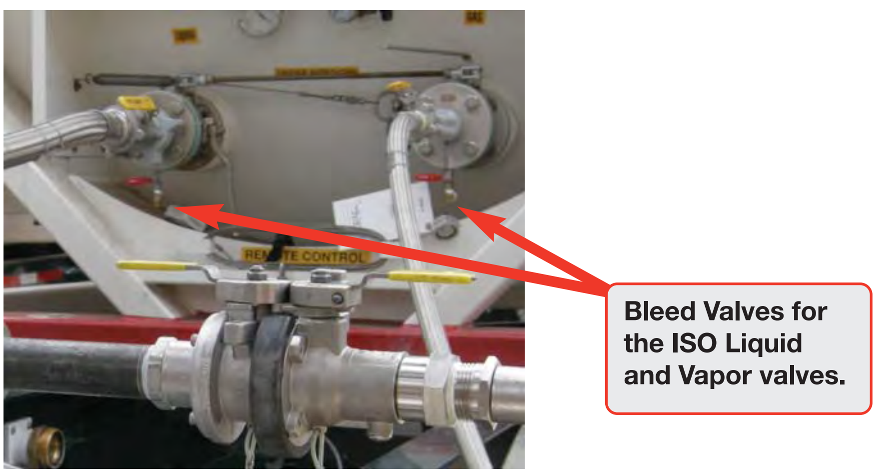
- Circulate using the following guidance:

Pump Capacity
1,700 kg/hr

Quantity in ISO Tank	Duration
≥ 10 MT	30 minutes
< 10 MT	15 minutes

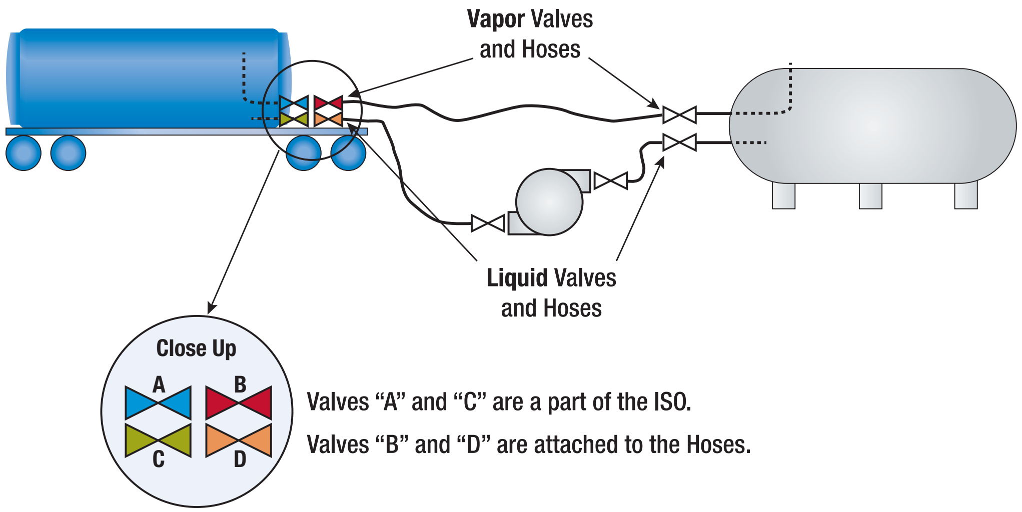
- Note that the above circulation times will have to be adjusted based on the capacity of available pumps.

g. Stop the pump.
h. Connect the sample cylinder, prepared per the procedure in Section 3, on the discharge side of the pump, but prior to the ISO.
   - Start the pump
   - Open the sample cylinder valve
   - Fill with a minimum of 1,000 g
   - Close the valve to the sample cylinder and the sample valve on the pump
   - Stop the pump
   - Disconnect the sample bottle



i. Begin hose recovery procedures to minimize and/or prevent product loss.
   - Connect the suction of recovery pump to the liquid sample valve, pictured above as a bleed valve connection, on the liquid discharge line of the ISO
   - Connect the discharge of the recover pump to the vapor sample valve, picture above as a bleed connection valve, on the vapor equalization line of the ISO

- Open both sample valves
- Verify flow of product, should be pulling product out of the liquid hoses from the liquid fill line on the storage, through the pump and back into the vapor side of the ISO. See diagram below for the proper valve arrangement
  - Valve C is Closed
  - Valve D is Open
  - Valve B is Closed
  - Valve A is Open
- Open the valves for the recovery pump
- Engage the pump to recover the product
- Recover product to 3mbar of total pressure on the recovery pump
- Close all valves
- Disconnect all piping and equipment
- Close all valves. Disconnect all piping and equipment



3. CYLINDERS

3.1 Cylinders returned from end customer whose valves exhibit no evidence of tamper (i.e. the pilot plate of the CGA670 has not been damaged or removed) do not require analysis.

3.2 Tanks returned from Distributor – no analysis required.

3.3 Tanks returned whose valves exhibit evidence of tamper (i.e. the pilot plate of the CGA670 has been damaged or removed) recover the 1234yf to a bulk tank and pull the cylinder pressure to less than 0.5 bar.

If sampling is required

a. Ensure site personnel are wearing all PPE required for handling 1234yf.
b. Inspect the area to ensure the presence of only properly certified equipment. Remove any spark generating device from the immediate sampling area.
c. Position the ISO in the designated area for safely handling R1234yf. If the area is not marked to handle 1234yf, STOP immediately and consult the onsite HS&E professional.
d. Evacuate a clean sample cylinder; ensure to use proper sample cylinder preparation.
e. Attach an adapter to the cylinder valve for the appropriate sample you are attempting to collect.

- For Ton Cylinders the valve closest to the 12 o'clock position for vapor sample and closest to the 6 o'clock position for the liquid sample.
- For all other cylinders, use the valve marked "vapor and liquid" for the proper sample.

f. Under ideal conditions, the sampling hose used will be as short as possible to minimize the opportunity for introduction of Non-Condensable Gases and moisture into the line.

g. Visually inspect sample cylinder hose to ensure that it is safe for use. Check for
- Fraying
- Gouges
- Kinks
- Any other defects

h. Connect a sample cylinder to the adapter.

i. Position a gas detector near the sample cylinder.

j. Open the corresponding tank valve.

k. Slightly open the hose connection at the sample cylinder to vent the hose. Vent until gas detector detects gas.

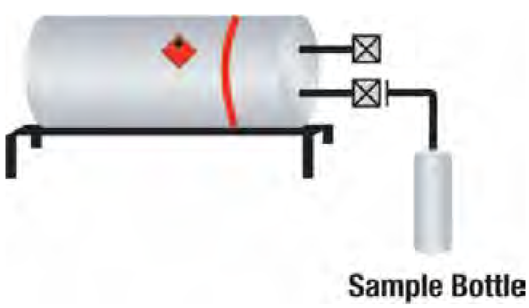
l. Tighten the connection.

m. Open the sample bottle valve to fill.

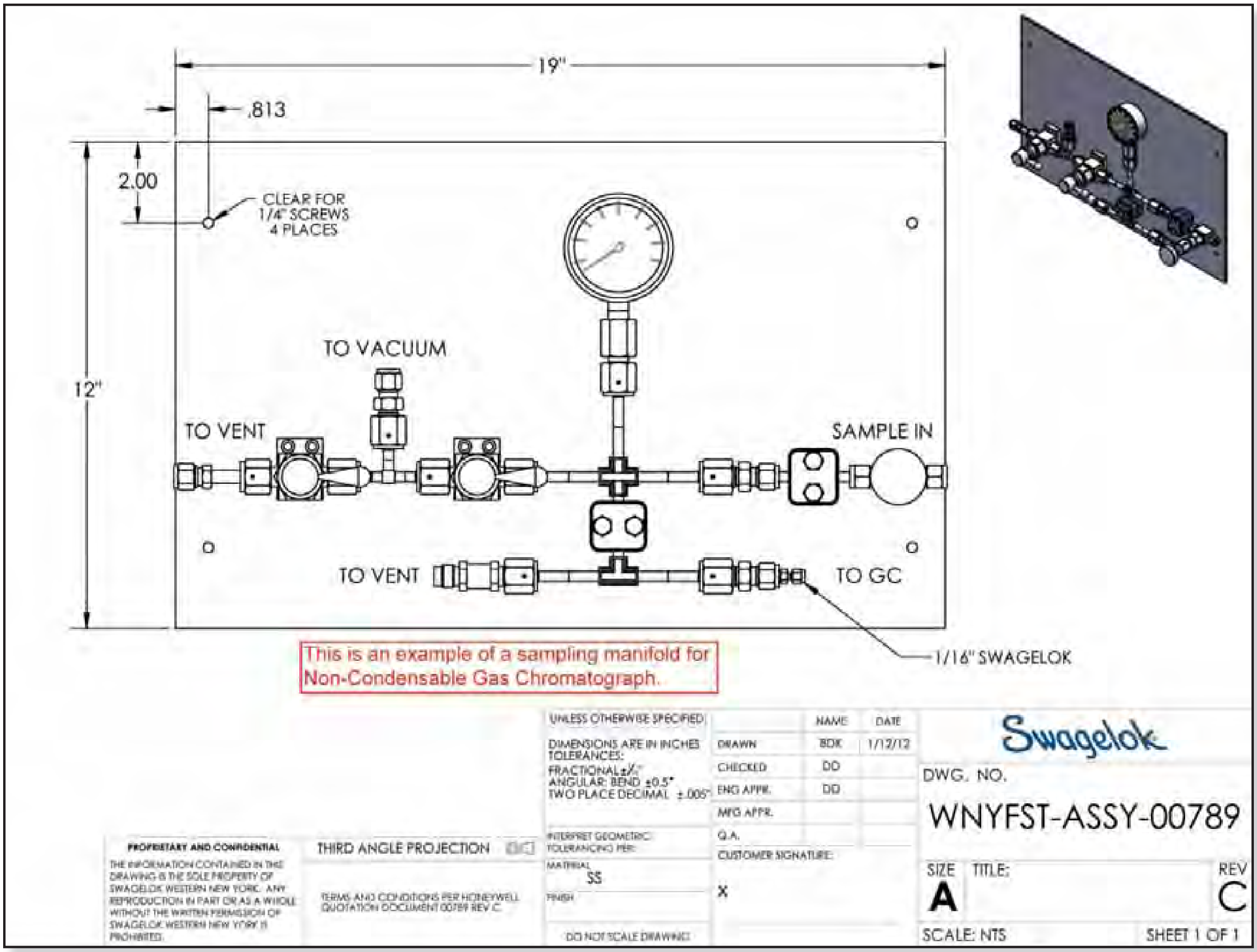
n. Draw 30g vapor sample/600g liquid sample.

o. Close the cylinder valve and the tank valve.

p. Disconnect the sample hose and the sample adapter.



Connection of Sample Cylinder to Gas Chromatograph



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Visual Inspection for Appearance, Particulates and Solids in HFO Refrigerants

Material:	HFO Refrigerants
Analyte:	Appearance Particulates and Solids
Technique:	Visual Inspection
Specific Method:	HFO-Refrigerants-10
Supersedes:	None
Also Required:	None

PURPOSE

This method describes the visual inspection of HFO Refrigerants.

SCOPE

This method is for use with virgin HFO Refrigerants.

PRINCIPLE

The HFO Refrigerant is inspected visually for any abnormal appearance, particulates and solids.

SAFETY PRECAUTIONS

1. Consult the MSDS for each chemical used in this method prior to using the method for analysis. Follow the guidelines specified by the MSDS.

This method may involve the use of hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

SPECIAL APPARATUS AND REAGENTS

Note: EQUIVALENTS MAY BE SUBSTITUTED.

1. 500 mL Pyrex Erlenmeyer Flask

PROCEDURE

1. Fill flask with at least 100 mL of product directly from the bulk container, filled cylinder or storage tank of the lot that is being tested.
2. Visually check sample in flask for any foreign products in the material. This includes rust, dirt, oil, discoloration, etc.
3. Any amount of foreign material in the product will result in the lot/cylinder failing visual inspection.
4. The failing cylinder will need to be filtered and retested prior to approval.

Written: Jim Tu
Date: 04/25/2012
Revised: Jim Tu
Date: 07/12/2012
Approved: John L. Welch

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Determination of Moisture in HFO Refrigerants

Material:	HFO Refrigerants
Analyte:	Moisture (Water vapor)
Technique:	Coulometric Karl Fisher Titrimetry
Specific Method:	HFO-Refrigerants-52
Supersedes:	None
Also Required:	None

PURPOSE

The purpose of this method is to determine the water in virgin HFO Refrigerants

SCOPE

This test method is for use with virgin HFO Refrigerants

PRINCIPLE

The moisture of HFO Refrigerants is determined by taking a known quantity of sample and titrating it with Karl Fisher reagent in a coulometric titrator to an electronic endpoint.

APPLICABILITY

This method is applicable to the determination of moisture as ug/g (ppm) in virgin HFO Refrigerants

SAFETY PRECAUTIONS

1. HFO Refrigerants – see MSDS.
2. HYDRANAL® - COULOMAT A and HYDRANAL® -COULAMAT C are proprietary, pyridine free, methanolic solutions for coulometric Karl Fisher titrators. See MSDS.

This method may involve the use of hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

SPECIAL APPARATUS AND REAGENTS

Note: EQUIVALENTS MAY BE SUBSTITUTED.

1. Mitsubishi CA-06 Karl Fisher Titrator.
2. Sample cylinder, stainless steel, 125mL (Optional- Only used if sample has to be taken from a larger cylinder).
3. 1/8 inch stainless steel needle valve.
4. 1-1/4 inch to 1/8 inch reducing fitting.
5. 1/8 inch stainless steel tubing, approximately 9 inches.

6. ¼ inch refrigeration fitting.
7. Heat gun.
8. HYDRANAL® -COULOMAT A #34807 anode solution, 500mL. Available from Fisher Scientific.
9. HYDRANAL® -COULOMAT CG #34840 cathode solution, 5ml. Available from Fisher Scientific.
10. HYDRANAL® Water Standard 0.10.

PROCEDURE

1. Prepare the instrument according to the manufacturer's instructions. If the Mitsubishi CA-06 Karl Fisher titrator is used, add 5 mL of Coulomat CG to cathode's inner compartment. Add 100 mL of Coulomot A to the anode compartment of the cell. Turn instrument on. Press <Titr Current> and allow instrument to stabilize (< 0.05 ug/sec reading on the display). Set Titration parameters:
   Delay-5 min.
   Sens: 0.1
2. Check the instrument using PROCEDURE LQA1-18 and HYDRANAL® Water Standard 0.10.
3. Weigh the cylinder to the nearest 0.1 grams and record the weight as #1.
4. Attach needle assembly to cylinder. Make sure needle valve is in the closed position. Open main sample valve.
5. Install the needle into the titration cell solution making sure it does not touch either the anode or the cathode.
6. Heat the needle section of the needle assembly with the heat gun for a least 1 minute to remove water vapor.
7. Titrate away any water that came from the needle assembly by pressing the titration button.
8. When the display reads, "Stable," and the ug/sec reading is less than 0.1, press <START>. Continue applying heat to the needle and immediately introduce sample into the Karl Fisher vessel. Bubble sample at a rate of 1.5 to 1.8 liters per minute. As soon as sample starts entering the vessel, remove drying tube from the titration vessel to keep pressure from building up in the vessel.
9. Close sample valve after 4.0 minutes. Let the sample that is left in the needle assembly bubble into the vessel. Twenty to 30 grams of sample should be introduced. Replace the drying tube after the entire sample is in the vessel.
10. Remove the needle assembly by closing the needle valve and disconnecting it from the cylinder. Reweigh the sample cylinder to the nearest 0.1 grams and record as weight #2.
11. Record the Micrograms (ug) of moisture present in the sample. Calculate result.
12. Repeat steps 3 - 9 until three results agree within ± 10 percent of each other. Report the average of these three results.

CALCULATION

$$\text{Moisture (ug/g)} = \frac{\text{Titration data (ug)*}}{\text{Wt.\#1-Wt.\#2}}$$

Report results to the nearest 0.1 ug/g.
The minimum report is 2.5 ug/g

* Titration data from instrument (Step 10).

PRECISION AND ACCURACY

A study conducted at the Buffalo Research Lab on a sample of HFC-134a with an average water content of 9.0 ug/g showed the standard deviation to be 1.48 ug/g with a relative standard deviation of 16.5 percent.
A spiking recovery conduct with the above mentioned sample showed the recovery to be 97.2 percent when conducted around the samples at 20 ppm.

Written: John L. Welch
Date: 10/07/2008
Revision: Jim Tu
Date: 07/122/2012
Approved: John L. Welch

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Determination of Acidity in HFO Refrigerants

Material:	HFO Refrigerants
Analyte:	Acidity
Technique:	Alkalimetric Titration
Specific Method:	HFO-Refrigerants-2
Supersedes:	None
Also Required:	None

PURPOSE

This method describes the determination of acidity in HFO Refrigerants.

SCOPE

This test method is for use with virgin HFO Refrigerants.

PRINCIPAL

The acidity of HFO Refrigerants is determined by bubbling a known quantity of sample through water. Any acidity imparted to the water is titrated with standardized sodium hydroxide.

SAFETY PRECAUTIONS

1. Consult the MSDS for each chemical used in this method prior to using the method for analysis. Follow the guidelines specified by the MSDS.

This method may involve the use of hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

SPECIAL APPARATUS AND REAGENTS

Note: EQUIVALENTS MAY BE SUBSTITUTED.

1. Buret, Micro, 5 mL with 0.01 mL graduations and a PTFE stopcock.
2. Gas dispersion tube, polyethylene. Bel-Art Products No.F 13691 or equivalent.
3. Evaporating dish, porcelain, 525 mL capacity or equivalent.
4. **Water.** All water used in the preparation of reagents and in the procedure is either distilled or deionized.
5. **Sodium hydroxide, 0.1 N solution standardized.** Prepare and standardize as directed in ASTM E200-91or obtain from Fisher, Cat. No. SS276-1 and standardize as directed in ASTM E200-91.
6. **Sodium hydroxide 0.01 N solution.** Pipet 100.0 mL of 0.1 N sodium hydroxide solution (Reagent from step 6) into a 1000-mL volumetric flask, dilute to the mark with water and mix. The final solution will have a normality 1/10 the normality of the step 6 reagent, or obtain from Fisher, Cat. No. SS284-1 and standardize as directed in ASTM E200-91.

7. **Hydrochloric acid, approximately 0.1 N solution.** Prepare and standardize as directed in ASTM E200-91or obtain from Fisher, Cat. No. SA54-4 and standardize as directed in ASTM E200-91.
8. **Hydrochloric acid, approximately 0.01 N solution.** Transfer 100.0 mL of the 1.0 N hydrochloric acid (Reagent from step 8) into a 1000-mL volumetric flask and dilute to the mark with water and mix. The final solution will have a normality 1/10 the normality of the step 8 reagent. An alternative is to obtain from Fisher, Cat. No. SA62-1.
9. **Bromothymol blue indicator,** 1.0 g/L solution. Dissolve 0.1 g of bromothymol blue, sodium salt, in 100mL of water. Store solution in a dropping bottle.

PROCEDURE

1. Place approximately 150 mL of water in the gas dispersion tube or other suitable vessel. Add 6-8 drops of bromothymol blue indicator.
2. Weigh the sample cylinder to the nearest 0.1 gram and record the weight as A. Support the cylinder so that the sample will be drawn from the liquid phase.
3. Connect the sample cylinder and the outlet to the gas dispersion tube. Keep the connections as short as possible.
4. Adjust the water solution to the green endpoint with 0.01 N sodium hydroxide or 0.01 N Hydrochloric Acid as required (Note 1).
5. Bubble sample through the dispersion tube at a rate of 1-2 liters per minute until at least 100 grams of sample has been added.
6. A positive result for acidity will result in conversion of the indicator from blue-green to yellow (pH <7.6). A negative result for acidity will result in no change in the indicator color or a change to blue. (Note 2)
7. If positive result is detected, pour the contents of the dispersion tube into a 525-mL porcelain dish and titrate the solution to the green endpoint with 0.01 N sodium hydroxide from a 5-mL micro buret.
8. Reweigh the sample cylinder to the nearest 0.1 gram and record this weight as B.

CALCULATION

$$\text{Acidity as ug/g HCl} = \frac{\text{mL NaOH x normality NaOH x 36,460}}{\text{A-B}}$$

Report results to the nearest 0.1 ug/g.
The minimum reportable result shall be 0.5 ug/g

NOTES

1. The volume of NaOH or HCl used for this adjustment should not be included in the titration in procedure Step 4.
2. If the solution remains green or turns blue after sample introduction, no acidity is present in the sample and the minimum reportable amount must be reported.

PRECISION AND ACCURACY

Studies are planned.

Written: John L. Welch
Date: 10/07/2008
Revision: Jim Tu
Date: 07/12/2012
Approved: John L. Welch

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Determination of Non-Volatile Residue in HFO Refrigerants

Material:	HFO Refrigerants
Analyte:	Total Non-Volatile Residue
Technique:	Gravimetric
Specific Method:	HFO-Refrigerants-6
Supersedes:	None
Also Required:	None

PURPOSE

The purpose of this method is to determine the total residue in HFO Refrigerants.

SCOPE

This test method is for use with HFO Refrigerants.

PRINCIPLE

The total residue of HFO Refrigerants is determined by taking a known quantity of sample and evaporating it in a tared weighing dish, the residue is dried at 105°C, and reweighed. The increase in weight of the dish is the weight of total residue.

APPLICABILITY

This method is applicable to the determination of total residue as ug/g (ppm) in HFO Refrigerants.

SAFETY PRECAUTIONS

1. HFO Refrigerants are compressed liquefied gas which becomes very cold as it volatilizes. See MSDS.

This method may involve the use of hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

SPECIAL APPARATUS AND REAGENTS

Note: EQUIVALENTS MAY BE SUBSTITUTED.

a. Sample cylinder with cylinder valve, 300-500 mL capacity. Aluminum, steel or stainless steel with adaptor to 1/8” Swagelok fitting.
b. Needle valve, 1/8” Swagelok fitting, SS-SS2 or equivalents.
c. 6” (15 cm) 1/8” Stainless steel tubing.
d. Aluminum dishes, 110 mm diameter, Fisher Catalog 08-732-108, or equivalent.
e. Heat gun.

Determination of Non-Volatile Residue in HFO Refrigerants

PROCEDURE

1. Collect about 100-150 grams of HFO Refrigerant in the clean, dry sample cylinder assembly from the liquid phase of a sample container. Weigh the assembly to 0.1g and record as (A).
2. Attach assembly needle valve to sampling cylinder and connect the valve outlet to the 1/8” tubing.
3. Weigh one clean and dry aluminum dish to 0.0001g and record the tare weight of sample as (B).
4. Place the aluminum dish and sampling cylinder in a fume hood. Reverse the cylinder so the HFO Refrigerant is flowing out as liquid. Position the 1/8” tubing outlet pointing to the center of the aluminum dish. Make sure the needle valve is set at minimum flow position. Open the cylinder valve slowly and allow the HFO Refrigerant flow into the aluminum dish. Adjust the needle valve so the liquid flow rate is about 20-50 mL/minute. Adjust flow rate carefully so HFO Refrigerant does not splash out from the aluminum dish and the 1/8” tubing is not touching the HFO Refrigerant in the dish. Allow about 100 mL of HFO Refrigerant flow into aluminum dish. Close the cylinder valve.
5. Gently heat the needle valve and 1/8” tubing with heat gun to make sure no residual HFO Refrigerant is between the needle valve and cylinder valve nor in the tubing.
6. Allow HFO Refrigerant to be evaporated from aluminum dish and place the dish in a 105°C oven for 30 minutes.
7. Allow the sampling to cool to room temperature and the moisture to evaporate from the cylinder surface. Disassemble the needle valve and 1/8” tubing. Reweigh the sampling cylinder to 0.1g and record as (C).
8. Remove the dish from the oven, cool in a desiccator, reweigh the dishes to 0.0001g and record the final weights as (D).

CALCULATION

$$\text{ug/g (ppm) Total Residue} = \frac{[D-B] \times 1{,}000{,}000}{[C-A]}$$

Report result to the nearest 0.1 ug/g
The minimum report is 1 ug/g

Where: A = Gross weight of the sampling cylinder with liquid HFO Refrigerant, in grams
B = Tare weight of the aluminum dish, in grams
C = Final weight of the sampling cylinder, in grams
D = Final weight of the aluminum dish, in grams

PRECISION AND ACCURACY

Studies are planned.

Written: John L. Welch
Date: 10/07/2008
Revision: Jim Tu
Date: 07/12/2012
Date: 9/24/2012: Revised the procedure so the methylene chloride is not needed for this analysis.
Date:11/15/2012: Correct Fisher catalog part number for aluminum dishes

Honeywell International, Inc.
Performance Materials and Technologies
Buffalo Research Laboratory
Buffalo, New York 14210
716-827-6245

Determination of Chloride in HFO Refrigerants

Material:	HFO Refrigerants
Analyte:	Chloride
Technique:	Silver Nitrate Precipitation
Specific Method:	HFO-Refrigerants-4
Supersedes:	None
Also Required:	None

PURPOSE

This method describes the determination of chloride in HFO Refrigerants.

SCOPE

This test method is for use with virgin HFO Refrigerants.

PRINCIPLE

The chloride of HFO Refrigerants is determined by bubbling a known quantity of sample through silver nitrate/methanol solution. Any chloride will be precipitation as silver chloride where visual turbidity could be observed.

SAFETY PRECAUTIONS

1. Consult the MSDS for each chemical used in this method prior to using the method for analysis. Follow the guidelines specified by the MSDS.

This method may involve the use of hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

SPECIAL APPARATUS AND REAGENTS

Note: EQUIVALENTS MAY BE SUBSTITUTED.

1. Amber-glass bottle, 300 mL
2. Research grade silver nitrate ($AgNO_3$)
3. Research grade anhydrous methanol (CH_3OH)
4. Concentrated nitric acid (HNO_3)

PROCEDURE

Prepare alcoholic silver nitrate solution as follows

1. Add 8 grams of silver nitrate to 200 mL of anhydrous methanol in an amber-glass bottle.
2. Place stopper in bottle and mix contents until no more of the silver nitrate dissolves.
3. Allow remaining solids to settle and use the clear, supernatant liquid, filtered, if necessary.

Sample analysis

1. Weigh a clean evacuated sample cylinder to the nearest 0.1 grams and record the weight as (A).
2. Collect about 10 to 30 g of HFO Refrigerants liquid in the sample cylinder. Weigh the sample cylinder and record the weight as (B).
3. Calculated the volume of HFO Refrigerants in the sample cylinder using following equation.

$$\text{Volumne} = \frac{(B - A)}{\text{Density of 1234yf@ambient T}}$$

4. Add the same volume of anhydrous methanol to a 100-mL test tube.
5. For every 5 mL of anhydrous methanol add 3 drops of alcoholic silver nitrate solution to the test tube. Add one drop of nitric acid. Swirl until mixed.
6. Bubble all HFO Refrigerants sample into the test tube slowly. At the end, swirl until well mixed.
7. Observe results.
   a. If solution is clear, test is NEGATIVE for inorganic chlorides. Report as passes test.
   b. If solution is cloudy, test is POSITIVE for inorganic chlorides. Report as fails test.

PRECISION AND ACCURACY

The sensitivity of the chloride turbidity test using 5 mL of HFO Refrigerants in 5 mL of methanol containing three drops of saturated $AgNO_3$ is approximately 3 ppm[1].

1. AHRI Standard 700-95, appendix C.

Written: Jim Tu, 04/25/2012
Revised: Jim Tu, 07/12/2012
Approved: John L. Welch

Honeywell International, Inc.
Performance Materials and Technologies
Buffalo Research Laboratory
Buffalo, New York 14210
716-827-6245

Determination of HFO Refrigerants Assay

APPLICATION

This method describes the determination of purity and impurity profile for HFO refrigerants production samples by gas chromatography.

PRINCIPLE

A representative sample is injected into a gas chromatograph using a 2.0 mL gas tight syringe. The components present are detected with a flame ionization detector, identified by retention times, then quantified using peak area.

SAFETY PRECAUTIONS

1. HFO Refrigerants are a compressed liquefied gas which becomes very cold as it volatilizes. See MSDS.

This method may involve the use of hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

APPARATUS:

Note: EQUIVALENTS MAY BE SUBSTITUTED

1. Gas chromatograph equipped with a flame ionization detector (FID), Perkin-Elmer 9000, or equivalent.
2. Electronic interface, Perkin-Elmer 900 or equivalent. Totalchrom software version 6 and a personal computer for data reduction and output.
3. 2.0 mL Gas tight syringe (sample size 1.0mL).
4. Column: 1percent SP™-1000, 60/80 Carbopack B column, 24 ft, 1/8”, stainless steel column. (available through SUPELCO)

INSTRUMENT CONDITIONS:

Carrier Flow (helium)	20 mL/minute (approx. 60 psi)
FID Hydrogen Flow	45 mL/minute
FID Air Flow	450 mL/minute
Injector Temperature	200°C
Injection Volume	1.0mL
Detector Temperature	250°C
Sensitivity	20, -3
Oven Temperature Program:	
Initial Temperature	35°C
Initial time	5 minutes
Temperature Ramp	10°C/minute
Temperature 2	200°C
Hold	10 minutes
Equilibration Time:	not less than 0.5 minute

STANDARDIZATION - VOLUME %

The volume percent gas standards will be provided by Honeywell.

SAMPLE PREPARATION

A 1.0 mL gas sample of the vaporized liquid HFO Refrigerants from a tedlar bag is injected into a GC using a 2-mL gas tight syringe.

PROCEDURE

1. After GC has stabilized, inject the HFO Refrigerants sample and collect chromatographic data using above conditions.
2. Calculate Volume percent based upon the data from the known standard

Written by: Jim Tu 7/9/2012

Honeywell International, Inc.
Performance Materials and Technologies
Buffalo Research Laboratory
Buffalo, New York 14210
716-827-6245

Determination of Non-Condensable Gases in HFO Refrigerants

Material:	HFO Refrigerants
Analyte:	Non-Condensable gases
Technique:	Gas Chromatography
Specific Method:	HFO-Refrigerants-8
Supersedes:	None
Also Required:	None

PURPOSE

The purpose of this method is to determine the non-condensable gases in virgin HFO Refrigerants as air.

SCOPE

This test method is for use with virgin HFO Refrigerants

PRINCIPLE

A measured volume of sample from the vapor phase of a sample cylinder is chromatographed with the area counts of the air peak being compared to those of standards similarly chromatographed.

LIMITATIONS AND INTERFERENCES

Care must be taken to inject only sample vapor. Injections of liquid phase will yield significantly lower results (non-condensable gases are only marginally soluble in HFO Refrigerants liquid, can damage the test gauge and overload the column. All compound identities are based on retention time and interfering compounds can be misidentified.

APPLICABILITY

This method is applicable to the gas chromatographic determination of non-condensable gases in virgin HFO Refrigerants.

SAFETY PRECAUTIONS

1. HFO Refrigerants are a compressed liquefied gas which becomes very cold as it volatilizes. See MSDS.

This method may involve the use of hazardous materials, operations and equipment.
This method does not purport to address all of the safety problems associated with its use. It is the responsibility of whomever uses this method to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

SPECIAL APPARATUS AND REAGENTS

Note: EQUIVALENTS MAY BE SUBSTITUTED.

a. Gas chromatography: Hewlett-Packard 5890, equipped with a thermal conductivity detector.
b. Electronic integrator or data station: Perkin-Elmer Turbochrom.

c. Gas chromatographic column: stainless steel 6 foot x 1/8 inch containing Porapak QS, 80-100 mesh. available from Supelco.
d. Flow meter.
e. Six-port gas sample valve port and loop, 1-mL from Valco.
f. Gas handling manifold with vacuum test gauge (0-760mmHg), Ashcroft (302084SD02L15#A).
g. Helium, chromatographic grade.
h. Precision vacuum pump, Model DD-90 (0.1mmHg). Fisher Scientific Cat. No. 01-182-13.
i. Certified gas mixture standard – 1.5 volume percent air balanced helium. Available from specialty gas supply company.

PROCEDURE

Operating Conditions.

Gas Chromatographic conditions

Detector	TCD
Carrier gas	helium 20 mL/min.
Injection Port Temp	175°C
Detector Temp.	220°C
Column Temp.	35°C for 8 minutes, ramp temperature 20°C/minute to 200°C
Max. Column Temp.	250°C
Sample Size	1 mL loop containing 600mmHg of sample
Detector sensitivity	High

Totalchrom conditions

Delay Time	0.00 min.
Run Time	14.5 min.
Sampling Rate	1.25 points/ second
Range	0
Autozero	OFF
Bunch Factor	1 points
Noise Threshold	1 uV
Area Threshold	5.00 uV
Width Ratio	0.100
Valley-to-peak Ratio	0.100
Peak Height Ratio	5.000
Adjusted Height Ratio	4.000
Valley Height Ratio	3.000

COMPONENT INFORMATION

Components retention time can be acquired by certified gas mixture standard.

PROCEDURE

1. Using the appropriate regulator, connectors and tubing, attach the standard cylinder to the sample manifold in an upright position.
2. With the standard cylinder valve closed, evacuate the sampling manifold, loop and lines.
3. Close the vacuum valve, open the cylinder valve, and then purge the sample loop and lines with standard gas.
4. Close cylinder valve, and then open vacuum valve.
5. Repeat steps 2 - 4 two more times then evacuate.

6. Turn off vacuum valve. Open the cylinder valve and charge 600 mm Hg of standard to the sample loop. Allow the pressure to stabilize, and then inject the standard.
7. Determine and record the area counts of the air peak.
8. Analyze the standard three times and determine the average area counts.
9. Remove standard cylinder and repeat steps 1–8 for the HFO Refrigerants sample cylinder. Analyze the sample in duplicate.

CALCULATIONS

1. Calculate the Volume percent of air in the sample using the following equation

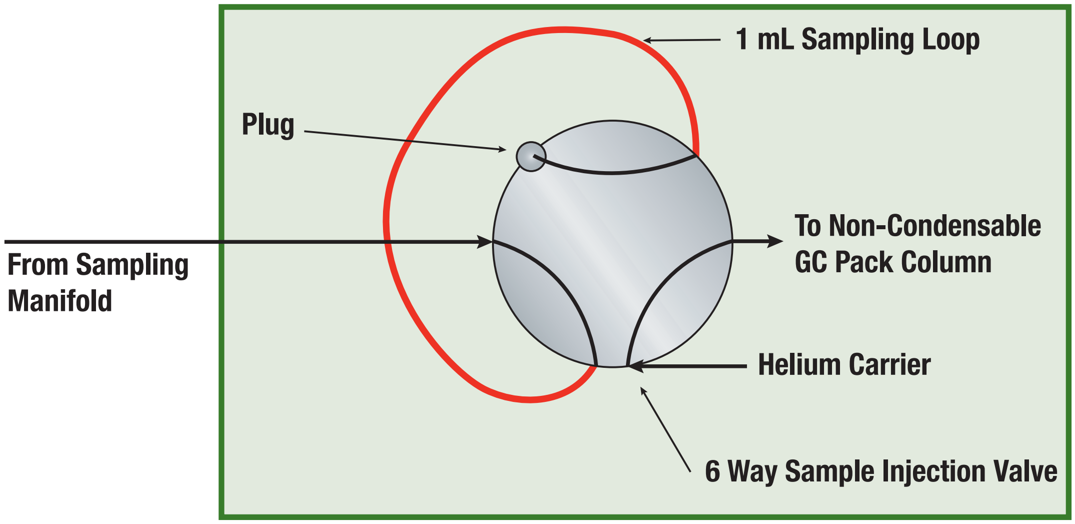
$$\text{Vol.\% Air} = \frac{\text{Vol \% Air Standard x Average Area counts Air in Sample}}{\text{Average Area counts of Air peak of the standard}}$$

Total non-condensable = Vol. % Air

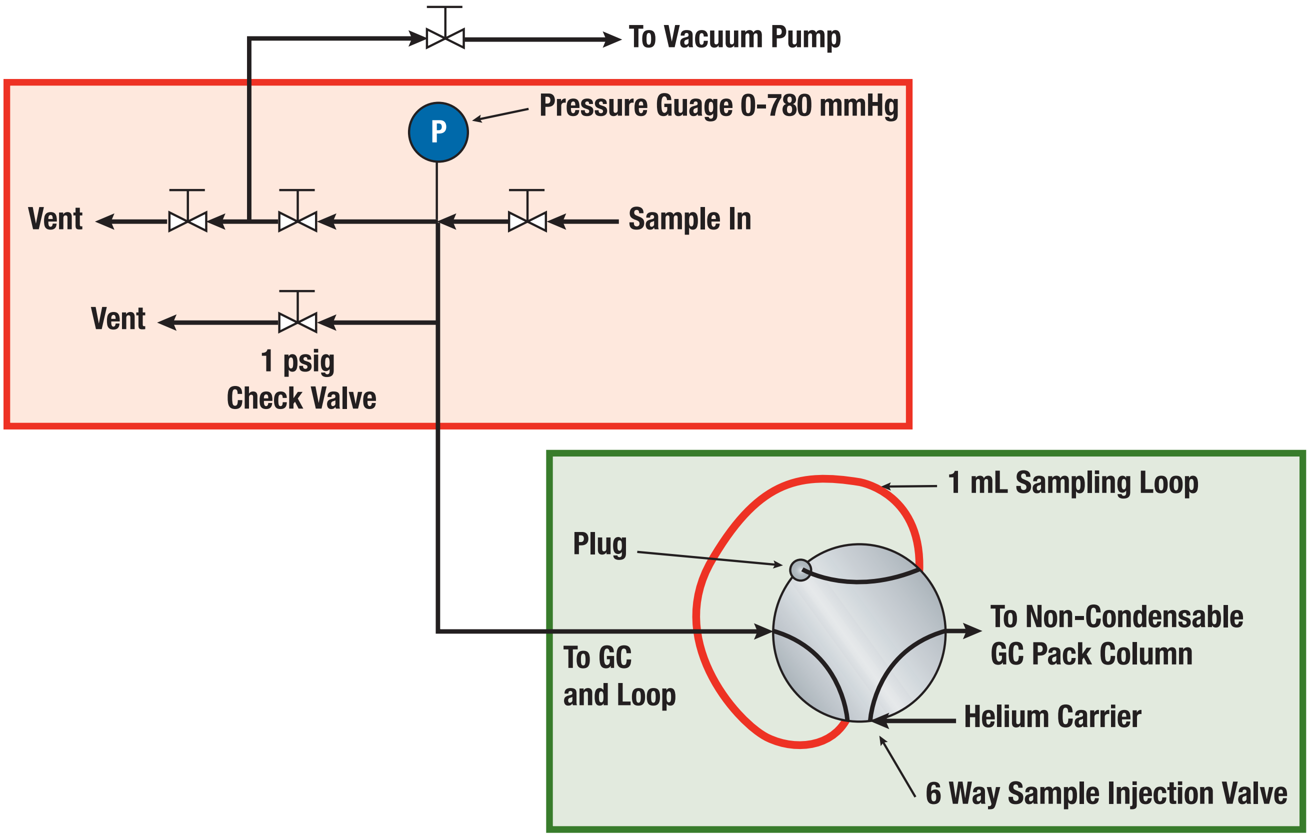
Report results to the nearest 0.1%.
Minimum reportable result is 0.1%

Written: John L. Welch
Date: 10/07/2008
Revision: Jim Tu
Date: 07/12/2012 – revise the column length to match AHRI Standard 700-2006, Appendix C and revise the total non-condensable as Air vol.%
Date 9/24/2012 – remove figure 1 which is no longer applicable.
Approved: John L. Welch

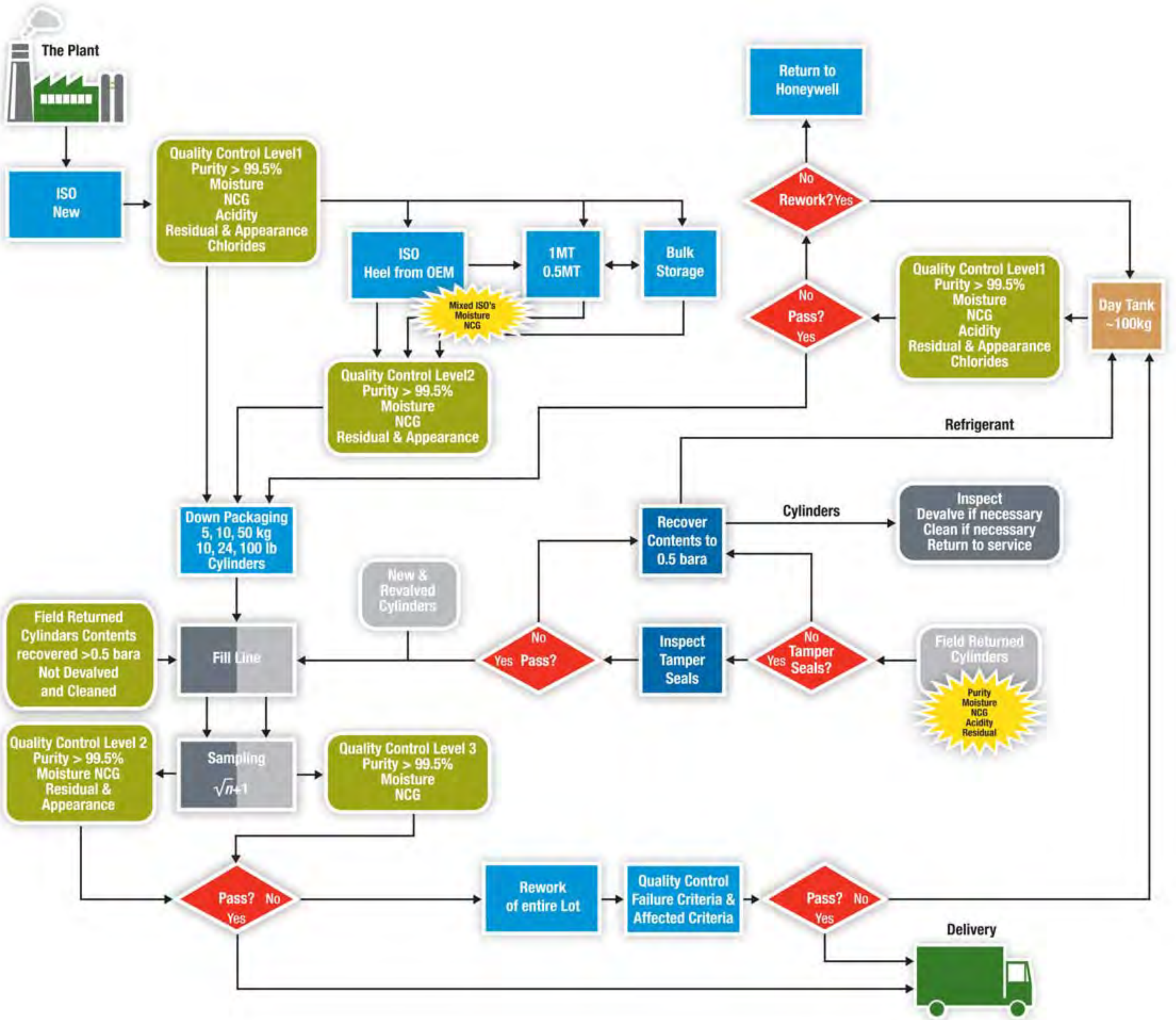
Scheme for Non-Condensable GC Injection Valve



Scheme for Non-Condensable GC Sampling Manifold



Process Map – Distribution and QC



Sample Size Summary Chart

Analyses Level Summary

Sample type	Required Analyses	Frequency/ When	Retain Sample?	Cylinder size	Analysis	1234yf sampling amount
Incoming virgin bulk materials (ISO container)	Level 1	Every container at receiving	Yes	1L / liquid (Also the retained sample)	Assay, Moisture, Non-Volatile Residue, Acidity, Chlorides	1000g
				300ml-1L / gas	Non Condensable Gas	~20g
Bulk storage and intermediate material cylinders	Level 2	One per lot or new materials are added	No	300ml-1L / liquid	Assay, Moisture, Non-Volatile Residue	250-280g
				300ml-1L / gas	Non Condensable Gas	~20g
ISO heel from OEL filling	Level 2	One per lot	No	300ml-1L / liquid	Assay, Moisture, Non-Volatile Residue	250-280g
				300ml-1L / gas	Non Condensable Gas	~20g
Day tank	Level 1	As needed	No	500ml-1L / liquid	Assay, Moisture, Non-Volatile Residue, Acidity, Chlorides	350-380g
				300ml-1L / gas	Non Condensable Gas	~20g
Down Packaged containers less than 450 kg, 1000 lb but greater than 100 kg only						
Returned cylinders from OEM producers	Level 3	$\sqrt{\eta}$ +1 per lot	No	300ml-1L / liquid	Assay, Moisture,	100-130g
				300ml-1L / gas	Non Condensable Gas	~20g
Returned cylinders from aftermarket customers **with** tamper evident seals	Level 3	$\sqrt{\eta}$ +1 per lot	No	300ml-1L / liquid	Assay, Moisture,	100-130g
				300ml-1L / gas	Non Condensable Gas	~20g
HFO Refrigerants cylinders **without** tamper evident seals or cylinders with the tamper seal broken	Level 2	$\sqrt{\eta}$ +1 per lot	No	300ml-1L / liquid	Assay, Moisture, Non-Volatile Residue	250-280g
				300ml-1L / gas	Non Condensable Gas	~20g
For down packaged containers smaller than 100 kg. Perform analyses from the containers directly						
Down packaged containers 450 kg, 1000 lb or greater	Level 2	One per lot	No	300ml-1L / liquid	Assay, Moisture, Non-Volatile Residue	250-280g
				300ml-1L / gas	Non Condensable Gas	~20g
	Level 3	The rest of the lot	No	300ml-1L / liquid	Assay, Moisture	100-130g
				300ml-1L / gas	Non Condensable Gas	~20g
Bulk ISO shipment	Level 1	Every ISO before shipment	Yes	1L / liquid (Also the retained sample)	Assay, Moisture, Non-Volatile Residue, Acidity, Chlorides	1000g
				300ml-1L / gas	Non Condensable Gas	~20g
Reworked material	As needed	Every container	No	N/A		
Bulk heel for return of the ISO to Honeywell	As Requested by Honeywell					

Notes: 1) For ISO, bulk tanks and down packaged containers greater than 100 kg, use sampling cylinders for QA/QC analysis.
2) For down packaged containers smaller than 100 kg., perform analyses from the containers directly.
3) For ISO retain sample, the QA/QC analyses will be performed from the sampling cylinder and then the sampling cylinder becomes retained sample cylinder.

Created by: Jim Tu 10/23/2012

Part 4
Cylinder Specifications and Drawings

4

4.5 kg Non Returnable Cylinder Specification

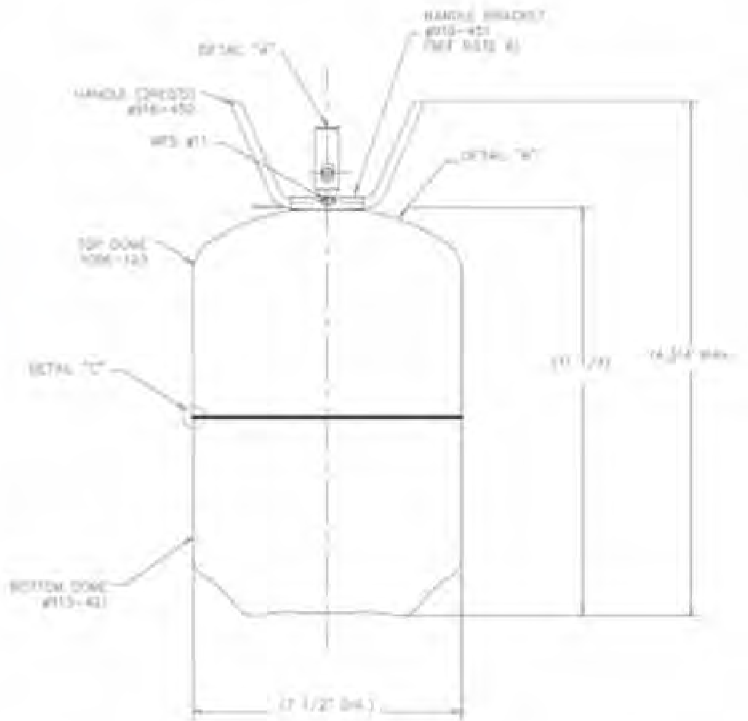
Regions: Asia-Pacific (ex. Japan, Australia and South Korea)

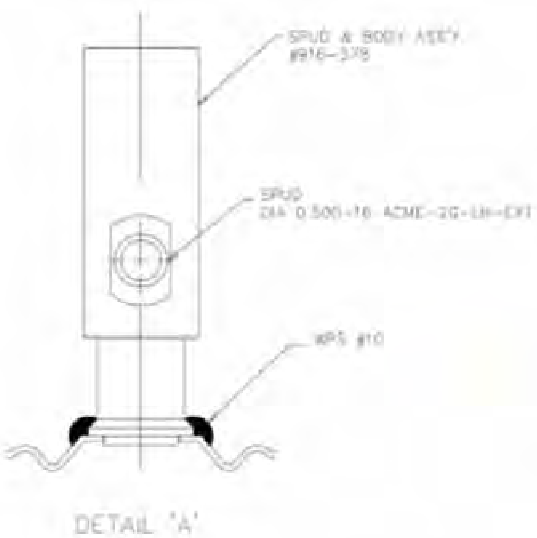
Water Capacity: 15 lbs / 6 Liters

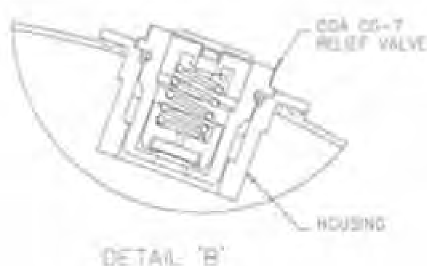
Features: DOT39 Compliant CG-7 with a Pressure Relief Device for flammables

Valve Outlet: CGA 166

Thread Pattern: 0.500 – 16 ACME – 2G – LH – EXT (Left Handed Threads)







4.5 kg Non Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	S-7863-YF	Page	1	of	3
Date:	2/18/13				
Supersedes Spec. No.:	New				
Change:	J color	Rev 3			
Product:	1234yf				
Location:	Danville				

1. Type:
   Steel Cylinder, 15 lbs. water capacity, DOT-39/TC-39M
   JUG, Non-Returnable

2. Detail Requirements:

   a. **Capacity:** 415 cu. in. (15.4 lbs. w.c.) minimum.

   b. **Material:** ASTM 620, Class I, drawing quality aluminum killed low carbon steel.

   c. **Construction:** Two drawn steel shells, circumferentially welded or brazed, with welded foot ring or extruded feet and steel valve body with welded carrying handle.

   Service Pressure: 260 psig
   Test Pressure: 325 psig

   All cylinders are to be designed, constructed, inspected, leak checked, burst-tested and date coded in accordance with DOT-39 /TC-39M specifications and CGA “Recommended Safe Practices for DOT-39 Fluorocarbon Steel Cylinders.”
   Deviations from these DOT/TC specifications and CGA recommendations are not authorized.

   No modifications in the design of the cylinder, valve, relief device or unit carton may be made without prior authorization from Honeywell.

   d. **Valve and Pressure Relief Device:** Each cylinder to be equipped with a refillable valve and relief device as follows:

   Valve: Steel valve body with 0.500-16 ACME-2G-LH-EXT. (CGA 166) threaded outlet, welded into top center of cylinder. A solid stem of glass-filled nylon to be crimped into the valve body. Design of this valve is such that once the stem has been torqued closed, the non-refillable mechanism is activated, thereby preventing refill and allowing only discharge of contents

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	S-7863-YF	Page	2	of	3
Date:	2/18/13				
Supersedes Spec. No.:	New				
Change:	J color	Rev 3			
Product:	1234yf				
Location:	Danville				

1. Type:

   Steel Cylinder, 15 lbs. water capacity, DOT-39/TC-39M
   JUG, Non-Returnable

2. Detail Requirements:

Pressure Relief Device: CGA CG-7 reseating relief device to be welded into upper shoulder of cylinder. Relief device operating range: 340-520 psig.

Cylinders to be shipped with valves open and outlets sealed with push-on plastic caps.

e. **Tare Weight (approximate):** 3 1/2 lbs.

f. **Dimensions (approximate):** 7 1/2” O.D. x 14 1/2” O.H.

g. **Interior:** Must be dry, clean and free of rust, oil, water and other foreign matter.

h. **Markings:** Cylinders and unit cartons to be legibly date coded in accordance with CGA “Recommendations”. Cylinder to bear required DOT-39/TC-39M markings.

i. **Painting & Printing:** Cylinders to be thoroughly dried in preparation for painting. Paint to be uniformly applied to exterior surface, relief disc cup and handle. Paint color and silk screen decoration are as follows:

Solstice 1234yf - Cylinder to be painted white, valve opening to be protected from overspray.

A contrasting 2” wide red [Pantone 485C] band is to be painted around the circumference of the cylinder positioned just below the cylinder shoulder radius at the top of the cylinder, per SAE J2844, AHRI Guideline N-2008: 4.8.

Silk screen to be centered with valve outlet.

Silk screen and paint must be thoroughly dried before cylinder is packed into shipper

4.5 kg Non Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	S-7863-YF	Page	3	of	3
Date:	2/18/13				
Supersedes Spec. No.:	New				
Change:	J color	Rev 3			
Product:	1234yf				
Location:	Danville				

1. Type:
   Steel Cylinder, 15 lbs. water capacity, DOT-39/TC-39M
   JUG, Non-Returnable

j. **Carton:** Each cylinder to be packed into a single unit carton, positioned so that the valve outlet points toward the die cut circular hole. Top flaps to be folded shut; bottom flaps to be stapled or glued.

Cylinders/cartons to be unitized for shipment on four-way entry wooden pallets, measuring 36” x 48”.

Cartons, to be unprinted natural kraft and constructed to Honeywell’s specification no. S-6805-8.

Honeywell

4.5 kg Returnable Cylinder Specification

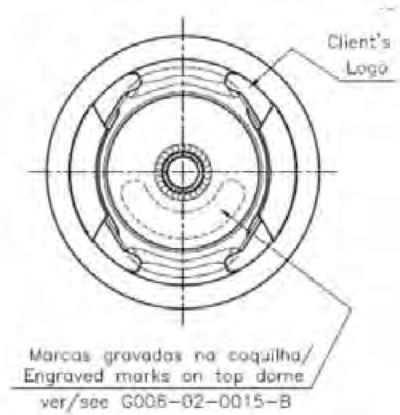
Regions: Asia-Pacific (ex. Japan)

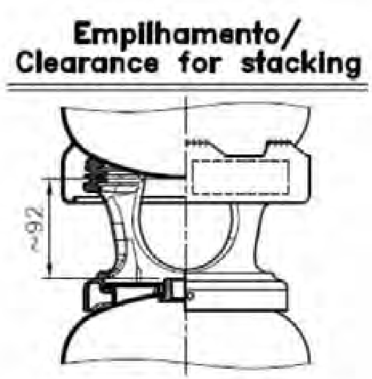
Water Capacity: 15 lbs / 6 Liters

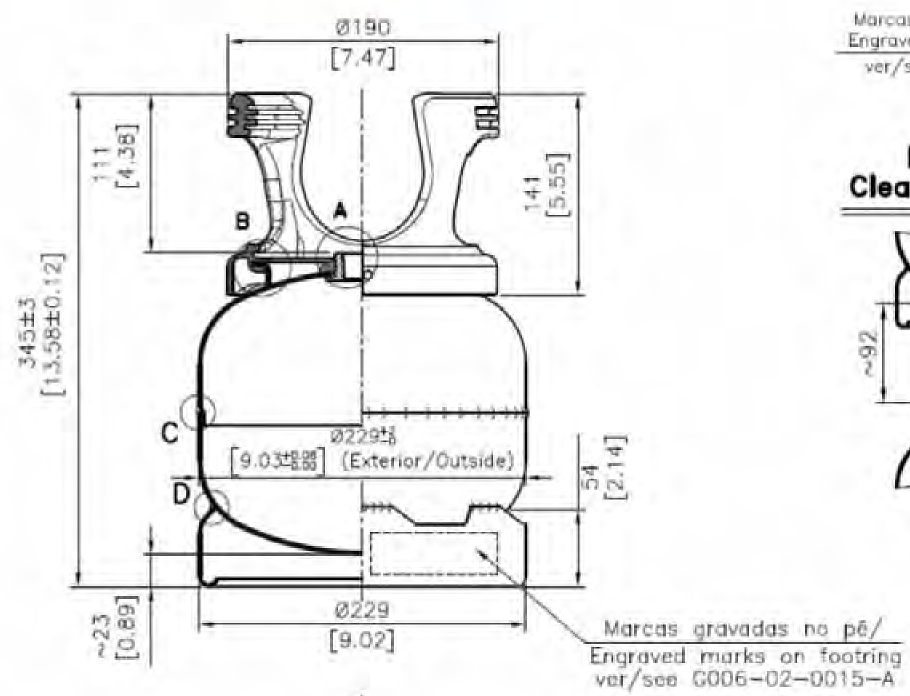
Features: Light weight and plastic handles for easy transport, dual phase valve for gas or liquid discharge

Valve Outlet: CGA 166

Thread Pattern: 0.500 – 16 ACME – 2G – LH – EXT (Left Handed Threads)







4.5 kg Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	M-8110-YF	Page	1	of	2
Date:	2/18/13				
Supersedes Spec. No.:	8110-YF	Rev 1			
Change:	J color				
Product:	Solstice® 1234yf				
Location:					

1. Type:
   Returnable Steel Cylinder 15.5 lbs. Water Capacity
   DOT 4BA400/TC/EN

2. Detail Requirements:

a. **Capacity:** 15.5 lbs. water, minimum.

b. **Material:** Open hearth or electric steel of with minimum wall thickness of .082”.
Compositions of steel to be in accordance with DOT 4BA/TC/EN specifications.

c. **Construction:** Two drawn steel shells circumferentially welded, with welded foot ring and collar. Construction to comply with DOT 4BA specifications for a service pressure of 400 psig. and Transport Canada (TC) 4BA specifications for a service pressure of 400 psig

d. **Opening:** Top head to have ¾”-14 NGT opening.

e. **Valve and Pressure Relief Device:**

Option A: Neriki air-activated liquid/vapor valve #DCU-2-018-1A with .500-16ACME-LH-EXT **(CGA 166)** outlet and replaceable pressure relief valve #3EA-003-2 installed.

Valve inlet CGA ¾-14NGT Taper 1/16

The start-to-discharge pressure of the relief valve must be between 600 and 800 psig; the flow rating pressure shall not exceed 800 psig.

Each valve to be assembled with a securely clamped polyethylene dip tube extending to the base of the cylinder. Valve to be installed such that the outlet faces the handle opening.

f. **Tare Weight:** 11. lbs. (approximate) with valve.

g. **Dimensions:** (Approximately) 7 ½” O.D. x 14 3/4” from bottom of foot ring to top of collar.

h. **Interior:** Must not contain in excess of 1.5 grams of particulate matter (rust, slag, scale and other solids) and must show no evidence of moisture or oil

4.5 kg Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	M-8110-YF	Page	2	of	2
Date:	2/18/13				
Supersedes Spec. No.:	8110-YF	Rev 1			
Change:	J color				
Product:	Solstice® Refrigerants 1234yf				
Location:					

1. Type:
   Returnable Steel Cylinder 15.5 lbs. Water Capacity
   DOT 4BA400/TC/EN

2. Detail Requirements:

i. **Markings:** Collar to bear required DOT 4BA 400 markings and the following:
- "Honeywell"
- Tare weight including valve
- Water capacity

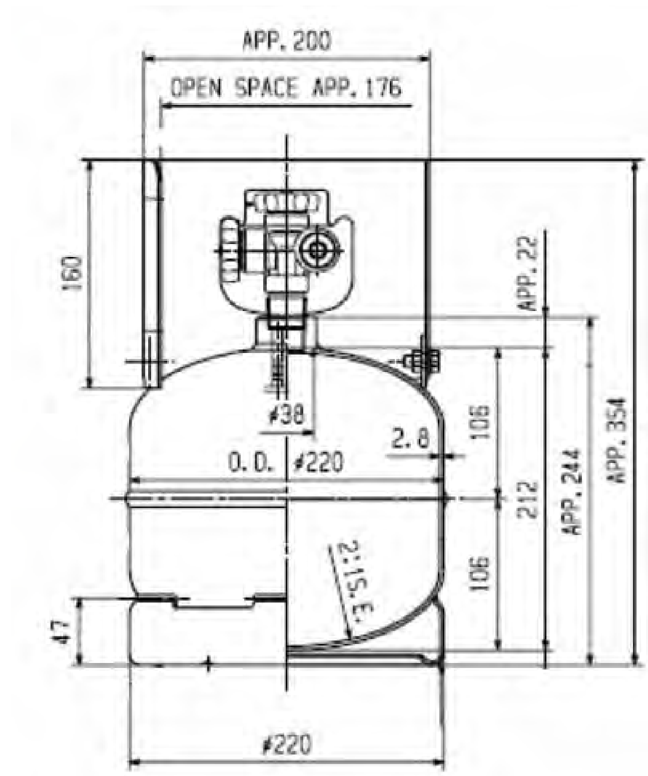
j. **Painting:** Solstice **1234YF**- Cylinder to be painted white, valve opening to be protected from overspray. A contrasting 2" wide red [Pantone 485C] band is to be painted around the circumference of the cylinder positioned just below the cylinder shoulder radius at the top of the cylinder, per SAE J2844, AHRI Guideline N-2008: 4.8.

k. **Test Reports:** Copies of complete cylinder test reports are to be supplied to

Honeywell
Fluorine Products
101 Columbia Turnpike
Morristown, NJ. 07962
Attn: Insert the Name of the buyer from the PO

Cylinder manufacturer will also maintain copies of these reports.

5 kg KHK Returnable Cylinder Specification



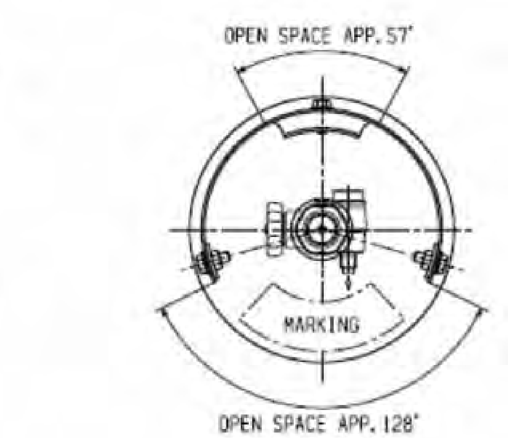
Region for use: Japan

Design Features: Tamper Proof Evident Sticker, Anti-Fill Protection, Dual Phase Valve, Dip Tube attached, Liquid or Vapor Discharge

Certifications: KHK

Cylinder Specifications: 6 Liter Water Capacity, 3.0 MPa Hydraulic Test Pressure, Tare Weight ~4.5kg

Valve Outlet: CGA 166, Left Handed Threads 0.500 – 16 ACME – 2G – LH – EXT



11.3 kg Non Returnable Cylinder Specification

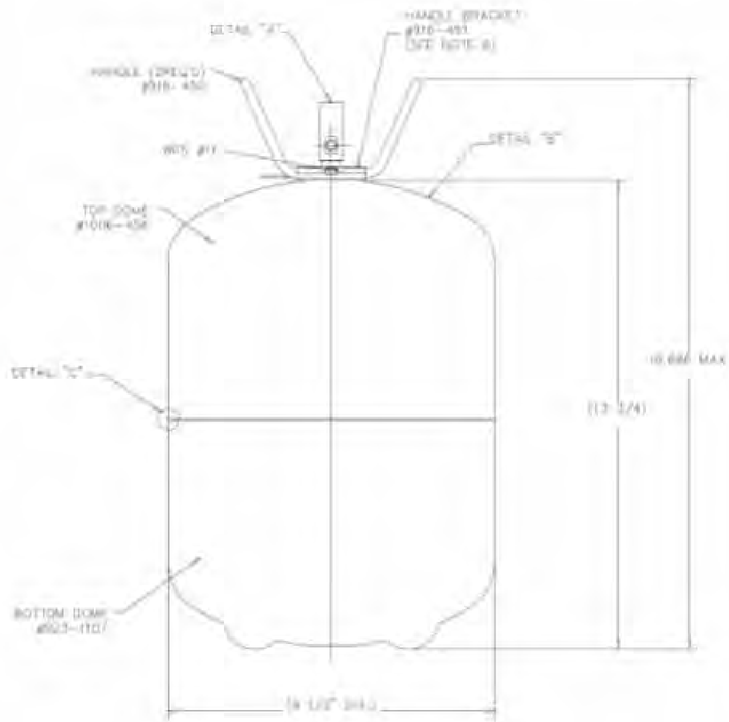
Regions: Asia-Pacific (ex. Japan, Australia and South Korea)

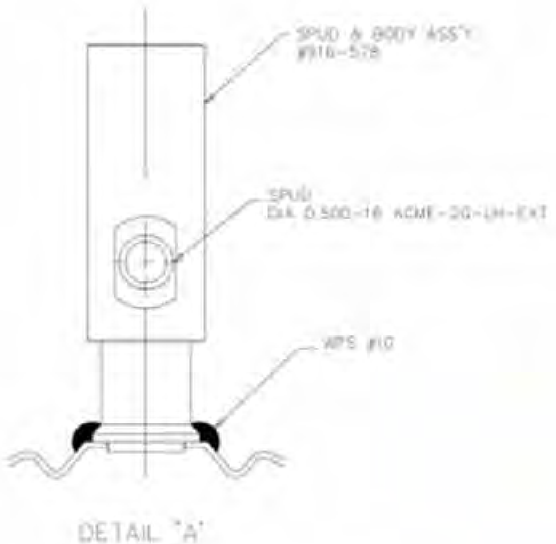
Water Capacity: 29.7 lbs / 13.6 Liters

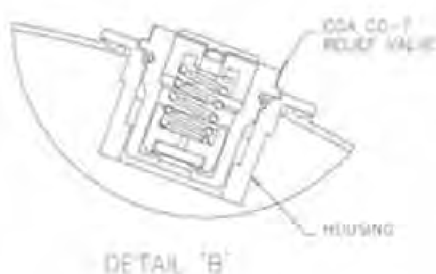
Features: DOT39 Compliant CG-7 with a Pressure Relief Device for flammables

Valve Outlet: CGA 166

Thread Pattern: 0.500 – 16 ACME – 2G – LH – EXT (Left Handed Threads)







11.3 kg Non Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	S-1234-YF	Page	1	of	2
Date:	2/18/13				
Supersedes Spec. No.:					
Change:	J color	Rev 3			
Product:	1234yf				
Location:					

1. Type:
   30 lb. Non-Returnable, Non-Refillable, Steel Cylinder (JUG) (9½ inch)

2. Detail Requirements:

a. **Capacity:** 840 cu. in. (30.4 lbs. w.c.) nominal

b. **Material:** ASTM 620, Class I, drawing quality aluminum killed low carbon steel.

c. **Construction:** Two drawn steel shells, circumferentially welded or brazed, with welded foot ring or extruded feet and steel valve body with welded carrying handle.

Service Pressure: 260 psig
Test Pressure: 325 psig

All cylinders are to be designed, constructed, inspected, leak checked, burst-tested and date coded in accordance with DOT-39 specifications and CGA "Recommended Safe Practices for DOT-39 Fluorocarbon Steel Cylinders."

Deviations from these DOT specifications and CGA recommendations are not authorized.

No modifications in the design of the cylinder, valve, pressure relief device or unit carton may be made without prior authorization from Honeywell.

d. **Valve and Pressure Relief Device:**

Each cylinder to be equipped with a non-refillable valve and pressure relief device as follows:

Valve: Steel valve body with .500-16 ACME-2G-LH-EXT. (CGA 166) threaded outlet, welded into top center of cylinder. A solid stem of glass-filled nylon to be crimped into the valve body. Stem must be in the open position to allow for evacuation and filling of the cylinder. Design of this valve is such that once the stem has been torqued closed, the non-refillable mechanism is activated, thereby preventing refill and allowing only discharge of contents from the cylinder.

11.3 kg Non Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	S-1234-YF	Page	1	of	2
Date:	2/18/13				
Supersedes Spec. No.:					
Change:	J color	Rev 3			
Product:	1234yf				
Location:					

1. Type:

   30 lb. Non-Returnable, Non-Refillable, Steel Cylinder (JUG) (9½ inch)

2. Detail Requirements:

Pressure Relief Device: CGA CG-7 reseating relief device to be welded into upper shoulder of cylinder. Relief device operating range: 340-520 psig.

Cylinders to be shipped with valves open and outlets sealed with push-on plastic caps.

e. **Tare Weight (approximate):** 6 lbs.

f. **Dimensions (approximate):** 9½"O.D. x 16 ½" O.H.

g. **Interior:** Must be dry, clean and free of rust, oil, water and other foreign matter.

h. **Markings:** Cylinders and unit cartons to be legibly date coded in accordance with CGA "Recommendations". Silk screen to bear required DOT-39 markings

i. **Painting & Printing:** Cylinders to be thoroughly dried in preparation for painting. Paint to be uniformly applied to exterior surface, relief disc cup and handle. Paint color and silk screen decoration are as follows:

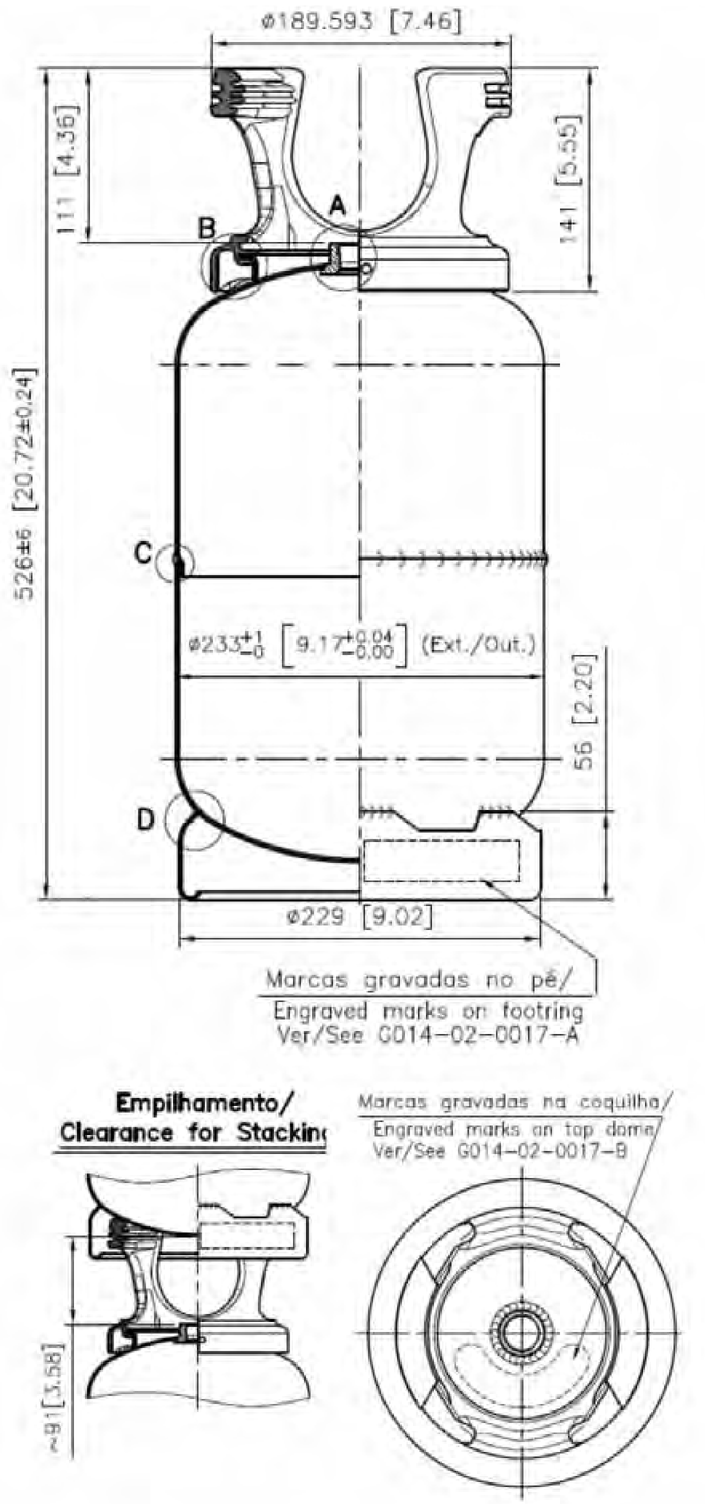
Solstice 1234YF- Cylinder to be painted white, valve opening to be protected from overspray.
A contrasting 2" wide red [Pantone 485C] band is to be painted around the circumference of the cylinder positioned just below the cylinder shoulder radius at the top of the cylinder, per SAE J2844, AHRI Guideline N-2008: 4.8

Silk screen to be centered with valve outlet
Silk screen and paint must be thoroughly dried before cylinder is packed into shipper carton.

j. **Carton:** Each cylinder to be packed into a single unit carton, positioned so that the valve outlet points toward the die cut circular hole. Scored top flaps to be folded inward, securing the handles. Top flaps to be stapled twice or glued. Bottom flaps may be stapled or glued. Cylinders/cartons to be unitized for shipment on four-way entry wooden pallets, measuring 36" x 48", or 38" x 48", in accordance with instructions from receiving location.

Cartons are to be constructed to Honeywell specification no. S-6807-13.

11.3 kg Returnable Cylinder Specification



Regions: Asia-Pacific (ex. Japan)

Water Capacity: 29.7 lbs / 13.6 Liters

Features: Light weight and plastic handles for easy transport, dual phase valve for gas or liquid discharge

Valve Outlet: CGA 166

Thread Pattern: 0.500 – 16 ACME – 2G – LH – EXT (Left Handed Threads)

11.3 kg Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	M-8100yf	Page 1 of 2	
Date:	2/18/13		
Supersedes Spec. No.:	New	Rev 1	
Change:	J color		
Product:	1234yf		
Location:	Danville		

1. Type:
   Returnable Steel Cylinder 30.0 lbs. water capacity
   DOT 4BA400/TC4BAM28/EN

2. Detail Requirements:

   a. **Capacity:** 30.0 lbs. water

   b. **Material:** Open hearth or electric steel with minimum wall thickness of 0.090 in.

   c. **Construction:** To comply with DOT/TC 4BA/EN specifications for a service pressure of 400 psig. Collar to be heavy gauge 270 degree style with a 1/4" hole drilled opposite the opening; foot ring to be heavy gauge. Foot rings and collars to be nestable for stacking.

   d. **Opening:** Top spud to have 3/4 in.-14NGT opening.

   e. **Valve and Pressure Relief Device:**

   Option A: Neriki air-activated liquid/vapor valve #DCU-2-018-1A with .500-16ACME-LH-EXT (CGA 166) outlet and replaceable pressure relief valve #3EA-003-2 installed. Valve inlet CGA ¾-14NGT Taper 1/16

   The start-to-discharge pressure of the relief valve must be between 600 and 800 psig; the flow rating pressure shall not exceed 800 psig. Each valve to be assembled with a securely clamped polyethylene dip tube extending to the base of the cylinder. Valve to be installed such that the outlet faces the handle opening.

   f. **Tare Weight:** Approximately 18.8 lbs.

   g. **Dimensions:** 9 in. diameter x 20 in. height.

   h. **Interior:** Must be dry, clean, and free of rust, oil, water and other foreign matter.

11.3 kg Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	M-8100yf	Page	2	of	2
Date:	2/18/13				
Supersedes Spec. No.:	New	Rev 1			
Change:	J color				
Product:	1234yf				
Location:	Danville				

1. Type:
   Returnable Steel Cylinder 30.0 lbs. water capacity
   DOT 4BA400/TC4BAM28/EN

2. Detail Requirements:

i. **Markings:** Collar to bear required DOT/TC 4BA/EN markings and manufacturer's registered symbol and serial number. Purchaser's identification to be included as follows:

"Honeywell"

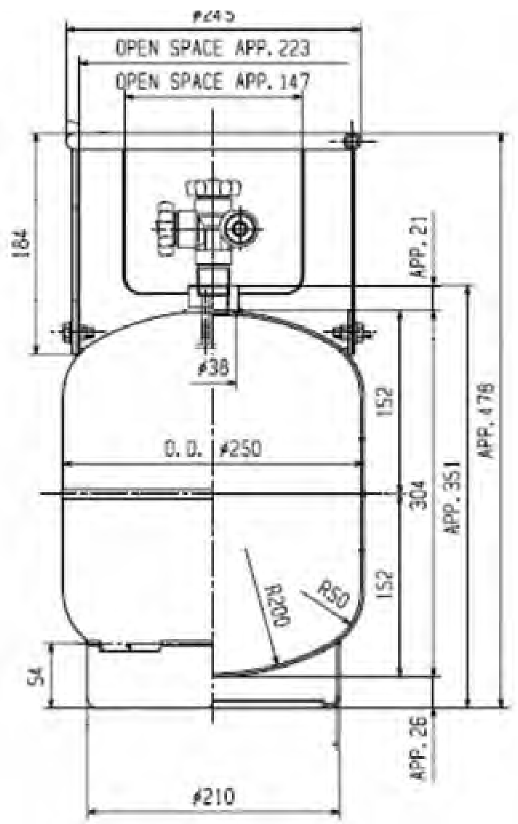
Tare weight of cylinder, including valve, to be stamped on collar.

j. **Painting:** Solstice® **1234YF**- Cylinder to be painted white, valve opening to be protected from overspray. A contrasting 2" wide red [Pantone 485C] band is to be painted around the circumference of the cylinder positioned just below the cylinder shoulder radius at the top of the cylinder, per SAE J2844, AHRI Guideline N-2008: 4.8.

k. **Test Reports:** Cylinder test reports are to be sent to:

Honeywell
Fluorine Products
101 Columbia Road
Morristown, NJ. 07962
ATTN: The Buyers Name associated with the PO

10 kg KHK Returnable Cylinder Specification



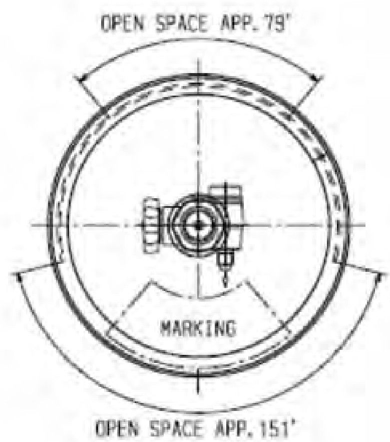
Region for use: Japan

Design Features: Tamper Proof Evident Sticker, Anti-Fill Protection, Dual Phase Valve, Dip Tube attached, Liquid or Vapor Discharge

Certifications: KHK

Cylinder Specifications: 11.8 Liter Water Capacity, 3.0 MPa Hydraulic Test Pressure, Tare Weight ~7kg

Valve Outlet: CGA 166, Left Handed Threads 0.500 – 16 ACME – 2G – LH – EXT



45.3 kg Returnable Cylinder Specification

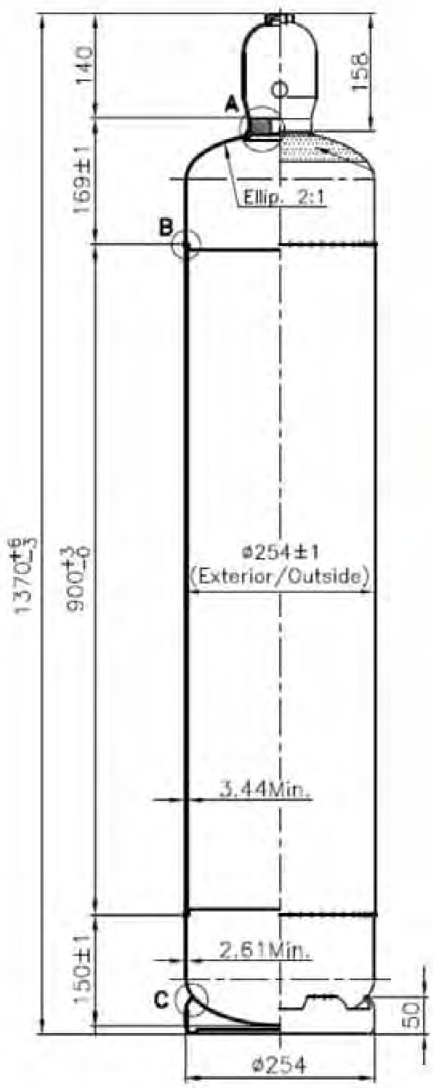
Regions: Asia-Pacific (ex. Japan)

Water Capacity: 123 lbs / 55.8 Liters

Features:
Manageable size cylinders in tight spaces and good capacity for lower production environments

Valve Outlet:
CGA 670
Dual Phase

Thread Pattern:
1.030 – 14 NGO –LH – EXT
(Left Handed Threads)



45.3 kg Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	M-8120-YF	Page	1	of	2
Date:	2/18/13				
Supersedes Spec. No.:	New	Rev 1			
Change:	J color				
Product:	1234yf				
Location:					

1. Type:
   Returnable Steel Cylinder 123 lbs. Water Capacity
   DOT 4BW400/TC4BWM27/EN

2. Detail Requirements:

a. **Capacity:** 123 lbs. water, minimum.

b. **Material:** Open hearth or electric steel of prescribed analysis.

c. **Construction:** Longitudinally welded shell with ellipsoidal head welded to each end, with welded foot ring and 3 1/8”-11 TPI spud welded on top for valve cover. Construction to comply with U.S. Department of Transportation (DOT) and Transport Canada (TC) 4BW specifications for a service pressure of 260 psig.

d. **Opening:** Top spud to have ¾”-14 NGT opening. Cylinders to be equipped either with a specified valve and dip tube or a steel plug, installed wrench tight to prevent accumulation of moisture and contamination. Cylinders to be supplied with valve covers.

e. **Valve and Pressure Relief Device:**

Option A:

Neriki air-activated liquid/vapor valve #D-7CU-502-2 with.1.030-14NGO--LH-EXT (CGA 670) outlet and replaceable pressure relief valve #3EA-003-2 installed.

Valve inlet CGA ¾-14NGT Taper 1/16

The start-to-discharge pressure of the relief valve must be between 600 and 800 psig; the flow rating pressure shall not exceed 800 psig.

Each valve to be assembled with a securely clamped polyethylene dip tube extending to the base of the cylinder. Valve to be installed such that the outlet faces the handle opening.

f. **Tare Weight:** 65 lbs. (approximate) with valve and cap.

g. **Dimensions:** (Approximate) 10” O.D. x 48” from bottom of foot ring to top face of threaded opening.

h. **Interior:** Must not contain in excess of 1.5 grams of particulate matter (rust, slag, scale and other solids) and must show no evidence of moisture or oil.

45.3 kg Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	M-8120-YF	Page	2	of	2
Date:	2/18/13				
Supersedes Spec. No.:	New	Rev 1			
Change:	J color				
Product:	1234yf				
Location:					

1. Type:
   Returnable Steel Cylinder 123 lbs. Water Capacity
   DOT 4BW400/TC4BWM27/EN

2. Detail Requirements:

i. **Markings:** Shoulder to bear required DOT/TC 4BW/EN markings and manufacturer's registered symbol and serial number. Owner's registered symbol to be stamped on shoulder, opposite the DOT/TC markings, as follows:

"Honeywell"

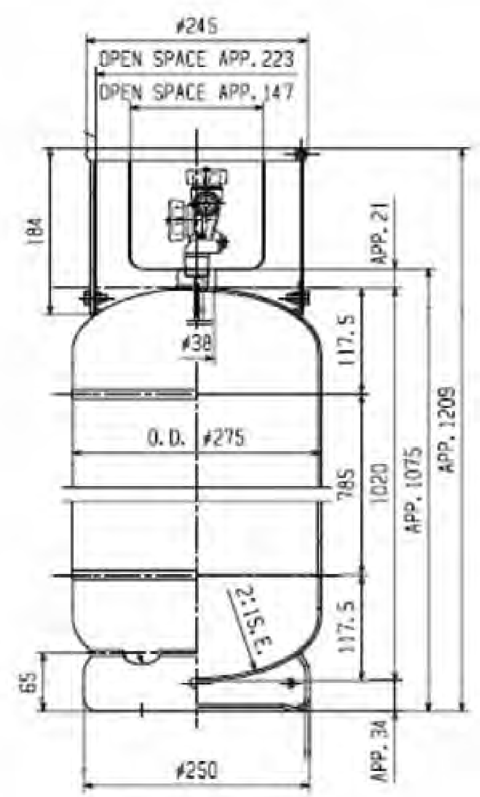
Tare weight of cylinder (include 1¾ lbs. for valve) to be stamped on shoulder.

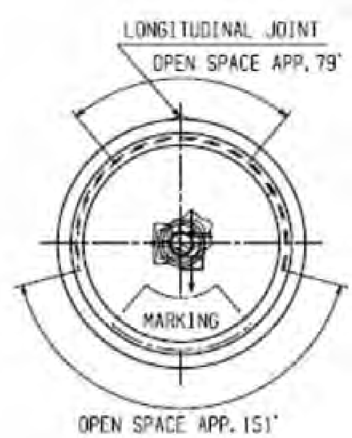
j. **Painting:** Solstice® 1234YF- Cylinder to be painted white, valve opening to be protected from overspray. A contrasting 2" wide red [Pantone 485C] band is to be painted around the circumference of the cylinder positioned just below the cylinder shoulder radius at the top of the cylinder, per SAE J2844, AHRI Guideline N-2008: 4.8.

k. Test Reports: Cylinder test reports are to be sent to:

Honeywell
Fluorine Products
101 Columbia Road
Morristown, NJ. 07962
Attn: The purchasing contact indicated on the PO

50 kg KHK Returnable Cylinder Specification





Region for use: Japan

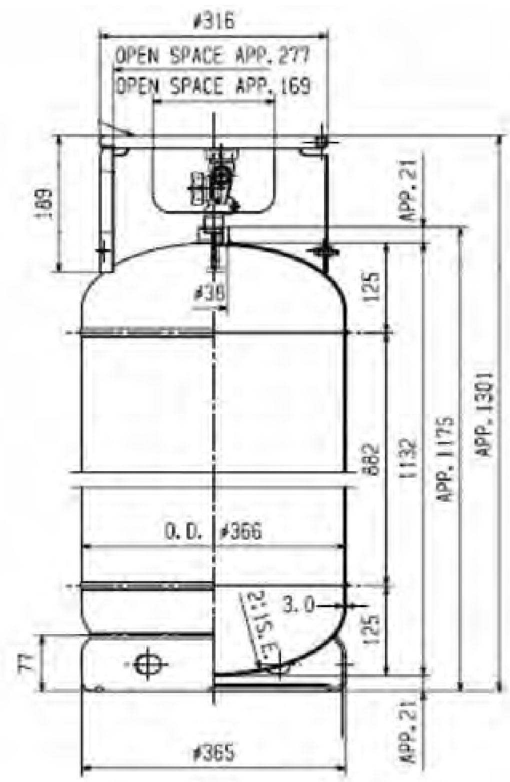
Design Features: Tamper Proof Evident Sticker, Anti-Fill Protection, Dual Phase Valve, Dip Tube attached, Liquid or Vapor Discharge

Certifications: KHK

Cylinder Specifications: 54 Liter Water Capacity, 3.0 MPa Hydraulic Test Pressure, Tare Weight ~24kg

Valve Outlet: CGA 670, Left Handed Threads 1.030 – 14 NGO – LH – EXT

100 kg KHK Returnable Cylinder Specification



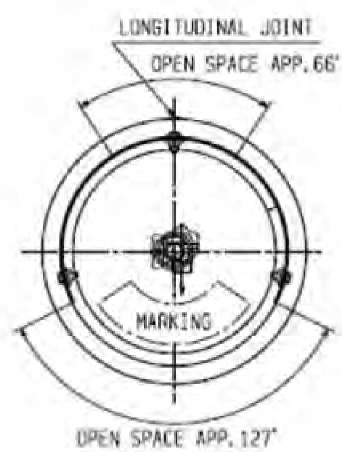
Region for use: Japan

Design Features: Tamper Proof Evident Sticker, Anti-Fill Protection, Dual Phase Valve, Dip Tube attached, Liquid or Vapor Discharge

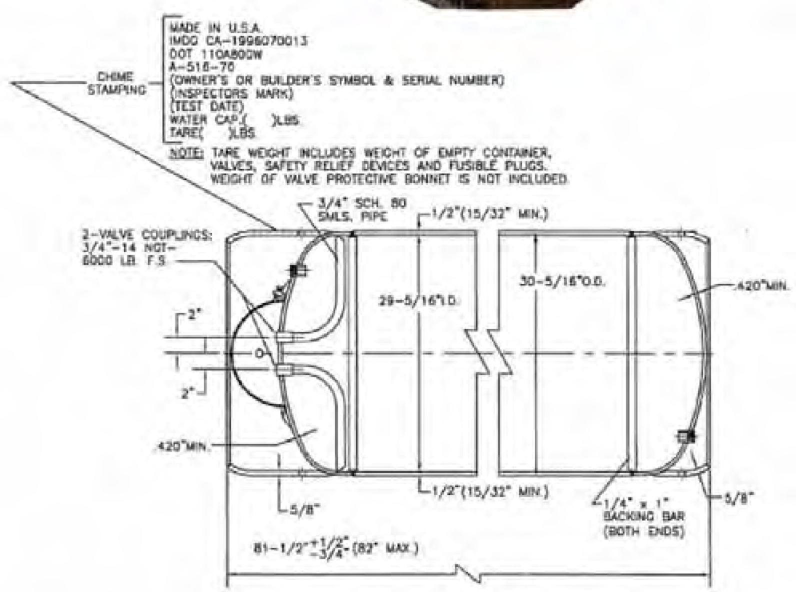
Certifications: KHK

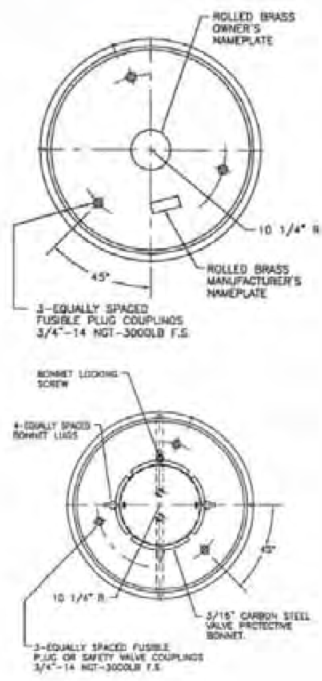
Cylinder Specifications: 108 Liter Water Capacity, 3.0 MPa Hydraulic Test Pressure, Tare Weight ~38kg

Valve Outlet: CGA 670, Left Handed Threads 1.030 – 14 NGO – LH – EXT



794 kg Returnable Cylinder Specification





Regions: Asia-Pacific (ex. Japan)

Water Capacity: 1600 lbs

Features: Utilized as a mini-Bulk tank, enough capacity for high production, requires special equipment to maneuver

Valve Outlet: CGA 670, Single Outlet (x2)

Thread Pattern: 1.030-14NGO-LH-EX

794 kg Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	S-7816yf	Page 1 of 2	
Date:	2/18/13		
Supersedes Spec. No.:	New	Rev 1	
Change:	J color		
Product:	1234yf		
Location:	Danville		

1. Type:
   "Ton Cylinder" Multi Unit Tank Car Tank
   DOT-110A800W

2. Detail Requirements:

   a. **Capacity:** 1600 lbs. water, minimum
   1674 lbs. water, average

   b. **Material:** Carbon steel plate. Composition and thickness of steel to be in accordance with DOT-110A800W specification.

   c. **Construction:** Cylindrical steel shell with fusion-welded heads formed concave to pressure. Construction to comply with DOT-110A800W specification.

   d. **Openings:** Each head to have three equally spaced ¾"-14 NGT couplings (for pressure relief devices). One head to have two ¾"-14 NGT valve couplings spaced 4" apart on center line. Each valve coupling to be connected to a ¾" schedule 80 eduction pipe. Two valves, Neriki # D-7CU-602-1A , to be installed.

   e. **Pressure Relief Device & Valves:**
   Tank to be equipped with five fusible plugs. Neriki # S-1-010-1, with two installed on valve end and three on opposite end. One relief valve, Neriki # S-1-009-1, to be installed on valve end.

   f. **Tare Weight:** (average) 1425 lbs. (complete with fittings and bonnet)

   g. **Dimensions:** 30 5/16" O. D. x 81 ½" + ½" – ¾" L.

   h. **Interior:** Must be dry, clean, and free of rust, oil, water and other foreign matter.

794 kg Returnable Cylinder Specification

Honeywell
Fluorine Products
P.O. Box 1053
Morristown, NJ 07962-1053

Container Purchase Specifications

Spec No.:	S-7816yf	Page	2	of	2
Date:	2/18/13				
Supersedes Spec. No.:	New	Rev 1			
Change:	J color				
Product:	1234yf				
Location:	Danville				

1. Type:
   "Ton Cylinder" Multi Unit Tank Car Tank
   DOT-110A800W

2. Detail Requirements:

i. **Markings:** Tank is to be marked on the valve end chime in accordance with 49CFR, Section 179.30018(a). Marking to include owner's registered symbol, as follows, and tare weight.

"Honeywell"

Brass owner's nameplate to be stamped with the following information:

HONEYWELL--MORRISTOWN, NEW JERSEY (circumferentially in ¼" letters)

DOT-110A800W	(5/16" letters)
SOLSTICE®	(1/2" letters)
SERIAL	(1/4" letters)
TEST DATE	(1/4" letters)
TARE LBS.	(1/4" letters)

j. **Painting:** Solstice® 1234YF- Cylinder to be painted white, valve opening to be protected from overspray. A contrasting 2" wide red [Pantone 485C] band is to be painted around the circumference of the cylinder positioned just below the cylinder shoulder radius at the top of the cylinder, per SAE J2844, AHRI Guideline N-2008: 4.8.

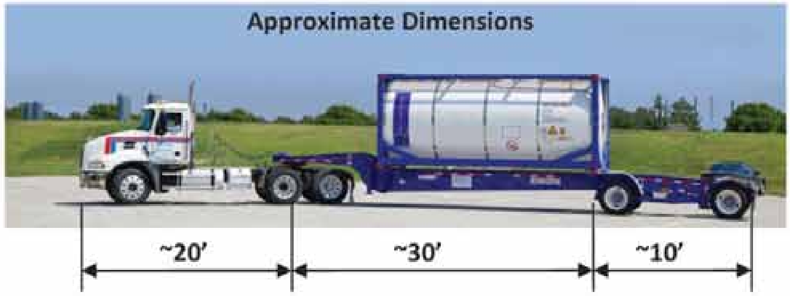
k. **Test Reports:** Copies of complete test reports are to be supplied to Honeywell, Morristown, NJ office.
Attn: To the buyer issuing the PO
Tank manufacturer will also maintain copies of these reports.

l. **Miscellaneous:** Tank to be shipped with all fittings and protective bonnet installed.

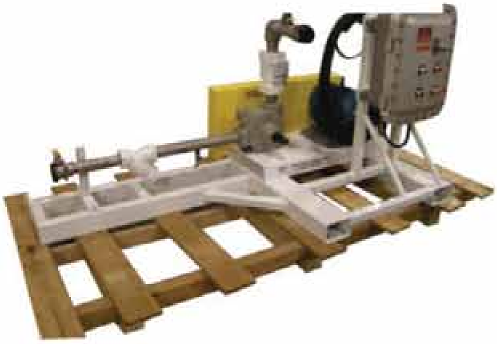
Delivery Quantity: 33,000 lbs / 15,000 kg

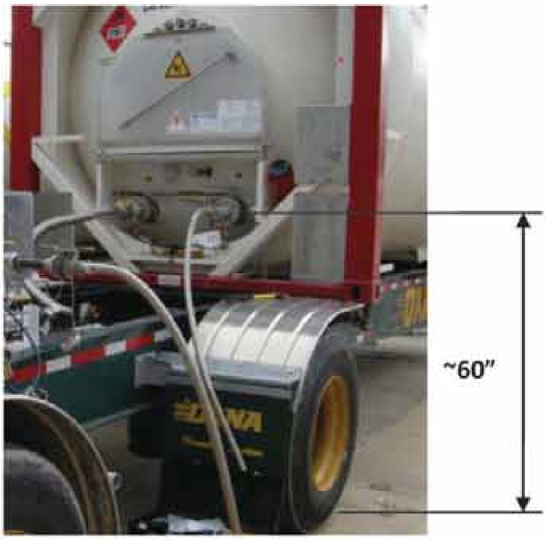
Water Capacity:
6,470 gals / 24,500 liters

Features:
Bulk Deliveries for OEM facilities



Quest Unloading Skid Pump





Tank container full specification

EURU504500-8			
GENERAL			
Type	IM5	Group	Gas tank
ISO Type	1 CC	# of compartments	1
Length	20'	Height	8' 6"
Width	8'	T-Code	T50
Regulation	New	Nominal capacity	24,500 l
Manufacturer	GASCON	Maximum gross weight	34,000 kg
Date of manufacturer	11-Oct-2011	Tare weight	7,670 kg
TANK VESSEL			
Max. allowable working pressure	27.50 bar		
Vacuum pressure	1.00 bar		
Test pressure	36.30 bar	Material	CS- P460 NL1 modified
RID design pressure		Design temperature	50 °C
Inside diameter	2386 mm	Design code	ASME sect. Vill div.2 - Stamp U2
Bafles	Yes	Internal lining	Zinc
FRAME			
Frame type	Beam tank	Walkway	No
Stacking	170,000 kgs	Collapsible handrall	No
		Grip lift	No
FITTINGS			
Manhole position	At the rear		
Manhole nominal diameter	500 mm - 20 in		
Number of closures	24		
Closure type	Bolt		
Manhole gasket	PTFE with SS core		
Spill box	Yes with lids		
Callibration card	No		
Guaging fitting	No		

EUROTAINER

Tank container full specification

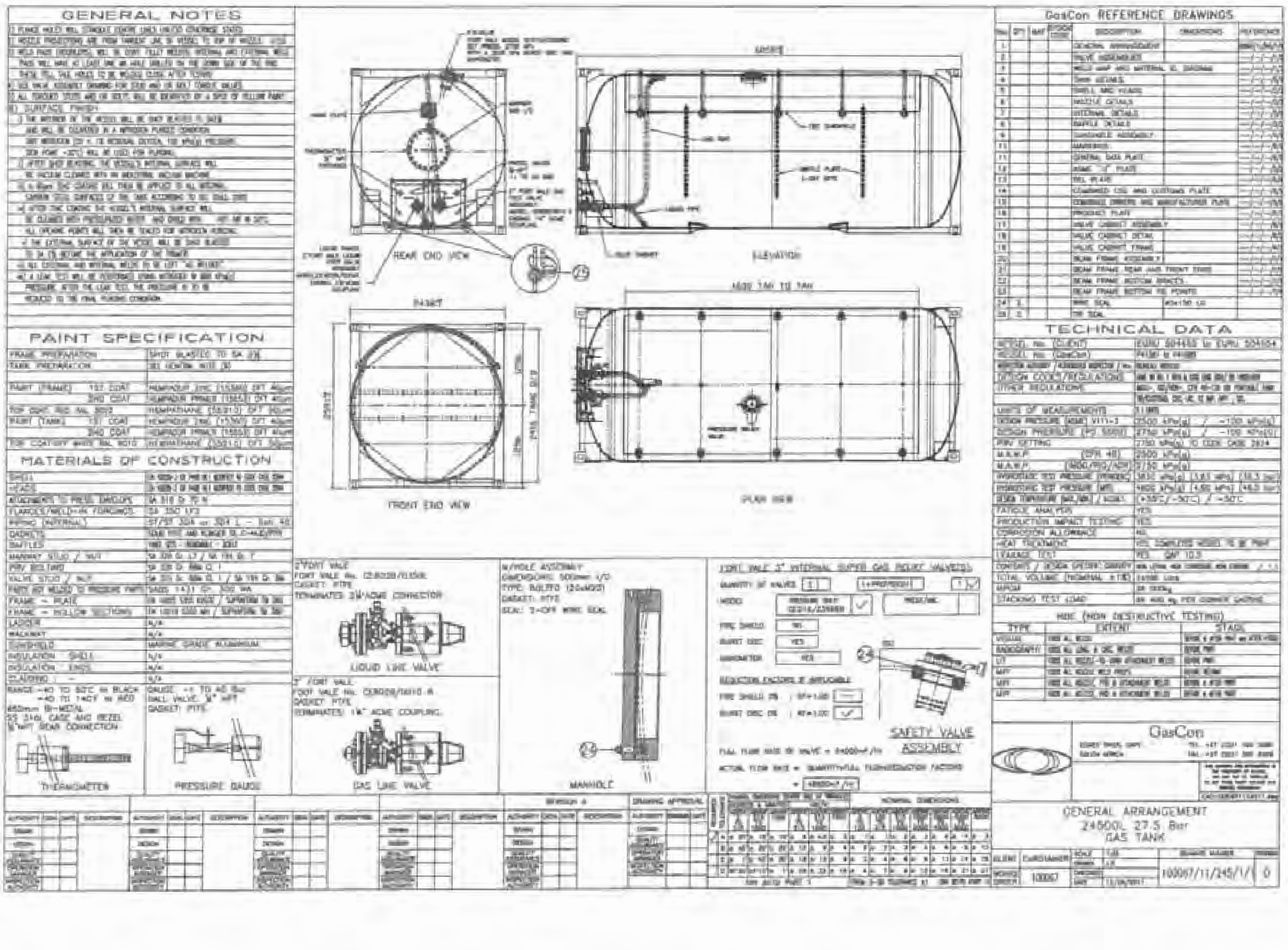
EURU504500-8			
DISCHARGE			
Discharge Type	**Bottom only**		
Liquid Line	Quantity: 1	*Gas Line*	Quantity: 1
Position	At the rear	Position	At the rear
Internal valve type	Stainless steel	Internal valve type	Stainless steel
Internal valve diameter	50 mm - 2 in	Internal valve diameter	50 mm - 2 in
Internal valve brand	Fort Vale	Internal valve brand	Fort Vale
Valve type	Ball-SS	Valve type	Ball-SS
Valve diameter	50 mm - 2 in	Valve diameter	50 mm - 2 in
Valve brand	Fort Vale	Valve brand	Fort Vale
Coupling type	ACME	Coupling type	ACME
Coupling diameter	82.55 mm - 3.25 in	Coupling diameter	44.45 mm - 1.75 in
Closure type	Cap 3"1/4	Closure type	Cap 1"3/4
Gasket between valves	PTFE with SS core	Gasket between valves	PTFE with SS core
SAFETY DEVICES			
Safety devices	1 SRV + 1 BD in series		
Breather	No	Protection cover	No
Relief valve 1 / Brand	Fort Vale		
Relief valve 1 / Type	Stainless steel		
Relief valve 1 / Diameter	80 mm - 3 in		
Relief valve 1 / Settings	27.50 bar - 399 psi		
Flame trap	Yes	Flame trap	No
Manometer	0/40 bar - 0/580 psi		
Rupture disc 1 / Brand	Continental Disc		
Rupture disc 1/Type	SS 316L		
Diameter	80 mm - 3 in		
Settings	30.25 bar - 438.00 psi		

EUROTAINER

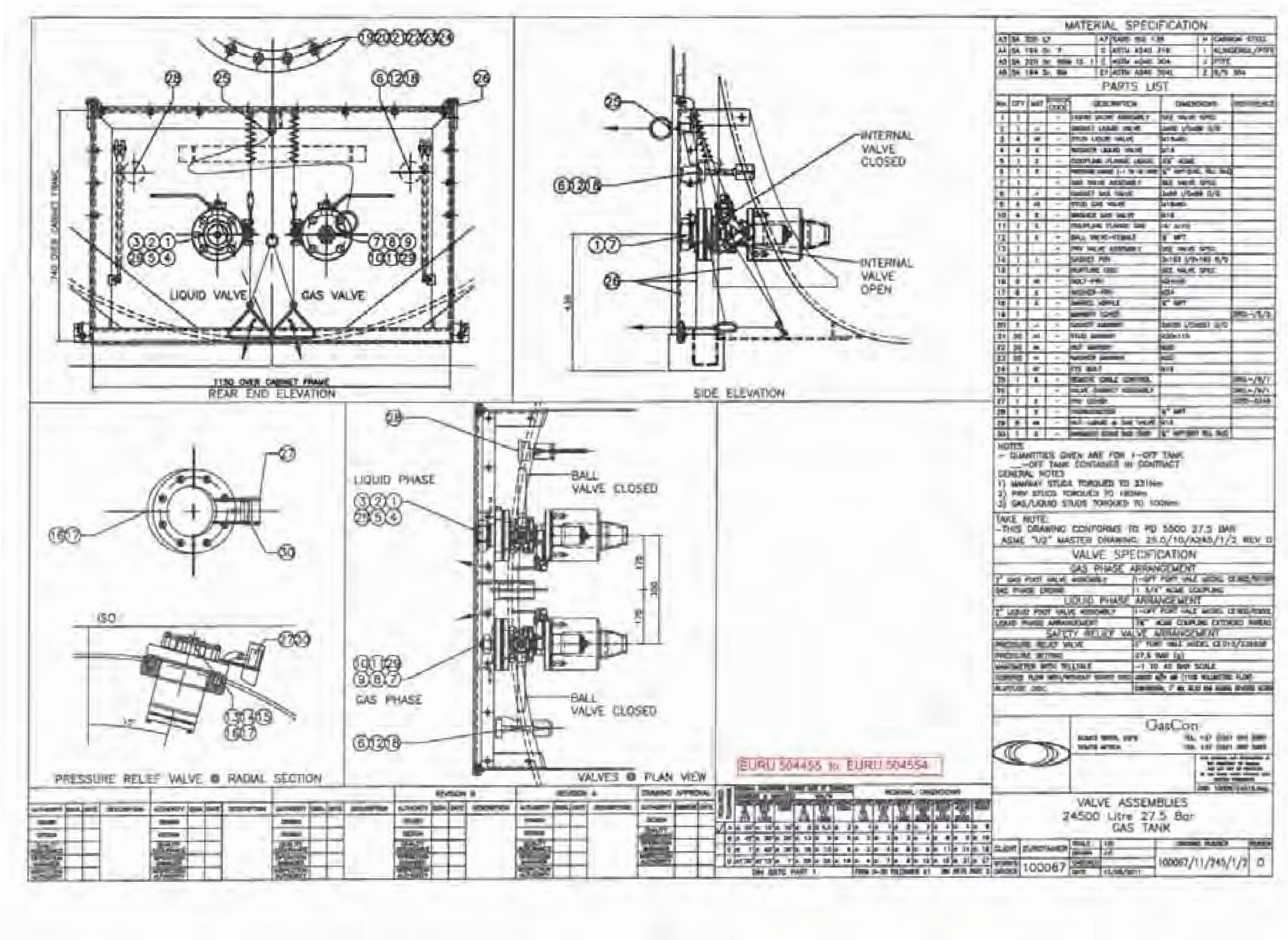
Tank container full specification

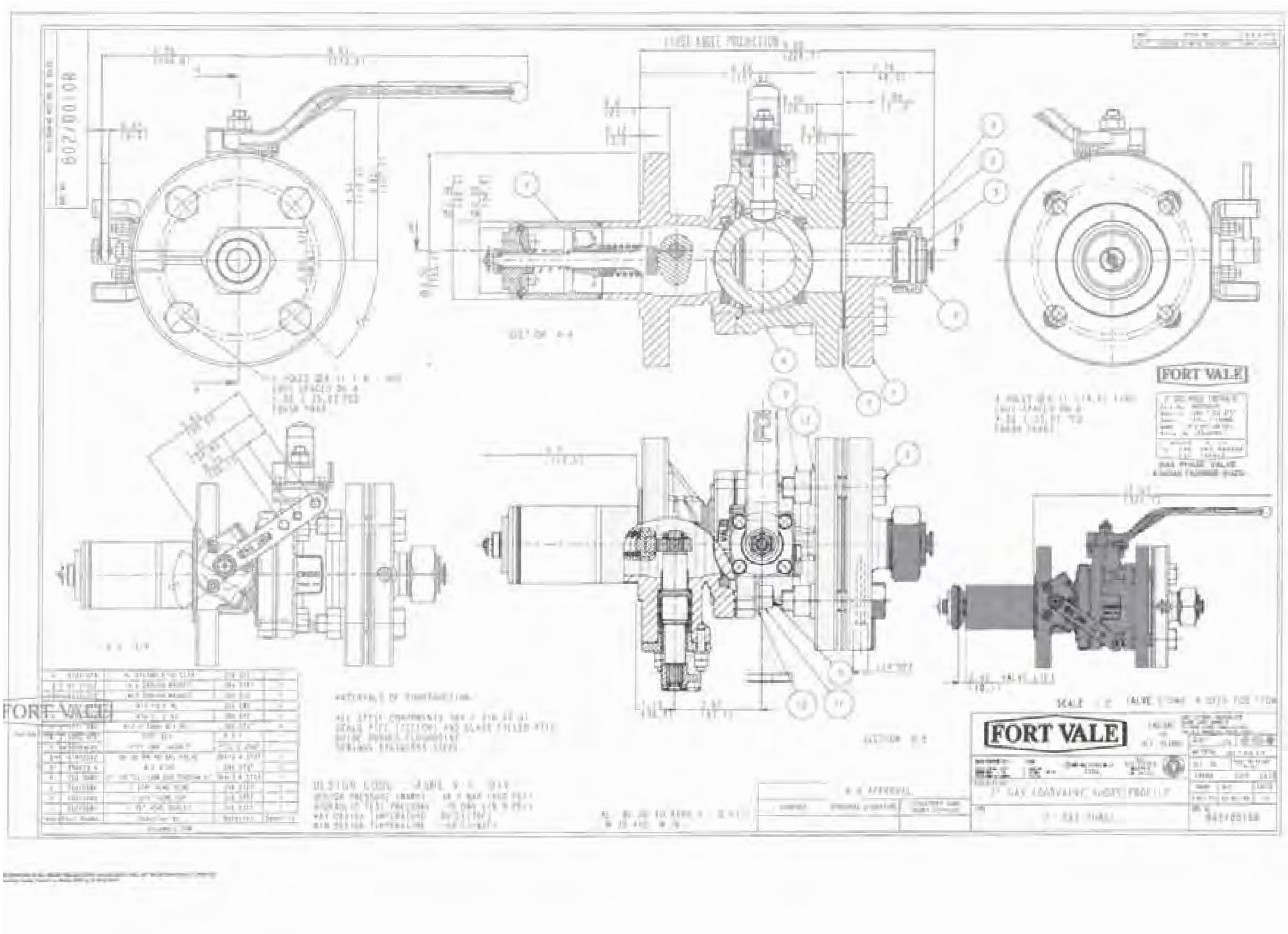
EURU504500-8			
INSULATION			
Composition		Cladding	Not specified
Insulation thickness		Sunshield	Yes
APPROVALS			
CSC	Yes	AAR600	Yes
IMDG	Yes	FRA	No
RID / ADR	Yes	CTC	Yes
US DOT / CFR49	UN + U Stamp 2	Japanese fire approval	No
Exemption	SP 14301	MITI	Hydro tested
UIC	Yes	SQLO	Yes
		TPED	Yes
TEST DATES			
	Last		Next
CSC inspection	11 Oct 2011		11 Oct 2016
Hydraulic test	11 Oct 2011		11 Oct 2016
Air test	11 Oct 2011		11 Apr 2014

ISO Container Specification

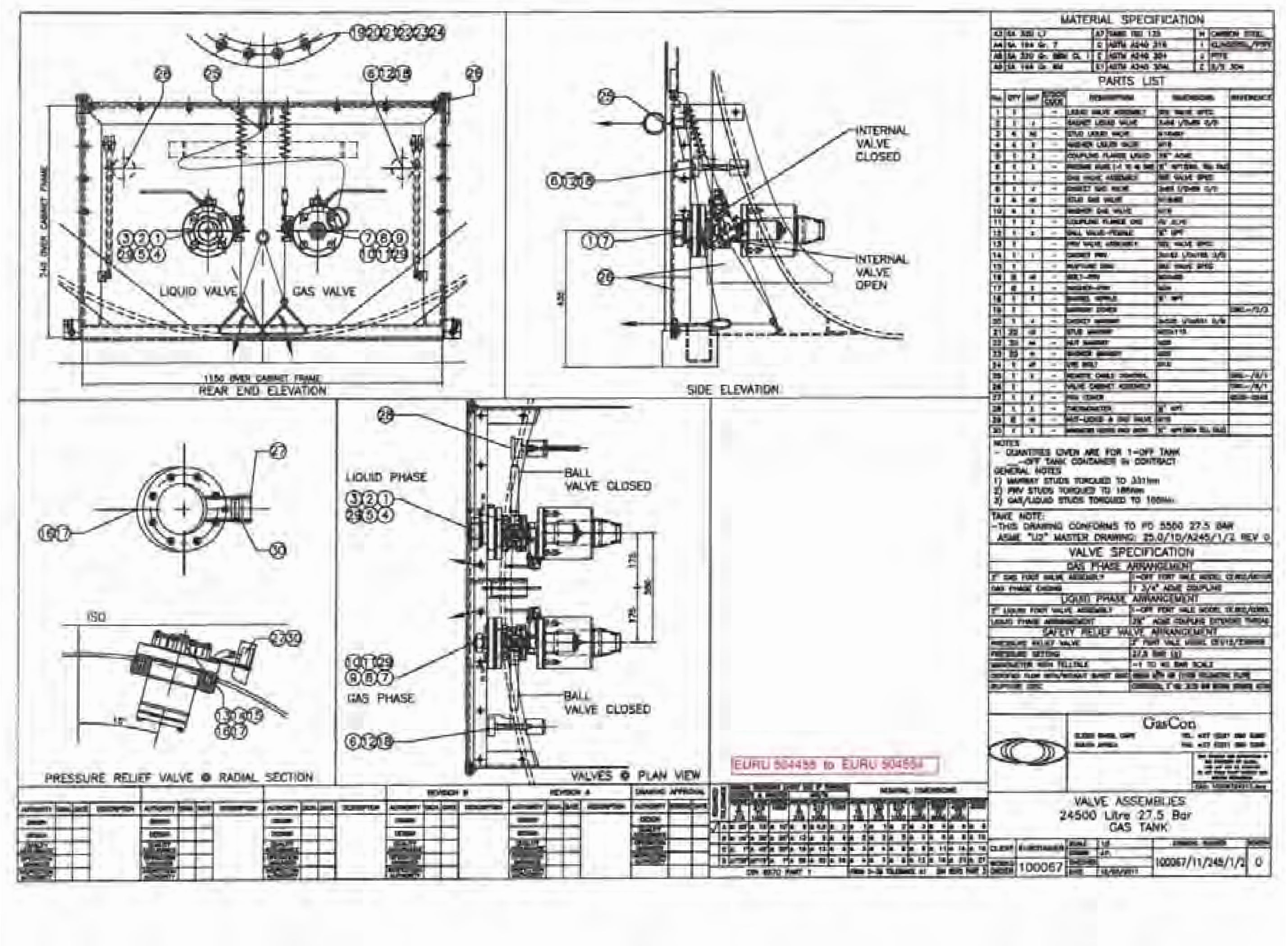


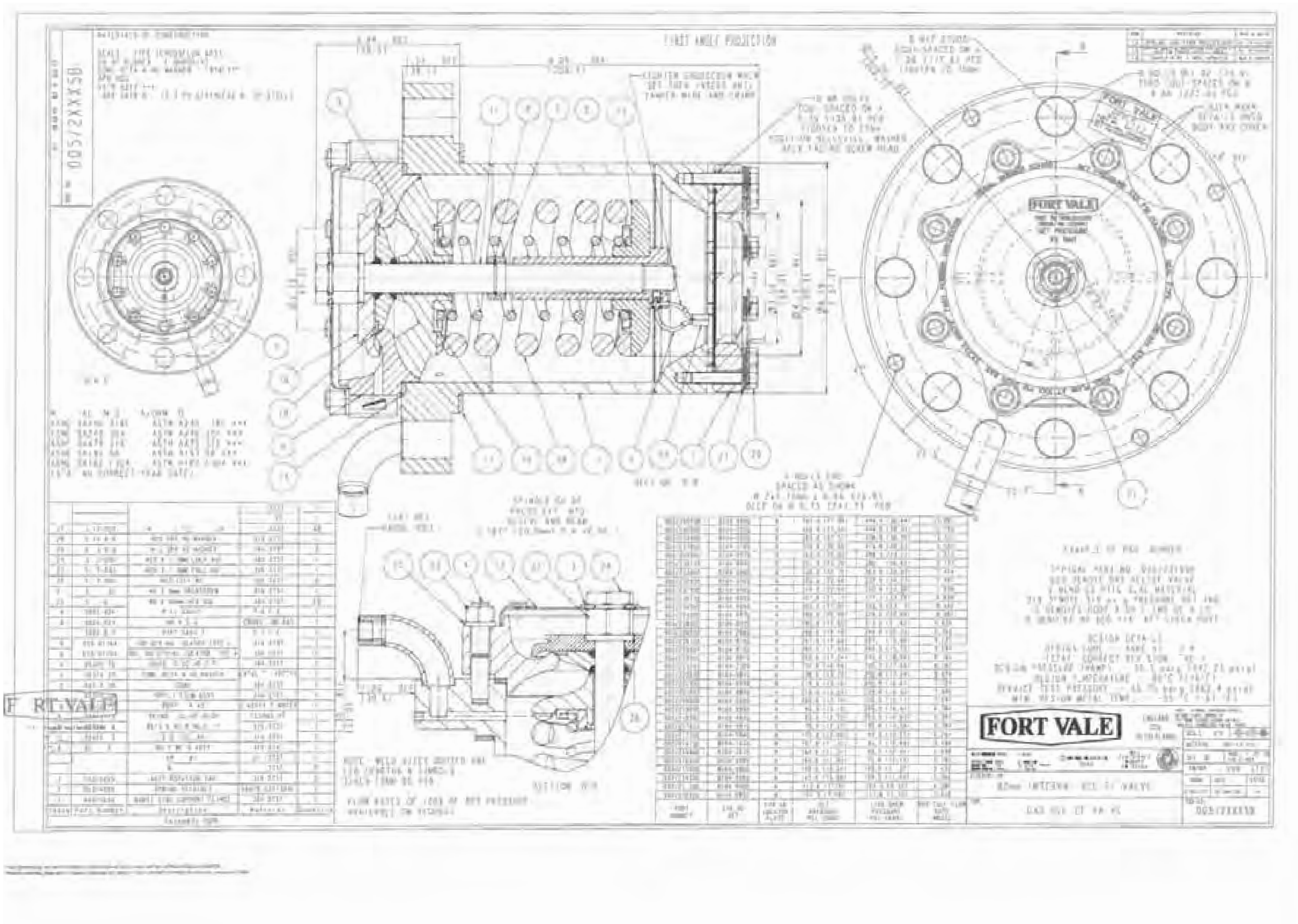
ISO Container Specification



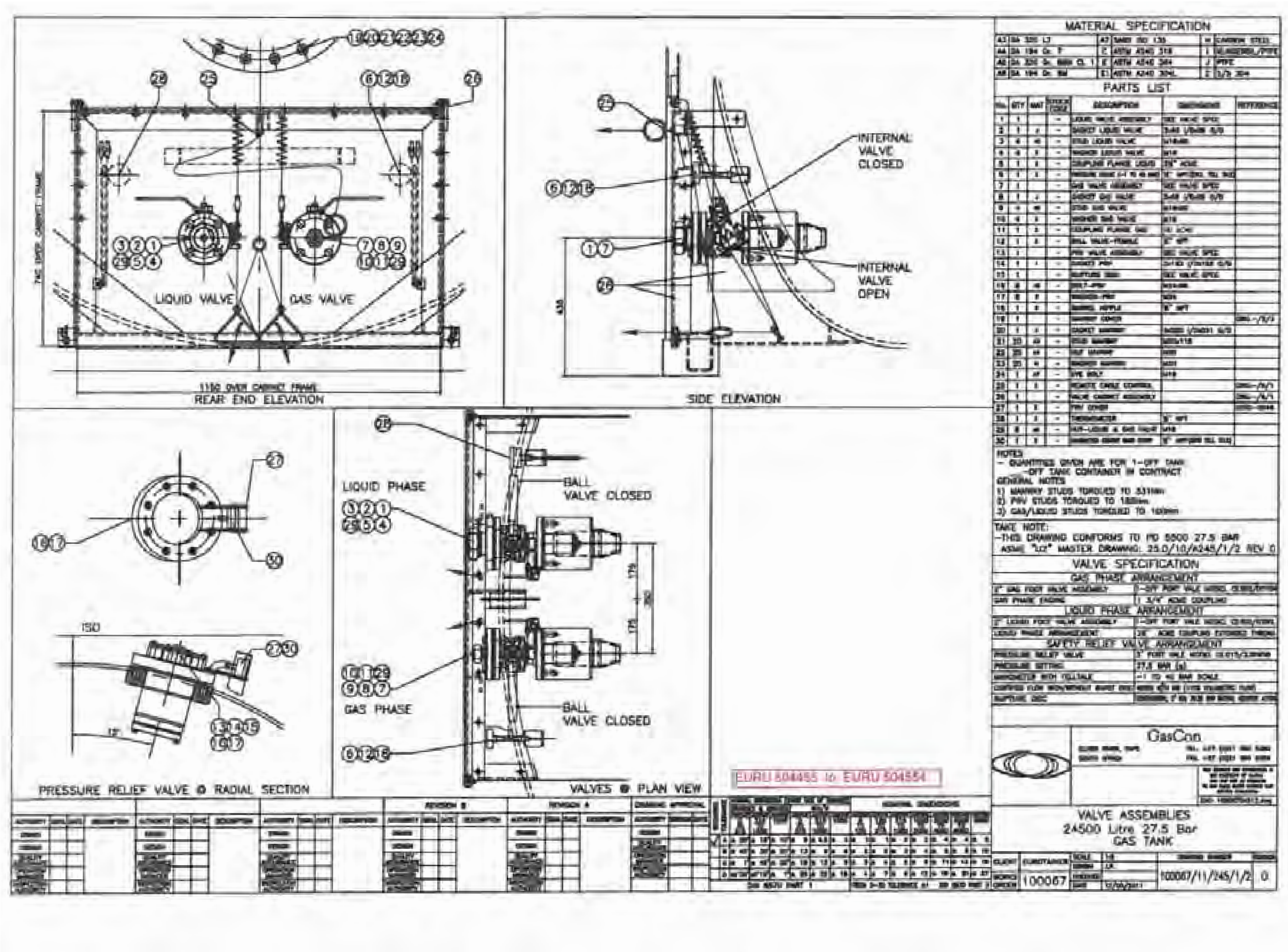

FORT VALE
FORT VALE
FORT VALE

ISO Container Specification

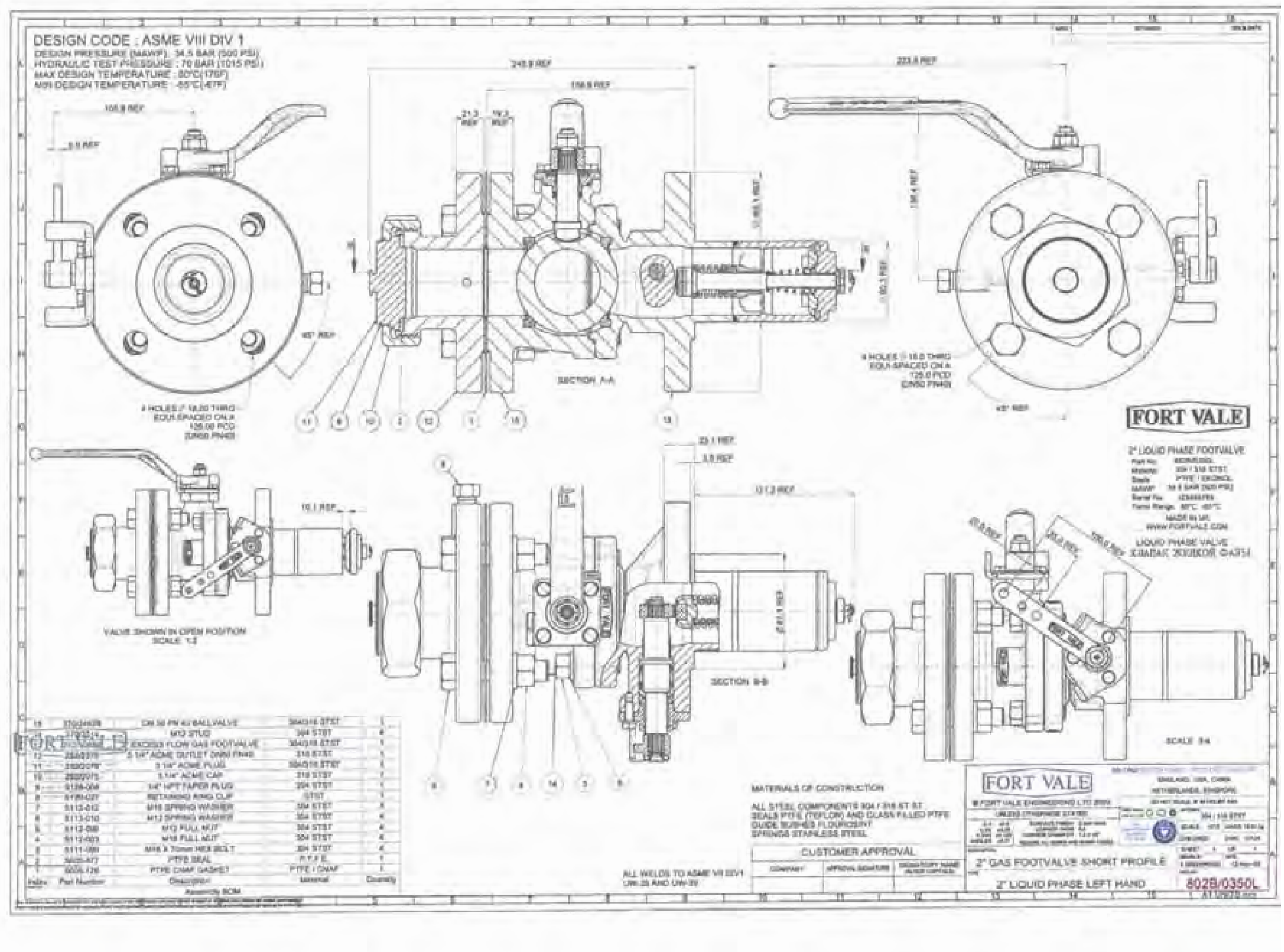



FORT VALE

ISO Container Specification



ISO Container Specification



Cylinder Labels and Tags

Cylinder Labels and Tags

Honeywell

Solstice™ yf Refrigerant (R-1234yf)
2,3,3,3 -TETRAFLUOROPROP-1-ENE
LIQUEFIED GAS, FLAMMABLE, N.O.S. HFO-1234yf

CAS No. : 754-12-1
UN No. : 3161
Net Wt. : KG

DANGER

Hazard statements:
Extremely flammable gas
Contains gas under pressure; may explode if heated.
Other hazards:
Causes asphyxiation in high concentrations. The victim will not realize that he/she is suffocating.
May cause skin, eye and respiratory tract irritation when contacted.
Rapid evaporation of the liquid may cause frostbite.

Notes:
[Safety]
Wear personal protective equipment as required. Keep away from heat / sparks / open flames / hot surfaces.
No smoking.
Do not breathe dust/gas/mist/vapors/spray.
[First aid]
If inhaled, remove personnel to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
In case of spills or leaks, evacuate personnel to safe areas. Remove all sources of ignition. Ventilate the area.
In case of fire, use extinguishing media - water, dry chemical, carbon dioxide or alcohol-resistant foam.
Risk of container bursting. May generate toxic gas on contact with flame or hot surfaces. Use self-contained breathing apparatus.
[Storage]
Keep containers away from direct sunlight and from heat and ignition sources. Keep containers in well-ventilated place. Keep containers at temperature not exceeding 50 degree Celsius.
For more information, please refer to Honeywell Material Safety Data Sheet.

Emergency Numbers
For US Medical Emergencies: +1-800-498-5701 or +1-651-523-0309
For US Transportation Emergencies: +1-800-424-9300 or +1-703-527-3887
In Japan: +(81)-345209637

Honeywell Japan Inc.
1-16-1 Kaigan Minato-ku, Tokyo 105-0022 New Pier Takeshiba South Tower 20F
Tel. +81-3-6730-7106 Fax. +81-3-6730-7221

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Part 5
Valve Specifications and Drawings

5

CGA 166 Valve Specification

Features:

US EPA Compliant Outlet

SAE Recommended Outlet

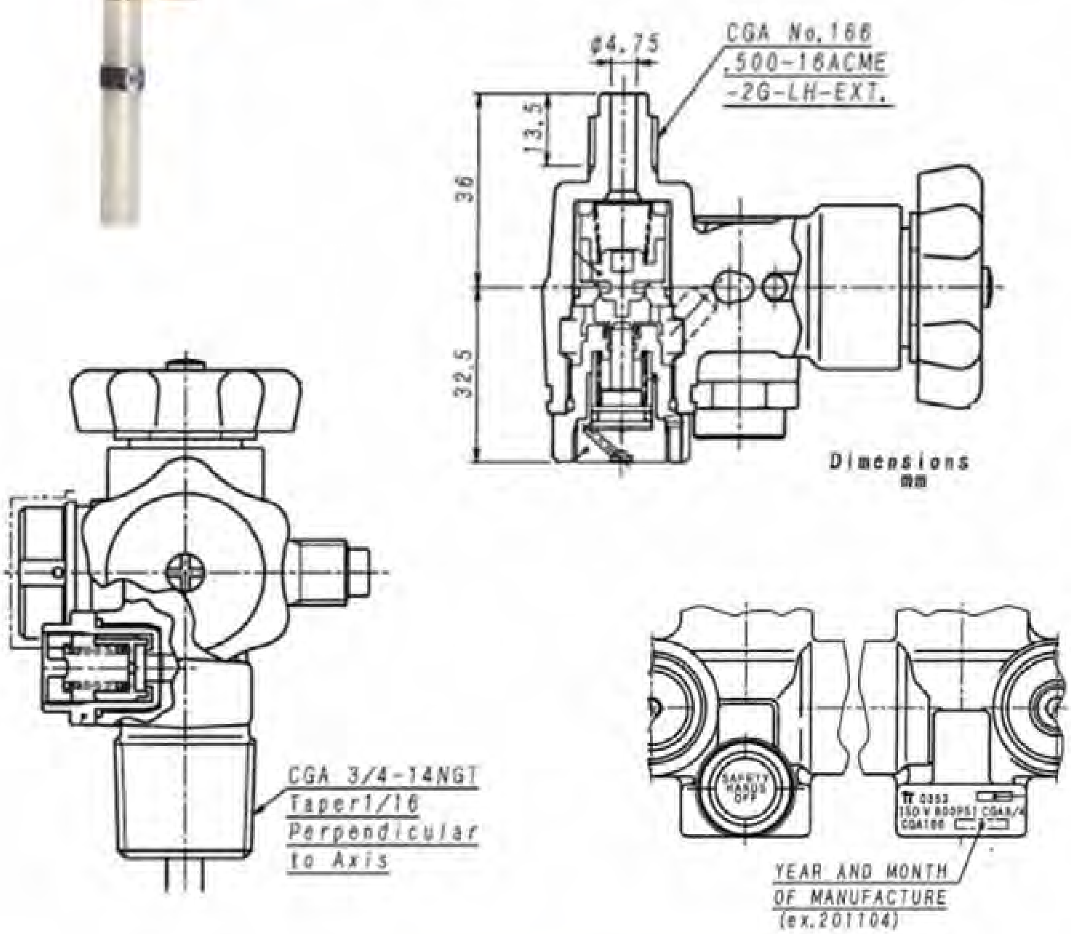
CGA 166 Outlet Connections

Dual Phase Valve

(Red Handle Liquid – Blue Handle Vapor)

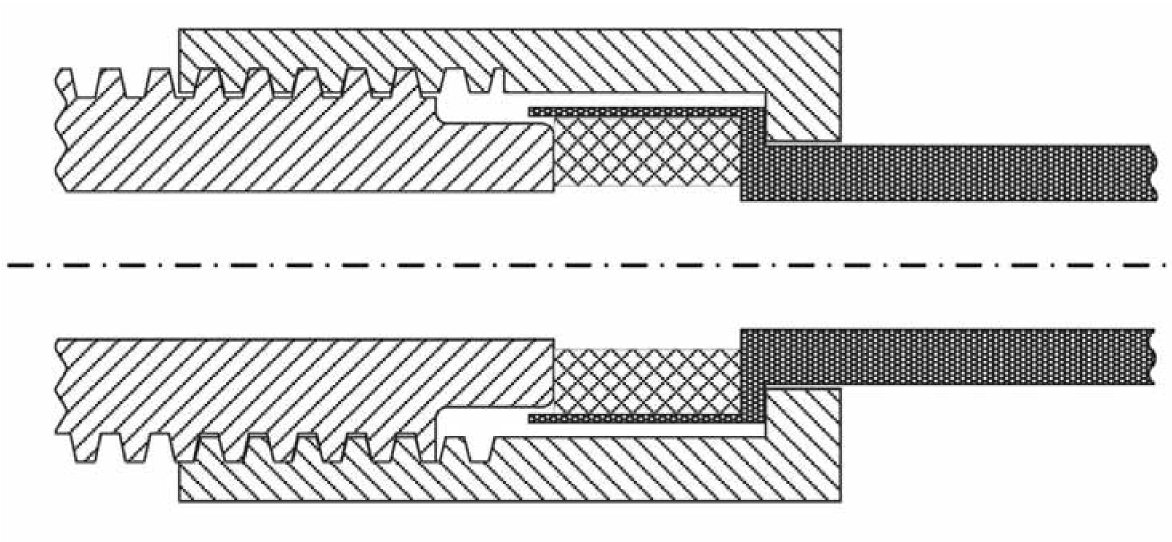
Thread Pattern:

0.500 – 16 ACME – 2G - LH



Cylinder and Hose Connections Solstice™ yf Refrigerant

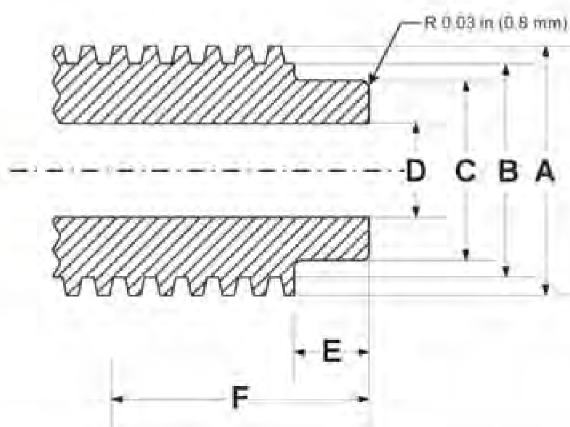
0.500 – 16 ACME – 2G – LH
CGA 166



Cylinder and Hose Connections Solstice™ yf Refrigerant

0.5 – 16 ACME – LH fitting for SAE J2844

Drawing and Dimensions are provided as a convenience only. Individual designs may vary provided a robust, leak tight seal with the cylinder connection is accomplished.

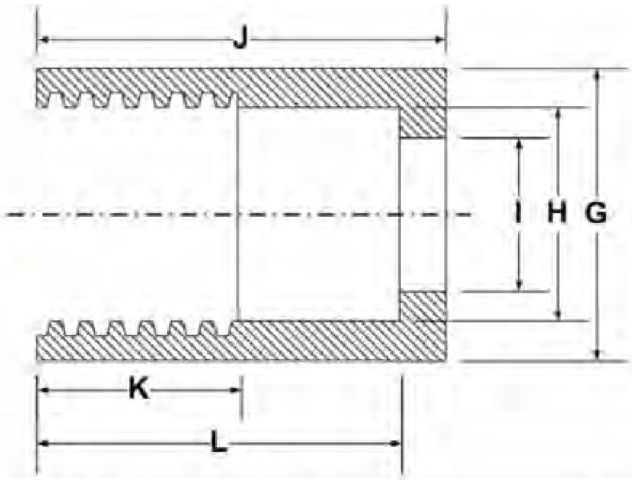


0.500-16 ACME-2G-LH-EXT	SI units	English units
Major Diameter (A)	12.700 – 12.573 mm	0.5000 – 0.4950 in
Minor Diameter (B)	10.858 – 10.411 mm	0.4275 – 0.4099 in
Relief Diameter (C)	9.14 ± 0.25 mm	0.360 ± 0.010 in
Bore Diameter (D)	4.78 ± 0.05 mm	0.188 ± 0.002 in
Cutback (E)	4.1 ± 0.25 mm	0.16 ± 0.01 in
Full Thread (F)	13.51 mm (min.)	0.532 in (min.)
Pitch Diameter	11.762 – 11.466 mm	0.4631 – 0.4514 in

Cylinder and Hose Connections Solstice™ yf Refrigerant

0.5 – 16 ACME – LH fitting for SAE J2844

Drawing and Dimensions are provided as a convenience only. Individual designs may vary provided a robust, leak tight seal with the cylinder connection is accomplished.



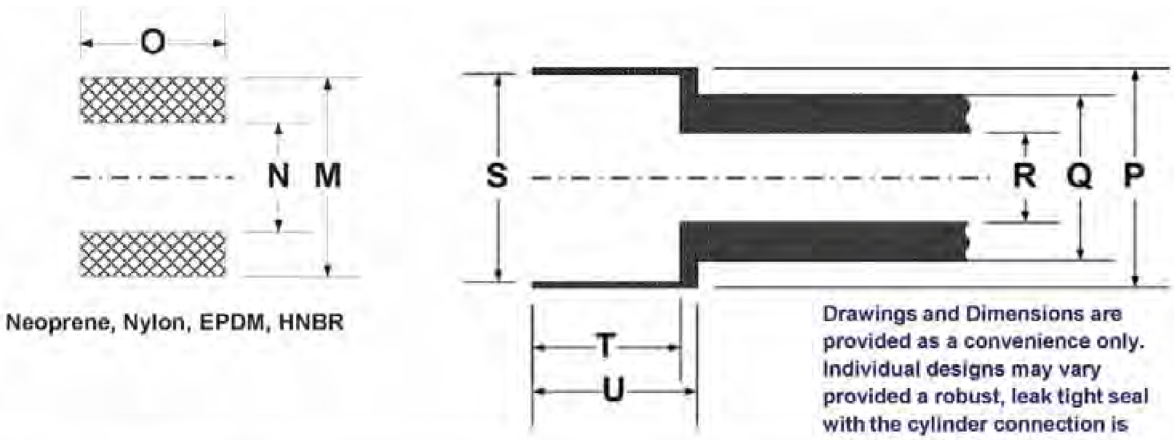
0.500-16 ACME-2G-LH-INT	SI units	English units
Diameter (G)	17.5 mm	11/16 in
Bore Diameter (H)	10.41 ± 0.25 mm	0.410 ± 0.010 in
Hole Diameter (I)	7.87 – 8.13 mm	0.310 – 0.320 in
Length (J)	21.34 mm	0.840 in
Full Thread (K)	10.16 – 10.67 mm	0.400 – 0.420 in
Length (L)	18.54 mm	0.730 in
Major Diameter	12.954 – 13.208 mm	0.5100 – 0.5200 in
Minor Diameter	11.113 – 11.240 mm	0.4375 – 0.4425 in
Pitch Diameter	11.908 – 12.205 mm	0.4688 – 0.4805 in

Knurl Finish

CGA 166 Valve Specification

Cylinder and Hose Connections Solstice™ yf Refrigerant

0.5 – 16 ACME – LH fitting for SAE J2844



Drawings and Dimensions are provided as a convenience only. Individual designs may vary provided a robust, leak tight seal with the cylinder connection is accomplished.

Washer & Nipple	SI units	English units
Diameter (M)	9.27 ± 0.08 mm	0.365 ± 0.003 in
Hole Diameter (N)	5.08 mm	0.200 in
Length (O)	6.73 mm	0.265 in
Shoulder Diameter (P)	9.91 – 10.01 mm	0.390 – 0.394 in
Shank Diameter (Q)	7.49 – 7.62 mm	0.295 – 0.300 in
Hole Diameter (R)	4.1 mm	0.16 in
Bore Diameter (S)	9.45 ± 0.05 mm	0.370 ± 0.002 in
Length (T)	6.73 – 6.86 mm	0.265 – 0.270 in
Shoulder Length (U)	7.62 ± 0.25 mm	0.300 ± 0.010 in

CGA 670 Valve Specification

Features:

US EPA Compliant Outlet

SAE Recommended Outlet

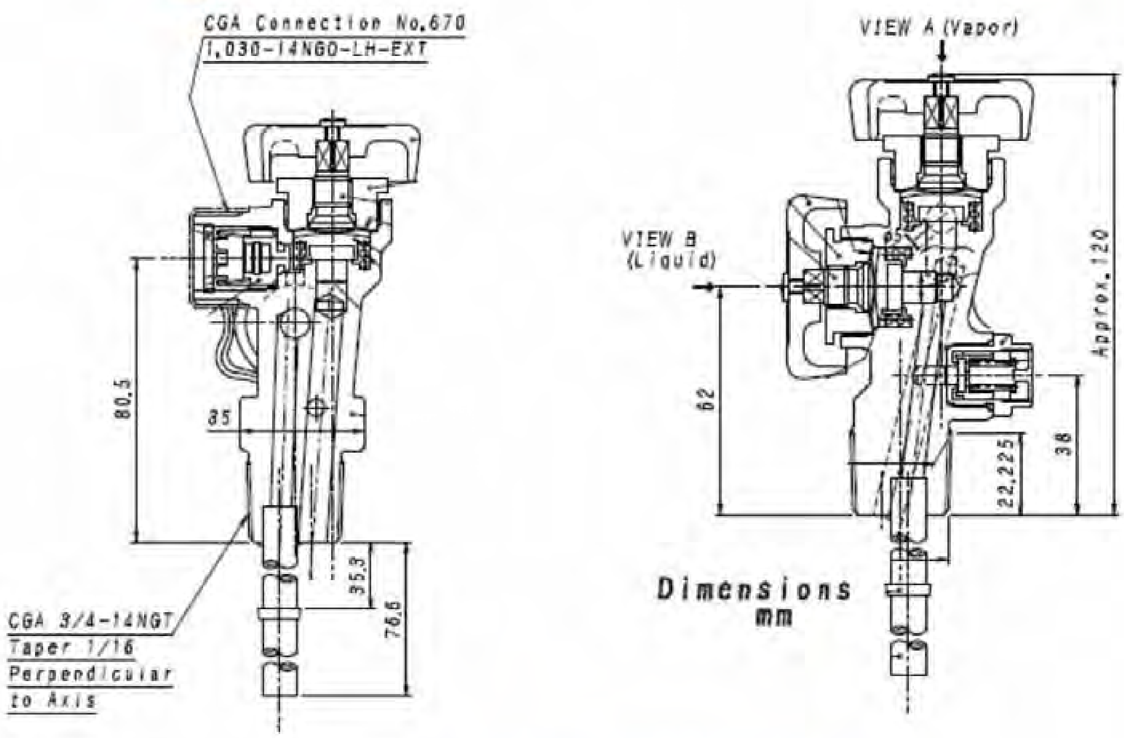
CGA 670 Outlet Connections

Dual Phase Valve

(Red Handle Liquid – Blue Handle Vapor)

Thread Pattern:

1.030 – 14 NGO –LH – EXT



Honeywell

CGA 670 Single Phase Valve Specification

Features:

US EPA Compliant Outlet

SAE Recommended Outlet

CGA 670 Outlet Connections

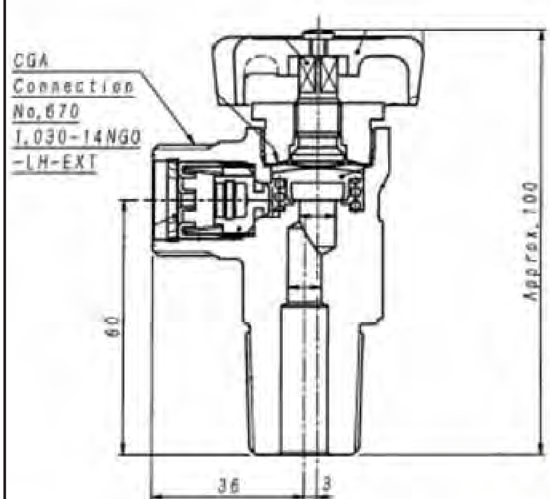
Single Phase (2 per cylinder)

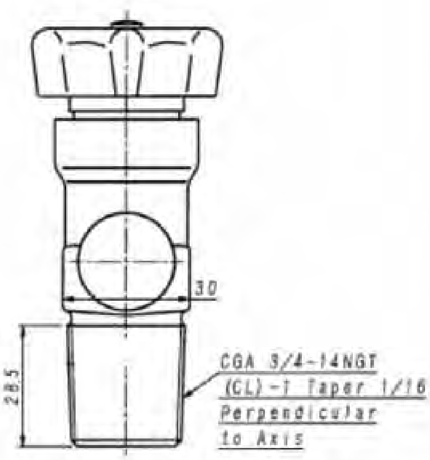
(Red Handle Liquid – Blue Handle Vapor)

Used with larger cylinders (Half Tons and Larger)

Thread Pattern:

1.030 – 14 NGO –LH – EXT





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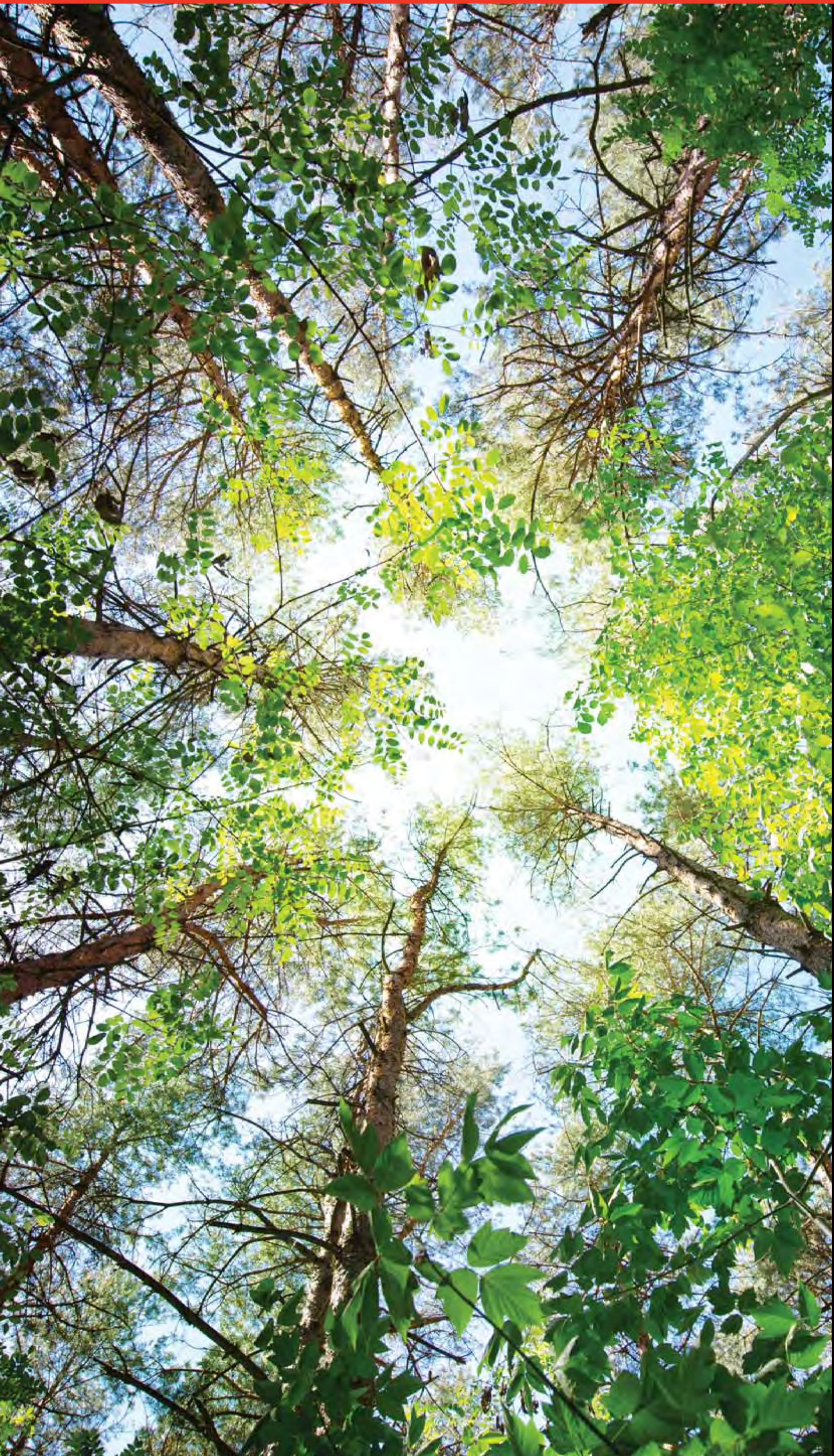
Part 6
Regulatory Information

6



Transportation regulation of hazardous materials

For information on transportation of hazardous materials by highway, rail, vessel, and air, please contact Travis Williams.

Travis Williams
Honeywell International Inc
Conversion Manager
(225) 405-1865
travis.williams2@honeywell.com

To download The Code of Federal Regulation (CFR) please visit the US government website http://www.phmsa.dot.gov/hazmat/regs.

The regulations for gases are not all located in one section. The Hazardous Material Regulation (HMR) are in Subchapter C, Parts 171, 172, 173, 174, 175, 176, 177, and 178 non-bulk packaging. Parts 172, 173, and 178 are the most referenced.

17488 Federal Register / Vol. 76, No. 60 / Tuesday, March 29, 2011 / Rules and Regulations

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 82

[EPA–HQ–OAR–2008–0664; FRL–9275–8]

RIN 2060–AP11

Protection of Stratospheric Ozone: New Substitute in the Motor Vehicle Air Conditioning Sector Under the Significant New Alternatives Policy (SNAP) Program

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: The Environmental Protection Agency's (EPA) Significant New Alternatives Policy (SNAP) program is expanding the list of acceptable substitutes for use in the motor vehicle air conditioning end-use as a replacement for ozone-depleting substances. The Clean Air Act requires EPA to review alternatives for ozone-depleting substances and to disapprove substitutes that present overall risks to human health and the environment more significant than those presented by other alternatives that are available or potentially available. The substitute addressed in this final rule is for use in new passenger cars and light-duty trucks in the motor vehicle air conditioning end-use within the refrigeration and air conditioning sector. EPA finds hydrofluoroolefin (HFO)-1234yf acceptable, subject to use conditions, as a substitute for chlorofluorocarbon (CFC)-12 in motor vehicle air conditioning for new passenger cars and light-duty trucks. The substitute is a non-ozone-depleting gas and consequently does not contribute to stratospheric ozone depletion.

DATES: This final rule is effective on May 31, 2011. The incorporation by reference of certain publications listed in the rule is approved by the Director of the Federal Register as of May 31, 2011.

ADDRESSES: EPA has established a docket for this action under Docket ID No. EPA–HQ–OAR–2008–0664. All documents in the docket are listed on the *http://www.regulations.gov* Web site. Although listed in the index, some information is not publicly available, *e.g.*, confidential business information (CBI) or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available either electronically through *http://www.regulations.gov* or in hard copy at the Air Docket, EPA/DC, EPA West, Room 3334, 1301 Constitution Ave., NW., Washington, DC. This Docket Facility is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the Air Docket is (202) 566–1742.

FOR FURTHER INFORMATION CONTACT: Margaret Sheppard, Stratospheric Protection Division, Office of Atmospheric Programs; Environmental Protection Agency, Mail Code 6205J, 1200 Pennsylvania Avenue, NW., Washington, DC 20460; telephone number (202) 343–9163, fax number, (202) 343–2338; e-mail address at *sheppard.margaret@epa.gov*.

Notices and rulemakings under the SNAP program are available on EPA's Stratospheric Ozone Web site at *http://www.epa.gov/ozone/snap/regulations.html*. The full list of SNAP decisions in all industrial sectors is available at *http://www.epa.gov/ozone/snap*.

SUPPLEMENTARY INFORMATION: This final rule provides motor vehicle manufacturers and their suppliers an additional refrigerant option for motor vehicle air conditioning (MVAC) systems in new passenger cars and light-duty trucks. HFO–1234yf (2,3,3,3-tetrafluoroprop-1-ene), the refrigerant discussed in this final action, is a non-ozone-depleting substance.

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I. Does this action apply to me?

This final rule regulates the use of the chemical HFO–1234yf (2,3,3,3-tetrafluoroprop-1-ene, Chemical Abstracts Service Registry Number [CAS Reg. No.] 754–12–1) as a refrigerant in new motor vehicle air conditioning (MVAC) systems in new passenger cars and light-duty trucks. Businesses in this end-use that might want to use HFO–1234yf in new MVAC systems in the future include:

- Automobile manufacturers
- Manufacturers of motor vehicle air conditioners.

Regulated entities may include:

TABLE 1—POTENTIALLY REGULATED ENTITIES, BY NORTH AMERICAN INDUSTRIAL CLASSIFICATION SYSTEM (NAICS) CODE

Category	NAICS code	Description of regulated entities
Industry	336111	Automobile Manufacturing.
Industry	336391	Motor Vehicle Air-Conditioning Manufacturing.

This table is not intended to be exhaustive, but rather a guide regarding entities likely to be regulated by this action. If you have any questions about whether this action applies to a particular entity, consult the person listed in the preceding section, FOR FURTHER INFORMATION CONTACT.

II. What abbreviations and acronyms are used in this action?

100-yr—one-hundred year time horizon
AEGL—Acute Exposure Guideline Level
AIST—the National Institute for Advanced Industrial Science and Technology of Japan
ASHRAE—American Society for Heating, Refrigerating, and Air-Conditioning Engineers
ATSDR—the U.S. Agency for Toxic Substances and Disease Registry
BAM—Bundesanstalt für Materialforschung und-prüfung (German Federal Institute for Materials Research and Testing)
CAA—Clean Air Act
CAS Reg. No.—Chemical Abstracts Service Registry Number
CBI—Confidential Business Information
CFC—chlorofluorocarbon
CFC–12—the ozone-depleting chemical dichlorodifluoromethane, CAS Reg. No. 75–71–8
CFD—Computational Fluid Dynamics
CFR—Code of Federal Regulations
cm/s—centimeters per second
CO_2—carbon dioxide, CAS Reg. No. 124–38–9
CRP—Cooperative Research Program
DIN—Deutsches Institut für Normung (designation for standards from the German Institute for Standards)
DIY—"do-it-yourself"
DOT—the United States Department of Transportation
EPA—the United States Environmental Protection Agency
EO—Executive Order
FMEA—Failure Mode and Effect Analysis
FR—Federal Register
GWP—Global Warming Potential
HF—Hydrogen Fluoride, CAS Reg. No. 7664–39–3
HI—Hazard Index
HFC—hydrofluorocarbon
HFC–134a—the chemical 1,1,1,2-tetrafluoroethane, CAS Reg. No. 811–97–2
HFC–152a—the chemical 1,1-difluoroethane, CAS Reg. No. 75–37–6
HFO—hydrofluoroolefin
HFO–1234yf—the chemical 2,3,3,3-tetrafluoroprop-1-ene, CAS Reg. No. 754–12–1
ISO—International Organization for Standardization
JAMA—Japan Automobile Manufacturers Association
JAPIA—Japan Auto Parts Industries Association
LCA—Lifecycle Analysis
LCCP—Lifecycle Climate Performance
LFL—Lower Flammability Limit
LOAEL—Lowest Observed Adverse Effect Level
mg/L—milligram per liter
MIR—Maximum Incremental Reactivity
mJ—millijoule
mm—millimeter
MOE—Margin of Exposure
MPa—megapascal
MRL—Minimal Risk Level
MVAC—Motor Vehicle Air Conditioning
NAICS—North American Industrial Classification System
ng/L—nanograms per liter
NHTSA—the U.S. National Highway Traffic Safety Administration
NOAEL—No Observed Adverse Effect Level
NOEC—No Observed Effect Concentration
NPRM—Notice of Proposed Rulemaking
NTTAA—National Technology Transfer and Advancement Act
ODP—Ozone Depletion Potential
ODS—znOzone-Depleting Substance
OEM—Original Equipment Manufacturer
OMB—Office of Management and Budget
OSHA—the United States Occupational Safety and Health Administration
PAG—Polyalkylene Glycol
PMN—Pre-Manufacture Notice
POCP—Photochemical Ozone Creation Potential
POD—Point of Departure
ppm—parts per million
ppt—parts per trillion
psig—pounds per square inch gauge
R–1234yf—ASHRAE designation for refrigerant HFO–1234yf
R–134a—ASHRAE designation for refrigerant HFC–134a
R–152a—ASHRAE designation for refrigerant HFC–152a
R–744—ASHRAE designation for refrigerant CO_2
RCRA—the Resource Conservation and Recovery Act
RFA—Regulatory Flexibility Act
SAE—SAE International, formerly the Society of Automotive Engineers
SBA—the United States Small Business Administration
SIP—State Implementation Plan
SNAP—Significant New Alternatives Policy
SNUN—Significant New Use Notice
SNUR—Significant New Use Rule
SO_2—sulfur dioxide, CAS Reg. No. 7446–09–5
TEWI—Total Equivalent Warming Impact
TFA—Trifluoroacetic acid, CF_3COOH, also known as trifluoroethanoic acid, CAS Reg. No. 76–05–1
TSCA—the Toxic Substances Control Act
TWA—Time-Weighted Average
UBA—Umweltbundesamt (German Federal Environment Agency)
UF—Uncertainty Factor
UMRA—Unfunded Mandates Reform Act
VDA—Verband der Automobilindustrie (German Association for the Automobile Industry)
VOC—Volatile Organic Compound
v/v—volume to volume
WEEL—Workplace Environmental Exposure Limit

III. What is EPA's final decision for HFO–1234yf for motor vehicle air conditioning (MVAC)?

In this final rule, EPA is finding HFO–1234yf acceptable, subject to use conditions, as a substitute for CFC–12 in new MVAC systems for passenger cars and light-duty trucks. This determination does not apply to the use of HFO–1234yf as a conversion or retrofit for existing MVAC systems. In addition, it does not apply to the use of HFO–1234yf in the air conditioning or refrigeration systems of heavy-duty trucks, refrigerated transport, or off-road vehicles such as agricultural or construction equipment.

EPA is not mandating the use of HFO–1234yf or any other alternative for MVAC systems. This final rule is adding HFO–1234yf to the list of acceptable substitutes, subject to use conditions, in new MVAC systems. Automobile manufacturers have the option of using any refrigerant listed as acceptable for this end-use, so long as they meet any applicable use conditions.

Under this decision, the following enforceable use conditions apply when HFO–1234yf is used in a new MVAC system for passenger cars and light-duty trucks:

1. HFO–1234yf MVAC systems must adhere to all of the safety requirements of SAE[1] J639 (adopted 2011), including requirements for a flammable refrigerant warning label, high-pressure compressor cutoff switch and pressure relief devices, and unique fittings. For connections with refrigerant containers of 20 lbs or greater, use fittings consistent with SAE J2844 (adopted 2011).

2. Manufacturers must conduct Failure Mode and Effect Analysis (FMEA) as provided in SAE J1739 (adopted 2009). Manufacturers must keep the FMEA on file for at least three years from the date of creation.

IV. What are the final use conditions and why did EPA finalize these conditions?

Summary of the Use Conditions

The first use condition requires that MVAC systems designed to use HFO–1234yf must meet the requirements of the 2011 version of the industry standard SAE J639, "Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems." Among other things, this standard sets safety standards that include unique fittings to connect refrigerant containers to the MVAC system; a warning label indicating the refrigerant's identity and indicating that it is a flammable refrigerant; and requirements for engineering design strategies that include a high-pressure compressor cutoff switch and pressure relief devices. This use condition also requires that fittings for refrigerant

[1] Designates a standard from SAE International, formerly the Society of Automotive Engineers.

containers of 20 lbs or greater will be consistent with SAE J2844 (same fittings as for low-side service port in SAE J639).

The second use condition requires the manufacturer of MVAC systems and vehicles (*i.e.*, the original equipment manufacturer [OEM]) to conduct and keep records of a risk assessment and failure Failure Mode and Effects Analysis (FMEA) for at least three years from the date of creation. There is an existing industry standard, SAE J1739, that gives guidance on how to do this. It is standard industry practice to perform the FMEA and to keep it on file while the vehicle is in production and for several years afterwards (U.S. EPA, 2010a).

Reasons for Revised Use Conditions

EPA proposed five use conditions in the Notice of Proposed Rulemaking (NPRM) (October 19, 2009; 74 FR 53445). One use condition required manufacturers to meet all the safety requirements in the standard SAE J639, "Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems" and required use of unique servicing fittings from that standard. Another use condition required automobile manufacturers to perform Failure Mode and Effect Analysis (FMEA) and to keep records of the FMEA.

The remaining three proposed use conditions specifically addressed risks of flammability of HFO–1234yf and indirectly addressed risks of generating hydrogen fluoride (HF) from combustion of HFO–1234yf. For the first of those proposed use conditions, which addressed the passenger compartment, the concentration of HFO–1234yf was not to exceed the lower flammability limit (LFL) in the free space for more than 15 seconds. For the second proposed use condition, which addressed the engine compartment, the concentration of HFO–1234yf was not to exceed the LFL for any period of time. A third proposed use condition, which also addressed the engine compartment, would have required protective devices, isolation and/or ventilation techniques in areas where there is a potential to generate HFO–1234yf concentrations at or above 6.2% volume to volume (v/v) in proximity to exhaust manifold surfaces and hybrid or electric vehicle electric power sources.

EPA based our determination of the appropriate use conditions to include in the final rule using information in the docket at the time of proposal, comments received on the proposed rule, and additional information we have received since the NPRM was published. We provided additional opportunities for comment on the public comments and additional information we received with them when we re-opened the comment period on the proposed rule (74 FR 68558, December 28, 2009; 75 FR 6338, February 9, 2010). First, SAE International's Cooperative Research Program (hereafter called the SAE CRP) issued a new report on December 17, 2009 assessing risks of HFO–1234yf and carbon dioxide (CO_2) as refrigerants for MVAC. This report found that the risks of HFO–1234yf were low overall, and somewhat less than risks for another potential alternative refrigerant (CO_2, also know as R–744). The December 2009 CRP report found that the greatest risks from HFO–1234yf are likely to come from generation of HF, both from thermal decomposition and from ignition, rather than direct fire risks from ignition of HFO–1234yf (EPA–HQ–OAR–2006–0664–0056.2). (HF is a severe irritant to the skin, eyes, and respiratory system.) The SAE CRP estimates risks of excessive HF exposure at approximately 4.6×10^{-12} occurrences per vehicle operating hour and risks of ignition at approximately 9×10^{-14} occurrences per vehicle operating hour. These correspond roughly to one occurrence in the entire U.S. fleet of passenger vehicles over 2 years for HF risks and one occurrence in the U.S. vehicle fleet every 100 years for flammability risks.[2] For comparison, the risk for excessive HF exposure is less than one ten-thousandth the risk of a highway vehicle fire and one fortieth or less of the risk of a fatality from deployment of an airbag during a vehicle collision (EPA–HQ–OAR–2008–0664–0056.2). Even these estimates may be conservative because they assume that refrigerant could be released in a collision severe enough to rupture the evaporator (under the windshield) while the windshield and windows would remain intact and would prevent ventilation into the passenger cabin in case of a collision (EPA–HQ–OAR–2006–0664–0056.2).

Second, we received a number of public comments regarding the proposed use conditions. Some commenters claimed that the second use condition concerning concentrations in the engine compartment was infeasible because in the event of a leak, there would always be some small volume that would have a concentration over the LFL; these commenters further stated that exceeding the LFL would not necessarily create a risk of ignition, because one could have a leak that is not near a source of heat or flame (EPA–HQ–OAR–2006–0664–0116.2; EPA–HQ–OAR–2006–0664–0060). Some commenters stated that flammability was not a significant risk from use of HFO–1234yf, given the results of the SAE CRP risk assessment (December 17, 2009). These commenters stated that the use conditions limiting refrigerant concentrations were not necessary. These commenters also suggested a number of alternative ways of phrasing the use conditions in order to address risks from HF as well as flammability. Most of these comments suggested relying on the performance of a risk assessment and Failure Mode and Effect Analysis (FMEA) consistent with SAE J1739 to determine appropriate protective strategies. Other commenters stated that the use conditions were not sufficiently protective as proposed because of other risks: (1) Risks due to generation of HF from HFO–1234yf, both from thermal decomposition and from combustion; (2) risks from direct toxicity of HFO–1234yf; and (3) risks from flammability of HFO–1234yf because the LFL becomes lower than 6.2% at temperatures higher than 21 °C (EPA–HQ–OAR–2006–0664–0088, –0054, –0089, –0097 and –0057).

After evaluating the comments and the additional information made available to the public through the re-opened comment period, we have decided not to include the three use conditions that directly address flammability in the final rule. We believe these use conditions are not necessary to ensure that overall risks to human health and the environment from HFO–1234yf will be similar to or less than those of other available or potentially available refrigerants that EPA has already listed or proposed as acceptable for MVAC. This is because of the low overall levels of risk identified for HFO–1234yf from flammability and from ignition of HF (EPA–HQ–OAR–2008–0664–0056.2). The highest risk identified for HFO–1234yf is potential consumer exposure to HF from decomposition and ignition, which is of the same order of magnitude of risks of HF from the current most common automotive refrigerant, hydrofluorocarbon (HFC)–134a[3] (order of magnitude of 10^{-12} events per vehicle operating hour). EPA previously

[2] Assumes a fleet of approximately 250 million passenger vehicles and typical vehicle operation of 500 hours per year. Sources: U.S. Census, *http://www.census.gov/compendia/statab/2010/tables/10s1060.pdf;* SAE J2766, as cited in EPA–HQ–OAR–2008–0664–0056.2.

[3] HFC–134a is also known as 1,1,1,2-tetrafluoroethane or, when used as a refrigerant, R–134a. The Chemical Abstracts Service Registry Number (CAS Reg. No.) is 811–97–2.

found HFC–134a acceptable for use in new and retrofit MVAC systems (59 FR 13044; March 18, 1994; and 60 FR 31092, June 13, 1995), without use conditions addressing risks of HF. Since that time, EPA has heard of no cases where someone has been injured due to exposure to HF from decomposition of HFC–134a from an MVAC system, and a risk assessment from the SAE CRP found no published reports in the medical literature of injuries to fire fighters or vehicle passengers from HF or other decomposition products of HFC–134a (EPA–HQ–OAR–2008–0664–0008). The direct risk of flammability from HFO–1234yf is extremely small. Further, the risks of HFO–1234yf are comparable to or less than the risks from other available or potentially available alternatives in this end-use that EPA has already listed or proposed as acceptable (*e.g.*, HFC–152a,[4] HFC–134a, and CO_2) (EPA–HQ–OAR–2008–0664–0086.1).

We have concluded that the use conditions we are including in the final rule address the risks from both HF and flammability. Industry standard SAE J639 (adopted 2011) provides for a pressure relief device designed to minimize direct impingement of the refrigerant and oil on hot surfaces and for design of the refrigerant circuit and connections to avoid refrigerant entering the passenger cabin. These conditions will mitigate risks of HF generation and ignition. The pressure release device ensures that pressure in the system will not reach an unsafe level that might cause an uncontrolled, explosive leak of refrigerant, such as if the air conditioning system is overcharged. The pressure release device will reduce the likelihood that refrigerant leaks would reach hot surfaces that might lead to either ignition or formation of HF. Designing the refrigerant circuit and connections to avoid refrigerant entering the passenger cabin ensures that if there is a leak, the refrigerant is unlikely to enter the passenger cabin. Keeping refrigerant out of the passenger cabin minimizes the possibility that there would be sufficient levels of refrigerant to reach flammable concentrations or that HF would be formed and transported where passengers might be exposed.

The last proposed use condition, requiring manufacturers to conduct and keep records of FMEA according to the standard SAE J1739, remains unchanged.

The proposed use condition regarding conducting and keeping records of a Failure Mode and Effects Analysis according to the standard SAE J1739 remains unchanged. We have revised the remaining proposed use condition by replacing the reference to SAE J639 (adopted 2009) with a reference to the 2011 version of the standard and to the fittings for large refrigerant containers in SAE J2844 (2011). This is the most recent version of the SAE J639 standard, with new provisions designed specifically to address use of HFO–1234yf.

V. Why is EPA finding HFO–1234yf acceptable subject to use conditions?

EPA is finding HFO–1234yf acceptable subject to use conditions because the use conditions are necessary to ensure that use of HFO–1234yf will not have a significantly greater overall impact on human health and the environment than other available or potentially available substitutes for CFC–12 in MVAC systems. Examples of other substitutes that EPA has already found acceptable subject to use conditions for use in MVAC include HFC–134a and HFC–152a. HFC–134a is the alternative most widely used in MVAC systems today. EPA has also proposed to find CO_2 (R–744) acceptable subject to use conditions in MVAC (September 14, 2006; 71 FR 55140).

All alternatives listed as acceptable for use in MVAC systems in passenger cars and light-duty trucks are required to have unique fittings under use conditions issued previously under the SNAP Program at appendix D to subpart G of 40 CFR part 82 (61 FR 54040, October 16, 1996). Thus, all substitutes for use in MVAC systems in passenger cars and light-duty trucks are subject to those use conditions, at a minimum, if found acceptable and thus are identified as acceptable subject to use conditions. For HFO–1234yf, the unique fittings that must be used for MVAC systems are those required in the industry standard SAE J639 (2011). The fitting for refrigerant containers of 20 lbs or larger is specified in SAE J2844 (2011). The original submitter of HFO–1234yf to the SNAP program has provided EPA with a copy of and a diagram for these unique fittings. As described above, the fittings will be quick-connect fittings, different from those for any other refrigerant. The low-side service port and connections with containers of 20 lbs or greater will have an outside diameter of 14 mm (0.551 inches) and the high-side service port will have an outside diameter of 17 mm (0.669 inches), both accurate to within 2 mm. The submitter has not provided, and the SAE standards do not include, unique fittings for use with small refrigerant containers or can taps.[5] Thus, the final use conditions do not allow use of small containers for servicing MVAC systems.

In addition to the use conditions regarding unique fittings, which apply under appendix D to subpart G of 40 CFR part 82, EPA is requiring use conditions for the safe design of new MVAC systems using HFO–1234yf, consistent with standards of the automotive industry (*e.g.*, SAE J1739, SAE J639). These use conditions are intended to ensure that new cars and light-duty trucks that have MVAC systems that use HFO–1234yf are specifically designed to minimize release of the refrigerant into the passenger cabin or onto hot surfaces that might result in ignition or in generation of HF. The industry standard SAE J1739 gives guidelines on designing vehicles to address these risks.

Cost and Availability

EPA received initial estimates of the anticipated cost of HFO–1234yf from the manufacturer, claimed as confidential business information, as part of the initial SNAP submission (EPA–HQ–OAR–2008–0664–0013 and –0013.1). Initial publicly available estimates on the cost of HFO–1234yf were for approximately $40–60/pound (Weissler, 2008). The first automobile manufacturer to announce its commitment to use HFO–1234yf as a refrigerant has confirmed that the prices in its long-term purchase contracts are in the range that EPA considered at the time of proposal (Sciance, 2010).

In May 2010, two major chemical manufacturers, including the original submitter, issued a press release, committing to building a "world-scale manufacturing facility" to produce HFO–1234yf (EPA–HQ–OAR–2008–0664–0128.1). The same manufacturers have committed to providing HFO–1234yf in time to meet requirements of a European Union directive to use only refrigerants with GWP less than 150 in new automobile designs starting in 2011.

Environmental Impacts

EPA finds that HFO–1234yf does not pose significantly greater risk to the environment than the other substitutes that are currently or potentially

[4] HFC–152a is also known as 1,1-difluoroethane or, when used as a refrigerant, R–152a. The CAS Reg. No. is 75–37–6.

[5] The SAE J639 standard specifies unique fittings for high-side and low-side service ports and the manufacturer of HFO–1234yf supports these fittings. The unique fitting for large containers for use in servicing by professionals (*e.g.*, 20 or 30 lbs) is the same as the fitting for the low-side service port in SAE J639 and is also specified in SAE J2844, "R–1234yf New Refrigerant Purity and Container Requirements Used in Mobile Air-Conditioning Systems." (U.S. EPA, 2010b)

available. In at least one aspect, HFO–1234yf is significantly better for the environment than other alternatives currently found acceptable subject to use conditions. HFO–1234yf has a hundred-year time horizon (100-yr) global warming potential (GWP) of 4 (Nielsen *et al.*, 2007; Papadimitriou *et al.*, 2007), compared to a GWP of 124 for HFC–152a, and a GWP of 1430 for HFC–134a (IPCC, 2007). CO_2, another substitute currently under review in this end-use, has a GWP of 1, which is lower, but comparable to the GWP of HFO–1234yf. Information on the schedule for EPA's final rulemaking on CO_2 as a substitute in MVAC, RIN 2060–AM54, is available in EPA's regulatory agenda at *http://www.reginfo.gov/public/do/eAgendaMain*. A number of other refrigerant blends containing HFCs or HCFCs have been found acceptable subject to use conditions in MVAC that have higher GWPs in the range of 1000 to 2400, such as R–426A, R–414A, R–414B, R–416A, and R–420A. Further, HFO–1234yf has no ozone depletion potential (EPA–HQ–OAR–2008–0664–0013), comparable to CO_2, HFC–152a, and HFC–134a, and has less risk of ozone depletion than all refrigerant blends containing HCFCs that EPA previously found acceptable subject to use conditions for MVAC systems.

EPA also considered the aggregate environmental impact of all anticipated emissions of HFO–1234yf, both for the proposed rule and for this final rule. We performed a conservative analysis that assumed widespread use of HFO–1234yf as the primary refrigerant for MVAC, as well as for other refrigeration and air conditioning uses that were not included in the manufacturer's original submission (ICF, 2009; ICF, 2010a,b,c,e). Thus, we believe that actual environmental impacts are likely to be less than those we considered, either at the proposal or final stage.

Under Clean Air Act regulations (*see* 40 CFR 51.100(s)) addressing the development of State implementation plans (SIPs) to attain and maintain the national ambient air quality standards, HFO–1234yf is considered a volatile organic compound (VOC). Available information indicates that HFO–1234yf has greater photochemical reactivity than HFC–134a, which is exempt from the definition of "VOC" in 40 CFR 51.100(s). Some of the other acceptable substitutes in the MVAC end-use contain VOCs, such as R–406A, R–414A, R–414B, and R–426A. VOCs can contribute to ground-level ozone (smog) formation. For purposes of State plans to address ground-level ozone, EPA has exempted VOCs with negligible photochemical reactivity from regulation (40 CFR 51.100(s)). The manufacturer of HFO–1234yf has submitted a petition to EPA requesting that the chemical be exempted from regulation as a VOC, based on a claim that it has maximum incremental reactivity comparable to that of ethane (EPA–HQ–OAR–2008–0664–0116.1). Separate from this action, EPA is reviewing that request and plans to issue a proposed rule to address it. Information on the schedule for EPA's proposed rulemaking for exemption from regulation as a VOC for HFO–1234yf, RIN 2060–AQ38, is available in EPA's regulatory agenda at *http://www.reginfo.gov/public/do/eAgendaMain*.

Regardless of whether EPA determines to exempt HFO–1234yf from regulation as a VOC for State planning purposes, other analyses available in the docket during the public comment period indicated that the additional contribution to ground-level ozone due to a widespread switch to HFO–1234yf is likely to be around 0.01% or less of all VOC emissions, based on the formation of reactive breakdown products such as OH^- (Luecken *et al.*, 2009). Since issuing the NPRM, we performed an additional analysis that finds a worst-case increase in the Los Angeles region of 0.00080 ppm, or a contribution of only 0.1% of the 1997 8-hour standard for ground-level ozone of 0.08 ppm (ICF, 2010b). Our initial analysis at the proposal stage had estimated a maximum increase in ozone of 1.4 to 4.0% of the standard in the same region (ICF, 2009). The major difference between the 2009 and the 2010 versions of this analysis involved modeling of atmospheric chemistry. The 2010 study was based on the kinetics and decomposition products predicted for HFO–1234yf, rather than using the oxidation of sulfur dioxide (SO_2) as a proxy for decomposition of HFO–1234yf as was done in the 2009 study. The 2010 analysis used updated baseline emission estimates that were 1.5% higher to 5.8% lower than those in the 2009 analysis,[6] depending on the year analyzed (ICF, 2010e). We also evaluated environmental impacts based on alternative emissions estimates from a peer-reviewed journal article provided during the public comment period (Papasavva *et al.*, 2009);[7] these values ranged from 26.3% to 51.1% lower than EPA's estimates in the 2009 analysis (ICF, 2009; ICF, 2010c).

Another potential environmental impact of HFO–1234yf is its atmospheric decomposition to trifluoroacetic acid (TFA, CF_3COOH). TFA is a strong acid that may accumulate on soil, on plants, and in aquatic ecosystems over time and that may have the potential to adversely impact plants, animals, and ecosystems. Other fluorinated compounds also decompose into TFA, including HFC–134a. However, the amount of TFA produced from HFO–1234yf in MVAC is estimated to be at least double that of current natural and artificial sources of TFA in rainfall (Luecken *et al.*, 2009). An initial analysis performed for EPA at the proposal stage found that, with highly conservative emission estimates, TFA concentrations in rainwater could be as high as 1.8 mg/L for the maximum monthly concentration for the Los Angeles area and would be no higher than 0.23 mg/L on an annual basis, compared to a no observed adverse effect concentration of 1 mg/L for the most sensitive plant species (ICF, 2009). This analysis concluded, "Projected levels of TFA in rainwater should not result in a significant risk of ecotoxicity." A more recent analysis by Luecken *et al* (2009) that became available during the initial public comment period reached the conclusion that emissions of HFO–1234yf from MVAC could produce TFA concentrations in rainwater of 1/800th to 1/80th the no-observed adverse effect level (NOAEL) for the most sensitive algae species expected (Luecken *et al.*, 2009). The conclusions in the Luecken study are supported by additional analyses that have become available since we issued the proposed rule. A study from the National Institute of Advanced Industrial Science and Technology (AIST) in Japan, which became available during the re-opened comment period, estimated that concentrations of TFA in surface water would be approximately twice the level in rainwater (Kajihara *et al.*, 2010). This study found that this higher level in surface water would be roughly 1/80th

[6] These changes in estimates reflect ongoing updates to EPA's Vintaging Model, a model that considers industry trends in different end-uses that historically have used ODS.

[7] Analyzed scenarios considered HFO–1234yf emissions from MVAC and from both MVAC systems and stationary air conditioning and refrigeration systems. The analysis also considered scenarios with typical emissions from MVAC systems during the entire year similar to those from current MVAC systems using HFC–134a and another scenario with reduced emissions of HFO–1234yf of approximately 50 g/yr per vehicle, in line with emissions estimates in a study by Papasavva *et al.* (2009) (EPA–HQ–OAR–2008–0664–0114.1). Major differences between the data sources include assumptions of a lower leak rate (5.6% of charge vs. 8% of charge) and a lower annualized rate of leaks during servicing (3.2% of charge vs. 10% of charge) for the Papasavva *et al.* paper compared to assumptions in EPA's Vintaging Model (ICF 2010a).

the NOAEL for the most sensitive algae species, even with assumptions of high emissions levels (*i.e.*, assuming that all types of refrigeration and AC equipment currently using HFCs or HCFCs, not just MVAC systems, would use HFO–1234yf). Kajihara *et al.* (2010) evaluated scenarios specific to Japan, with emissions of approximately 15,172 ton/yr in 2050, compared to a maximum of 64,324 metric tons/yr in 2050 in ICF, 2009 or a maximum of 24,715 metric tons/yr in 2017 in Luecken *et al* (2009). All three studies noted the potential for accumulation in closed aquatic systems.

As we developed the proposed rule, the data we relied on indicated that in the worst case, the highest monthly TFA concentrations in the area with the highest expected emissions, the Los Angeles area, could exceed the no observed adverse effect concentration for the most sensitive plant species, but annual values would never exceed that value. Further, TFA concentrations would never approach levels of concern for aquatic animals (ICF, 2009). In a more recent analysis, ICF (2010a, b, c, e) performed modeling for EPA using the kinetics and decomposition products predicted specifically for HFO–1234yf and considered revised emission estimates that were slightly lower than in a 2009 analysis (ICF, 2009). The revised analysis found a maximum projected concentration of TFA in rainwater of approximately 1,700 ng/L, roughly one-thousandth of the estimate from our 2009 analysis (ICF, 2010b). This maximum concentration is roughly 34% higher than the 1,264 ng/L reported by Luecken *et al.* (2009), reflecting the higher emission estimates we used (ICF, 2010b). A maximum concentration of 1700 ng/L corresponds to roughly 1/600th of the NOAEL for the most sensitive algae species—thus, it is not a level of concern. We find these additional analyses confirm that the projected maximum TFA concentration in rainwater and in surface waters should not result in a significant risk of aquatic toxicity, consistent with our original proposal.

Human Health and Safety Impacts

Occupational risks could occur during the manufacture of the refrigerant, initial installation of the refrigerant into the MVAC system at the car assembly plant, servicing of the MVAC system, or final disposition of the MVAC system (*i.e.*, recycling or disposal). Consumer risks could occur to drivers or riders in the passenger compartment. Risks of exposure to consumers could also occur if they purchase HFO–1234yf and attempt to install or service the MVAC system without proper training or use of refrigerant recovery equipment. In addition, members of the general public, consumers, and first-responders could face risks in the case of a vehicle accident that is severe enough to release the refrigerant.

To evaluate these potential human health and safety impacts, we considered EPA's own risk assessments (EPA–HQ–OAR–2008–0664–0036 and –0038), as well as detailed risk assessments with fault-tree analysis from the SAE CRP for HFO–1234yf and CO_2 (EPA–HQ–OAR–2008–0664–0008 and –0056.2), and scientific data provided in public comments on the topics of health and safety risks.[8] Health and safety risks that we evaluated included direct toxicity of HFO–1234yf, both long-term and short-term; toxicity of HF formed through thermal decomposition or combustion of HFO–1234yf; and flammability of HFO–1234yf.

Occupational Risks

For long-term occupational exposure to HFO–1234yf, EPA compared worker exposures to a workplace exposure limit of 250 ppm[9] over an 8-hour time-weighted average. For short-term occupational exposure to HFO–1234yf, we compared worker exposure to an acute exposure limit of 98,211 ppm, divided by a margin of exposure of 30, for a value of 3270 ppm over 30 minutes.[10,11]

Section 609 of the Clean Air Act requires technicians servicing MVAC systems for consideration (*e.g.*, receiving money, credit, or services in exchange for their work) to use approved refrigerant recycling equipment properly and to have proper training and certification. Therefore, we expect that professional technicians have the proper equipment and knowledge to minimize their risks due to exposure to refrigerant from an MVAC system. Thus, we found that worker exposure would be low. Further, EPA intends to pursue a future rulemaking under Section 609 of the CAA to apply also to HFO–1234yf (*e.g.*, servicing practices, certification requirements for recovery and recycling equipment intended for use with MVACs using HFO–1234yf, any potential changes to the rules for training and testing technicians, and recordkeeping requirements for service facilities and for refrigerant retailers). If workers service MVAC systems using certified refrigerant recovery equipment after receiving training and testing, exposure levels to HFO–1234yf are estimated to be on the order of 4 to 8.5 ppm on an 8-hour time-weighted average (as compared with a 250 ppm workplace exposure limit) and 122 ppm on a 30-minute average (as compared with a short-term exposure level of 98,211 ppm/[margin of exposure of 30] or 3270 ppm). (EPA–HQ–OAR–2008–0664–0036; EPA–HQ–OAR–2008–0664–

[8] On September 30, 2010, we received a final report from the German Federal Environment Agency (UBA) with additional information from testing of HFO–1234yf's potential for flammability and for generating hydrogen fluoride. Although this comment was received too late in the rulemaking process for us to analyze it in depth, our preliminary review found that the procedures they used contain many unrealistic provisions that are not relevant to our decision and in some tests did not provide proper controls (e.g., lacking a comparison to HFC–134a under the same conditions). Concerning flammability risk, the results do not vary significantly from those we are relying on for the final rule. Thus, our preliminary review of the UBA test procedures and results does not suggest that we should re-evaluate our decision to find HFO–1234yf acceptable subject to use conditions.

[9] This was based on a NOAEL of 4000 ppm from the study, "An Inhalation Prenatal Developmental Toxicity Study of HFO–1234yf (2,3,3,3-Tetrafluoropropene) in Rabbits." EPA–HQ–OAR–2008–0664–0041. We used a factor of 1.9 to account for differences in blood concentrations between animals and humans, and a margin of exposure or collective uncertainty factor of 30. Uncertainty factors of 3 were assigned for animal to human extrapolation, and 10 for variability within the human population. The long-term workplace exposure limit was calculated as follows: 4000 ppm (animal exposure) × 1.9 (ratio of estimated human exposure/animal exposure) × ⅓ (UF for animal to human extrapolation) × ⅒ (UF for variability within the human population) exposure) = 250 ppm. This value was compared against 8-hour average concentrations. See EPA–HQ–OAR–2008–0664–0036 and EPA–HQ–OAR–2008–0664–0038.

[10] This was based on a NOAEL of 51,690 ppm from the study, "Sub-acute (2-week) Inhalation Toxicity Study with HFO–1234yf in rats." EPA–HQ–OAR–2008–0664–0020 through-0020.4, a factor of 1.9 to account for differences in blood concentrations between animals and humans and a margin of exposure or collective uncertainty factor of 30. Uncertainty factors of 3 were assigned for animal to human extrapolation, and 10 for variability within the human population. The short-term workplace exposure value was calculated as follows: 51,690 ppm (animal exposure) × 1.9 (ratio of estimated human exposure/animal exposure) = 98,211 ppm This value was then divided by the expected exposure in each scenario, and compared against the target margin of exposure of 30. *See* EPA–HQ–OAR–2008–0664–0036 and EPA–HQ–OAR–2008–0664–0038.

[11] For comparison, the SAE CRP used exposure limits of 500 ppm over 8 hours and 115,000 ppm over 30 minutes to evaluate risks for these same time periods. These are based on the 8-hr Workplace Environmental Exposure Limit (WEEL) for HFO–1234yf and for short-term exposure, assuming a NOAEL of approximately 405,800 ppm from the study, "Acute (4-hour) inhalation toxicity study with HFO–1234yf in rats." Note that EPA disagrees with the finding that the acute inhalation toxicity study found a NOAEL. We consider this study to show adverse effects at all levels because of the presence of grey discoloration in the lungs of the test animals. In order to ensure sufficient protection, EPA's risk assessment used a NOAEL from a subacute study instead of a LOAEL from an acute study.

0038). We also analyzed exposure levels during manufacture and final disposition at vehicle end-of-life, and found that they would be no higher than 28 ppm on a 15-minute average or 8.5 ppm on an 8-hour time-weighted average (EPA–HQ–OAR–2008–0664–0038). Therefore, the manufacture, use, and disposal or recycling of HFO–1234yf are not expected to present a toxicity risk to workers.

We did not analyze the risk of generation of HF in the workplace. In its December 17, 2009 *Risk Assessment for Alternative Refrigerants HFO–1234yf and R–744 (CO_2)*, the SAE CRP indicated that "service technicians will be knowledgeable about the potential for HF generation and will immediately move away from the area when they perceive the irritancy of HF prior to being exposed above a health-based limit" (EPA–HQ–OAR–2008–0664–0056.2). Since there is a similar potential to form HF from other MVAC refrigerants that have been used for years, such as CFC–12 or HFC–134a, it is reasonable to assume that service technicians, recyclers, and disposers will handle HFO–1234yf similarly and that use of HFO–1234yf does not pose a significantly greater risk in the workplace with regard to HF generation than the use of those other refrigerants.

In that same report, the SAE CRP also discussed qualitatively the risks for emergency responders, such as firefighters or ambulance workers that respond in case of a vehicle fire or collision. With regard to risk of fire, the CRP report stated that "Due to the low burning velocity of HFO–1234yf, ignition of the refrigerant will not contribute substantially to a pre-existing fire" (EPA–HQ–OAR–2008–0664–0056.2). EPA considers this reasonable, given a burning velocity for HFO–1234yf of only 1.5 cm/s. This is more than an order of magnitude less than the burning velocity of gasoline, which is approximately 42 cm/s (Ceviz and Yuksel, 2005). Concerning first responder exposure to HF, the SAE CRP stated, "Professional first responders also have training in chemical hazards and possess appropriate gear which will prevent them from receiving HF exposures above health-based limits" (EPA–HQ–OAR–2008–0664–0056.2). We agree with this assessment. Other MVAC refrigerants containing fluorine such as CFC–12, which was historically used, and HFC–134a, which is the predominant refrigerant currently in use, also can produce HF due to thermal decomposition or combustion, and smoke and other toxic chemicals are likely to be present in case of an automotive fire (CRP, 2008). Therefore, it is reasonable to expect that first responders are prepared for the presence of HF and other toxic chemicals when approaching a burning vehicle and that they will wear appropriate personal protective equipment.

EPA's risk screen for HFO–1234yf evaluated flammability risks, including occupational risks. Modeling of concentrations of HFO–1234yf in workplace situations such as at equipment manufacture and during disposal or recycling at vehicle end-of-life found short-term, 15-minute concentrations of 28 ppm or less—far below the lower flammability limit (LFL) of 6.2% by volume (62,000 ppm) (EPA–HQ–OAR–2008–0664–0038). The SAE CRP's risk assessments evaluated flammability risks by comparing concentrations of HFO–1234yf with the LFL of 6.2%. The SAE CRP conducted Computational Fluid Dynamics (CFD) modeling of exposure levels in case of a leak in a system in a service shop. The SAE CRP's earlier February 26, 2008 risk assessment found that a leaked concentration of HFO–1234yf exceeded the LFL only in the most conservative simulation, with the largest refrigerant leak and with all air being recirculated within the passenger cabin (EPA–HQ–OAR–2008–0664–0010). Updated CFD modeling performed for the December, 2010 SAE CRP risk assessment found that concentrations of HFO–1234yf sometimes exceeded the LFL, but only within ten centimeters of the leak or less (EPA–HQ–OAR–2008–0664–0056.2). The risk assessment found the risk of this occupational exposure scenario to be on the order of 10^{-26} cases per working hour. We note that HFO–1234yf is less flammable and results in a less energetic flame than a number of fluids that motor vehicle service technicians and recyclers or disposers deal with on a regular basis, such as oil, anti-freeze, transmission fluid, and gasoline. HFO–1234yf is also less flammable than HFC–152a, a substitute that we have already found acceptable for new MVAC systems subject to use conditions. Thus, EPA finds that the risks of flammability in the workplace from HFO–1234yf are similar to or lower than the risk posed by currently available substitutes when the use conditions are met.

Consumer Exposure

EPA's review of consumer risks from toxicity of HFO–1234yf indicated that potential consumer (passenger) exposure from a refrigerant leak into the passenger compartment of a vehicle is not expected to present an unreasonable risk (EPA–HQ–OAR–2008–0664–0036, EPA–HQ–OAR–2008–0664–0038). However, consumer exposure from filling, servicing, or maintaining MVAC systems may cause exposures at high enough concentrations to warrant concern. Specifically, this risk may be due to a lack of professional training and due to refrigerant handling or containment without the use of refrigerant recovery equipment certified in accordance with the regulations promulgated under CAA Section 609 and codified at subpart B of 40 CFR part 82. Consumer filling, servicing, or maintaining of MVAC systems may cause exposures at high enough concentrations to warrant concern (EPA–HQ–OAR–2008–0664–0036). However, this rule does not specifically allow for use of HFO–1234yf in consumer filling, servicing, or maintenance of MVAC systems. The manufacturer's submission specifically addressed HFO–1234yf as a refrigerant for use by OEMs and by professional technicians (EPA–HQ–OAR–2008–0664–0013.1).

The use conditions in this final rule provide for unique service fittings relevant to OEMs and to professional technicians (*i.e.*, unique fittings for the high-pressure side and for the low-pressure side of the MVAC system and unique fittings for large cylinders of 20 lb or more). EPA would require additional information on consumer risk and a set of unique fittings from the refrigerant manufacturer for use with small cans or containers of HFO–1234yf before we would be able to issue a revised rule that allows for consumer filling, servicing, or maintenance of MVAC systems with HFO–1234yf.

EPA has issued a significant new use rule (SNUR) under the authority of TSCA (October 27, 2010; 75 FR 65987). Under 40 CFR part 721, EPA may issue a SNUR where the Agency determines that activities other than those described in the premanufacture notice may result in significant changes in human exposures or environmental release levels and that concern exists about the substance's health or environmental effects. Manufacturers, importers and processors of substances subject to a SNUR must notify EPA at least 90 days before beginning any designated significant new use through a significant new use notice (SNUN). EPA has 90 days from the date of submission of a SNUN to decide whether the new use "may present an unreasonable risk" to human health or the environment. If the Agency does not determine that the new use "may present an unreasonable risk," the submitter would be allowed to engage in the use, with or without certain restrictions. The significant new uses identified in the SNUR for HFO–1234yf are: (1) Use other than as a refrigerant in motor vehicle air conditioning systems in new passenger cars and vehicles; (2) commercial use other than in new passenger cars and vehicles in which the charging of motor vehicle air conditioning systems with HFO–1234yf was done by the motor vehicle OEM; and (3) distribution in commerce of products intended for use by a consumer for the purposes of servicing, maintenance and disposal involving HFO–1234yf.

Under existing regulations in appendix D to subpart G of 40 CFR part 82, "A refrigerant may only be used with the fittings and can taps specifically intended for that refrigerant and designed by the manufacturer of the refrigerant. Using a refrigerant with a fitting designed by anyone else, even if it is different from fittings used with other refrigerants, is a violation of this use condition." The manufacturer and submitter for HFO–1234yf has provided unique fittings for the high-pressure side and for the low-pressure side of the MVAC system and for large cylinders for professional use (typically 20 lb or more [12]). Therefore, until the manufacturer provides unique fittings to EPA's SNAP Program for use with can taps or other small containers for consumer use and until EPA publishes a final rule identifying such unique fittings, it would be a violation of the use condition in appendix D to use HFO–1234yf in small cans or containers for MVAC. Before issuing a rule allowing use of HFO–1234yf with fittings for small cans or containers for MVAC, we would first need to conclude through either review under TSCA or under the SNAP program that use of these smaller canisters would not pose an unreasonable risk to consumers.

In our review of consumer risks from HFO–1234yf, we considered information concerning consumer exposure to HF from thermal decomposition or combustion of HFO–1234yf. EPA's analysis at the time of the proposed rule focused on the flammability risk to consumers, which at the time we believed to be a significant risk in its own right, as well as a way to prevent consumer exposure to HF from combustion of HFO–1234yf. However, in preparing our proposal, we had available and did consider the SAE CRP's 2008 evaluation of scenarios that might cause consumer or occupational exposure to HF (CRP, 2008). This report stated:

> Decomposition of HFO–1234yf in a fire scenario might, in theory, pose a significant acute health risk to passengers or firemen. But in the event of a fire, other toxic chemicals will be produced by combustion of other automotive components and thus decomposition of the refrigerant may increase the risk for fire fighters and would not introduce an entirely new type of hazard. It is also anticipated that only a small portion of the refrigerant charge will be converted to these decomposition products. In U.S. EPA's assessment of risk of R–152a and CO_2 (R–744), the agency cited a study by Southwestern Laboratories which indicated that a 100% R–134a atmosphere only produced an HF concentration of 10 ppm when passed through a tube heated to 1,000 °F (Blackwell *et al.*, 2006). A search of the medical literature also did not reveal any published reports of injuries to fire fighters or vehicle passengers resulting from exposures to COF_2 or HF produced in fires involving refrigerants. (EPA–HQ–OAR–2008–0664–0008, p. 67)

After the SAE CRP's 2008 evaluation, SAE CRP members conducted tests to measure HF concentrations and to identify factors that were most likely to lead to HF formation (EPA–HQ–OAR–2008–0664–0056.2). One test on HF concentrations inside a car cabin found maximum concentrations were in the range of 0 to 35 ppm in trials both with HFO–1234yf and with HFC–134a, with concentrations dropping to 10 ppm or less after 10 minutes. In a second test of HF generated in the engine compartment, HF concentrations from thermal decomposition of HFO–1234yf reached as high as 120 ppm in the engine compartment in the worst case, with interior passenger cabin values of 40 to 80 ppm. Under the same extreme conditions (flash ignition, temperature of 700 °C, closed hood), HF concentrations from thermal decomposition of HFC–134a reached 36.1 ppm in the engine compartment with interior passenger cabin values of 2 to 8 ppm. The other trials with less extreme conditions found HF concentrations from HFO–1234yf in the engine compartment of 0 to 8 ppm.

The SAE CRP selected an Acute Exposure Guideline Limit (AEGL)−2 of 95 ppm over 10 minutes as its criterion for determining toxicity risk from HF.[13] Thus, even assuming levels inside a passenger compartment reached the highest level that occurred during the tests—80 ppm—a passenger inside a vehicle would at worst experience discomfort and irritation, rather than any permanent effects. HF levels that could result in similar effects were also observed for HFC–134a. The SAE CRP concluded that the probability of such a worst-case event is on the order of 10^{-12} occurrences per operating hour [14] (EPA–HQ–OAR–2008–0664–0056.2). This level of risk is similar to the current level of risk of HF generated from HFC–134a (EPA–HQ–OAR–2008–0664–0086.1). To date, EPA is unaware of any reports of consumers affected by HF generated by HFC–134a, which has been used in automobile MVAC systems across the industry since 1993. Thus, we do not expect there will be a significant risk of HF exposure to consumers from HFO–1234yf.

Depending on the charge size of an HFO–1234yf MVAC system, which may range from as little as 400 grams to as much as 1600 grams (ICF, 2008), it is possible in a worst case scenario to reach a flammable concentration of HFO–1234yf inside the passenger compartment. This could occur in the case of a collision that ruptures the evaporator in the absence of a switch or other engineering mitigation device to prevent flow of high concentrations of the refrigerant into the passenger compartment, provided that the windows and windshield remain intact. As stated in the SAE CRP, ignition of the refrigerant once in the passenger cabin is unlikely (probability on the order of 10^{-14} occurrences per operating hour) because the only causes of ignition within the passenger cabin with sufficient energy to ignite the refrigerant would be use of a butane lighter (EPA–OAR–2008–0664–0056.2). If a passenger were in a collision, or in an emergency situation, it is unlikely that they would choose to operate a butane lighter in the passenger cabin. Additionally, it is unlikely ignition would occur from a flame from another part of the vehicle because automobiles are constructed to seal off the passenger compartment with a firewall. If a collision breached the passenger compartment such that a flame from another part of the vehicle could reach it, that breach would also create ventilation that would lower the refrigerant concentration below the

[12] EPA has issued lists of approved unique fittings for refrigerants in MVAC (*see http://www.epa.gov/ozone/snap/refrigerants/fittlist.html*). These have been issued for the high-side service port, low-side service port, 30-lb cylinders (that is, the most typical size container for use in professional servicing), and small cans (containers typically used by consumers). The label "30-lb cylinders" is not intended to restrict the existence of other container sizes that professional service technicians might use (e.g., 50 lb, 20 lb, 10 lb).

[13] The AEGL–2 is defined as "the airborne concentration of a substance * * * above which it is predicted that the general population, including susceptible individuals could experience irreversible or other serious, long lasting adverse effects or an impaired ability to escape." *http://www.epa.gov/oppt/aegl/pubs/define.htm.*

[14] If we assume 250 million passenger vehicles in the U.S. and typical driving times of 500 hours per year per vehicle, a risk of 4.6×10^{-12} per operating hour equates roughly to one event every 2 years for all drivers in the entire U.S.

lower flammability limit. Similarly, if either a window or the windshield were broken in the collision, the ventilation created would lower the refrigerant concentration below the lower flammability limit. Therefore, EPA finds that flammability risks of HFO–1234yf to passengers inside a vehicle will be low. Further, these risks are likely to be less than those from HFC–152a, another flammable refrigerant that EPA has previously found acceptable subject to use conditions, because HFC–152a has a lower LFL and a lower minimum ignition energy than HFO–1234yf (EPA–HQ–OAR–2008–0664–0008, –0013.4, –0056.2).

Overall Conclusion

EPA finds that the use of HFO–1234yf in new passenger vehicle and light-duty truck MVAC systems, subject to the use conditions being adopted in the final rule, does not present a significantly greater risk to human health and the environment compared to the currently-approved MVAC alternatives or as compared to CO_2, which has been proposed for approval in this end-use.

VI. What is the relationship between this SNAP rule and other EPA rules?

A. Significant New Use Rule

Under the Toxics Substances Control Act, EPA has issued a Significant New Use Rule (75 FR 65987; October 27, 2010) for 1-propene, 2,3,3,3-tetrafluoro-, which is also known as HFO–1234yf. This rule requires persons who intend to manufacture, import, or process HFO–1234yf for a use that is designated as a significant new use in the final SNUR to submit a SNUN at least 90 days before such activity may occur. EPA has 90 days from the date of submission of a SNUN to decide whether the new use "may present an unreasonable risk" to human health or the environment. If the Agency does not determine that the new use "may present an unreasonable risk," the submitter would be allowed to engage in the use, with or without certain restrictions. The significant new uses identified in the final SNUR and subject to the SNUN requirement are: Use other than as a refrigerant in motor vehicle air conditioning systems in new passenger cars and vehicles; commercial use other than in new passenger cars or vehicles and in which the charging of motor vehicle air conditioning systems with HFO–1234yf was done by the motor vehicle OEM; and distribution in commerce of products intended for use by a consumer for the purpose of servicing, maintenance and disposal involving HFO–1234yf. The health concerns expressed in the final SNUR are based primarily on potential inhalation exposures to consumers during "do-it-yourself" servicing, as well as a number of other relevant factors.

B. Rules Under Sections 609 and 608 of the Clean Air Act

Section 609 of the CAA establishes standards and requirements regarding servicing of MVAC systems. These requirements include training and certification of any person that services MVAC systems for consideration,[15] as well as standards for certification of equipment for refrigerant recovery and recycling. EPA has issued regulations interpreting this statutory requirement and those regulations are codified at subpart B of 40 CFR part 82. The statutory and regulatory provisions regarding MVAC servicing apply to any refrigerant alternative and are not limited to refrigerants that are also ODS. This final SNAP rule addresses the conditions for safe use of HFO–1234yf in new MVAC systems. Thus, the requirements in this rule apply primarily to OEMs, except for specific requirements for service fittings unique to HFO–1234yf. MVAC end-of-life disposal and recycling specifications are covered under section 608 of the CAA and our regulations issued under that section of the Act.

VII. What is EPA's response to public comments on the proposal?

This section of the preamble summarizes the major comments received on the October 19, 2009 proposed rule, and EPA's responses to those comments. Additional comments are addressed in a response to comments document in docket EPA–HQ–OAR–2008–0664.

A. Acceptability Decision

Comment: Several commenters supported EPA's proposal to find HFO–1234yf an acceptable substitute for CFC–12 in MVACs. These commenters stated that available information indicates that HFO–1234yf will not pose significant health risks or environmental concerns under foreseeable use and leak conditions and that it has a strong potential to reduce greenhouse gas emissions from motor vehicles. Also, these commenters declared that HFO–1234yf's risks were similar to or less than those of other available alternatives, such as HFC–134a, HFC–152a, and CO_2. A commenter referenced the work of the SAE CRP, which concluded that HFO–1234yf can be used safely through established industry practices for vehicle design, engineering, manufacturing, and service.

Other commenters opposed finding HFO–1234yf acceptable or stated that there was insufficient information to support a conclusion. These commenters stated that the risks of HFO–1234yf were greater than those of other available alternatives, such as HFC–134a, CO_2, and hydrocarbons.

Response: For the reasons provided in more detail above, EPA has determined that HFO–1234yf, if used in accordance with the adopted use conditions, can be used safely in MVAC systems in new passenger vehicles and light-duty trucks. The use conditions established by this final rule ensure that the overall risks to human health and the environment are comparable to or less than those of other available or potentially available substitutes, such as HFC–134a, HFC–152a, or CO_2. EPA did not compare the risks to those posed by hydrocarbons since we have not yet received adequate information for hydrocarbons that would allow us to make such a comparison for use in MVAC.[16]

Comment: Some commenters suggested that EPA should consider other substitutes for CFC–12 in MVAC, such as CO_2 or hydrocarbons. An organization representing the automotive industry stated that the risks from using CO_2 in MVAC systems are below the probability of other adverse events which society considers acceptable and are roughly 1.5 orders of magnitude greater than the risks from using HFO–1234yf.

Response: This rule only concerns EPA's decision on the use of HFO–1234yf in new passenger vehicles and light-duty trucks. In a separate action, EPA has proposed to find CO_2 acceptable subject to use conditions as a substitute for CFC–12 in MVAC systems for new motor vehicles (September 16, 2006; 71 FR 55140). Information on the schedule for EPA's final rulemaking on CO_2 as a substitute in MVAC, RIN 2060–AM54, is available in EPA's regulatory agenda at *http://www.reginfo.gov/public/do/eAgendaMain*. We currently have inadequate information on hydrocarbons to consider adding them to the list of substitutes for MVAC. We

[15] Service for consideration means receiving something of worth or value to perform service, whether in money, credit, goods, or services.

[16] EPA previously reviewed two hydrocarbon blends for use in MVAC and found them unacceptable, stating "Flammability is a serious concern. Data have not been submitted to demonstrate that [the hydrocarbon blend] can be used safely in this end-use." Appendixes A and B to subpart G of 40 CFR part 82.

will review additional substitutes if they are submitted with complete and adequate data to allow an evaluation of whether such substitutes may be used safely within the meaning of section 612 of the CAA as compared with other existing or potential substitutes in the MVAC end-use.

B. Use Conditions

Comment: Several commenters stated that the proposed use conditions limiting concentrations of HFO–1234yf below the lower flammability limit are overly stringent or even impossible to meet and are not needed for safe usage. Some automobile manufacturers suggested relying upon established standards and practices, such as SAE protocols and standards, instead of use conditions. Some commenters suggested alternative language for use conditions. Other commenters expressed concern that the proposed use conditions limiting concentrations of HFO–1234yf would preclude the use of HFO–1234yf by any vehicle that is not initially designed to use this refrigerant.

Response: As described above, EPA agrees that the use conditions, as proposed, require modification. In this final rule, we have removed the first three proposed use conditions, which required design to keep refrigerant concentrations below the LFL. *See* section IV of the preamble, "What are the final use conditions and why did EPA finalize these conditions?" for our basis. With respect to the commenter who suggested that the proposed use conditions limiting concentrations of HFO–1234yf below the LFL would not allow use except in systems initially designed to use this refrigerant, we note that this decision is limited to use in new motor vehicles and light-duty trucks. Further, the proposed use conditions limiting refrigerant concentration are not included in the final rule and thus do not have implications for a future decision concerning retrofits.

Comment: One commenter provided test results from the Bundesanstalt für Materialforschung und -prüfung (BAM—Federal Institute for Materials Research and Testing) that tested various mixtures of HFO–1234yf and ethane (EPA–HQ–OAR–2008–0664–0053.3). The commenter stated that the tests show that explosions can occur at HFO–1234yf concentrations below its lower flammability limit (LFL) of 6.2% when minimal amounts of gaseous hydrocarbons are available. This commenter stated that the maximum concentrations of HFO–1234yf allowed under any use condition need to be far below the 6.2% LFL to ensure safety. Other commenters agreed with these concerns. Yet other commenters looked at the same test data and stated that the testing was not relevant to real-world situations in MVAC because it is unlikely that such large amounts of ethane or other gaseous hydrocarbons (0.8–2.4% by volume) would form in a vehicle. One commenter stated that HFO–1234yf reduces the flammability of ethane compared to ethane alone, and that HFO–1234yf reduces flammability of ethane more than CO_2 or argon, substances used as fire suppressants (EPA–HQ–OAR–2008–0664–0115.1).

Response: We do not believe that the BAM testing of the flammability limits of mixtures of HFO–1234yf and ethane is relevant to assessing the risks of HFO–1234yf as a refrigerant in MVAC. Examples of flammable substances in the engine compartment may include compressor oil mixed with the refrigerant, motor oil, cleaners, anti-freeze, transmission fluid, brake fluid, and gasoline. These are typically liquid and there is no evidence that any vapors that might form would include significant amounts of ethane. These fluids typically contain larger molecules with higher boiling points than ethane (*e.g.*, octane, polyalkylene glycol). It seems more likely, as one commenter suggested, that these flammable fluids would ignite before breaking down into concentrations of ethane considered in the BAM testing. Further, the results of the testing are not surprising; based on a scientifically known chemical equilibrium principle known as Le Chatelier's principle—the lower flammability limit of a mixture of two flammable substances falls between the lower flammability limits of the two individual substances. The range of LFLs for flammable mixtures of ethane and refrigerants HFC–134a, HFO–1234yf, and CO_2 is largest for CO_2 and is similar for HFC–134a and HFO–1234yf (Besnard, 1996).

A more relevant test to compare risks for HFO–1234yf and other alternative refrigerants in MVAC is to consider flammability of a mixture of compressor oil and refrigerant, as occurs in MVAC systems. Such testing, conducted as part of the SAE CRP, found that mixtures of HFO–1234yf and 5% oil and HFC–134a and 5% oil both ignited at temperatures higher than what usually occurs in a vehicle (730 °C or higher for HFO–1234yf and 800 °C or higher for HFC–134a).

Furthermore, we note that the final use conditions do not rely on the lower flammability limit. As explained in more detail in sections IV and V of the preamble, "What are the final use conditions and why did EPA finalize these use conditions?" and "Why is EPA finding HFO–1234yf acceptable subject to use conditions?", we believe that the risks from HFO–1234yf and its decomposition products are very small and are comparable to or less than the risks from other acceptable alternatives available or potentially available for use in MVAC systems. The use conditions established in this final rule require manufacturers to design systems to prevent leakage from refrigerant system connections that might enter the passenger cabin, and to minimize impingement of refrigerant and oil onto hot surfaces, as required by SAE J639 (adopted 2011). These use conditions will further reduce already low risks from flammability and HF generation.

Comment: One commenter provided data from a presentation showing that the lower flammability limit of HFO–1234yf decreases as temperature increases. The commenter stated that the proposed LFL of 6.2% may not be conservative enough.

Response: EPA agrees that the LFL decreases as temperature increases. However, for the analysis relied on for the proposed rule, we considered an LFL relevant to the temperatures that might be expected in a collision or leak scenario and that would not be so high as to be a higher risk factor than exposure to HF. The data provided by the commenter show an LFL of 5.7% at 60 °C (140 °F) and an LFL of 5.3% at 100 °C (212 °F). If a passenger were exposed to temperatures this high in the passenger compartment for any extended period of time, he or she would suffer from the heat before there was a risk of the refrigerant igniting. However, after considering the available information, we find it is not necessary to require a concentration of HFO–1234yf below the LFL to address this refrigerant's risks; rather, risks are sufficiently addressed with the final use conditions. As discussed above in section IV of the preamble, "What are the final use conditions and why did EPA finalize these conditions?", we believe that the flammability risks from HFO–1234yf are very small and overall risks from HFO–1234yf are comparable to or less than the risks from other acceptable alternatives used in MVAC. EPA finds that the use conditions in this final rule are sufficient to manage risks of injury or adverse health effects caused by HFO–1234yf.

Comment: Regarding the first proposed use condition that would limit the concentration of HFO–1234yf below the LFL in the passenger cabin, several commenters stated that the risks of refrigerant leaking into the passenger compartment and exceeding the LFL are very low. Some automobile manufacturers stated that it may not be possible to keep the concentration below the LFL in the event of a collision; however, the commenters said that even if concentrations in the passenger cabin exceeded the LFL, it would be extremely difficult to ignite the refrigerant. Some commenters stated that the engineering strategies that would be necessary to implement the proposed use condition would actually increase overall risk by increasing the risk of conveying smoke and fumes from the engine compartment into the passenger compartment in the event of an accident. Some commenters suggested alternative language for the use condition to give greater flexibility in engineering responses to allow for differences between vehicles.

Response: As discussed above in section IV of the preamble, EPA is not including the proposed use condition requiring that a specific level of refrigerant concentration inside the passenger cabin is not exceeded.

Comment: One commenter suggested that the use conditions for limiting concentrations in the passenger cabin should require the incorporation of engineering strategies and/or devices "such that foreseeable leaks" rising to the specified concentration levels can be avoided. Similarly, the commenter stated that any use condition limiting concentrations in the engine compartment should be limited to "prevention of ignition caused by foreseeable leaks." The commenter noted that EPA did this in a similar use condition in its final SNAP rule for HFC–152a, another flammable refrigerant for MVAC with greater flammability risk. The commenter stated that this would be consistent with safety requirements of the National Highway Traffic Safety Administration (NHTSA) and would ensure that EPA's use conditions are feasible.

Response: As discussed above in section IV of the preamble, EPA is not including the proposed use condition and is not limiting the refrigerant concentration inside the passenger cabin or the engine compartment.

Comment: A number of commenters did not support the proposed use condition on concentrations of HFO–1234yf in hybrid and electric vehicles. One commenter recommended eliminating this use condition, as the SAE CRP risk assessment concludes there are no real world safety risks. Another commenter suggested referring to the SAE or ISO (International Organization for Standardization) standards in place of a specific use condition. One commenter stated that electric terminals on hybrid vehicles are well protected to prevent fires and should not ignite the refrigerant. Another commenter stated that an accident severe enough to cause refrigerant leakage would also result in damage to the duct between the evaporator [in the MVAC system] and the battery pack, preventing an increase in refrigerant concentrations at the battery pack. One commenter stated that it is difficult to establish generic SNAP use conditions for hybrid vehicles, and individual manufacturers need to understand particular design features of their hybrid vehicles to ensure safe refrigerant application.

Three commenters expressed concern for using HFO–1234yf in hybrid and electric vehicles and stated that the use condition is not conservative enough. One commenter stated that the maximum concentrations of HFO–1234yf need to be far below the 6.2% LFL based on new tests done at the Federal Institute for Materials Research and Testing (BAM) and that they are unsure whether or not additional measures can effectively avoid the risk of explosive mixtures. Another commenter stated that HFO–1234yf would raise concerns in the field of battery cooling needed in electric vehicles because flammability and chemical reactions would pose major risks, which could lead to legal consequences for OEMs.

Response: As discussed above in section IV of the preamble, EPA is not including the proposed use condition and is not requiring protective devices, isolation and/or ventilation techniques where levels of refrigerant concentration may exceed the LFL in proximity to exhaust manifold surfaces or near hybrid or electric vehicle power sources. As discussed above, we do not believe that the BAM testing of the flammability limits of mixtures of HFO–1234yf and ethane is relevant to assessing the risks of HFO–1234yf as a refrigerant in MVAC. Based on information provided by OEMs that manufacture hybrid vehicles, we conclude that there will be sufficient protection against fire risk and generation of HF in the engine compartment for hybrid vehicles because they have protective coverings on power sources that will prevent any sparks that might have enough energy to ignite refrigerant and engine surfaces will not be hotter than those in conventional vehicles (EPA–HQ–OAR–2008–0664–0081.1, –0081.2). Further, we agree that it is reasonable to assume that a collision severe enough to release refrigerant from the evaporator (under the windshield) would also release it in a location far enough away from the battery pack to keep refrigerant concentrations at the battery pack below the LFL. CFD modeling performed for the December, 2010 SAE CRP risk assessment found that concentrations of HFO–1234yf only exceeded the LFL within ten centimeters of the leak or less (EPA–HQ–OAR–2008–0664–0056.2), but the battery pack is typically placed more than ten centimeters away from the evaporator. EPA expects that OEMs will include assessment of risks from the exhaust manifold, hybrid power source, and electric vehicle power source as part of the FMEA required under one of the final use conditions in this rule.

Comment: Some commenters responded to EPA's request for comment as to whether the use conditions should apply only when the car ignition is on. These commenters indicated that it is unnecessary for the use conditions on refrigerant concentrations within the passenger compartment to apply while a vehicle's ignition is off because it is unlikely that a collision would occur, that high temperatures would occur, or that refrigerant would enter the passenger cabin when the ignition, and thus the MVAC system, is off. Another commenter stated that it should be mandatory for all electric power sources to be shut off when the ignition is off.

Response: As discussed above in section IV of the preamble, EPA is not including the proposed use conditions that specified a refrigerant concentration not to be exceeded.

Comment: Several commenters stated that the proposed limits on concentrations of HFO–1234yf in the engine compartment cannot be met, even hypothetically, and that imposition of such a use condition would delay or even prevent the use of HFO–1234yf. Other commenters stated that the engineering required to meet the proposed use condition is almost certain to preclude the use of HFO–1234yf by any vehicle that was not initially designed to use this refrigerant.

Response: EPA is not including in the final rule the proposed use condition that sets a specific limit for refrigerant concentrations inside the engine compartment. *See* section IV of the preamble, "What are the final use conditions and why did EPA finalize these conditions?" for further rationale.

Comment: Several commenters agreed with EPA's proposal to require use of unique fittings and a warning label that identify the new refrigerant and restrict the possibility of cross-contamination with other refrigerants. Other commenters suggested that no use conditions are necessary because established standards and practices would be adequate for safe use of HFO–1234yf.

Response: The use conditions referenced by the commenters were established in a separate final rule, promulgated in 1996, which applies to all refrigerants used in MVAC (*see* appendix D to subpart G of 40 CFR part 82). EPA has not proposed to modify that existing rule for purposes of its acceptability determination for HFO–1234yf. These requirements indicate to technicians the refrigerant they are using and thus help reduce risks to the technician by ensuring that the technician will handle the refrigerant properly. In addition, these use conditions serve to prevent contamination of refrigerant supplies through unintended mixing of different refrigerants. For purposes of meeting that existing regulatory requirement, this final rule specifies use of fittings for the high-pressure side service port, the low-pressure side service port, and for refrigerant containers of 20 pounds or greater. The submitter for HFO–1234yf has provided these fittings to the Agency and they are consistent with the SAE standard J639. In addition, the final rule retains the requirement for a warning label identifying the refrigerant, consistent with SAE J639.

Comment: Some commenters agreed with EPA's proposal to require a high-pressure compressor cut-off switch, as per SAE J639. Another commenter suggested that the compressor cut-off switch would be useful for all systems in which the discharge pressure can reach the burst pressure, not just those systems with pressure relief devices.

Response: EPA is maintaining the requirement that HFO–1234yf MVAC systems must have a high-pressure compressor cut-off switch by requiring compliance with the SAE J639 standard. The SAE J639 standard requires a pressure relief device on the refrigerant high-pressure side of the compressor for all MVAC systems, and so the compressor cut-off switch will be required for all systems, as suggested by the commenter.

Comment: Several commenters supported the requirement for vehicle makers to conduct and maintain FMEAs. Other automobile manufacturers stated that the final SNAP rule finding HFC–152a acceptable as a substitute for CFC–12 in MVAC included this as a comment rather than as a use condition, and suggested that EPA do the same in the final rule for HFO–1234yf. Another commenter stated that FMEAs for each vehicle design are standard industry practice, and so no use condition is required; this commenter provided language for an alternate use condition should EPA choose to specify a use condition for vehicle design.

Response: EPA is retaining the requirement for FMEAs in the final rule as a use condition, rather than simply as an unenforceable comment. In an FMEA, vehicle designers analyze all the ways in which parts of the MVAC system could fail and identify how they will address those risks in design of the system. In addition, keeping records of an FMEA is important to ensuring safe use because it documents that vehicle designers have complied with the safety requirements of this rule. We believe that it is necessary to retain this requirement as a use condition in order to ensure that OEMs are required to analyze and address the risks and to document those efforts such that this analysis is available to demonstrate compliance to EPA in case of an EPA inspection. Information in the FMEAs complements the safety requirements in SAE J639 and is useful for demonstrating compliance. Because the revised SAE J639 standard refers to use of FMEAs more extensively, risk assessment using FMEAs is more critical for HFO–1234yf than it was for HFC–152a

Comment: A commenter requested that EPA specifically allow manufacturers to perform FMEAs according to equivalent standards developed by organizations other than SAE (*e.g.*, the International Organization for Standardization [ISO], the German Institute for Standards [DIN], or the Japan Automobile Manufacturers Association [JAMA]).

Response: We agree that standards from other standard-setting organizations may provide equivalent assurance of safe use. However, we are not aware at this time of any standards that do so. In order to ensure safe use of HFO–1234yf, we would need to review any other standard to ensure that it provides equivalent assurances of safety before allowing its use in place of the SAE standard. An OEM, for example, could petition EPA's SNAP program and provide copies of the other standard for consideration. If we agree that the other standard is equivalent, then we would add it to the use condition on FMEAs through a rulemaking.

Comment: A commenter expressed that EPA's approach to setting use conditions infringes upon the Department of Transportation's motor vehicle safety jurisdiction and that EPA does not have the authority to protect against any fire risk associated with motor vehicles.

Response: As an initial matter, we note that the commenter does not point to any specific legislative authority that supports his claim. Regardless, EPA disagrees with this commenter. Section 612 of the CAA provides that EPA may find substitutes for ODS acceptable if they present less risk to human health and the environment than other substitutes that are currently or potentially available. Congress did not establish any limits on EPA's authority for ensuring that substitutes are not more risky than other substitutes that are available and EPA has consistently interpreted this provision to allow the Agency to establish use conditions to ensure safe use of substitutes. In this case, we find that HFO–1234yf may be used safely, and with risks comparable to or less than those of other available substitutes for CFC–12 in the MVAC end-use, so long as it is used according to the use conditions established by this action. If the commenter were correct that the Department of Transportation (DOT) has sole authority to address safety risks from MVAC systems, in the absence of standards from DOT addressing HFO–1234yf's risks, EPA would need to determine that HFO–1234yf is unacceptable for use in MVACs.

C. Environmental Impacts

1. Ozone Depletion Potential

Comment: Several commenters agreed with EPA's proposed finding that HFO–1234yf would not contribute significantly to stratospheric ozone depletion, and that the ozone depletion potential (ODP) of HFO–1234yf is at or near zero. Two commenters claimed that the ODP of HFO–1234yf should be stated as "zero" instead of "nearly zero," and one commenter requested that EPA clarify that HFO–1234yf has an ODP less than that of HFC–134a.

Other commenters disagreed with EPA's statement that the ODP of HFO–1234yf is at or near zero. One commenter expressed concern that ODS may be used in the HFO–1234yf manufacturing process, or emissions of HFO–1234yf and its by-products from the manufacturing process may break down into gases with ODPs; this commenter advised EPA against listing HFO–1234yf as an acceptable replacement for HFC–134a in MVACs. Another commenter stated that HFO–1234yf requires further investigation since unsaturated HFCs such as HFO–1234yf might break down into gases that are ozone depleting.

Response: It is generally agreed among scientists that substances that contain chlorine, bromine or iodine may have an ozone depletion potential while those that contain only fluorine effectively have no ODP. In particular, this is because the CF_3 radical produced from HFCs has negligible reactivity (Ravishankara *et al.*, 1993); the same radicals would be expected from HFO–1234yf. HFO–1234yf contains no chlorine, bromine, or iodine. Also, the atmospheric lifetime of HFO–1234yf is estimated at only 11 to 12 days (Orkin *et al.*, 1997; Papadimitrou *et al.*, 2007), further reducing the amount of the chemical that could possibly reach the stratosphere. Unsaturated HFCs, such as HFO–1234yf, have at least one double bond or triple bond between two carbon atoms. Double bonds, like those in HFO–1234yf, are less stable than single bonds. A saturated HFC, such as HFC–134a, has only single bonds between atoms of carbon, and is thus more stable. Although HFO–1234yf may be more unstable than HFC–134a, EPA is not aware of any chemical reactions or decomposition pathways that would cause HFO–1234yf or its breakdown products to lead to ozone depletion and the commenter has provided no technical or scientific support for their claims. For purposes of our determination, whether its ODP is zero or nearly zero, we expect HFO–1234yf to have negligible impact on the ozone layer and we are listing it as acceptable, subject to use conditions.

2. Global Warming Potential

Comment: Several commenters agreed with EPA's statement that HFO–1234yf has a global warming potential (GWP) of 4 over a 100-year time horizon. Some commenters noted the potential environmental benefits of having a lower GWP refrigerant available. Other commenters stated that HFO–1234yf would not be a solution to high global warming impacts because of environmental and health impacts of breakdown products, including HF, trifluoroacetic acid (TFA), and aldehydes.

Response: EPA continues to believe that the 100-yr GWP of HFO–1234yf is 4, as supported by the commenters. We further agree with the commenters who state that there will be an environmental benefit if car manufacturers switch to HFO–1234yf from HFC–134a, a refrigerant with a GWP of 1430 relative to CO_2.

We disagree with the commenters who claim that environmental and health impacts of breakdown products are a major cause for concern or will prevent HFO–1234yf from being a useful solution to high global warming impacts. One commenter mentioned concerns about HF in the atmosphere, but HFO–1234yf does not decompose to form significant amounts of HF in the atmosphere. In fact, HFC–134a and HFC–152a result in more HF in the atmosphere than HFO–1234yf because those two compounds decompose to form both COF_2, carbonyl fluoride (and then HF and CO_2) and CF_3COF, trifluoroacetyl fluoride (and then TFA); in contrast, HFO–1234yf favors forming trifluoroacetyl fluoride (and then TFA) and does not decompose to carbonyl fluoride or to HF (ICF, 2010d). For a discussion on the potential human health impacts of HF, *see* sections V and VII.D.3, "Why is EPA finding HFO–1234yf acceptable subject to use conditions?" and "Toxicity of Hydrogen Fluoride."

The fluorinated breakdown product that we have identified of greatest concern is TFA, because of its persistence and potential impacts on aquatic plants. As discussed above in section V and below in section VII.C.5, "Formation of Trifluoroacetic Acid and Ecosystem Impacts," the projected concentrations of TFA, based on a conservative analysis, will be far below the level expected to cause any adverse impacts on aquatic life.

EPA agrees that the breakdown products from the decomposition of HFO–1234yf will include aldehydes, but we disagree that this is a cause for concern. As part of the analysis of the atmospheric breakdown products of HFO–1234yf, we found that worst-case concentrations of formaldehyde would reach 6 to 8 parts per trillion (ppt) on a monthly basis or an average of 3 ppt on an annual average basis, compared to a health-based limit of 8000 ppt,[17] *i.e.*, a level that is roughly 1000 to 2600 times lower than the health-based limit (ICF, 2010d). Acetaldehyde levels would be even lower, with worst-case concentrations of 1.2 ppt and annual average concentrations of 0.23 ppt, compared to a health-based limit of 5000 ppt [18] (ICF, 2010d). As discussed further below in section VII.D.1 of the preamble, "Toxicity of HFO–1234yf," these concentrations are one to three orders of magnitude less than ambient concentrations of formaldehyde and acetaldehyde without the introduction of HFO–1234yf (ICF, 2010d). Thus, aldehydes that would be decomposition products of HFO–1234yf in the atmosphere would not contribute significantly to adverse health effects for people on earth's surface.

Other fluorinated alternatives that are acceptable in the MVAC end-use, HFC–134a and HFC–152a, also create fluorinated breakdown products, and there is not evidence to show that those from HFO–1234yf create significantly more risk for human health or the environment than breakdown products from other alternatives. Thus, even assuming that risks from breakdown products would exist, based on use of HFO–1234yf in the MVAC end-use, we do not believe those risks are greater than the risks posed by other acceptable alternatives.

3. Lifecycle Emissions of HFO–1234yf

Comment: One commenter stated that HFO–1234yf has the best global lifecycle climate performance (LCCP) and lower CO_2 [equivalent] emissions compared to other alternatives. However, another commenter stated that HFO–1234yf has a lower thermodynamic efficiency than HFC–134a and that its use could lead to increases in CO_2 and other air pollutant emissions. The same commenter stated that there is no assurance that automakers would voluntarily add technologies to maintain current levels of MVAC efficiency when using HFO–1234yf.

Response: We note that EPA has chosen to use GWP as the primary metric for climate impact for the SNAP program, while also considering energy efficiency (March 18, 1994; 59 FR 13044). We have not used specific lifecycle metrics such as Total Equivalent Warming Impact (TEWI), Lifecycle Analysis (LCA) or LCCP as metrics for climate impact, since it is not clear that there is agreement in all industrial sectors or end-uses on which of these measures is most appropriate in which situations or how these metrics are to be calculated (SROC, 2005).

The available information on efficiency, LCCP and lifecycle emissions for MVAC does not raise concern that the indirect climate impacts from HFO–1234yf will cause significantly greater impacts on human health and the environment than other available alternatives. Looking at some of the information referenced by the commenters, we learned that:

- Bench testing for the Japan Automobile Manufacturers Association (JAMA) and the Japan

[17] The Agency for Toxic Substances and Disease Registry (ATSDR) has established a chronic inhalation minimal risk level (MRL) of 0.008 ppm (8,000 ppt) for formaldehyde (ICF, 2010d). MRLs are available online at *http://www.atsdr.cdc.gov/mrls/mrls_list.html*.

[18] EPA has established a Reference Concentration (RfC) of 0.005 ppm (5,000 ppt or 0.009 mg/m^3) for acetaldehyde (ICF, 2010d). A summary of EPA's documentation for its risk assessment and RfC derivation for acetaldehyde is available online at *http://www.epa.gov/ncea/iris/subst/0290.htm*.

Auto Parts Industry Association (JAPIA) found a system efficiency (coefficient of performance) for HFO–1234yf that is roughly 96% of that for HFC–134a (JAMA–JAPIA, 2008)

- LCCP analysis conducted by JAMA found that indirect CO_2 equivalent emissions from less efficient fuel usage due to use of the MVAC system were a few percent higher for HFO–1234yf and roughly 20 to 25% higher for CO_2, compared to HFC–134a (JAMA, 2008)
- JAMA's LCCP analysis found that when both direct emissions of refrigerant and indirect emissions from less efficient fuel usage are considered, HFC–134a has higher total climate impact than either HFO–1234yf or CO_2; in hotter climates like Phoenix, Arizona, HFC–134a has higher total climate impact than HFO–1234yf but slightly lower climate impact than CO_2; and in all cases, HFO–1234yf had the lowest total climate impact of the three alternatives. (JAMA, 2008)
- MVAC systems can be designed to improve efficiency through steps such as changing the compressor, sealing the area around the air inlet, changing the thermal expansion valve, improving the efficiency of the internal heat exchanger, adding an oil separator to the compressor, and changing the design of the evaporator. Optimized new MVAC systems using either HFO–1234yf or CO_2 can reduce fuel usage compared to current MVAC systems using HFC–134a. (Benouali *et al.*, 2008; Meyer, 2008; Monforte *et al.*, 2008)

EPA believes that there is good reason to expect that automobile manufacturers will choose to design new cars using more efficient MVAC components and systems than in the past because of recent regulations. The Department of Transportation has issued new regulations raising the Corporate Average Fuel Economy standards for vehicles and EPA has issued new regulations restricting greenhouse gas emissions from light-duty vehicles (75 FR 25324; May 7, 2010). Thus, in order to ensure that their fleets meet these standards, it is highly likely that automobile manufacturers will include MVAC systems optimized for efficiency in future models, regardless of the refrigerant used.

Comment: Concerning an appropriate rate of emissions for estimating environmental impacts of HFO–1234yf, three commenters recommended that EPA use 50 g per vehicle per year total lifecycle emission rate. These commenters cited the work of Wallington *et al.* (2008) and Papasavva *et al.* (2009).[19] Another commenter stated that HFO–1234yf is very likely to have a lower leak rate than HFC–134a, citing data on permeability for both refrigerants.

Response: EPA agrees that the permeability data indicate that regular leakage emissions of HFO–1234yf, which are released slowly through hoses, are likely to be lower than those from HFC–134a. However, this is only a portion of total emissions expected because emissions may also come through irregular leaks due to damage to the MVAC system, refrigerant loss during servicing, and refrigerant loss at the end of vehicle life. In response to the commenters who suggested that we use an annual emission rate of 50 g/vehicle/yr, we reexamined environmental impacts as part of our final environmental analysis (ICF, 2010c) using the recommended 50 g/vehicle/yr value and compared this to the impacts calculated assuming emissions are similar to those from HFC–134a in MVAC, as we did at the time of proposal (closer to 100 g/vehicle/yr). The emission values from using 50 g/vehicle/yr (*i.e.*, values from the Pappasavva *et al.* (2009) study) were 26.3% to 51.1% less than the emission estimates used in our analysis at the time of proposal (ICF, 2009; ICF, 2010a; ICF, 2010c). In either case, as described more fully in section V above and in sections VII.C.4 and VII.C.5, below, the overall environmental impacts on generation of ground-level ozone and of TFA were sufficiently low and the impacts of HFO–1234yf are not significantly greater than those of other available substitutes for MVAC. For further information, *see* the ICF analyses in the docket (ICF, 2010a,b,c,e).

4. Ground-Level Ozone Formation

Comment: Some commenters expressed concern about a potential increase in ground-level ozone of > 1–4% calculated in EPA's initial assessment (ICF, 2009) of environmental impacts of HFO–1234yf. Other commenters stated that HFO–1234yf will not contribute significantly to ground-level ozone. One commenter suggested that EPA provide an updated assessment of the potential contribution of HFO–1234yf to ground-level ozone, considering the additional information provided in public comments (*e.g.*, Luecken *et al.*, 2009 and Wallington *et al.*, 2009).[20]

Response: We proposed that HFO–1234yf would be acceptable, even with a worst-case increase in ground-level ozone of > 1 to 4%. In response to comments, EPA performed a new analysis that (1) used revised estimates of the expected emissions of HFO–1234yf; and (2) used reactions with ozone formation from hydroxyl radicals rather than using sulfur dioxide (SO_2) as a surrogate for the hydroxyl radical, OH , and rather than making assumptions about the relative reactivity of compounds. Our revised analysis (ICF, 2010b) estimates that emissions of HFO–1234yf might cause increases in ground-level ozone of approximately 0.08 ppb or 0.1% of the ozone standard in the worst case, rather than an increase of 1.4 to 4% as determined in our initial analysis (ICF, 2009). This value also agrees with results from Kajihara *et al.*, 2010 and Luecken *et al.*, 2009. This revised analysis provides additional support that HFO–1234yf will not create significant impacts on ground level ozone formation or on local air quality.

Comment: Some commenters disagreed with EPA's statement that HFO–1234yf has a photochemical ozone creation potential (POCP) comparable to that of ethylene (100), while others agreed with this conclusion. One commenter provided a peer reviewed study that estimated the POCP of HFO–1234yf to be 7 (Wallington *et al.*, 2010).

Response: Based on the comments received and additional studies, EPA believes that the initial assessment that assumed a POCP of 100 to 300 is overly conservative. We have revised our initial analysis to incorporate reaction kinetics specific to HFO–1234yf, consistent with Luecken *et al.*, 2009, which avoids making an assumption of POCP. EPA's revised analysis estimates worst-case increases in ground-level ozone formation of approximately 0.1% (ICF, 2010b). Compared to the uncertainty in the sources of emissions, the uncertainty in the measures that localities will take to meet the ozone standard, and the uncertainty in the analysis, a projected worst-case increase in ozone of 0.1% is not significant for purposes of determining that HFO–1234yf poses substantially greater human health or environmental risk than other alternatives. This provides further support for our proposed determination that the conditioned use of HFO–1234yf does not present a

[19] Papasavva *et al.* (2009) includes several sources of emissions of automobile refrigerant, including regular leaks through hoses, irregular leaks, refrigerant loss during servicing, and refrigerant loss at end of vehicle life.

[20] Prepublication version of Wallington *et al.*, 2010 (Docket item EPA–HQ–OAR–2008–0664–0084.2)

significantly larger risk to human health and the environment compared to HFC–134a, and in many cases likely poses less risk. For further information, *see* the analysis of environmental impacts in section V of the preamble, "Why is EPA finding HFO–1234yf acceptable subject to use conditions?" and *see* the analysis in the docket (ICF, 2010b).

Comment: A commenter provided a link to a paper (Carter, 2009) that found the maximum incremental reactivity (MIR) for HFO–1234yf to be about the same as that for ethane. Based on the MIR value for HFO–1234yf, some commenters stated that EPA should find HFO–1234yf to be exempt from the definition of VOC.

Response: (Note: EPA has previously found certain compounds exempt from the definition of "volatile organic compound" [VOC] for purposes of air regulations in State Implementation Plans, 40 CFR 51.100(s), if they have a MIR equal to or less than that of ethane on a mass basis [69 FR 69298, November 29, 2004; 74 FR 29595, June 23, 2009; also *see* interim EPA guidance at 70 FR 54046, September 13, 2005].) In a separate rulemaking process, EPA is considering whether to list HFO–1234yf under 40 CFR 51.100(s) as exempt from the definition of VOC for purposes of air regulations that States may adopt in State Implementation Plans.

5. Formation of Trifluoroacetic Acid and Ecosystem Impacts

Comment: Several commenters agreed with EPA's proposed finding that the projected maximum concentration of TFA in rainwater from degradation of HFO–1234yf does not pose a significant aquatic toxicity risk. Other commenters raised concern about the potential impacts of TFA on biodiversity, ecosystems, and human health. One commenter questioned the sustainability of HFO–1234yf, so long as there are questions remaining about its environmental fate and degradation. One commenter stated that artificial input of TFA into the environment should be avoided because of its toxicity and chemical properties. Another commenter stated that HFO–1234yf poses additional environmental concerns compared to HFC–134a and advised against finding it acceptable while the issue of TFA production is being further researched.

Response: We continue to conclude for purposes of our decision here that the degradation of HFO–1234yf into TFA does not pose a significant risk of aquatic toxicity or ecosystem impacts. All available research indicates that, assuming emissions are no more than twice the current level of emissions from HFC–134a from MVAC, TFA concentrations in surface water and rainwater will be on the order of 1/800th to 1/80th of the no observed adverse effect level (NOAEL) for the most sensitive known alga (Luecken *et al.*, 2009; Kajihara *et al.*, 2010). We have revised our analysis on TFA concentrations using the known reaction kinetics of HFO–1234yf. The revised estimate of the worst-case TFA concentration in rainwater is approximately 1700 ng/L, similar to the concentrations in Luecken *et al.* (2009) of 1260 ng/L and Kajihara *et al.* (2010) of 450 ng/L. We believe this provides a sufficient margin of protection to find that the use of HFO–1234yf in MVAC will not pose significantly greater risks than other available alternatives in this end-use.

Comment: Some commenters stated that further research on TFA is necessary.

Response: EPA has considered additional studies submitted during the public comment period (Luecken *et al.*, 2009; Kajihara *et al.*, 2010) and has performed further analysis on this issue. Luecken *et al.* (2009) predicted through modeling that in the U.S., HFO–1234yf used in MVAC would result in enough TFA to increase its concentration in rainwater to 1/80th to 1/800th of the NOAEL for the most sensitive plant species considered. Kajihara *et al.* (2010) predicted through modeling that in Japan, HFO–1234yf use in all potential refrigeration uses would increase the TFA concentration in surface water to no more than 1/80th of the NOAEL for the most sensitive plant species considered. This study also found that surface water concentrations were roughly twice those in rainwater. Thus, even with highly conservative modeling that also considered accumulation in surface water, the concentrations of TFA are likely to be at least 80 times lower than a level expected to have no impact on the most sensitive aquatic species.

We also performed a further modeling analysis using refined assumptions on emissions and the mechanisms by which HFO–1234yf might break down. We found that the worst-case concentration of TFA would be approximately 1700 ng/L, similar to the concentrations in Luecken *et al.* (2009) of 1260 ng/L and Kajihara *et al.* (2010) of 450 ng/L (ICF, 2010b). These additional studies and analyses indicate even less risk than the studies available at the time of proposal and thus provide further support that TFA emissions from MVAC system will not pose a significant risk of aquatic toxicity or ecosystem impacts.

We also note that EPA has an obligation to act on submissions in a timely manner under the Clean Air Act (§ 612(d)). Given that research to date has not indicated a significant risk, we disagree that the Agency should delay a final decision to await further studies that may be done in the future. If future studies indicate that HFO–1234yf poses a significantly greater environmental risk than we now believe, section 612(d) provides a process for an interested party to petition the Agency to change a listing decision.

Comment: Two commenters stated that EPA's initial modeling (EPA–HQ–OAR–2008–0664–0037) greatly overestimates the local deposition of TFA from oxidation of HFO–1234yf. In particular, one commenter claimed that the modeling's use of the oxidation of SO_2 to sulfate ion, SO_3^-, as a proxy for the oxidation of HFO–1234yf is overly conservative because a large portion of SO_2 is in aerosol form, unlike for HFO–1234yf. This commenter also referred to the impacts found in the peer-reviewed paper by Luecken *et al.* (2009).

Response: EPA agrees that the use of the oxidation of SO_2 to SO_3^- as a proxy for the oxidation of HFO-1234yf likely results in overestimating TFA concentrations. This is because the sulfate particle is a condensation nucleus in the wet deposition process and it has a very high removal efficiency compared to the gas phase process for wet deposition that acts with HFO–1234yf and its decomposition products. Further, TFA forms more slowly from HFO–1234yf than sulfate forms from SO_2 (ICF, 2010b).

We have repeated the modeling using refined assumptions on emissions and the mechanisms by which HFO–1234yf might break down. This revised assessment (ICF, 2010b) found TFA concentrations roughly one-thousandth those in the earlier assessment (1700 ng/L compared to 1,800,000 ng/L in ICF, 2009). This additional research provides stronger support for our conclusion that the degradation of HFO–1234yf into TFA does not pose a significant risk of aquatic toxicity or ecosystem impacts.

Comment: Some commenters disagreed with a statement in the ICF (2009) analysis concerning TFA concentrations in surface waters, that "the exception to this is vernal pools and similar seasonal water bodies that have no significant outflow capacity." These commenters believe that Boutonnet *et al.* (1999) showed that accumulation of trifluoroacetate, a compound closely related to TFA, was rather limited in seasonal water bodies. The commenters also stated that Benesch *et al.* (2002) conducted an experimental study of the impacts of TFA on vernal pools, in which no impacts were observed.

Response: The statement from ICF, 2009 in context stated:

NOECs [No-observed effect concentrations] were compared to rainwater TFA concentrations because for most water bodies, it is difficult to predict what the actual TFA concentration will be. This is because concentrations of environmental contaminants in most fresh water bodies fluctuate widely due to varying inputs and outputs to most ponds, lakes, and streams. Comparison of NOECs to rainwater concentrations of TFA is actually more conservative because TFA is expected to be diluted in most freshwater bodies. The exception to this is vernal pools and similar seasonal water bodies that have no significant outflow capacity. (ICF, 2009)

We note that the "exception" described in the analysis is an exception to the expectation that TFA will be diluted more in freshwater bodies than in rainwater. We believe that the available evidence confirms that vernal pools do not dilute TFA as much as freshwater bodies with outflow capacity. Modeling by Kajihara *et al.*, 2010 found surface water concentrations were roughly twice those in rainwater. However, even these concentrations were not high enough to be of significant concern for environmental impacts. As noted previously, even the highest levels of TFA concentrations were at least 80 times less than the NOAEL for the most sensitive aquatic species examined.

D. Health and Safety Impacts

1. Toxicity of HFO–1234yf

Comment: Three commenters stated that there are no toxicity concerns with using HFO–1234yf, and two commenters noted that HFO–1234yf is comparable to HFC–134a in terms of human health effects. One commenter also stated that HFO–1234yf does not present a developmental toxicity or lethality risk. Seven commenters stated that there are potential toxicity concerns with use of HFO–1234yf. One commenter cautioned EPA against listing HFO–1234yf as acceptable for use in MVACs on the grounds of increased concerns over developmental effects and other toxic effects on human health.

Response: EPA continues to believe that HFO–1234yf, when used in new MVAC systems in accordance with the use conditions in this final rule, does not result in significantly greater risks to human health than the use of other available or potentially available substitutes, such as HFC–134a or CO_2. The results of most of the toxicity tests for HFO–1234yf either confirmed no observed adverse health effects, or found health effects at similar or higher exposure levels than for HFC–134a. For example, HFC–134a caused cardiac sensitization at 75,000 ppm but HFO–1234yf did not cause cardiac sensitization even at 120,000 ppm, the highest level in the study (NRC, 1996; WIL 2006). NOAELs from subacute exposure were higher for HFO–1234yf than for HFC–134a (NOAELs of 51,690 for HFO–1234yf with no effects seen in the study, compared to 10,000 ppm for HFC–134a with lung lesions and reproductive effects seen at 50,000 ppm [NRC, 1996; TNO, 2005]). No adverse effects were seen at 50,000 ppm or any other level in subchronic (13-week) studies for both HFO–1234yf and HFC–134a (NRC, 1996; TNO, 2007a).

In mutagenicity testing for HFO-1234yf, the two most sensitive of five strains of bacteria showed mutation; however, this screening test for carcinogenic potential is known to have only a weak correlation with carcinogenicity (Parodi *et al.*, 1982; [21] Kirkland *et al.*, 2005 [22]), so a positive result in this test for the two most sensitive strains is not sufficient reason to consider HFO–1234yf to be a significant health risk. Mutagenicity testing for HFC–134a by the same test found no evidence of mutagenicity. Screening for carcinogenic potential in a genomics study did not identify HFO–1234yf as a likely carcinogen (Hamner Institutes, 2007). A two-year cancer assay for HFC–134a did not find evidence of carcinogenicity (NRC, 1996).

EPA considers the results of developmental testing to date to be of some concern, but not a sufficient basis to find HFO–1234yf unacceptable for purposes of this action under the SNAP program. In a developmental study on rats, cases of wavy ribs were seen in some developing fetuses during exposure to HFO–1234yf (TNO 2007b); however, effects on bone formation were also seen for HFC–134a (NRC, 1996). It is not clear if this effect is reversible or not. Interim results from a two-generation reproductive study did not find an association between exposure to HFO–1234yf and skeletal effects. This two-generation reproductive study for HFO–1234yf finds a NOAEL of 5000 ppm for delayed mean time to vaginal opening in F1 females (females in the first generation of offspring). A subacute (28-day) test for HFC–134a (single generation) found a NOAEL of 10,000 ppm for male reproductive effects (NRC, 1996). A developmental test on rabbits exposed to HFO–1234yf did not find effects on the developing fetus. However, some of the mother rabbits in this study died. The reason for the deaths is not known. The data on developmental effects are inconsistent depending on the test performed and the species tested. The development effects observed in the developmental study on rats are not significantly different from the developmental effects observed for HFC–134a. In any case, as discussed above in section V and below in this section, our risk assessments found that HFO–1234yf would likely be used with exposure levels well below those of concern in the uses allowed under this rule. Thus, we do not find the observed developmental effects sufficient reason for finding HFO–1234yf unacceptable in this rule.

For purposes of this action, we prepared our risk assessment for long-term exposure using the level at which no deaths or other adverse health effects were seen in the rabbit developmental study—a "no observed adverse effect level" or NOAEL—to ensure that exposed people would be protected. The longer-term, repeated exposure in that study would be the exposure pattern (though not necessarily the exposure level) for a worker using HFO–1234yf on a regular basis or for a consumer exposed in a car due to a long, slow leak into the passenger compartment. Using the NOAEL concentration of 4000 ppm as a starting point, we found no situations where we expect exposure to exceed the level that EPA considers safe for long-term or repeated exposure (EPA–HQ–OAR–2008–0664–0036). Thus, we consider the potential toxicity risks of HFO–1234yf for those uses allowed under this action to be addressed sufficiently to list it as acceptable subject to use conditions.

Comment: Based on a risk assessment conducted by one commenter, the commenter concluded that if HFO–1234yf is used under the conditions specified in the commenter's risk assessment, adverse health impacts would not be expected to car occupants, to servicing personnel, or to do-it-yourself (DIY) consumers. This commenter noted differences between the margin-of-exposure approach to

[21] Predictive ability of the autoradiographic repair assay in rat liver cells compared with the Ames test; S. Parodi; M. Taningher; C. Balbi; L. Santi; *Journal of Toxicology and Environmental Health*, Vol. 10, Issue 4 & 5, October 1982, pages 531–539.

[22] Kirkland *et al.* (2005) Evaluation of a battery of three in vitro genotoxicity tests to determine rodent carcinogens and non-carcinogens. I. Sensitivity, specificity and relative predictivity, *Mutation Research*, 584, 1–256.

assessing risk, as in EPA's risk assessment (EPA–HQ–OAR–2008–0664–0036), and the commenter's hazard index (HI) approach. The commenter further stated that in all cases, the predicted hazard index for HFO–1234yf was only one-half of the values predicted for HFC–134a, and in some cases, only one-third of the HFC–134a values, demonstrating from a health perspective that HFO–1234yf is a viable alternative to HFC–134a.

Response: EPA agrees that adverse health impacts would not be expected to car occupants or to servicing personnel, so long as the use conditions of this rule are observed. However, EPA has issued a Significant New Use Rule under TSCA (October 27, 2010; 75 FR 65987) that would require submission of additional information to EPA prior to the manufacture, import or processing of HFO–1234yf for certain uses, including distribution in commerce of products intended for use by a consumer for the purposes of servicing, maintenance and disposal involving HFO–1234yf (*e.g.*, "do-it-yourself" servicing of MVAC systems).

Where available, it is EPA policy to use a NOAEL (No-Observed-Adverse-Effect Level) for the point of departure (POD) for risk assessment. This is the highest exposure level that did not cause an adverse health effect in a study. In this case, EPA selected the POD from an animal (rat 2-week inhalation) study. Because animals may respond to different exposure levels than humans, there is some uncertainty when extrapolating from animals to humans. For this reason, an Uncertainty Factor (UF) is applied when extrapolating from animals to humans—typically a factor of 10 is used but, in this case, since there was a reasonable estimate of the pharmacokinetic component of the uncertainty, this UF was reduced to 3. An additional UF is applied to account for variation in the human population response to a chemical exposure—in this case, a UF of 10 was used. The two UFs give a resultant UF of 30 to yield an acceptable level of health risk. As stated in the final SNUR, EPA's policy for review of new chemicals under TSCA is to divide the POD by the exposure level to obtain the MOE. For HFO–1234yf, the "acceptable level of health risk" would be an MOE of 30 or greater.

The commenter proposed dividing the estimated exposure to HFO–1234yf by the POD levels to obtain a HI. As a result, if the exposure is less than the POD, the HI is < 1 and the commenter considered this an "acceptable level of health risk." The commenter's approach to the hazard index does not factor in uncertainties about extrapolating from animal to human responses, nor does it address variability within the human population with regard to thresholds of response to chemical exposures. EPA has consistently applied the margin of exposure (MOE) approach to evaluations of pre-manufacture notices (and for certain other risk assessments) in order to account for the uncertainties discussed above. The SNAP program considered work performed during evaluation of the pre-manufacture notice (EPA–HQ–OAR–2008–0664–0036), as well as a separate SNAP program risk screen (EPA–HQ–OAR–2008–0664–0038). SNAP program risk screens compare expected exposures to exposure limits that incorporate uncertainty factors based on EPA guidance, rather than calculating either a hazard index or a margin of exposure. Any of these approaches to risk assessment will come to a similar conclusion about whether there is a potential health concern when using the same point of departure, uncertainty factors, and exposure estimates.

The Agency and the commenter disagree on all three of these inputs to the risk assessment and hence have reached different conclusions. Despite these differences, the assessments relied on by both the commenter and EPA show that there is low risk both to car occupants and to service technicians. EPA's risk assessment indicates a potential risk to DIYers (EPA–HQ–OAR–2008–0664–0036). As stated previously in this action, this issue is further addressed through the Agency's authority under TSCA.

Comment: In response to EPA's risk assessment (EPA–HQ–OAR–2008–0664–0036), two commenters disagreed with the use of a 2-week study for evaluating 30 minute exposures and stated that acute toxicity (4-hour test) or cardiac sensitization test results would be more appropriate for acute exposure evaluations.

Response: Commenters have suggested that EPA use data from the 4-hour acute toxicity study or from the cardiac sensitization study as a starting point ("point of departure") for assessing risks of short-term (acute) exposure. However, cardiac sensitization studies are for very short durations—on the order of 10 minutes—and they only address cardiac sensitization. HFO–1234yf does not induce cardiac sensitization. EPA selected the point of departure for acute effects from a multiple-exposure 2-week (subacute) rat inhalation study on HFO–1234yf, reasoning that if no effects were seen in the duration of the study (6 hours per day, 5 days per week for 2 weeks), that no effects would be seen from a single exposure at a similar exposure level, either. Further, the subacute exposure rat study included more thorough pathology examinations than those included in a cardiac sensitization study.

The acute 4-hour exposure study in rats showed some lung effects at approximately 200,000 ppm, the lowest exposure level in the study. Thus EPA considers 200,000 ppm to be a LOAEL (Low-Observed-Adverse-Effect Level). If a LOAEL were used in the risk assessment instead of a NOAEL, EPA would use an uncertainty factor to estimate a NOAEL, which would result in a lower POD than what was used. For example, if EPA had started with the LOAEL of 200,000 ppm, it would have required an additional MOE of 10 to estimate a NOAEL from a LOAEL, for a total MOE of 300 instead of 30. This would have resulted in a more conservative risk assessment than using the NOAEL from the 14-day subacute study. In the 4-hour acute toxicity study, some of the animals had grey, discolored lungs at all exposure levels in the study, and we considered this an adverse effect. Thus, EPA could only determine a lowest observed adverse effect level (LOAEL) from the 4-hour acute study and could not determine a no observed adverse effect level (NOAEL). It is longstanding Agency policy to use the NOAEL where available instead of a LOAEL, because of greater assurance of a safe exposure level. EPA instead used the NOAEL for the next shortest study, the subacute 14-day study, as the endpoint of concern for short term exposure because the LOAEL from the acute 4-hour study is an endpoint showing effects that may not result in safe exposure levels for humans. If we had used the value from the 4-hour acute toxicity study, we would have had to consider additional uncertainty that would have resulted in a more conservative, more restrictive risk assessment than using the NOAEL from the 14-day subacute study.

Further, EPA has uncertainties about using the available single exposure studies on HFO–1234yf to determine the MOEs for different exposure scenarios. As a result of concerns with these studies, EPA calculated single exposure MOEs from the NOAEL in the 2-week inhalation toxicity study of HFO–1234yf in rats. There are some uncertainties in the single exposure (acute) assessments because of the observation of lethality in rabbit dams after multiple exposures to HFO–1234yf in a developmental study. For these reasons, EPA recommended an acute inhalation toxicity study on rabbits in the proposed SNUR to address the question of whether pregnant rabbits would die from a single exposure (April 2, 2010; 75 FR 16706).

Comment: A commenter asserted that EPA's methodology to estimate the exposure levels associated with the DIY use, using the SAE CRP (2008) Phase II Report, greatly exaggerates the exposure that could be experienced in actual use conditions. Another commenter calculated exposure to a DIYer assuming that the refrigerant fills a garage and concluded that exposure would be less than the manufacturer's recommended exposure limit of 1000 ppm. The first commenter stated that the 30 minute time-weighted average (TWA) value used by the EPA is unrealistic as are the exposure estimates presented in Scenarios 1 and 2 of the supporting document EPA–HQ–OAR–2008–0664–0036. The specific exposure parameters that the commenters questioned were assumptions regarding:

- Garage volume;
- Time the user spent under the hood during recharging operations;
- The size of the space where any leaking gas would disperse;
- The air exchange rate in a service area that should be well-ventilated when the engine is running;
- Use of the refrigerant in a closed garage with no ventilation; and,
- The amount of refrigerant used during recharge operations.

During the comment period for the proposed SNUR, the PMN and SNAP submitter conducted a simulated vehicle service leak testing, using HFC–134a as a surrogate, indicating that exposures from use of a 12-oz can during consumer DIY use are below the Agency's level of concern for HFO–1234yf (Honeywell, 2010a).

Response: Concerning exposure estimates for DIYers, the exposure values in the EPA risk assessment (EPA–HQ–OAR–2008–0664–0036) are bounding estimates of the maximum possible theoretical concentrations. The EPA assessment used the industry-modeled DIY scenarios and assumptions in a 2008 report by Gradient Corporation for the SAE CRP (CRP, 2008) as a starting point for creating the bounding estimates. To do so, EPA assumed that the entire leakage mass of each industry-modeled scenario was released to its corresponding volume with no air exchange. These assumptions are conservative and protective, as intended.

We considered the calculations provided by one commenter that assumed that the refrigerant fills a garage. However, this analysis assumes a longer-term, steady-state concentration after the refrigerant has diffused throughout the garage and uses a long-term, 8-hour time-weighted average exposure recommendation for comparison. EPA's concerns about DIY consumer exposure focuses on short-term acute exposures, including peak exposures over a few minutes near the consumer's mouth and nose because typically a DIY consumer will only need a short period of time to recharge a single MVAC system (Clodic *et al.*, 2008). Thus, the commenter's calculations do not address EPA's concerns.

After reviewing the consumer DIY use exposure study from the SNAP/PMN submitter, EPA responded with a list of clarifying questions (U.S. EPA, 2010c), to which the submitter subsequently responded (Honeywell, 2010b). Although the submitter's responses were helpful, EPA still has concerns about potential exposures to consumers during DIY use and the inherent toxicity of HFO–1234yf. However, since this acceptability determination is limited to use with fittings for large containers, which DIYers would not purchase, our concerns about potential health risk to DIY users need not be addressed in this action. We would plan to evaluate this issue further before taking a final action on a SNAP submission for unique fittings for small containers. We further note that the Agency would analyze this issue in the context of any SNUN filed pursuant to the recently issued SNUR (75 FR 65987). Although we do not reach any conclusion in this final rule regarding safe use by DIYers, we make the following observations about the submitted study. With regards to exposure, the peak concentration values from the submitted study are as high as 3% by volume, equivalent to 30,000 ppm. These peaks appeared to occur in the first one or two minutes of each emission. Accordingly, EPA would need exposure data presented and averaged out over shorter Time Weighted Averages (TWAs) than the 30 minutes currently in the study, because it would appear that a number of these early exposure peaks could result in TWA values that would result in MOEs less than the acceptable Agency level of 30 described above in this section. This is important because the data on HFO–1234yf are insufficient to differentiate whether the toxicity is due to blood level alone from an acute exposure, is due to accumulated exposure over time ("area under the curve"), or is due to some combination of both. Since blood equilibrium levels are reached within minutes, a high level of exposure in a short duration could result in blood levels exceeding a threshold if the mode of action of the toxicity of HFO–1234yf is due to blood levels of the chemical. EPA expects that exposure data with additional TWAs of 3, 5, and 10 minutes would help to resolve these issues of consumer exposure.

Comment: One commenter stated that HFOs could harm the human nervous system. The commenter cited a diagram of breakdown products in a slide presentation given by the Montreal Protocol Scientific Assessment Panel in July 2009 and suggested that the toxic impact of aldehydes formed as breakdown products would be higher than that of carbonic acids.

Response: EPA agrees that the breakdown products from the decomposition of HFO–1234yf will include aldehydes, but we disagree that this is a cause for concern. The aldehydes that would be produced as atmospheric breakdown products of HFO–1234yf are formaldehyde and acetaldehyde (ICF, 2010d). Their health effects include respiratory effects; irritation of the eyes, nose, and throat; and corrosion of the gastrointestinal tract. EPA also considers formaldehyde and acetaldehyde to be probable human carcinogens (U.S. EPA, 2000; ICF, 2010d). The decomposition products of HFO–1234yf are not noted for causing neurotoxic effects, and toxicity tests for HFO–1234yf did not identify this as an effect.

As part of analysis of the atmospheric breakdown products of HFO–1234yf, we found that worst-case concentrations of formaldehyde would reach 6 to 8 parts per trillion (ppt) on a monthly basis or an average of 3 ppt on an annual average basis, compared to a health-based limit of 8000 ppt [23]—*i.e.*, a level that is roughly 1000 to 2600 times lower than the health-based limit (ICF, 2010d). Acetaldehyde levels would be even lower, with worst-case concentrations of 1.2 ppt and annual average concentrations of 0.23 ppt, compared to a health-based limit of 5000 ppt [24] (ICF, 2010d). Thus, aldehydes that would be decomposition products of HFO–1234yf in the atmosphere would not contribute significantly to adverse human health effects (ICF, 2010d).

Aldehydes, including formaldehyde and acetaldehyde, are already present in

[23] The Agency for Toxic Substances and Disease Registry (ATSDR) has established a chronic inhalation minimal risk level (MRL) of 0.008 ppm (8,000 ppt) for formaldehyde (ICF, 2010d). MRLs are available at *http://www.atsdr.cdc.gov/mrls/mrls_list.html.*

[24] EPA has established a Reference Concentration (RfC) of 0.005 ppm (5,000 ppt or 0.009 mg/m^3) for acetaldehyde (ICF, 2010d). A summary of EPA's documentation for its risk assessment and RfC derivation for acetaldehyde is available online at *http://www.epa.gov/ncea/iris/subst/0290.htm.*

the atmosphere in significant amounts from natural sources such as plants, from direct emissions, from combustion products, or from breakdown of other compounds such as hydrocarbons (NRC, 1981; Rhasa and Zellner, 1987). The current background level of formaldehyde in the atmosphere ranges from 80 ppt in pristine areas to approximately 3300 ppt in New York, NY—one to three orders of magnitude more than the worst-case generation of formaldehyde from HFO–1234yf (ICF, 2010d). The maximum incremental acetaldehyde concentration calculated due to use of HFO–1234yf was approximately three orders of magnitude less than the average concentration of acetaldehyde in areas with pristine air quality (ICF, 2010d). Thus, the additional aldehydes created during decomposition of HFO–1234yf in the atmosphere are not likely to have a significant impact on human health.

Comment: Some commenters stated that additional research and review of the available information regarding toxicity of HFO–1234yf needs to be conducted.

Response: EPA has an obligation to act on submissions in a timely manner under the Act (§ 612(d)). Our risk assessments to date have found no significant risk for car passengers or drivers, professional servicing personnel, or workers disposing of or recycling vehicles containing HFO–1234yf. We believe these assessments are sufficient to support this action. We note that these assessments rely on somewhat conservative assumptions.

We note that we expect there will be no toxicity risks to DIYers because EPA must receive and take regulatory action to allow unique fittings for use with small cans of refrigerant before DIYers could be exposed, as per appendix D to subpart G of 40 CFR part 82. Further, because HFO–1234yf is not expected to be introduced into any new cars until late 2011 or later, we expect to have further information and to take further action before DIYers could be exposed. In addition, the final SNUR would not allow distribution in commerce of products intended for use by a consumer for the purposes of servicing, maintenance and disposal involving HFO–1234yf until at least 90 days after submission of a SNUN.

We recognize that more studies will be performed on HFO–1234yf, further addressing risk. EPA's New Chemicals Program has recommended additional testing of acute exposure in rabbits, including pregnant rabbits (April 2, 2010; 75 FR 16706). In addition, the manufacturer is voluntarily conducting a multi-generation reproductive study. If these or other future studies call into question the basis for our decision today, section 612 allows citizens to petition EPA to change or modify a listing decision or EPA could determine on its own to reassess this decision.

Comment: In late comments, a commenter stated that EPA appears to be relying on a SNUR to reduce risks to human health from exposure to HFO–1234yf. This commenter stated that EPA must re-open the comment period on the proposed SNAP rule so that commenters may reassess the extent to which the final restrictions of the SNUR will be effective at limiting adverse human health effects. The same commenter noted that information on new price levels and availability is needed to assess the effectiveness of the SNUR.

Response: EPA's final SNUR addresses potential risks to human health from exposure to HFO–1234yf. However, as discussed above in section V of the preamble, "Why is EPA listing HFO–1234yf as acceptable subject to use conditions?", this final SNAP rule does not allow for the use of HFO–1234yf with small cans or containers (*i.e.*, container sizes that would be purchased by DIY users, such as small cans and containers less than 5 lbs) because it does not contain specifications for unique fittings for can taps and for these smaller containers. Existing SNAP program regulations in appendix D to subpart G of 40 CFR part 82 require the use of unique fittings for specific purposes (*e.g.*, high pressure-side service port, small can taps) for each MVAC refrigerant, as submitted by the refrigerant manufacturer. Before HFO–1234yf can be introduced in small containers typically used by DIYers, the manufacturer must submit unique fittings to EPA, we must conclude that they are unique, and we must issue new proposed and final rules specifying those fittings. In addition, the final SNUR would not allow distribution in commerce of products intended for use by a consumer for the purposes of servicing, maintenance and disposal involving HFO–1234yf until at least 90 days after submission of a SNUN. These and other requirements ensure—to the extent possible, with the information currently available to EPA—that HFO–1234yf has no greater risk overall for human health and the environment than other available refrigerants for MVAC.

Under the final SNUR, it is necessary for EPA to receive and complete its review of a significant new use notice (SNUN) with additional information on consumer exposure risks before—if the Agency so decides—HFO–1234yf may be manufactured, imported or processed for the purpose of use in DIY servicing, with or without other restrictions. We would also consider information in the SNUN before issuing a final rule specifying unique fittings for use with small containers of refrigerant.

In comments EPA received on the proposed SNAP rule, the initial direct final SNUR that was withdrawn and the proposed SNUR, no commenters suggested making the provisions of the SNUR stricter or suggested adding use conditions under the SNAP program for addressing risks to consumers during DIY servicing. A number of commenters stated that no restrictions were needed to address risks to consumers during DIY servicing, while other commenters stated more broadly that EPA should find HFO–1234yf unacceptable because of its toxicity risks. We provided an additional opportunity for comment on the SNAP rule after the direct final SNUR was issued (February 1, 2010; 75 FR 4083), in response to a request to reopen the public comment period (EPA–HQ–OAR–2008–0664–0077.1), in part to allow comment on the relationship between these two rulemakings that both address HFO–1234yf. However, we do not believe that the conditions of the final SNUR are necessary to the determination that we are making here. As noted above, this final rule does not allow for the servicing of HFO–1234yf from container sizes that would be purchased by DIY users because of the lack of an approved unique fitting for smaller containers. Further rulemaking under SNAP will occur prior to such use and any risks can be addressed in that rulemaking package. At that time, we will be able to fully consider the impact of the final SNUR.

2. Flammability

Comment: Five commenters stated that HFO–1234yf has a low likelihood of ignition, especially under the conditions encountered in an automotive application. One commenter stated that the mere presence of high refrigerant concentrations does not contribute to a hazardous condition because an ignition source of sufficient energy must also be present. Another commenter disagreed with EPA's view that a flammability risk exists. Other commenters stated that additional review of the available information regarding flammability of HFO–1234yf needs to be conducted. Some commenters stated that EPA should consider restricting concentrations of HFO–1234yf to much lower concentrations than to the lower flammability limit (LFL) of 6.2%.

Response: The available evidence indicates that HFO–1234yf will not present a significant risk of flammability and that any risk it poses is not greater than the risk presented by other available alternatives. For example, because of its higher LFL, its considerably higher minimum ignition energy (5000 mJ to 10,000 mJ), and its slower flame speed (1.5 cm/s), HFO–1234yf is less flammable than HFC–152a, a substitute that EPA has already found acceptable subject to use conditions.

Further, an analysis conducted for SAE International's Cooperative Research Program by Gradient Corporation (CRP, 2009) found that there was a very low flammability risk (on order of 10^{-14} occurrences per operating hour or 1 occurrence in 100 years across the entire U.S. fleet of passenger vehicles). This was due to the low probability of achieving a concentration of HFO–1234yf above the LFL at the same time as having a sufficiently high energy source to cause the refrigerant to ignite. Further, even that low probability of ignition of HFO–1234yf may be overstated, because it assumes that a vehicle collision severe enough to crack open the evaporator (located under the windshield and steering wheel) is not severe enough to crack the windshield or windows that would hold refrigerant in the passenger compartment. In a sensitivity analysis, the SAE CRP considered how the flammability risk would change if a refrigerant release into the passenger compartment only occurs in a collision causing damage to more than the MVAC system. That analysis estimated that the risk of exposure to an open flame would then be reduced by a factor of 23,000, to approximately 4×10^{-19} occurrences per vehicle operating hour (EPA–HQ–OAR–2008–0664–0056.2).

For the reasons provided above in sections IV and VII.B of the preamble, "What are the final use conditions and why did EPA finalize these use conditions?" and "Use conditions," EPA does not believe it is necessary to establish a use condition limiting refrigerant concentrations, whether at 6.2% or some other, lower value. We believe the final use conditions sufficiently address flammability risks.

Comment: Three commenters stated that HFO–1234yf is flammable and that the proposed regulation does not offer any restrictions to protect those persons handling HFO–1234yf, nor does it restrict its sale and use by the general public.

Response: The purpose of the use conditions is to ensure that HFO–1234yf will not pose a greater risk to human health or the environment than other available or potentially available substitutes. For all of the reasons provided in sections IV and V above, EPA has determined that HFO–1234yf will not pose a greater risk than other substitutes for MVAC. As explained above, EPA proposed restricting concentrations of the refrigerant below the LFL of 6.2% as a use condition. Based on comments and additional analysis, EPA has concluded that it is not necessary to require use conditions limiting refrigerant concentrations to below the LFL; rather, the use conditions now specify design parameters for MVAC systems and require an FMEA. This will ensure that systems are designed to minimize risk not only from flammability, but also from exposure to HF.

We will address use by service personnel through a rulemaking under section 609 of the CAA. Although these rules will further address issues of interest to service personnel and others that might handle HFO–1234yf used in MVAC systems, we note that our risk assessments of use of HFO–1234yf found that significant flammability risks do not exist for personnel installing the refrigerant at equipment manufacture, professional servicing personnel, and personnel working with automobiles at equipment end-of-life (EPA–HQ–OAR–2008–0664–0036 and –0038). Moreover, we note that an industry-sponsored analysis of risks found the risk of ignition of HFO–1234yf to a technician is extremely small, on the order of 10^{-26} occurrences per working hour (EPA–HQ–OAR–2008–0664–0056.2).

As we have explained above, this rule only addresses the use of large containers for professional use (typically 20 lbs or larger) and thus HFO–1234yf may not be used in small container sizes that would be the type purchased by the general public. We will address the issue of risk to DIY users through a future rulemaking under SNAP if we receive a request for unique fittings for smaller containers from the refrigerant manufacturer. We also are addressing risks to DIY users through the Significant New Use Rule under the Toxic Substances Control Act (October 27, 2010; 75 FR 65987).

Comment: One commenter stated that compared with HFC–134a, the explosion probability of HFO–1234yf is much higher based on testing done at the Federal Institute for Materials Research and Testing (Bundesanstalt für Materialforschung und-prüfung, BAM). Other commenters disagreed with those flammability conclusions, finding the testing results to be expected but not representative of real-world use in MVAC. These commenters stated that the flammability risks of HFO–1234yf were not significant and that the mixtures of HFO–1234yf and ethane used in the testing would not be seen in MVAC in actual operations.

Response: As explained above in section VII.B, we do not believe that these tests are relevant for assessing the flammability risks of HFO–1234yf as used in MVAC systems because they evaluated flammability based on the presence of ethane, a substance that should not be present in any situation that might cause flammability risks for MVAC systems.

3. Toxicity of Hydrogen Fluoride (HF)

Comment: Two commenters stated that there is low risk due to exposure to HF. One of these commenters stated that (1) for vehicles that do not discontinue the use of the blower after collision, the risk due to exposure to HF from use of HFO–1234yf is approximately twice the risk with the current use of HFC–134a, and (2) for vehicles that discontinue the use of the blower after collision, the risk due to exposure to HF when using HFO–1234yf is approximately the same as that with the current use of HFC–134a (on order of 10^{-12} occurrences per operating hour, or one in one trillion). The second commenter stated that there is no need for concentration limits to protect against exposure to HF because the risks from exposure to HF from HFO–1234yf are similar to what would be experienced with HFC–134a. One commenter also stated that concentrations of HF as low as 0.3 ppm cause a sensation of irritation. The commenter stated that this characteristic would deter someone from remaining exposed to excessive concentrations from an open hood.

Other commenters stated that there is a high probability of HF generation in cars from HFO–1234yf. One commenter stated that the flammability of HFO–1234yf makes the production of HF more likely and increases the risk of HF exposure to vehicle passengers, to workers at chemical facilities, automotive manufacturing facilities, vehicle servicing facilities, and to the general public. Two commenters stated that various health and safety concerns related to HF generation and its toxicity are well studied and documented, and three commenters stated that use of HFO–1234yf is unacceptable as there is increased potential for HF exposure and related casualties.

Response: EPA has considered the potential for generation of HF from HFO–1234yf, including the SAE CRP's evaluation of scenarios that might cause workplace and consumer exposure to HF (EPA–HQ–OAR–2008–0664–0056.2). SAE CRP members conducted tests to measure HF concentrations and to identify factors that were most likely to lead to HF formation. One set of tests conducted in a car found that HF measurements inside the passenger cabin were 35 ppm or less (EPA–HQ–OAR–2008–0664–0056.2). This highest value occurred during release of the entire charge of refrigerant of 1000 g into the passenger cabin with ignition started by a butane lighter augmented with an additional spark—a highly conservative scenario. (A more typical charge would be 575 g, and it would be unlikely to have the amount of ignition energy that occurred artificially in the experiment with use of both a butane lighter and an additional spark source.) A second set of tests focusing on HF in the engine compartment tried to simulate a major rupture in the AC system that would release 12 g/s of refrigerant across 5 cm onto an artificial hot surface at temperatures of 450 °C (typical of the exhaust manifold) and 700 °C (most extreme case), with the car hood in various positions. This testing found HF concentrations as high as 120 ppm at the hot surface in the engine compartment in the worst case, with interior passenger cabin values of 40 to 80 ppm in the worst case (EPA–HQ–OAR–2008–0664–0056.2). This test was conservative for the following reasons: The temperature was high, representing extreme conditions; the refrigerant was released extremely close to the hot surface; the hood was closed; and the refrigerant ignited briefly. The other test trials under less extreme conditions resulted in HF concentrations of a few ppm. The test trials also found somewhat lower concentrations of HF generated during testing of HFC–134a using the same procedures and apparatus, with maximum concentration of 36 ppm in the engine compartment and concentrations of less than 8 ppm in the passenger compartment in the worst case. The SAE CRP selected an Acute Exposure Guideline Limit (AEGL)–2 [25] of 95 ppm over 10 minutes as its criterion for determining excessive risk. This limit was developed to protect against irreversible health effects when exposure remains below the limit of 95 ppm over 10 minutes, but short-term discomfort or irritation could still occur. Thus, even assuming a passenger inside a vehicle was exposed to HF at the highest level found in the test of 80 ppm, exposure at this level would at worst cause discomfort and irritation, rather than permanent or disabling health effects.

For both HFO–1234yf and for HFC–134a, HF concentrations in the passenger compartment fell between the level that would protect against all adverse health effects (AEGL–1 of 1.0 ppm for 10 minutes to 8 hours) and the level that would protect against irreversible or disabling health effects (AEGL–2 of 95 ppm over 10 minutes) (NRC, 2004). The SAE CRP concluded that the probability of such a worst case event is on the order of 10^{-12} occurrences per operating hour (EPA–HQ–OAR–2008–0664–0056.2). Commenters provided information indicating that this level of risk for HF generation is the same order of magnitude for both HFC–134a and for HFO–1234yf. EPA considers the risk level presented by HFO–1234yf to be similar to that of the refrigerant currently being used by automobile manufacturers, HFC–134a. Therefore, there is no reason to regulate HFO–1234yf more stringently to protect against HF exposure than for HFC–134a.

Comment: One commenter stated that testing with HFOs commissioned by the environmental organization Greenpeace in 2001 hinted at a multitude of decomposition products with high reactivity. The commenter stated that apparently even lubricants (polyalkylene glycol—PAG) break down to HF when in contact with HFO–1234yf in a MVAC system. The commenter further expressed that BAM testing showed that burning HFO–1234yf resulted in concentrations of HF greater than 90 ppm in the engine compartment. The commenter concluded that the tests prove that in a standard system with standard charge (900 grams) and oil, the risk for humans would be incalculable.

Response: The commenter has not provided sufficient information on the testing commissioned by Greenpeace in 2001 for the Agency to determine what the results were or whether the testing conditions are relevant to this action. Concerning the BAM testing, EPA has not seen a testing report or a detailed description of the experimental method that allows for a full evaluation. Based on the information provided by the commenter, the temperature of the released substance reached 600 °C and HF concentrations of over 90 ppm were measured in the engine compartment. According to a risk assessment from an automobile manufacturer, such a high temperature is unlikely and could only be achieved on the exhaust manifold under heavy engine loads such as when a vehicle is climbing a hill, and the temperature of the exhaust manifold would drop in a minute or so during deceleration (EPA–HQ–OAR–2008–0664–0081.1). It is not clear what the conditions were for the study mentioned by the commenter. For example, it is not clear if the refrigerant was mixed with compressor oil as it normally would be in an MVAC; inclusion of oil with a relatively low flashpoint would be expected to lead to ignition at lower temperatures (EPA–HQ–OAR–2008–0664–0056.2; EPA–HQ–OAR–2008–0664–0118.1). It also is not clear if the compressor fan was operating during the test. During normal vehicle operation, the fan would cool down the compressor and the engine compartment, avoiding the temperature of 600 °C on hot surfaces in the engine.

Other tests have found that HF concentrations in the engine compartment were approximately 5 ppm or less and only in the worst case (hot surface temperature of 700 °C, closed hood on engine compartment) did HF concentrations attain a value of approximately 120 ppm in the engine compartment (OAR–2008–0664–0056.2). This level is slightly higher than the AEGL–2 of 95 ppm on a 10-minute average and is lower than the AEGL–3 for HF of 170 ppm on a 10-minute average, the value that would protect against life-threatening exposure but would not necessarily prevent long-term health effects. However, we note that we do not anticipate any circumstance where a person would be exposed to these levels in an engine compartment because such conditions would not occur during vehicle servicing, but rather during vehicle operation. Further, in the case of a collision resulting in a fire, we would expect that professional first responders have training in chemical hazards and possess appropriate gear which would prevent them from receiving HF exposures above health-based limits (EPA–HQ–OAR–2008–0664–0056.2) and an interested by-stander would quickly back away from a fire or from irritating HF vapors, thus preventing excessive HF exposure. The concentration measured in the passenger compartment in the same worst-case situation was in the range of 40 to 80 ppm, less than the concentration in the engine compartment and less than the AEGL–2 intended to protect against long-term health effects. Thus, we disagree with the commenter's assertion that HF exposures from thermal decomposition or combustion of refrigerant would be likely to result in fatalities. We further

[25] An AEGL–2 is intended to apply to an emergency situation where someone would try to move away from the hazard in a short period of time and may suffer some temporary irritation, but no permanent health damage. Irreversible or disabling but non-fatal health effects could occur between the AEGL–2 and the higher AEGL–3.

note that the HF concentrations found in the passenger compartment were lower than the health-based limit, the AEGL–2 of 95 ppm over 10 minutes.

We also note that the risks presented by HFO–1234yf are not significantly different than the risk posed by HFC–134a, the refrigerant currently in use in MVAC systems. Mixtures of HFC–134a and compressor oil also combust and generate HF. Testing performed using HFC–134a under worst-case conditions in the engine compartment (hot surface temperature of 700 °C, closed hood on engine compartment) found HF concentrations as high as 36 ppm in the engine compartment and 2 to 8 ppm in the passenger compartment. The amount of HF generated from a typical charge of HFC–134a, if it all burned or decomposed, could be even more than for the expected charge of HFO–1234yf because charge sizes using HFO–1234yf are expected to be smaller (EPA–HQ–OAR–2008–0664–0056.2). The SAE CRP considered potential risks of HF exposure from both HFO–1234yf and from HFC–134a. Both presented potential risks on the order of 10^{-12} occurrences per operating hour (EPA–HQ–OAR–2008–0664–0056.2, –0096.1). This corresponds to less than one case per year across the entire fleet of motor vehicles in the U.S. Although there is no specific testing data on HF production from HFC–152a, another acceptable refrigerant for MVAC, since this compound contains fluorine, it presents risks of HF generation as well. As discussed above in Section IV of the preamble, we are not requiring specific use conditions that regulate production of HF, either directly or indirectly, because of the low level of risk. However, the final use conditions in this rule address the risks of HF production, as well as risks of flammability, by requiring certain design safety features of MVAC systems using HFO–1234yf and by requiring risk analysis for each car model through FMEAs.

Comment: A commenter provided results from a test by IBExU on the decomposition of HFO–1234yf under heat (EPA–HQ–OAR–2008–0664–0053.3). This commenter strongly warned against a decision in favor of HFO–1234yf because it would form highly toxic HF when burning. Three commenters disagreed that the results of the IBExU testing were relevant because test conditions did not represent realistic conditions. One commenter said that the SAE risk assessment, which used actual vehicle test data for HF formation, found that actual HF formation rates are far below the levels [from the IBExU test results] cited by the first commenter, the Federal Environmental Agency (Umweltbundesamt—UBA).

Response: The IBExU testing of HF generation from HFO–1234yf is not relevant to assessing the risks of HFO–1234yf as a refrigerant in MVAC. Laboratory tests concerning the nature of HF generation on hot surfaces found that this depends on the contact time of reactants on the hot surface, the temperature of the hot surface and the movement of refrigerant in diluted concentrations due to airflow (EPA–HQ–OAR–2008–0664–0056.2; EPA–HQ–OAR–2008–0664–0116.2). The IBExU testing involved heating the refrigerant steadily in a sealed flask. Thus, the contact time in that test was far greater than would occur in an engine compartment and the movement of refrigerant in that test was essentially zero, unlike in an engine compartment where there would be constant air movement.

Comment: Another test from BAM reported by UBA examined HF formation from HFO–1234yf and from HFC–134a (EPA–HQ–OAR–2008–0664–0080.1). Fifty grams of refrigerant was streamed through a hole of 2 mm diameter onto a hot metal surface. The study found that pure HFO–1234yf exploded on the hot surface whereas pure HFC–134a did not. The study also found that when HFO–1234yf was mixed with 3% oil, it exploded at 600 °C. The commenter stated that handling of HFO–1234yf in the presence of hot metal surfaces results in HF formation in concentrations far above allowed workplace concentrations.

Response: These results are not consistent with results from hot-plate tests conducted by an automobile manufacturer and by a chemical manufacturer for the SAE CRP (EPA–HQ–OAR–2008–0664–0056.2; EPA–HQ–OAR–2008–0664–0115.1). Those manufacturers found that neither HFO–1234yf nor HFC–134a alone ignited at 900 °C. One of these tests found that HFO–1234yf mixed with PAG oil combusted starting at 730 °C, while HFC–134a mixed with PAG oil ignited at 800 °C and above; the other test observed no ignition of a blend of each refrigerant with PAG oil at 800 °C, but both blends ignited at 900 °C. Based on the lack of reproducibility of the specific ignition temperature, it appears that the specific ignition temperature may depend on variables in the testing (*e.g.*, flash point of the oil used, amount of mixture used, angle of application, and air flow available). This information also shows that mixtures of refrigerant with compressor oil can combust at lower temperatures than pure refrigerant and that mixtures of HFO–1234yf and oil and mixtures of HFC–134a and oil present similar risks of ignition and HF generation. Thus, we concluded that the risks of toxicity from HF exposure due to combustion or decomposition of HFO–1234yf are comparable to those from HFC–134a.

Further, the risks from toxicity of HF posed by both refrigerants are small. The SAE CRP estimates this risk on the order of 10^{-12} cases per operating hour (EPA–HQ–OAR–2008–0664–0086.1). This is equivalent to less than one event per year across the entire fleet of motor vehicles in the U.S. For comparison, this is less than one ten-thousandth the risk of a highway vehicle fire and one fortieth or less of the risk of a fatality from deployment of an airbag during a vehicle collision (EPA–HQ–OAR–2008–0664–0056.2).

E. Retrofit Usage

Comment: Several commenters stated that HFO–1234yf should be allowed initially in new vehicles but should not be used to retrofit vehicles using HFC–134a, or at least not unless there are industry standards to guide such a process. Other commenters stated that it is critical to allow a natural phase-out of the fleet of cars using HFC–134a as the refrigerant, rather than requiring retrofitting existing cars with HFO–1234yf. A commenter expressed concern that retrofitting of HFC–134a MVAC systems with HFO–1234yf would result in cases of cross-contamination of refrigerant, while another commenter contested this statement and found it unsupported. Other commenters opposed obstacles that would prevent older MVACs from being retrofitted to the new refrigerant. These commenters mentioned the potential for greenhouse gas benefits when retrofitting systems currently using HFC–134a with HFO–1234yf.

Response: The submitter did not request review of HFO–1234yf for retrofitting vehicles and thus EPA did not review HFO–1234yf as acceptable (or acceptable subject to use conditions) for retrofitting in MVAC in this rulemaking. Consistent with the request submitted to the Agency, we proposed to find HFO–1234yf acceptable for use subject to use conditions in new MVAC systems and evaluated its risks only for use in new systems. We will consider the retrofit use of HFO–1234yf in MVAC systems if we receive a submission that specifically addresses retrofitting and the risks that are unique to retrofitting. In response to the commenter who raised a concern about a "phase-out" of HFC–134a and the potential that we would "require" use of HFO–1234yf, we note that our rulemakings under SNAP do not require use of any specific substitute. Rather, under SNAP, we have established lists of substitutes that are acceptable for use in various end-uses (such as for MVACs) and end-users are free to choose which substitute to use, but must do so consistent with any use conditions that apply. As stated in the rule establishing the SNAP program, "The Agency * * * does not want to intercede in the market's choice of available substitutes, unless a substitute has been proposed or is being used that is clearly more harmful to human health and the environment than other alternatives." 59 FR 13046, March 18, 1994. We further note that this rulemaking does not change the status of HFC–134a, which remains an acceptable substitute for use in MVACs, subject to use conditions.

F. Use by "Do-it-Yourselfers"

Comment: Some commenters raised concerns about EPA's statements in the proposed rule about potential health effects that might occur without professional training and the use of CAA Section 609 certified equipment. These commenters stated that the studies and testing in the docket support a finding that use of HFO–1234yf by non-professionals is safe and do not offer valid technical support for EPA's concerns.

Response: EPA's risk assessment and risk screen both indicated that worst-case exposure levels expected during servicing by do-it-yourselfers are of potential concern (EPA–HQ–OAR–2008–0664–0036 and EPA–HQ–OAR–2008–0664–0038). In both documents, this was based upon estimated exposure levels from a 2008 risk assessment by Gradient Corporation for the SAE CRP (EPA–HQ–OAR–2008–0664–0008). In EPA's risk assessment (EPA–HQ–OAR–2008–0664–0036), we found that the level that EPA determined did not cause health effects in laboratory animals might be only 2 to 3 times higher than the exposure predicted for that use (the "margin of exposure"). Our risk assessment indicated a higher, more protective margin of exposure of at least 30 was needed to account for uncertainty in the extrapolation from animals to humans and for variability in the human population. In other words, we found that based on worst-case assumptions, a do-it-yourselfer's exposure could be 10 or more times the level that EPA considered safe. The margin of exposure was calculated using a conservative estimated exposure level of 45,000 ppm over 30 minutes and a human equivalent concentration of 98,211 ppm from a no-observed adverse effect level that we selected as the point of departure for risk assessment (EPA–HQ–OAR–2008–0664–0036).

However, under this final rule, unique fittings have only been submitted for servicing fittings for the high-side and low-side ports and for large containers of HFO–1234yf and thus the acceptability listing is limited to use of HFO–1234yf with the unique fittings specified (*e.g.*, for large containers of 20 pounds or more). We expect these containers would not be purchased by DIYers because of their expense ($800 or more per container) and because they would contain enough refrigerant for 10 charges or more. We will continue to review the issue of safe use for DIYers if and when we are requested to review unique fittings for a smaller container size. In addition, EPA is further addressing the issue of risks to DIYers in the Significant New Use Rule for 1-propene-2,3,3,3-tetrafluoro- (75 FR 65987, October 27, 2010). This SNUR requires submission of a SNUN at least 90 days before sale or distribution of products intended for use by a consumer for the purpose of servicing, maintenance and disposal involving HFO–1234yf.

EPA's proposed rule on the use of HFO–1234yf as a substitute for CFC–12 in new MVAC systems did not propose to establish use conditions for servicing vehicles by certified professionals, but our analyses indicate that there is not significant risk to certified professionals, because HFC–134a, which is currently used in most MVAC systems, presents similar risks and professionals have the knowledge and equipment to mitigate any risks. We plan to further address servicing by professionals when we develop a new rule under section 609 of the Clean Air Act for servicing and maintenance of MVAC systems.

Comment: Some commenters supported prohibiting sale of HFO–1234yf in small containers. Other commenters stated that only certified technicians should be allowed to purchase and use refrigerants, including HFC–134a and HFO–1234yf. Other commenters found no data to support restrictions on the sale of HFO–1234yf to non-professionals.

Response: As noted previously, the submission only addressed unique fittings for large containers (*e.g.*, 20 lbs or larger) of HFO–1234yf. If anyone is interested in using HFO–1234yf in small cans or other small containers, they would need to contact the refrigerant manufacturer to submit unique fittings for approval under the SNAP program. Thus, under this final rule, we believe that only certified technicians will purchase HFO–1234yf because the larger containers are likely to be prohibitively expensive for individuals performing DIY servicing ($800 or more for a 20 lb cylinder) and are likely to be too large for most individuals to use, containing enough refrigerant for 10 or more charges.

We also note that in a separate final rule under the authority of TSCA (October 27, 2010; 75 FR 65987), EPA requires among other things, that notice must be given to EPA 90 days before (1) HFO–1234yf is used commercially other than in new passenger cars and vehicles in which the charging of motor vehicle air conditioning systems with HFO–1234yf was done by the motor vehicle OEM or (2) sale or distribution of products intended for use by a consumer for the purpose of servicing, maintenance and disposal involving HFO–1234yf.

Comment: A commenter stated that banning DIY use of HFO–1234yf will mean that car owners will be forced to have professionals perform service work on their AC systems at a significantly higher cost. This commenter stated that millions of lower-income motorists may be forced to go without air conditioning each year or may seek out lower-cost alternatives such as propane or HFC–152a.

Response: While this final rule effectively prohibits DIY use because the final use conditions do not include unique fittings allowing for use with small refrigerant containers, we are not making any final determination about whether HFO–1234yf may be safely used by DIYers. As we noted above, we have not yet received a submission for DIY use or received unique fittings for small containers from the manufacturer, but would evaluate such submissions when we receive one. We note that because it is unlikely that any cars will have MVAC systems with HFO–1234yf before the 2013 model year, we believe the availability of small containers for DIY use will not be of concern until such cars are sold and there is a need to recharge a new MVAC system on a model year 2013 vehicle. The separate final Significant New Use Rule that the Agency has issued under TSCA (75 FR 65987; October 27, 2010) requires submission of a Significant New Use Notice at least 90 days before sale or distribution of products intended for DIY use.

With respect to the commenter who suggests that some people may seek lower cost alternatives, presumably to repair an existing MVAC, we note that under current EPA regulations in appendix D to subpart G of 40 CFR part 82, it is not legal to top-off the refrigerant in an MVAC system with a different substitute refrigerant.

G. Servicing Issues

Comment: Several commenters stated that appropriate training and certification should be required to purchase HFO–1234yf for use in MVACs. Four commenters also stated that the final regulation should include a provision requiring proof of certification in order to purchase HFO–1234yf, and recommended that current AC systems tests (*i.e.*, for CAA section 609 certification) be updated.

Some commenters disagreed with EPA's statement that HFO–1234yf may cause serious health effects when used in servicing and maintaining MVACs without professional training. Another commenter stated that EPA is limiting productivity by only allowing dealerships to perform refrigerant maintenance, and that independent MVAC service shops should be allowed to be certified. The commenter also questioned who will monitor "certified" technicians employed by dealerships that may do work on the side. A commenter representing automobile dealerships specifically opposed mandatory requirements for certification of technicians because of potential costs and burden on small businesses.

Response: As background for the public comments, we note that under EPA's regulations implementing section 609, one must be a section 609 certified technician in order to purchase CFC–12 or other ODS for use in MVAC (40 CFR 82.34(b)). Section 609(e) of the CAA itself specifically prohibits sale of small containers less than 20 pounds with Class I or Class II substances suitable for use as a refrigerant in MVAC, except for individuals performing service for consideration in compliance with section 609. However, there is no comparable restriction on the sale of HFC–134a or on other substitutes for MVAC that do not contain Class I or Class II ODS, such as HFO–1234yf.

In the NPRM (74 FR 53449), EPA stated that any specific training and certification requirements would be adopted through a rulemaking under the authority of CAA section 609 and would be codified in subpart B of 40 CFR part 82, which contains the regulations implementing section 609. We will address concerns regarding certification and training requirements during that separate rulemaking process. We note, however, that the CAA itself mandates that persons performing service for consideration that involve the refrigerant must be properly trained and certified. Furthermore, as noted previously, we believe that there is not a significant health risk to professionals from HFO–1234yf because they will have the knowledge and equipment to mitigate any risks. Also, because HFC–134a presents similar risks to HFO–1234yf, and the flammability risks of HFO–1234yf are less than those for HFC–152a, the health risks of HFO–1234yf are not significantly greater than those of other available substitutes.

With regard to whether independent service shops could service MVACs with HFO–1234yf or whether service would be limited to "dealerships," we note that neither this rule nor any other CAA regulation would limit servicing to dealerships. The comment may concern the withdrawn SNUR, 75 FR 4983 (February 1, 2010), which referred to the "original equipment manufacturer"; the commenter may have interpreted this term to mean an automobile dealership. The final SNUR (October 27, 2010; 75 FR 65987) requires a significant new use notice to EPA at least 90 days before "commercial use other than in new passenger cars and vehicles in which the charging of motor vehicle air conditioning systems with the PMN substance [HFO–1234yf] was done by the motor vehicle original equipment manufacturer." This requirement restricts commercial use of HFO–1234yf to use for vehicles that were initially charged with HFO–1234yf by the automobile's manufacturer, as opposed to allowing commercial use of HFO–1234yf for vehicles initially charged with a different refrigerant. The term "original equipment manufacturer" refers to the automobile manufacturer, not to dealerships.

Comment: Commenters indicated that SAE International is developing standards for safety and servicing of alternative refrigerant HFO–1234yf MVAC systems. Another commenter stated that there are appropriate mechanisms within the industry for training. One commenter representing automobile dealerships objected to mandatory Section 609 technician certification and training for use of HFO–1234yf, stating that because dealerships already train technicians on flammable substances in accordance with hazard communication standards of the Occupational Safety and Health Administration (OSHA), and since the risks associated with HFO–1234yf are similar to those that already exist in MVAC service facilities, mandatory training and proof of training is not necessary. To enable training pursuant to the OSHA hazard communication standard, the commenter stated that MVAC system and refrigerant suppliers should provide dealerships with sufficient information on the hazards posed by HFO–1234yf.

Response: EPA is issuing use conditions in this final rule that reference relevant SAE technical standards on safety. This rule does not, however, include a use condition requiring technician training and does not refer to specific training standards. We agree with the commenter that current technician training generally should be sufficient to ensure that professional technicians will use HFO–1234yf safely. Although this SNAP determination does not contain a use condition regarding technician training, as noted above, section 609 of the CAA requires technician training for persons servicing for consideration. EPA will consider in a separate rulemaking under section 609, whether it is necessary to modify our existing regulations under section 609 to include additional specifications for HFO–1234yf.

Comment: A commenter representing automobile dealerships opposed mandatory requirements for recycling and containment of the refrigerant because of potential costs and minimal environmental benefits.

Response: This rulemaking does not impose requirements for recycling or containment of the refrigerant. A separate rulemaking under CAA section 609 will address practices required in the servicing of MVAC systems using HFO–1234yf, including recycling and recovery. Further, EPA notes that Section 608 of the CAA prohibits the intentional release of any refrigerant during the maintenance, repair, service, or disposal of refrigeration and air conditioning equipment, unless the Administrator determines through rulemaking that such release does not pose a threat to the environment. We have not made such a determination for HFO–1234yf.

H. Cost, Availability, and Small Business Impacts

Comment: One late commenter stated that there was insufficient information in the record on the cost, terms of availability and anticipated market share of HFO–1234yf for EPA to make the required statutory findings that HFO–1234yf "reduces the overall risk to human health and the environment" by comparison to other alternatives that are already available. The commenter stated that this information is necessary in order for EPA to assess anticipated environmental effects adequately. The same commenter stated that EPA's environmental analysis is based on price assumptions that were not disclosed and are no longer valid, and thus, EPA should subpoena the information from the manufacturer and reopen the public comment period.

Response: EPA believes that there was sufficient information in the record at the time of proposal for us to complete a meaningful environmental analysis, even in the absence of definitive cost information. At the time of proposal, we had available both estimates from a trade magazine provided by the manufacturer (Weissler, 2008), as well as estimates of price provided in the initial submission from the manufacturer (EPA–HQ–OAR–2008–0664–0013). The estimates of price provided by the manufacturer were claimed as confidential business information and thus were not available in the record to the public.

We typically use this type of information for purposes of determining market penetration for a particular substance, so that we can evaluate how much of the substitute will likely be used and thus the environmental risks it might pose. In this case, however, because the automobile industry tends to prefer use of a single substitute, information on the cost of the substitute was not critical to our analysis. Thus, in conducting our environmental analysis, we took a conservative approach, assuming that all new MVAC systems began using HFO–1234yf by 2020 (*i.e.*, full market penetration). We also considered an even more conservative scenario, in which HFO–1234yf would be the only refrigerant used for stationary air conditioning and for refrigeration as of 2020, as well as for MVAC. Even with these highly conservative assumptions, we found that there would not be sufficient negative environmental impacts due to emissions of HFO–1234yf to warrant finding it unacceptable.

In the proposal, we mentioned a cost estimate for HFO–1234yf of $40–$60/lb (Weissler, 2008). More recently, the first automobile manufacturer announcing its intention to use HFO–1234yf confirmed that this range does not underestimate prices of HFO–1234yf and is consistent with the manufacturer's long-term purchase contracts (Science, 2010). Thus, the most recent information shows costs to be similar to those we considered at the time of proposal. This data contradicts the late commenter's assertion that the manufacturer's effective monopoly would result in significantly different, higher costs that would invalidate EPA's earlier analysis. In any event, assuming that costs were higher as suggested by the commenter, then we expect that use of HFO–1234yf would be less than assumed for our health and environmental risk analysis. As mentioned in the proposal, emissions, and thus the resulting environmental effects such as impacts on local air quality or on production of TFA, would be expected to be less under a scenario with higher prices and less use of HFO–1234yf. Our analysis assumes widespread use and thus its results would be protective.

We note that where a new chemical is introduced, there is some uncertainty in the price. At best, the manufacturer can provide rough estimates of price and of market share before the chemical is produced in commercial quantities and becomes subject to supply and demand pressures. EPA's requirement for information on cost, anticipated availability in the market, and anticipated market share (40 CFR 82.178(a)(14) through (16)) should not be construed as requiring precise, detailed cost estimates based upon a well-defined methodology. As noted above, we use these numbers for the purposes of predicting market penetration and thus how much of a particular substitute might be used and thus pose an environmental risk. As we did for HFO–1234yf, we typically take an environmentally-protective approach to our evaluation, assuming use at least as high as that the cost and availability information may indicate.

Comment: A late commenter stated that the information in the record is insufficient for EPA to make a statutory finding that HFO–1234yf is "currently or potentially available." The commenter stated that a previous decision by the United States Court of Appeals for the District of Columbia Circuit (*Honeywell International, Inc.* v. *EPA*, 374 F.3d 1363 (D.C. Cir. 2004)) implied that an interpretation of the term "available" in CAA section 612(c)(2) could potentially consider economic factors if EPA adopted such an approach as a reasonable interpretation of the statutory language. The commenter states that EPA should obtain information as to the anticipated cost of HFO–1234yf if the manufacturer does not grant licenses to produce.

Response: The CAA does not require that EPA find a substitute to be available or potentially available when finding it acceptable. Section 612(c) states: "* * * It shall be unlawful to replace any class I or class II substance with any substitute substance which the Administrator determines may present adverse effects to human health or the environment, where the Administrator has identified an alternative to such replacement that—reduces the overall risk to human health and the environment; and is currently or potentially available. * * *"

This section makes clear that it is not the substitute under review that must be available or potentially available, but rather alternative replacements for ODS that EPA determines pose less overall risk to human health and the environment than the substitute being reviewed. Thus, if there are alternatives to the substance under review that are currently or potentially available and that pose less risk, EPA cannot find the substitute under review acceptable. Section 612(c) establishes no requirement that EPA must determine that the substitute under review is "available." *See also* 40 CFR 82.180(b) (describing types of listing decisions EPA can make in reviewing substitutes[26]). We note that even if EPA was required to determine that the substitute under review is available or potentially available before it could make an acceptability determination, we believe that the available information supports that HFO–1234yf is potentially available. EPA's definition of "potentially available" at 40 CFR 82.172 provides that "potentially available" is defined as any alternative for which adequate health, safety, and environmental data, as required for the SNAP notification process, exist to make a determination of acceptability, and which the Agency reasonably believes to be technically feasible, even if not all testing has yet been completed and the alternative is not yet produced or sold. This definition makes explicit that it is not necessary to have perfect information on a substitute nor is it necessary for the substitute to be produced or sold in order for EPA to consider it "potentially available." Instead, it is necessary for EPA to find the health, safety and environmental data adequate to make a determination of acceptability, and for the Agency to reasonably believe that the alternative is "technically feasible," in order for the alternative to be potentially available. We believe the record contains adequate information showing that HFO–1234yf

[26] The regulations for the SNAP program include cost and availability as one of the criteria for review as to whether a substitute is acceptable or unacceptable as a replacement for ozone depleting substances (82.180(a)(7)(vii)), along with a number of criteria for different aspects of health and environmental impacts. Cost and availability are included as criteria because they affect assumptions we may make about a substitute regarding its risks, *i.e.*, we need to know its cost and availability so we can make assumptions about the risk it might pose. In this case, we assumed that HFO–1234yf would be used widely across the industry in new MVACs because widespread use of a single refrigerant in new car models has been the industry practice with MVAC systems. Thus, more detail on cost and availability of the substitute was not necessary in order to identify assumptions we should make for estimating risk.

is potentially available. The manufacturer has submitted the information required under 40 CFR 82.178 (*e.g.*, pre-manufacture notice form and TSCA/SNAP addendum form containing: Name and description of the substitute, physical and chemical information, information on ODP and global warming impacts, toxicity data, data on environmental fate and transport, flammability, exposure, cost and estimated production). The submitter has also provided unique fittings as required under appendix D to subpart G of 40 CFR part 82. Thus, we believe that there is "adequate health, safety, and environmental data." Even if the commenter were correct about claims that higher costs would result if the manufacturer does not grant licenses for production, as discussed above, this does not affect the adequacy of the health, safety, and environmental data for HFO–1234yf, because we have protectively assumed widespread use that would result in more emissions and greater environmental impacts. In addition, based on the experimental work conducted by the automobile industry, we reasonably believe that HFO–1234yf is technically feasible as a refrigerant. Thus, HFO–1234yf would still be "potentially available" under the SNAP program's definition.

One commenter points to *Honeywell International, Inc.* v. *EPA*, 374 F.3d 1363 in urging EPA to explicitly include cost as a consideration in determining whether a substitute is "potentially available." In that case, the court vacated and remanded a SNAP decision in which EPA listed a foam blowing substitute as acceptable subject to "narrowed use limits" on the basis that for some niche foam blowing uses, the substitutes that were already listed as acceptable might not be available. Under the narrowed use limits, the end-user would need to demonstrate and document that other substitutes were not technically feasible for a particular use. The court vacated and remanded EPA's rule on the basis that EPA had considered cost in concluding that already listed substitutes might not be available based on "technical" feasibility, and that EPA had not attempted to justify the rule on the ground that the statute allows it to consider economic factors in making its SNAP determinations. The court left open the question of whether EPA could attempt to interpret the term "available" in section 612(c) as allowing for consideration of costs.

Again, we note that "available or potentially available" applies only to the substitutes against which the substitute at issue is being compared. The Agency has not decided whether consideration of the cost of other substitutes should be a factor to consider in determining whether they are available or potentially available and thus should (or should not) be used for comparison to a substitute under review. However, we note that for purposes of the substitute under review, the Agency firmly believes that cost should not be the primary or sole basis for finding a substitute unacceptable. EPA's role is to determine the health and environmental risk associated with the use of substitutes and the market should serve to address the issue of costs. Costs will necessarily be a factor considered by the automobile manufacturers in deciding which substitute to use.

Comment: Two commenters stated that EPA needed to perform further analysis on the potential small business impacts and costs of EPA's regulations and the introduction of HFO–1234yf. A commenter representing recyclers of automobiles and scrap metal expressed concern about the regulatory burden and costs that automotive recyclers are likely to incur if they must manage flammable refrigerants that are regulated as hazardous waste under EPA's regulations implementing the Resource Conservation and Recovery Act (RCRA). The same commenter also suggests that the RCRA subtitle C regulations would need to be changed to alleviate the hazardous-waste management requirements for handling HFO–1234yf. The other commenter mentioned the costs to service and repair shops, end-of-life vehicle recyclers, and automobile dealerships, and stated that EPA needed to analyze costs to these small businesses under the Regulatory Flexibility Act (RFA). This latter commenter stated that EPA should determine if a significant change in price and supply expectations would affect the way that these businesses handle and deal with automobile repairs and recycling.

Response: The RFA applies only when there are small entities subject to the requirements of the proposed or final rule. 5 U.S.C. § 604(a)(3). We believe the potential burden of complying with RCRA regulations placed on those recycling or recovering a substitute is generally not pertinent to a decision of whether HFO–1234yf should be found acceptable under SNAP. To the extent the commenters are suggesting that we must evaluate such costs for purposes of the Regulatory Flexibility Act, we note that under the RFA we evaluate costs imposed by the enforceable regulations being promulgated. To the extent the costs referred to by the commenter are already imposed under RCRA, they would not be new costs, but costs associated with the relevant RCRA regulations. Moreover, under this SNAP final rule, EPA is not requiring the use of HFO–1234yf, and thus the costs associated with its use are not due to enforceable regulatory requirements under SNAP. To the extent there are enforceable requirements for those persons who choose to use this new substitute, those requirements (the "use conditions") apply primarily to manufacturers of automobiles and MVAC systems, because they concern design of MVAC systems. The one use condition of the rule that applies to servicing of MVAC systems, and thus, could apply to small businesses, is the requirement for specific unique service fittings. However, EPA's existing SNAP regulations at appendix D to subpart G of 40 CFR part 82 already require unique service fittings as specified by the refrigerant manufacturer. Thus, the costs of purchasing new unique fittings for this refrigerant are imposed by the pre-existing regulation. This rule specifies the requirements for the type of unique fitting, in accordance with the fittings provided to EPA by the manufacturer. These fittings are part of the SAE J639 standard. It is not clear that there would be any cost differential between these specific unique fittings and others that the automotive industry could adopt instead. For these reasons, EPA is able to certify that this regulation will not create a significant impact on a significant number of small entities.

Regulations concerning disposal of refrigerant from MVAC systems and other refrigerant-containing appliances under section 608 of the CAA are at subpart F of 40 CFR part 82. Cost and benefit estimates for these regulations are at *http://www.regulations.gov*, docket EPA–HQ–OAR–2003–0167. EPA notes that there may be costs of servicing or of disposal (end-of-life) to small businesses under future regulations under section 609 or 608 of the CAA. We will conduct an analysis of such costs, and any potential significant impacts on small entities, as necessary, as part of those future rulemakings.

Comment: A commenter stated that to comply with requirements of the Unfunded Mandates Reform Act (UMRA), EPA needed to perform further analysis on the potential costs of EPA's SNAP regulations for HFO–1234yf to determine if the rule would result in the expenditure of $100 million or more per year by the private sector. In particular, the commenter stated that EPA must obtain more information on pricing and the effect of the manufacturer's patent to analyze this.

Response: UMRA applies only to "enforceable duties" imposed on State, local, and Tribal governments or on the private sector. The SNAP rule does not impose duties on governments. As we have noted previously, the SNAP program does not mandate the use of any specific substitute for ozone depleting substances. Rather, through this action, we are expanding the choices of MVAC refrigerants available to the private sector. The issue raised by the commenter concerning the cost of the refrigerant and the effect of the manufacturer's patent on pricing is not related to any requirement of the rule, and thus, EPA is not required to consider that cost under UMRA.

VIII. How does the SNAP program work?

A. What are the statutory requirements and authority for the SNAP program?

Section 612 of the Clean Air Act (CAA) requires EPA to develop a program for evaluating alternatives to ozone-depleting substances (ODS). EPA refers to this program as the Significant New Alternatives Policy (SNAP) program. The major provisions of section 612 are:

1. Rulemaking

Section 612(c) requires EPA to promulgate rules making it unlawful to replace any class I (*i.e.*, chlorofluorocarbon, halon, carbon tetrachloride, methyl chloroform, methyl bromide, and hydrobromofluorocarbon) or class II (*i.e.*, hydrochlorofluorocarbon) substance with any substitute that the Administrator determines may present adverse effects to human health or the environment where the Administrator has identified an alternative that (1) reduces the overall risk to human health and the environment, and (2) is currently or potentially available.

2. Listing of Unacceptable/Acceptable Substitutes

Section 612(c) requires EPA to publish a list of the substitutes unacceptable for specific uses and to publish a corresponding list of acceptable alternatives for specific uses. The list of acceptable substitutes is found at *http://www.epa.gov/ozone/snap/lists/index.html* and the lists of "unacceptable", "acceptable subject to use conditions", and "acceptable subject to narrowed use limits" substitutes are found at subpart G of 40 CFR part 82.

3. Petition Process

Section 612(d) grants the right to any person to petition EPA to add a substance to, or delete a substance from, the lists published in accordance with section 612(c). The Agency has 90 days to grant or deny a petition. Where the Agency grants the petition, EPA must publish the revised lists within an additional six months.

4. 90-Day Notification

Section 612(e) directs EPA to require any person who produces a chemical substitute for a class I substance to notify the Agency not less than 90 days before new or existing chemicals are introduced into interstate commerce for significant new uses as substitutes for a class I substance. The producer must also provide the Agency with the producer's unpublished health and safety studies on such substitutes.

5. Outreach

Section 612(b)(1) states that the Administrator shall seek to maximize the use of Federal research facilities and resources to assist users of class I and II substances in identifying and developing alternatives to the use of such substances in key commercial applications.

6. Clearinghouse

Section 612(b)(4) requires the Agency to set up a public clearinghouse of alternative chemicals, product substitutes, and alternative manufacturing processes that are available for products and manufacturing processes which use class I and II substances.

B. What are EPA's regulations implementing section 612?

On March 18, 1994, EPA published the original rulemaking (59 FR 13044) which established the process for administering the SNAP program and issued EPA's first lists identifying acceptable and unacceptable substitutes in the major industrial use sectors (subpart G of 40 CFR part 82). These sectors include: Refrigeration and air conditioning; foam blowing; cleaning solvents; fire suppression and explosion protection; sterilants; aerosols; adhesives, coatings and inks; and tobacco expansion. These sectors compose the principal industrial sectors that historically consumed the largest volumes of ODS.

Section 612 of the CAA requires EPA to list as acceptable only those substitutes that do not present a significantly greater risk to human health and the environment as compared with other substitutes that are currently or potentially available.

C. How do the regulations for the SNAP program work?

Under the SNAP regulations, anyone who plans to market or produce a substitute to replace a class I or II ODS in one of the eight major industrial use sectors must provide notice to the Agency, including health and safety information on the substitute at least 90 days before introducing it into interstate commerce for significant new use as an alternative. This requirement applies to the person planning to introduce the substitute into interstate commerce,[27] typically chemical manufacturers, but may also include importers, formulators, equipment manufacturers, or end-users[28] when they are responsible for introducing a substitute into commerce.

The Agency has identified four possible decision categories for substitutes: acceptable; acceptable subject to use conditions; acceptable subject to narrowed use limits; and unacceptable. Use conditions and narrowed use limits are both considered "use restrictions" and are explained below. Substitutes that are deemed acceptable with no use restrictions (no use conditions or narrowed use limits) can be used for all applications within the relevant end-uses within the sector. Substitutes that are acceptable subject to use restrictions may be used only in accordance with those restrictions. It is illegal to replace an ODS with a substitute listed as unacceptable, unless certain exceptions (*e.g.*, test marketing, research and development) provided by the regulation are met.

After reviewing a substitute, the Agency may determine that a substitute is acceptable only if certain conditions in the way that the substitute is used are met to minimize risks to human health and the environment. EPA describes such substitutes as "acceptable subject to use conditions." Entities that use these substitutes without meeting the

[27] As defined at 40 CFR 82.104 "interstate commerce" means the distribution or transportation of any product between one state, territory, possession or the District of Columbia, and another state, territory, possession or the District of Columbia, or the sale, use or manufacture of any product in more than one state, territory, possession or District of Columbia. The entry points for which a product is introduced into interstate commerce are the release of a product from the facility in which the product was manufactured, the entry into a warehouse from which the domestic manufacturer releases the product for sale or distribution, and at the site of United States Customs clearance.

[28] As defined at 40 CFR 82.172 "end-use" means processes or classes of specific applications within major industrial sectors where a substitute is used to replace an ozone-depleting substance.

associated use conditions are in violation of section 612 of the Clean Air Act and EPA's SNAP regulations.

For some substitutes, the Agency may permit a narrowed range of use within an end-use or sector. For example, the Agency may limit the use of a substitute to certain end-uses or specific applications within an industry sector. The Agency requires a user of a narrowed use substitute to demonstrate that no other acceptable substitutes are available for their specific application by conducting comprehensive studies. EPA describes these substitutes as "acceptable subject to narrowed use limits." A person using a substitute that is acceptable subject to narrowed use limits in applications and end-uses that are not consistent with the narrowed use limit is using the substitute in an unacceptable manner and is in violation of section 612 of the CAA and EPA's SNAP regulations.

The Agency publishes its SNAP program decisions in the **Federal Register** (FR). EPA publishes decisions concerning substitutes that are deemed acceptable subject to use restrictions (use conditions and/or narrowed use limits), or for substitutes deemed unacceptable, as proposed rulemakings to allow the public opportunity to comment, before publishing final decisions.

In contrast, EPA publishes decisions concerning substitutes that are deemed acceptable with no restrictions in "notices of acceptability," rather than as proposed and final rules. As described in the rule initially implementing the SNAP program (59 FR 13044), EPA does not believe that rulemaking procedures are necessary to list alternatives that are acceptable without restrictions because such listings neither impose any sanction nor prevent anyone from using a substitute.

Many SNAP listings include "comments" or "further information" to provide additional information on substitutes. Since this additional information is not part of the regulatory decision, these statements are not binding for use of the substitute under the SNAP program. However, regulatory requirements so listed are binding under other regulatory programs. The "further information" classification does not necessarily include all other legal obligations pertaining to the use of the substitute. While the items listed are not legally binding under the SNAP program, EPA encourages users of substitutes to apply all statements in the "further information" column in their use of these substitutes. In many instances, the information simply refers to sound operating practices that have already been identified in existing industry and/or building-codes or standards. Thus, many of the statements, if adopted, would not require the affected user to make significant changes in existing operating practices.

D. Where can I get additional information about the SNAP program?

For copies of the comprehensive SNAP lists of substitutes or additional information on SNAP, refer to EPA's Ozone Depletion Web site at *http://www.epa.gov/ozone/snap/index.html.* For more information on the Agency's process for administering the SNAP program or criteria for evaluation of substitutes, refer to the SNAP final rulemaking published March 18, 1994 (59 FR 13044), codified at subpart G of 40 CFR part 82. A complete chronology of SNAP decisions and the appropriate citations are found at *http://www.epa.gov/ozone/snap/chron.html.*

IX. Statutory and Executive Order Reviews

A. Executive Order 12866: Regulatory Planning and Review

Under Executive Order (EO) 12866 (58 FR 51735, October 4, 1993), this action is a "significant regulatory action." It raises novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under EO 12866 and any changes made in response to OMB recommendations have been documented in the docket for this action.

B. Paperwork Reduction Act

This action does not impose any new information collection burden. Today's action is an Agency determination. It contains no new requirements for reporting. The only new recordkeeping requirement involves customary business practice. Today's rule requires minimal record-keeping of studies done to ensure that MVAC systems using HFO–1234yf meet the requirements set forth in this rule. Because it is customary business practice that OEMs conduct and keep on file Failure Mode and Effect Analysis (FMEA) on any potentially hazardous part or system from the beginning of production of a car model until three or more years after production of the model ends, we believe this requirement will not impose an additional paperwork burden. However, the Office of Management and Budget (OMB) has previously approved the information collection requirements contained in the existing regulations in subpart G of 40 CFR part 82 under the provisions of the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* and has assigned OMB control numbers 2060–0226. The OMB control numbers for EPA's regulations are listed in 40 CFR Part 9.

C. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of today's rule on small entities, small entity is defined as: (1) A small business as defined by the Small Business Administration's (SBA) regulations at 13 CFR 121.201; for NAICS code 336111 (Automobile manufacturing), a small business has < 1000 employees; for NAICS code 336391 (Motor Vehicle Air-Conditioning Manufacturing), a small business has < 750 employees; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

After considering the economic impacts of today's final rule on small entities, I certify that this action will not have a significant adverse economic impact on a substantial number of small entities. The only new requirement on small entities in this final rule is a requirement specifying the type of unique service fittings required when servicing MVAC systems using the refrigerant HFO–1234yf. Existing regulations at appendix D to subpart G of 40 CFR part 82 already require that there be unique service fittings for each refrigerant used in MVAC systems. Thus, the costs of purchasing new unique fittings for this refrigerant have already been imposed by the pre-existing regulation. This rule specifies the requirements for which type of unique fitting, in accordance with the fittings provided to EPA by the manufacturer. These fittings are part of the SAE J639 standard. It is not clear that there would be any cost differential between these specific unique fittings and others that the automotive industry could adopt instead. Thus, cost impacts of this final rule on small entities are expected to be small. This final rule is expected to relieve burden for some small entities, such as car repair shops, by allowing them the flexibility to use a new refrigerant that otherwise would have been prohibited under previous requirements at appendix B to subpart G of 40 CFR part 82 and by allowing them to use the easy-to-use "quick-connect" fittings for this refrigerant. Other final rule requirements apply to original equipment manufacturers, which are not small entities. These final rule requirements are the least burdensome option for regulation.

Original equipment manufacturers are not mandated to move to MVAC systems using HFO–1234yf. EPA is simply listing HFO–1234yf as an acceptable alternative with use conditions in new MVAC systems. This rule allows the use of this alternative to ozone-depleting substances in the MVAC sector and outlines the conditions necessary for safe use. By approving this refrigerant under SNAP, EPA provides additional choice to the automotive industry which, if adopted, would reduce the impact of MVACs on the global environment. This rulemaking does not mandate the use of HFO–1234yf as a refrigerant in new MVACs.

D. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104–4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and Tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures to State, local, and Tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including Tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

EPA has determined that this rule does not contain a Federal mandate that may result in expenditures of $100 million or more for State, local, and Tribal governments, in the aggregate, or the private sector in any one year. Today's rule does not affect State, local, or Tribal governments. The enforceable requirements of today's rule related to system design and documentation of the safety of alternative MVAC systems affect only a small number of original equipment manufacturers. Further, those requirements are consistent with requirements that the automotive industry has already adopted through consensus standards of SAE International. We expect that most manufacturers of automobiles and MVAC systems would attempt to meet those requirements or something very similar, even in the absence of EPA's regulations. The only requirement that is applied more widely than for original equipment manufacturers is a requirement specifying the type of unique service fittings required when servicing MVAC systems using the refrigerant HFO–1234yf. Existing regulations at appendix D to subpart G of 40 CFR part 82 already require that there be unique service fittings for each refrigerant used in MVAC systems. The fittings required in this final rule are part of the SAE J639 standard. Thus, the costs of this rule are consistent with standard industry practice and are expected to be much less than $100 million per year.

This action provides additional options allowing greater flexibility for industry in designing consumer products. The impact of this rule on the private sector will be less than $100 million per year. Thus, today's rule is not subject to the requirements of sections 202 and 205 of the UMRA. EPA has determined that this rule contains no regulatory requirements that might significantly or uniquely affect small governments. This regulation applies directly to facilities that use these substances and not to governmental entities. This rule does not mandate a switch to HFO–1234yf and the limited direct economic impact on entities from this rulemaking is less than $100 million annually.

E. Executive Order 13132: Federalism

Executive Order 13132, entitled "Federalism" (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." "Policies that have federalism implications" is defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

This action does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. This regulation applies directly to facilities that use these substances and not to governmental entities. Thus, Executive Order 13132 does not apply to this rule.

F. Executive Order 13175: Consultation and Coordination With Indian Tribal Governments

Executive Order 13175, entitled "Consultation and Coordination with Indian Tribal Governments" (59 FR 22951, November 6, 2000), requires EPA to develop an accountable process to ensure "meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications." This final rule does not have Tribal implications, as specified in Executive Order 13175. It does not significantly or uniquely affect the communities of Indian Tribal governments, because this regulation applies directly to facilities that use these substances and not to governmental entities. Thus, Executive Order 13175 does not apply to this rule.

G. Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks

This action is not subject to EO 13045 (62 FR 19885, April 23, 1997) because it is not economically significant as defined in EO 12866, and because the Agency does not believe the environmental health or safety risks addressed by this action present a disproportionate risk to children. This action's health and risk assessments are discussed in sections V and VII.D of the preamble and in documents EPA–HQ–OAR–2008–0664–0036 and HQ–OAR–2008–0664–0038 in the docket for this rulemaking.

H. Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use

This action is not a "significant energy action" as defined in Executive Order 13211 (66 FR 28355 (May 22, 2001)), because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. This action could impact manufacturing and repair of MVAC systems using an alternative refrigerant. This rule does not mandate a switch to HFO–1234yf. Preliminary information indicates that these new systems are more energy efficient than currently available systems in some climates. Therefore, we conclude that this rule is not likely to have a significant adverse effect on energy supply, distribution or use.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Public Law 104–113, 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (*e.g.*, materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This rulemaking involves technical standards. EPA has decided to use SAE International's most recent version of the SAE J1739 and SAE J639 standards. These standards can be obtained from *http://www.sae.org/technical/standards/*. These standards address safety and reliability issues in motor vehicle design, including MVAC systems using alternative refrigerants.

J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order (EO) 12898 (59 FR 7629 (Feb. 16, 1994)) establishes Federal executive policy on environmental justice. Its main provision directs Federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

EPA has determined that this final rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it increases the level of environmental protection for all affected populations without having any disproportionately high and adverse human health or environmental effects on any population, including any minority or low-income population. HFO–1234yf is a non-ozone-depleting substance with a low GWP. Based on the toxicological and atmospheric work described earlier, HFO–1234yf will not have any disproportionately high and adverse human health or environmental effects on any population, including any minority or low-income population. This final rule requires specific use conditions for MVAC systems, if car manufacturers chose to make MVAC systems using this low GWP refrigerant alternative.

K. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the **Federal Register**. A Major rule cannot take effect until 60 days after it is published in the **Federal Register**. This action is not a "major rule" as defined by 5 U.S.C. 804(2). This rule will be effective May 31, 2011.

X. References

The documents below are referenced in the preamble. All documents are located in the Air Docket at the address listed in section titled ADDRESSES at the beginning of this document. Unless specified otherwise, all documents are available in Docket ID No. EPA–HQ–OAR–2008–0664 at *http://www.regulations.gov*.

Benesch *et al.*, 2002. Investigation of Effects of Trifluoroacetate on Vernal Pool Ecosystems. *Environ. Tox and Chem.* Vol. 21, No. 3 pp. 640–647, 2002. Available online at *http://www3.interscience.wiley.com/journal/122678031/abstract?CRETRY=1&SRETRY=0*.

Benouali *et al.*, 2008. "A/C System Control Strategies for Major Refrigerant Options" June 11, 2008. Alternative Refrigerant Systems Symposium Phoenix, AZ. Available online at *http://www2.dupont.com/Refrigerants/en_US/assets/downloads/SmartAutoAC/2008_SAE_ARSS_Valeo_Eval.pdf*.

Besnard, S., 1996. Full Flammability Test of Gases and Gas Mixtures in Air. CERN. European Organization for Nuclear Research. 1996. Available online at *http://cdsweb.cern.ch/record/1217583/files/CM-P00055900.pdf*.

Boutonnet *et al.*, 1999. "Environmental Risk Assessment of Trifluoroacetic Acid," *Human and Ecological Risk Assessment*, Feb. 1999. Available online at *http://www.informaworld.com/smpp/content~db=all~content=a922749285~frm=abslink*.

CARB, 2008. Technical Support Document "Staff Analysis on Emissions and Economic Impact of Proposed Regulation for Small Containers of Automotive Refrigerant." Appendix G to Certification Procedures for Small Containers of Automotive Refrigerant. California Air Resources Board, effective March 10, 2010. Document incorporated by reference in California Code of Regulations (CCR), title 17, sections 95360 through 95370. Available online at *http://www.arb.ca.gov/regact/2009/hfc09/hfc09.htm*.

Carter, 2009. Investigation of Atmospheric Ozone Impacts of 2,3,3,3-Tetrafluoropropene. Final report to Honeywell International Contract UCR–09010016. William Carter, University of California, Riverside CA. June 2, 2009. Available online at *http://www.cert.ucr.edu/%7Ecarter/pubs/YFrept.pdf*.

Ceviz and Yuksel, 2005. "Cyclic variations on LPG and gasoline-fuelled lean burn SI engine." *Renewable Energy*. In press. Available online at *http://www.pm-kbase.com/articles/LPGsdarticle(8).pdf*.

Clodic *et al.*, 2008. *Evaluation of the Potential Impact of Emissions of HFC–134a From Non Professional Servicing of Motor Vehicle Air Conditioning Systems*. D. Clodic, A. Tremoulet, Y. Riachi, D. Sousa, L. Palandre, A. Garnier, S. Clodic and M. Lansard. Prepared under CARB Agreement No. 06–341. December, 2008. Available online at *http://www.arb.ca.gov/research/apr/past/06-341.pdf*.

CRP, 2008. Risk Assessment for Alternative Refrigerants HFO–1234yf Phase II. Prepared for SAE International Cooperative Research Program 1234 by Gradient Corporation. February 26, 2008. Docket number EPA–HQ–OAR–2008–0664–0008.

CRP, 2009. Risk Assessment for Alternative Refrigerants HFO–1234yf and R–744 (CO2) Phase III. Prepared for SAE International Cooperative Research Program 1234 by T. Lewandowski, Gradient Corporation, December 17, 2009. Docket number EPA–HQ–OAR–2008–0664–0056.2.

DuPont, 2008. DuPont internal testing. Cited in docket number EPA–HQ–OAR–2008–0664–0052.1.

Hamner Institutes, 2007. Toxicogenomic assessment of the carcinogenic potential of 2,3,3,3-tetrafluoropropene. The Hamner Institutes for Health Sciences. January 5, 2007. Docket numbers EPA–HQ–OAR–2008–0664–0030 through –0030.6.

Honeywell, 2010a. Comment on EPA Proposed Rule (simulated vehicle service leak testing and exposure study). Docket ID: EPA–HQ–OPPT–2008–0918–0088.

Honeywell, 2010b. Response to EPA questions. Docket ID: EPA–HQ–OPPT–2008–0918–0096.

ICF, 2008. ICF International. 2008. Air Conditioning Refrigerant Charge Size to Passenger Compartment Volume Ratio Analysis. Docket number EPA–HQ–OAR–2008–0664–0003.

ICF, 2009. ICF International. 2009. Revised Final Draft Assessment of the Potential Impacts of HFO–1234yf and the Associated Production of TFA on Aquatic Communities and Local Air Quality. Docket number EPA–HQ–OAR–2008–0664–0037.

ICF, 2010a. ICF International. 2010. Summary of HFO–1234yf Emissions Assumptions.

ICF, 2010b. ICF International. 2010. Revised Assessment of the Potential Impacts of HFO–1234yf and the Associated Production of TFA on Aquatic Communities, Soil and Plants, and Local Air Quality.

ICF, 2010c. ICF International. 2010. Sensitivity Analysis CMAQ results on projected maximum TFA rainwater concentrations and maximum 8-hr ozone concentrations.

ICF, 2010d. ICF International. 2010. Analysis of Potential Impacts of Aldehydes as Breakdown Products from HFO–1234yf.

ICF, 2010e. ICF International. 2010. Summary of Updates to the Vintaging Model that Impacted HFO–1234yf Emissions Estimates.

IPCC, 2007. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available online at *http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html.*

JAMA, 2008. "LCCP Result from JAMA." Japan Automobile Manufacturers Association, T. Ikegami; K. Inui; K. Aoki. VDA Alternative Refrigerant Winter Meeting, Saalfelden, Austria, February 13–14, 2008. Available online at *http://www.vda-wintermeeting.de/fileadmin/downloads2008/presentations/Tohru_Ikegami_Toyota_Kenta_Aoki_Nissan_JAMA.pdf.* (begins, p. 23).

JAMA–JAPIA, 2008. "New Refrigerants Evaluation Results" Japan Automobile Manufacturers Association-Japan Auto Parts Industries Association Consortium, T. Ikegami, M. Iguchi, K. Aoki, K. Iijima; VDA Alternative Refrigerant Winter Meeting, Saalfelden, Austria, February 13–14, 2008. Available online at *http://www.vda-wintermeeting.de/fileadmin/downloads2008/presentations/Tohru_Ikegami_Toyota_Kenta_Aoki_Nissan_JAMA.pdf.*

Kajihara *et al.*, 2010. "Estimation of environmental concentrations and deposition fluxes of R–1234–YF and its decomposition products emitted from air conditioning equipment to atmosphere". H. Kajihara, K. Inoue, K. Yoshida, R. Nagaosa. February 17–19, 2010. 2010 International Symposium on Next-generation Air Conditioning and Refrigeration Technology. Docket number EPA–HQ–OAR–2008–0664–0114.1.

Kirkland *et al.* (2005) Evaluation of a battery of three in vitro genotoxicity tests to determine rodent carcinogens and non-carcinogens. I. Sensitivity, specificity and relative predictivity. *Mutation Research*, 584, 1–256. Available online at *http://www.sciencedirect.com.*

Luecken *et al.*, 2009. Luecken, D.J., Waterland, R.L., Papasavva, S., Taddonio, K.N., Hutzell, W.T., Rugh, J.P., Andersen, S.O. 2009. Ozone and TFA Impacts in North America from the Degradation of 2,3,3,3-Tetrafluoropropene (HFO–1234yf), A Potential Greenhouse Gas Replacement. *Environ. Sci. Technol.*, submitted for publication. Docket number EPA–HQ–OAR–2008–0664–0112.3.

Meyer, 2008. "R–1234yf System Enhancements and Comparison to R–134a." 2008, Alternative Refrigerant Systems Symposium Phoenix, AZ. Available online at *http://www2.dupont.com/Refrigerants/en_US/assets/downloads/SmartAutoAC/2008_SAE_ARSS_Visteon_Eval.pdf.*

Monforte *et al.*, 2008 "Updated situation about alternative refrigerant evaluation" June 10–12, 2008, Alternative Refrigerant Systems Symposium Phoenix, AZ. *http://www2.dupont.com/Refrigerants/en_US/assets/downloads/SmartAutoAC/2008_SAE_ARSS_Renault_Fiat_PSA_Eval.pdf.*

Nielsen *et al.*, 2007. Nielsen, O.J., Javadi, M.S., Sulbaek Andersen, M.P., Hurley, M.D., Wallington, T.J., Singh, R. 2007. Atmospheric chemistry of $CF_3CF{=}CH_2$: Kinetics and mechanisms of gas-phase reactions with Cl atoms, OH radicals, and O_3. *Chemical Physics Letters* 439, 18–22. Available online at *http://www.cogci.dk/network/OJN_174_CF3CF=CH2.pdf.*

NRC, 1981. *Atmosphere-Biosphere Interactions: Toward a Better Understanding of the Ecological Consequences of Fossil Fuel Combustion.* Committee on the Atmosphere and the Biosphere, Board on Agriculture and Renewable Resources, Commission on Natural Resources, National Research Council. 1981. Available from NRC Press or online at *http://www.nap.edu/catalog.php?record_id=135.*

NRC, 1996. NRC Toxicity of Alternatives to Chlorofluorocarbons: HFC–134a and HCFC–123 (1996). Available online at *http://www.nap.edu/openbook.php?record_id=9268&page=29.*

NRC, 2004. *Acute Exposure Guideline Levels for Selected Airborne Chemicals: Volume 4* (2004) Board on Environmental Studies and Toxicology. The National Academies Press. Available online at *http://www.nap.edu/openbook.php?record_id=10902&page=127#p2000a02f9960127001.*

Orkin *et al.*, 1997. Rate constants for the reactions of OH with HFC–245cb ($CH_3CF_2CF_3$) and some fluoroalkenes (CH_2CHCF_3, CH_2CFCF_3, CF_2CFCF_3, and CF_2CF_2). *Journal of Physical Chemistry A* 101 (1997), pp. 9118–9124. Available online at *http://pubs.acs.org/doi/abs/10.1021/jp971994r.*

Papadimitriou *et al.*, 2007. $CF_3CF{=}CH_2$ and (Z)-CF3CF=CHF: temperature dependent OH rate coefficients and global warming potentials. V. Papadimitriou, R Talukdar, R. Portmann, A. Ravishankara and J. Burkholder. *Phys. Chem. Chem. Phys.*, 2007, Vol. 9, p. 1–13. Docket number EPA–HQ–OAR–2008–0664–0002. Available online at *http://pubs.rsc.org/en/Content/ArticleLanding/2008/CP/b714382f.*

Papasavva *et al.*, 2009. Estimated 2017 Refrigerant Emissions of 2,3,3,3-tetrafluoropropene (HFC–1234yf) in the United States Resulting from Automobile Air Conditioning. *Environ. Sci. Technol.* 2009. 43 pp. 9252–9259. Docket number EPA–HQ–OAR–2008–0664–0112.1. Available online at *http://www.ncbi.nlm.nih.gov/pubmed/20000517.*

Parodi *et al.*, 1982. Predictive ability of the autoradiographic repair assay in rat liver cells compared with the Ames test ; S. Parodi; M. Taningher; C. Balbi; L. Santi. *Journal of Toxicology and Environmental Health*, Vol. 10, Issue 4 & 5 October 1982, pages 531–539. Available online at *http://www.informaworld.com/smpp/content~db=all~content=a915968516.*

Ravishankara *et al.*, 1993. Do Hydrofluorocarbons Destroy Stratospheric Ozone? A. R. Ravishankara, Andrew A. Turnipseed, Niels R. Jensen, Stephen Barone, Michael Mills, Carleton J. Howard, and Susan Solomon. *Science*, Vol. 263, no. 5143, pp. 71–75. January 4, 1994. Available online at *http://www.sciencemag.org/cgi/content/abstract/263/5143/71.*

Rhasa and Zellner, 1987. Atmospheric Oxidation of Hydrocarbons. *Free Radical Research* 1987, Vol. 3, No. 1–5: Pages 199–209. Available online at *http://informahealthcare.com/doi/abs/10.3109/10715768709069785.*

Sciance, 2010. "General Motors R–1234yf Implementation," Presentation by Fred Sciance, General Motors to EPA staff. October 28, 2010. Docket number EPA–HQ–OAR–2008–0664–0138.

Spatz, 2008. Spatz, M and B. Minor 2008 "HFO–1234yf: A Low GWP Refrigerant for MAC", VDA Winter meeting. Available online at *http://www2.dupont.com/Refrigerants/en_US/assets/downloads/SmartAutoAC/MAC_VDA08_HFO_1234yf.pdf.*

SROC, 2005. Chapter 3 from *Safeguarding the Ozone Layer and the Global Climate System: Special Report of the Intergovernmental Panel on Climate Change.* Edited by Bert Metz, Lambert Kuijpers, Susan Solomon, Stephen O. Anderson, Ogunlade Davidson, Jose Pons, David de Jager, Tahl Kestin, Martin Manning and Leo Meyer. Cambridge University Press, 2005. Available online at *http://www.cambridge.org/catalogue/catalogue.asp?isbn=9780521682060.*

TNO, 2005. Sub-acute (2-week) Inhalation Toxicity Study with HFO–1234yf in Rats. 2005. Docket number EPA–HQ–OAR–2008–0664–0020 and attachments –0020.1 through –0020.4.

TNO, 2007a. Sub-chronic (13-week) inhalation toxicity study with HFO–1234yf in rats. 2007. Docket number EPA–HQ–OAR–2008–0664–0022 and attachments –0022.1 through –0022.5.

TNO, 2007b. Prenatal Developmental Inhalation Toxicity Study with HFO–1234yf in Rats. 2007. Docket number EPA–HQ–OAR–2008–0664–0023 and attachments –0023.1 through –0023.9.

U.S. EPA, 1994. U.S. Environmental Protection Agency (U.S. EPA). 1994. Methods for derivation of inhalation reference concentrations and application of inhalation dosimetry. EPA/600/8-90/066F. Office of Health and Environmental Assessment, Washington, DC. 1994. Available online at *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=71993.*

U.S. EPA, 2000. Hazard Summary for Formaldehyde, CAS ID# 50–00–0. Revised 2000. Available online at *http://www.epa.gov/ttn/atw/hlthef/formalde.html.*

U.S. EPA, 2010a. E-mail from Yaidi Cancel, EPA. To William Hill and Ward Atkinson, SAE Interior Climate Control Committee re: Minimum recordkeeping on SAE J1739. August 16, 2010.

U.S. EPA, 2010b. E-mail from Margaret Sheppard, EPA to Christopher Seeton and Kasia Bober, Honeywell re: Summary of our conference call on service fittings for HFO–1234yf. November 8, 2010.

U.S. EPA, 2010c. Clarifying questions for Honeywell on Exposure Study. Docket number EPA–HQ–OPPT–2008–0918–0095.

Wallington *et al.*, 2008. Emissions of CO_2, CO, NO_X, HC, PM, HFC–134a, N_2O and CH_4 from the Global Light Duty Vehicle Fleet. *Meteorologische Zeitschrift* 17. 109–116. Available online at *http://www.schweizerbart.de/resources/downloads/paper_free/56618.pdf.*

Wallington *et al.*, 2010. "Estimated Photochemical Ozone Creation Potentials (POCPs) of $CF_3CF{=}CH_2$ (HFO–1234yf) and Related Hydrofluoroolefins (HFOs)." T. Wallington, M. Andersen, O. Nielsen. *Atmospheric Environment.* Docket number EPA–HQ–OAR–2008–0664–0084.2. Available online at *http://www.sciencedirect.com* or at *doi:10.1016/j.atmosenv.2010.01.040.*

Weissler, P., 2008. "Consensus Building on Refrigerant Type." Automotive Engineering International. 9: 30–32. Docket number EPA–HQ–OAR–2008–0664–0006.

WIL, 2006. Acute Cardiac Sensitization Study of [name redacted] and HFO–1234yf in Dogs. WIL Laboratories, 2006. Docket number EPA–HQ–OAR–2008–0664–0019 and attachments –0019.1 through –0019.2.

List of Subjects in 40 CFR Part 82

Environmental protection, Administrative practice and procedure, Air pollution control, Incorporation by reference, Reporting and recordkeeping requirements, Stratospheric ozone layer.

Dated: February 24, 2011.

Lisa P. Jackson,

Administrator.

For the reasons set out in the preamble, 40 CFR part 82 is amended as follows:

PART 82—PROTECTION OF STRATOSPHERIC OZONE

■ 1. The authority citation for part 82 continues to read as follows:

Authority: 42 U.S.C. 7414, 7601, 7671–7671q.

Subpart G—Significant New Alternatives Policy Program

■ 2. Appendix B to Subpart G of Part 82 is amended as follows:

■ a. By adding one new entry to the end and by adding a note at the end of the first table.

■ b. By revising the entry for "CFC–12 Motor Vehicle Air Conditioners (Retrofit and New Equipment/NIKs)" in the table titled "Refrigerants—Unacceptable Substitutes".

The additions and revisions read as follows:

Appendix B to Subpart G of Part 82—Substitutes Subject to Use Restrictions and Unacceptable Substitutes

REFRIGERANTS—ACCEPTABLE SUBJECT TO USE CONDITIONS

Application	Substitute	Decision	Conditions	Comments
*	*	* *	* *	*
CFC–12 Automobile Motor Vehicle Air Conditioning (New equipment in passenger cars and light-duty trucks only).	HFO–1234yf as a substitute for CFC–12.	Acceptable subject to use conditions.	Manufacturers must adhere to all of the safety requirements listed in the Society of Automotive Engineers (SAE) Standard J639 (adopted 2011), including requirements for: unique fittings, flammable refrigerant warning label, high-pressure compressor cutoff switch and pressure relief devices. For connections with refrigerant containers of 20 lbs or greater, use fittings consistent with SAE J2844. Manufacturers must conduct Failure Mode and Effect Analysis (FMEA) as provided in SAE J1739 (adopted 2009). Manufacturers must keep the FMEA on file for at least three years from the date of creation.	Additional training for service technicians recommended. Observe requirements of Significant New Use Rule at 40 CFR 721.10182. HFO–1234yf is also known as 2,3,3,3-tetrafluoro-prop-1-ene (CAS No 754–12–1).

* * * * *

Note: The use conditions in this appendix contain references to certain standards from SAE International. The standards are incorporated by reference and the referenced sections are made part of the regulations in part 82:

1. SAE J639. Safety Standards for Motor Vehicle Refrigerant Vapor Compression Systems. February 2011 edition. SAE International.

2. SAE J1739. Potential Failure Mode and Effects Analysis in Design (Design FMEA), Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA). January 2009 edition. SAE International.

3. SAE J2844. R–1234yf (HFO–1234yf) New Refrigerant Purity and Container Requirements for Use in Mobile Air-Conditioning Systems. February 2011 edition. SAE International.

The Director of the Federal Register approves this incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. You may obtain a copy from SAE Customer Service, 400 Commonwealth Drive, Warrendale, PA 15096–0001 USA; e-mail: *CustomerService@sae.org;* Telephone: 1–877–606–7323 (U.S. and Canada only) or 1–724–776–4970 (outside the U.S. and Canada); Internet address: *http://store.sae.org/dlabout.htm.*

You may inspect a copy at U.S. EPA's Air Docket; EPA West Building, Room 3334; 1301 Constitution Ave., NW.; Washington, DC or at the National Archives and Records Administration (NARA). For questions regarding access to these standards, the telephone number of EPA's Air Docket is 202–566–1742. For information on the availability of this material at NARA, call 202–741–6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.*

* * * * *

REFRIGERANTS—UNACCEPTABLE SUBSTITUTES

End-use	Substitute	Decision	Comments
*	* *	*	* * *
CFC–12 Motor Vehicle Air Conditioners (Retrofit and New Equipment/NIKs).	R–405A	Unacceptable	R–405A contains R–c318, a PFC, which has an extremely high GWP and lifetime. Other Substitutes exist which do not contain PFCs.
	Hydrocarbon Blend B	Unacceptable	Flammability is a serious concern. Data have not been submitted to demonstrate it can be used safely in this end-use.
	Flammable Substitutes, other than R–152a or HFO–1234yf in new equipment.	Unacceptable	The risks associated with using flammable substitutes (except R–152a and HFO–1234yf) in this end-use have not been addressed by a risk assessment. R–152a and HFO–1234yf may be used in new equipment with the use conditions in appendix B to this subpart.

[FR Doc. 2011–6268 Filed 3–28–11; 8:45 am]

BILLING CODE 6560–50–P

Regulatory Announcement

EPA and NHTSA Set Standards to Reduce Greenhouse Gases and Improve Fuel Economy for Model Years 2017-2025 Cars and Light Trucks

The U.S. Environmental Protection Agency (EPA) and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) are issuing final rules extending the National Program to further reduce greenhouse gas (GHG) emissions and improve fuel economy for model years (MYs) 2017 through 2025 light-duty vehicles. EPA is establishing national GHG emissions standards under the Clean Air Act, and NHTSA is establishing Corporate Average Fuel Economy (CAFE) standards under the Energy Policy and Conservation Act, as amended by the Energy Independence and Security Act (EISA).

EPA's standards apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles, in MYs 2017 through 2025. The final standards are projected to result in an average industry fleetwide level of 163 grams/mile of carbon dioxide ($CO2$) in model year 2025, which is equivalent to 54.5 miles per gallon (mpg) if achieved exclusively through fuel economy improvements. Light-duty vehicles are currently responsible for nearly 60 percent of U.S. transportation-related petroleum use and GHG emissions.

This new phase in this broadly supported national program conserves billions of barrels of oil, cuts carbon pollution, protects consumer choice, and enables long-term planning for automakers.

EPA United States Environmental Protection Agency

Office of Transportation and Air Quality
EPA-420-F-12-051
August 2012

Regulatory Announcement

Building on Success

This MYs 2017-2025 program builds on the success of the first phase of the National Program for MYs 2012-2016 vehicles, which is projected to result in an average light-duty vehicle tailpipe CO2 level of 250 grams per mile by MY 2016, equivalent to 35.5 mpg (if achieved exclusively through fuel economy). Vehicles meeting the MYs 2012 and 2013 standards are on the road today, already saving consumers money at the pump.

Combined with the MYs 2012-2016 standards, today's final program will result in MY 2025 vehicles emitting one-half of the GHG emissions of a MY 2010 vehicle, representing the most significant federal action ever taken to reduce GHG emissions and improve fuel economy.

As with the first phase of the National Program, this second phase of the program was built on strong support from a wide range of stakeholders, including the automobile manufacturers. After President Obama announced plans for the second phase National Program on July 29, 2011, thirteen auto manufacturers representing over 90 percent of U.S. vehicle sales announced support for the program, as well as the State of California. The United Auto Workers, consumer organizations, environmental organizations, veterans groups, state/local governments, and nearly 300,000 individuals have also expressed strong support for the program.

Continuing the National Program ensures that auto manufacturers can build a single fleet of U.S. vehicles that satisfy requirements of both federal programs as well as California's program, thus helping to reduce costs and regulatory complexity while providing significant energy security and environmental benefits to the nation as a whole.

Benefits to Consumers

These standards will provide significant savings for consumers at the pump. Higher costs for new vehicle technology are projected to add, on average, about $1,800 for consumers who buy a new vehicle in MY 2025. Those consumers who drive their MY 2025 vehicle for its entire lifetime will save, on average, $5,700 to $7,400 (7 and 3 percent discount rates, respectively) in fuel savings, for a net lifetime savings of $3,400 to $5,000 (when compard to a vehicle meeting the MY 2016 standards). For those consumers who purchase their new MY 2025 vehicle outright, the discounted fuel savings will offset the higher vehicle cost in less than 3.5 years, and fuel savings will continue for as long as the consumer owns the vehicle.

Those consumers who purchase a new MY 2025 vehicle with a standard 5-year loan will immediately benefit as the monthly fuel savings offset the higher monthly payment by about $12 or about $140 per year. These savings assume a gasoline price of $3.87 in 2025 with small future increases throughout the vehicle's lifetime; if gas prices soar consumers would save even more money as a result of these more fuel-efficient vehicles.

The final standards preserve consumer choice -- that is, the standards should not affect consumers' opportunity to purchase the size of vehicle with the performance, utility and safety features that meet their needs. The standards have been designed in a way that does not create incentives to manufacture vehicles of any particular size (for example, there is no incentive to downsize.

Regulatory Announcement

Benefits from Greenhouse Gas Reductions and Less Oil Dependency

Over the lifetimes of the vehicles sold in MYs 2017-2025 standards, this program is projected to save approximately 4 billion barrels of oil and reduce GHG emissions by 2 billion metric tons, with net benefits to society in the range of $326 billion to $451 billion (7 and 3 percent discount rates, respectively). These savings come on top of savings that would already be achieved through the continuation of the MY 2016 standards.

The combined National Program for MYs 2012-2016 and MYs 2017-2025 is projected to save families more than $1.7 trillion in fuel costs and reduce America's dependence on oil by more than 2 million barrels per day in 2025, which is equivalent to one-half of the oil that we currently import from OPEC countries each day. In addition, the combined program will cut 6 billion metric tons of greenhouse gases over the lifetimes of the vehicles sold in MYs 2012-2025 – more than the total amount of carbon dioxide emitted by the United States in 2010. Consumers who purchase a new MY 2025 vehicle will save more than $8,000 in fuel costs over that vehicle's lifetime (when compared to a vehicle meeting the MY 2011 CAFE standards).

EPA's Greenhouse Gas Standards

EPA is finalizing a set of fleet-wide average carbon dioxide (CO2) emission standards for cars and light trucks. These standards are based on CO2 emissions-footprint curves, where each vehicle has a different CO2 emissions compliance target depending on its footprint value (related to the size of the vehicle). Generally, the larger the vehicle footprint, the higher the corresponding vehicle CO2 emissions target. As a result, the burden of compliance is distributed across all vehicles and all manufacturers. Manufacturers are not compelled to build vehicles of any particular size or type (nor does the rule create an incentive to do so), and no single vehicle is required to meet its individual target. Each manufacturer will have its own fleet-wide standard that reflects the vehicles it chooses to produce, and the GHG program provides a wide range of credit programs and flexibilities for manufacturers to meet the standards.

Table 1 shows the projected fleet-wide CO2 emission targets under this footprint-based approach. The car CO2 emission levels are projected to increase in stringency from 212 to 143 grams per mile (g/mi) between MY s 2017 and 2025. Similarly, fleet-wide CO2 emission levels for trucks are projected to increase in stringency from 295 in MY 2017 to 203 g/mi in MY 2025. EPA projects that the average light vehicle (combined car and truck) tailpipe CO2 compliance level in MY 2017 will be 243 g/mi, phasing down by MY 2025 to 163 g/mi, corresponding to 54.5 mpg in MY 2025 if all reductions were made through fuel economy improvements.

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Table 1 - Projected Fleet-Wide Emissions Compliance Targets under the Footprint-Based CO_2 Standards (g/mi) and Corresponding Fuel Economy (mpg)										
	2016 base	2017	2018	2019	2020	2021	2022	2023	2024	2025
Passenger Cars (g/mi)	225	212	202	191	182	172	164	157	150	143
Light Trucks (g/mi)	298	295	285	277	269	249	237	225	214	203
Combined Cars & Trucks (g/mi)	250	243	232	222	213	199	190	180	171	163
Combined Cars & Trucks (mpg)	35.5	36.6	38.3	40.0	41.7	44.7	46.8	49.4	52.0	54.5

Figures 1 and 2 show the actual footprint curves for cars and trucks, respectively. For passenger cars, the CO2 compliance values associated with the footprint curves would be reduced on average by 5 percent per year from the MY 2016 projected passenger car industry-wide compliance level through MY 2025. To address the challenges facing light-duty trucks, as we transition from the MY 2016 standards to MY 2017 and later, while preserving the utility (e.g., towing and payload capabilities) of those vehicles, EPA's standards provide a lower annual rate of improvement for light-duty trucks in the early years of the program. The average annual rate of CO2 emissions reduction in MYs 2017 through 2021 is 3.5 percent per year and 5 percent per year for MYs 2022 through 2025.

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Figure 1 CO2 (g/mile) Car Standards Curves

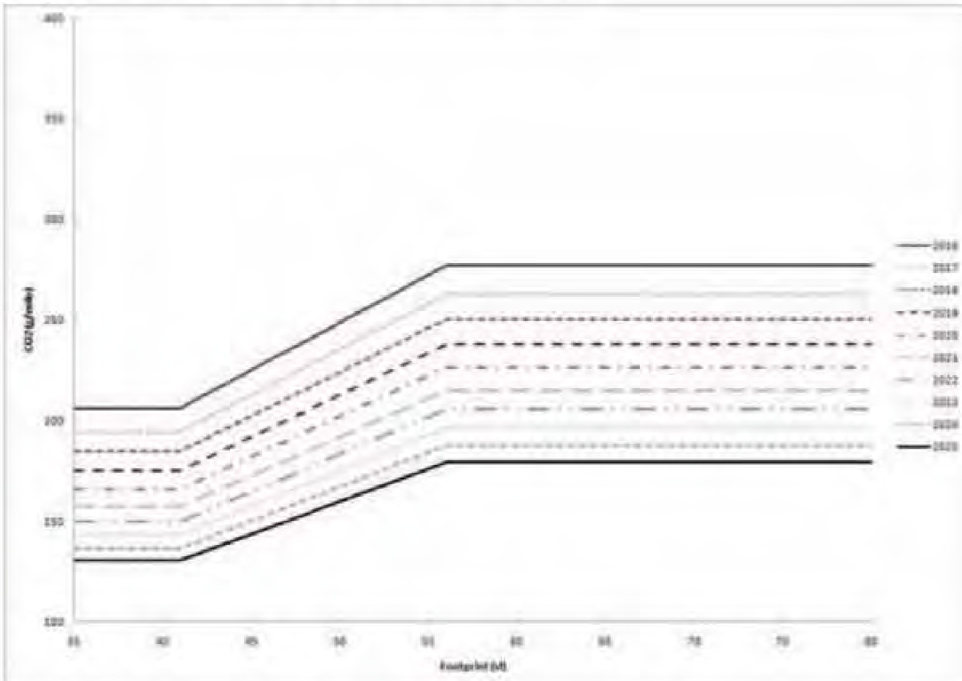
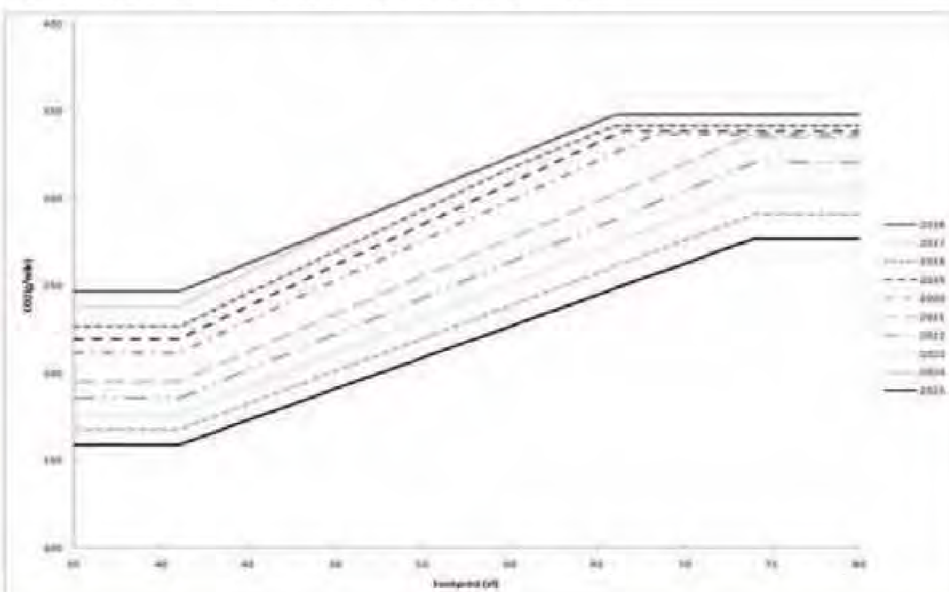


Figure 2 CO2 (g/mile) Truck Standard Curves



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Example footprint targets for popular vehicle models are shown in Table 2, illustrating the fact that different vehicle sizes will have varying CO2 emissions and fuel economy targets under the footprint-based standards. Vehicle CO2 emissions will be measured over the EPA city and highway tests.

Table 2 Model Year 2025 CO2 and Fuel Economy Targets for Representative MY 2012 Vehicles

Vehicle Type	Example Models	Example Model Footprint (sq. ft.)	EPA CO_2 Emissions Target (g/mi)*	NHTSA Fuel Economy Target (mpg) */ **
Example Passenger Cars				
Compact car	Honda Fit	40	131	61.1
Mid-size car	Ford Fusion	46	147	54.9
Full-size car	Chrysler 300	53	170	48.0
Example Light-duty Trucks				
Small SUV	4WD Ford Escape	43	170	47.5
Midsize crossover	Nissan Murano	49	188	43.4
Minivan	Toyota Sienna	56	209	39.2
Large pickup truck	Chevy Silverado (extended cab,6.5 foot base)	67	252	33.0

* Real-world CO2 is typically 25 percent higher and real-world fuel economy is typically 20 percent lower than the CO2 and CAFE values discussed here.

** The fuel economy mpg targets shown in the last column would be higher if using the MPG-equivalent values corresponding to the CO2 emissions targets, i.e., if all CO2 reductions were achieved exclusively with higher fuel economy technologies.

Vehicle Technologies to Reduce GHGs and Improve Fuel Economy

EPA projects that manufacturers will comply with the MYs 2017-2025 standards by using a wide range of technologies, including continual advances in gasoline engines and transmissions, vehicle weight reduction, lower tire rolling resistance, vehicle aerodynamics, diesel engines, and more efficient vehicle accessories. EPA expects that the majority of improvements will come from advancements in internal combustion engines, although we also expect to see some increased electrification of the fleet through the expanded production of stop/start, hybrid vehicles, plug-in hybrid electric vehicles, and electric vehicles. EPA also expects that vehicle air conditioning systems will continue to become more efficient, reduce leakage, and use alternative refrigerants with lower hydrofluorocarbon emissions.

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Mid-Term Evaluation

Given the long time frame at issue in setting standards for MYs 2022-2025, and given NHTSA's obligation to conduct a separate rulemaking in order to establish final standards for vehicles for those model years, EPA and NHTSA will conduct a comprehensive mid-term evaluation and agency decision-making process. As part of this undertaking, EPA and NHTSA will develop and compile up-to-date information for the evaluation, through a collaborative, robust and transparent process, including public notice and comment. EPA and NHTSA fully expect to conduct this mid-term evaluation in coordination with the California Air Resources Board (CARB), given our interest in maintaining a National Program to address GHG emissions and fuel economy. The comprehensive evaluation process will lead to final agency action by both agencies.

EPA's Program Flexibilities

EPA's final program includes provisions that offer compliance flexibility to auto manufacturers. Together these flexibilities are expected to provide sufficient lead time for manufacturers to make necessary technological improvements and to reduce the overall cost of the program, without compromising overall environmental objectives. The flexibilities also provide incentives to facilitate market penetration of the most advanced vehicle technologies.

Credit Banking and Trading - EPA will continue the same comprehensive program for averaging, banking, and trading of credits established in the MYs 2012-2016 program. Together, these provisions help manufacturers in planning and implementing the orderly phase-in of GHG-reducing technology in their production, consistent with typical redesign schedules. Credits may be carried forward, or banked, for five years, or carried back three years to cover a deficit in a previous year. A manufacturer may transfer credits across all vehicles it produces, both cars and light trucks. Trading of credits between companies is also permitted. To facilitate the transition to the increasingly more stringent MYs 2017-2025 standards, EPA is finalizing under its Clean Air Act authority a one-time CO2 credit carry-forward provision beyond 5 years, allowing credits generated from MYs 2010 through 2016 to be used through MY 2021.

Air Conditioning Improvement Credits - As with the MYs 2012-2016 program, manufacturers will be able to generate CO2-equivalent credits to use in complying with the CO2 standards for (1) improvements in air conditioning (A/C) systems that reduce tailpipe CO2 through efficiency improvements, and (2) for reduced refrigerant leakage--through better components and/or use of alternative refrigerants with lower global warming potential. Currently A/C systems use refrigerants containing hydrofluorocarbons (HFC) which are highly potent greenhouse gases, and EPA's A/C credits will give manufacturers an incentive to accelerate the use of refrigerants with much lower HFC emissions.

Off-Cycle Credits - Off-cycle technologies achieve CO2 reductions that are not reflected in current test procedures. Such off-cycle technologies might include solar panels on hybrids, engine start-stop or active aerodynamics. EPA is expanding and streamlining the MYs 2012-2016 off-cycle credit provisions for demonstrating and obtaining these credits. For MYs 2014 and later, EPA is finalizing a pre-approved list of technologies and credit values. Further, manufacturers will be

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Regulatory Announcement

able to apply for off-cycle technology credits beyond those listed (or for different credit values for the listed technologies) if they present sufficient data to EPA.

Incentives for Electric Vehicles, Plug-in Hybrid Electric Vehicles, Fuel Cell Vehicles, and Compressed Natural Gas Vehicles - To facilitate market penetration of the most advanced vehicle technologies as rapidly as possible, EPA is finalizing an incentive multiplier for compliance purposes for all electric vehicles (EVs), plug-in hybrid electric vehicles (PHEVs), fuel cell vehicles (FCV) and compressed natural gas (CNG) vehicles sold in MYs 2017 through 2021. This multiplier approach means that each EV/PHEV/FCV/CNGV would count as more than one vehicle in the manufacturer's compliance calculation. EVs and FCVs will start with a multiplier value of 2.0 in MY 2017, phasing down to a value of 1.5 in MY 2021. PHEVs and CNG vehicles will start at a multiplier value of 1.6 in MY 2017 and phase down to a value of 1.3 in MY 2021. There are no multipliers for MYs 2022-2025.

For EVs, PHEVs and FCVs, EPA is setting 0 g/mi as the tailpipe compliance value for EVs, PHEVs (electricity usage) and FCVs for MYs 2017-2021, with no limit on the quantity of vehicles eligible for 0 g/mi tailpipe emissions accounting. For MYs 2022-2025, 0 g/mi will only be allowed up to a per-company cumulative sales cap:

1) 600,000 vehicles for companies that sell 300,000 EV/PHEV/FCVs in MYs 2019-2021;
2) 200,000 vehicles for all other manufacturers.

For sales above these thresholds, manufacturers will be required to account for the net upstream GHG emissions for the electric portion of operation, using accounting methodologies set out in the rule.

Incentives for Advanced Technologies Including Hybridization for Full-Size Pickup Trucks - EPA is finalizing an additional CO2 per vehicle credit, for mild and strong hybrid electric (HEV) full-size pickup trucks, if this advanced technology is utilized across a designated percentage of a manufacturers' full-size pickup trucks. This incentive further encourages manufacturers to begin to transform the most challenged category of vehicles in terms of the penetration of advanced technologies.

Eligibility for this credit is conditioned on a minimum penetration of the technology in a manufacturer's full size pickup truck fleet. Mild HEVs pickup trucks will be eligible for a per vehicle credit of 10 g/mi during MYs 2017-2021 if the technology is used with at least 20% of a company's MY 2017 full-size pickup production and ramping up to at least 80% in MY 2021. Strong HEV pickup trucks will be eligible for 20 g/mi per vehicle credit during MYs 2017-2025 if the technology is used on at least 10% of the company's full size pickups.

In addition to the specific hybridization credits, because there are other technologies besides mild and strong hybrids which can significantly reduce GHG emissions and fuel consumption in pickup trucks, EPA is also finalizing a performance-based incentive CO2 emissions credit for full-size pickup trucks that achieve a significant CO2 reduction below the applicable target. To avoid double-counting, the same vehicle will not receive credit under both the HEV and performance based approaches.

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Treatment of Compressed Natural Gas (CNG), Plug-in Hybrid Electric Vehicles (PHEVs), and Flexible Fuel Vehicles (FFVs) - EPA is finalizing a methodology for determining CO2 levels for plug-in hybrid electric vehicles (PHEVs) and dual fuel compressed natural gas (CNG) vehicles. This methodology assumes how much of the time these vehicles will operate using the alternative fuel, and how much on gasoline. This methodology (called a "utility factor") assumes that owners of these vehicles will use the cheaper non-gasoline fuel most of the time, since that was a main reason for purchasing the vehicle.

As proposed, EPA is not establishing a utility factor for flexible fueled vehicles (FFVs) using E-85 and gasoline, since there is not a significant cost differential between an FFV and a conventional gasoline vehicle and historically consumers have only fueled these vehicles with E85 a very small percentage of the time. FFVs continue to be treated as they are treated in MY 2016 where emissions are weighted based on actual alternative fuel usage.

Provisions for Intermediate and Small Volume Manufacturers - In the MYs 2012-2016 rule, EPA provided less stringent CO2 standards through MY 2016 to manufacturers with U.S. sales of less than 50,000 vehicles under the Temporary Lead time Allowance Alternative Standards (TLAAS) program. For MYs 2017-2025 standards, EPA is providing additional lead time flexibility to these intermediate volume manufacturers to help ease their transition to the primary program standards. The lead time flexibility is available through MY 2020 and intermediate volume manufacturers are required to meet the primary standards starting in MY 2021.

EPA is allowing small volume manufacturers (SVMs) with U.S. sales of less than 5,000 vehicles to petition EPA for alternative CO2 standards, which will be established for eligible SVMs on a case-by-case basis. These SVMs are exempt under the MYs 2012-2016 CO2 standards. EPA is also allowing manufacturers that are able to demonstrate that they are operationally independent from their parent company and have U.S. sales of less than 5,000 vehicles to be eligible for SVM GHG provisions.

In addition, EPA is continuing to exempt small businesses (companies with less than 1,000 employees, as defined by the Small Business Administration) from all GHG standards and program requirements.

Public Participation

EPA developed this final rule after consideration of extensive public input. EPA and NHTSA heard from nearly 400 testifiers at three public hearings held in Detroit, Philadelphia and San Francisco during January 2012. The agencies received written comments from nearly 300,000 individuals and more than 140 organizations, including auto manufacturers and suppliers, state and local governments and their associations, consumer groups, labor unions, fuels and energy providers, auto dealers, academics, national security experts and veterans, environmental and other non-governmental organizations.

Regulatory Announcement

Background on the MYs 2017-2025 National Program

Following the successful adoption of a National Program for GHG and fuel economy standards for MYs 2012-2016 vehicles, President Obama requested the agencies to continue their efforts to develop a second phase of the National Program, with standards for MYs 2017-2025 light-duty vehicles. In a May 21, 2010, Presidential Memorandum, the President requested that EPA and NHTSA work together to develop a national program that would "…produce a new generation of clean vehicles." The President specifically requested that the agencies develop "...a coordinated national program under the CAA [Clean Air Act] and the EISA [Energy Independence and Security Act of 2007] to improve fuel efficiency and to reduce greenhouse gas emissions of passenger cars and light-duty trucks of model years 2017-2025." The President recognized our country could take a leadership role in addressing the global challenges of improving energy security and reducing greenhouse gas pollution, stating that "America has the opportunity to lead the world in the development of a new generation of clean cars and trucks through innovative technologies and manufacturing that will spur economic growth and create high-quality domestic jobs, enhance our energy security, and improve our environment."

The agencies worked with the State of California to address all elements requested in the May 21, 2010 Presidential Memorandum and completed an initial assessment of the technologies, strategies and underlying analyses that would be considered in setting standards for MYs 2017-2025, in consultation with a wide range of stakeholders. EPA and NHTSA issued an Interim Joint Technical Assessment Report (TAR) and a Notice of Intent (NOI) to conduct a joint rulemaking on September 30, 2010.[1] Following an opportunity for public comment, the agencies published a Supplemental NOI (SNOI)[2] in December 2010 highlighting many of the key comments received in response to the September NOI and the TAR and outlining plans for key technical analyses that would be undertaken in developing the proposed rulemaking.

On July 29, 2011, President Obama announced plans for the MYs 2017-2025 national program and EPA and NHTSA issued another SNOI[3], outlining plans for the MYs 2017-2025 proposed program. The State of California and thirteen auto manufacturers representing over 90 percent of U.S. vehicle sales provided letters of support for the program concurrent with the SNOI. The joint proposal to extend the National Program to MYs 2017-2025 light-duty vehicles was issued on November 16, 2011 and published in the Federal Register on December 1, 2011.[4]

For More Information

You can access the final rule, regulations and related documents on EPA's Office of Transportation and Air Quality (OTAQ) Web site at:

www.epa.gov/otaq/climate/regulations.htm

For more information on this rule, please contact the U.S. Environmental Protection Agency, Office of Transportation and Air Quality at:

E-mail: OTAQPUBLICWEB@epa.gov

1 75 FR 62739, October 13, 2010.
2 75 FR 76337, December 8, 2010.
3 76 FR 48758, August 9, 2011
4 76 FR 74854, December 1, 2011.

European Commission
Enterprise and Industry

ATEX GUIDELINES

GUIDELINES ON THE APPLICATION OF DIRECTIVE 94/9/EC OF THE EUROPEAN PARLIAMENT AND THE COUNCIL OF 23 MARCH 1994 ON THE APPROXIMATION OF THE LAWS OF THE MEMBER STATES CONCERNING EQUIPMENT AND PROTECTIVE SYSTEMS INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES

3RD EDITION - June 2009
UPDATE May 2011

NOTES

1. These Guidelines are intended to be a manual for all parties directly or indirectly affected by Directive 94/9/EC, commonly referred to as ATEX ("*Atmosphères Explosibles*") Products Directive. Readers' attention is drawn to the fact that this guide is intended only to facilitate the application of Directive 94/9/EC and it is the relevant national transposition of the text of the Directive which is legally binding. However, this document does represent a reference for ensuring consistent application of the Directive by all stakeholders. The Guidelines are intended to help ensure the free movement of products[1] in the European Union[2] by consensus amongst Member States' government experts and other parties concerned.

2. These Guidelines have been prepared by the competent services of the Directorate General Enterprise and Industry of the European Commission in collaboration with Member States, European industry, European standardisation and Notified Bodies.

3. The European Commission services will undertake to maintain this Guide. It is our goal to ensure that the information provided is both timely and accurate. If errors are brought to our attention, we will try to correct them. However the Commission accepts no responsibility or liability whatsoever with regard to the information in this Guide.

   This information is:

   - of a general nature only and is not intended to address the specific circumstances of any particular individual or entity;
   - not necessarily comprehensive, complete, accurate or up to date;
   - sometimes refers to external information over which the Commission services have no control and for which the Commission assumes no responsibility;
   - not professional or legal advice.

4. All references to the CE marking and EC Declaration of Conformity in this Guide relate only to the Directive 94/9/EC. To place products falling under Directive 94/9/EC on the market in the EU territory all other relevant legislation must be applied.

5. Further guidance, especially concerning specific type of products, can be found on the Commission's website on EUROPA: http://ec.europa.eu/enterprise/sectors/mechanical/documents/guidance/atex

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1 For the purpose of this guide the term "product" covers equipment, protective systems, safety, controlling and regulating devices, components and their combinations as they are defined in Directive 94/9/EC.

2 According to the agreement related to the European Economic Area (EEA) (Council and Commission Decision 94/1/EC of 13 December 1993 (OJ n° L 1 of 3 January 1994, p. 1) the territories of Liechtenstein, Iceland and Norway have to be considered, for the implementation of Directive 94/9/EC, in the same right as of the EU territory. When this term, EU territory, is used in this guide, the same applies to the EEA territory.

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TABLE OF CONTENTS

1 INTRODUCTION

The objective of these Guidelines is to clarify certain matters and procedures referred to in **Directive 94/9/EC**[3] concerning equipment and protective systems intended for use in potentially explosive atmospheres. The Guidelines should be used in conjunction with the Directive and with the European Commission's "Guide to the implementation of directives based on New Approach and Global Approach (Blue Guide)"[4].

These Guidelines are not only for the use of Member States' competent authorities, but also by the main economic operators concerned, such as manufacturers, their trade associations, bodies in charge of the preparation of standards as well as those entrusted with the conformity assessment procedures.

First and foremost, this document must ensure that, when correctly applied, the Directive leads to the removal of obstacles and difficulties related to the free circulation (free movement) of goods within the European Union (see footnote 2). It should be noted that the statements in these Guidelines refer only to the application of Directive 94/9/EC unless otherwise indicated. All parties concerned should be aware of other requirements, which may also apply (see chapter 6).

Directive 94/9/EC is a "New Approach" directive laying down Essential Health and Safety Requirements and leaving it to standards, primarily European harmonised standards, to give technical expression of the relevant requirements contained in the Directive.

Directive 94/9/EC is a total harmonisation directive, i.e. its provisions replace existing divergent national and European legislation which cover the same subjects as stipulated by Directive 94/9/EC.

As of 1 July 2003, all other relevant national regulations have been abolished and Directive 94/9/EC, as transposed into the national legislation of the Member States, is the sole legal instrument applicable.

"Use" Directives

The reader will want to be aware that where ATEX products are intended for use in a place of work, national and community legislation, intended to ensure the safety of employees will usually apply. In this respect different legislation applies to land based industries, the underground extraction of coal and other minerals, and offshore oil production[5].

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3 Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. OJ L 100, 19.4.1994, p. 1. Amended by Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003, OJ L 284, 31.10.2003, p. 1. Corrected by Corrigendum, OJ L 21, 26.1.2000, p. 42, and by Corrigendum, OJ L 304, 5.12.2000, p. 19.

4 http://ec.europa.eu/enterprise/policies/single-market-goods/documents/blue-guide

5 Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC). OJ L 023, 28.01.2000, p. 57-64.

Council Directive 92/91/EEC of 3 November 1992 concerning the minimum requirements for improving the safety and health protection of workers in the mineral-extracting industries through drilling (eleventh individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC); OJ L 348, 28.11.1992, p. 9-24.

Council Directive 92/104/EEC of 3 December 1992 on the minimum requirements for improving the safety and health protection of workers in surface and underground mineral-extracting industries (twelfth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC); OJ L 404, 31.12.1992, p. 10-25.

2 OBJECTIVE OF THE ATEX DIRECTIVE 94/9/EC

The objective of Directive 94/9/EC is **to ensure free movement for the products to which it applies** in the EU territory. Therefore the Directive, **based on Article 95 of the EC Treaty**, provides for harmonised requirements and procedures to establish compliance.

The Directive notes that to remove barriers to trade via the New Approach, provided for in the Council Resolution of 7 May 1985[4], essential requirements regarding safety and other relevant attributes need to be defined by which a high level of protection will be ensured. These **Essential Health and Safety Requirements (EHSRs)** are listed in Annex II to Directive 94/9/EC.

These Essential Health and Safety Requirements are specific with respect to:

- potential ignition sources of equipment intended for use in potentially explosive atmospheres;
- autonomous protective systems intended to come into operation following an explosion with the prime objective to halt the explosion immediately and/or limit the effects of explosion flames and pressures;
- safety devices intended to contribute to the safe functioning of such equipment with respect to ignition source and to the safe functioning of autonomous protective systems
- components with no autonomous function essential to the safe functioning of such equipment or autonomous protective system(s)

Since 1 July 2003 relevant products could only be placed on the market in the EU territory[5], freely moved and operated as designed and intended in the expected environment if they comply with Directive 94/9/EC (and other relevant legislation).

Directive 94/9/EC provides for the first time harmonised requirements for non-electrical equipment, equipment intended for use in environments which are potentially explosive due to dust hazards and protective systems. Safety devices intended for use outside explosive atmospheres which are required for or contribute to the safe functioning of equipment or protective systems with respect to risks of explosion are also included. This is an increase in scope compared to former national regulations for equipment and systems intended for use in potentially explosive atmospheres.

The requirements for compliance with the provisions of Directive 94/9/EC will be further developed in the following chapters.

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4 OJ No C 136, 4.6.1985 p. 1

5 Directive 94/9/EC is also applicable in other territories where a suitable international agreement is in operation. See the DG Enterprise and Industry website for more details: http://ec.europa.eu/enterprise/sectors/mechanical/international_competitiveness

3 GENERAL CONCEPTS[8]

For the purpose of this guide the term "product" covers equipment, protective systems, safety devices, components and their combinations.

It has to be stressed that Directive 94/9/EC carries obligations for the person who places products on the market and/or puts products into service, be it the manufacturer, his authorized representative, the importer or any other responsible person. The Directive does not regulate the use of equipment in a potentially explosive atmosphere which is covered, for instance, by Directives 1999/92/EC, 92/91/EC and 92/104/EC[9].

3.1 Placing ATEX products on the market

This means the first making available in the European Union, against payment or free of charge, of products, for the purpose of distribution and/or use in the EU territory.

Comments:

The concept of placing on the market determines the moment when products pass for the first time from the manufacturing stage to the market of the EU or the importing stage from a non-EU country to that of distribution and/or use in the EU. Since the concept of placing on the market refers only to the first time products are made available in the EU for the purpose of distribution and/or use in the EU, the ATEX Directive 94/9/EC covers only

a) *new* products manufactured within the EU,

b) "as-new" products according to the section 3.3,

c) *new or used* products imported from a non-EU country,

d) new or "as-new" products labelled by a person who is not the original manufacturer.

The Directive's provisions and obligations concerning placing on the market have applied after 30 June 2003 to each product individually and are irrespective of the date and place of manufacturing. It is the manufacturer's responsibility to ensure that each and all of his products comply where these fall under the scope of the Directive.

"Making available" means the transfer of the product, that is, either the transfer of ownership, or the physical hand-over of the product by the manufacturer, his authorised representative in the EU or the importer to the person responsible for distributing these onto the EU market or the passing of the product to the final consumer, intermediate supplier or user in a commercial transaction, for payment or free of charge, regardless of the legal instrument upon which the transfer is based (sale, loan, hire, leasing, gift, or any other type of commercial legal instrument). The ATEX product must comply with the Directive at the moment of transfer.

If a manufacturer, his authorised representative in the EU or the importer offers products covered by the Directive in a catalogue, they are deemed not to have been placed on the market until they are actually been made available for the first time. Therefore products offered in a catalogue do not have to be in full conformity with the provisions of the Directive 94/9/EC, but this fact should be clearly advertised in the catalogue.

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8 For general definitions see also the "Guide to the implementation Directives based on New Approach and Global Approach" ("Blue Guide" - see footnote 4). Further definitions specific to Directive 94/9/EC are covered in chapter 4 of this Guide.

9 See footnote 5.

The placing of products on the market does not concern:

- the disposal of products from the manufacturer to his authorised representative established in the EU who is responsible on behalf of the manufacturer for ensuring compliance with the Directive;
- imports into the EU for the purpose of re-export, i.e., under the processing arrangements;
- the manufacture of products in the EU for export to a non-EU country;
- the display of products at trade fairs and exhibitions[10]. These may not be in full conformity with the provisions of the Directive 94/9/EC, but this fact must be clearly advertised next to the products being exhibited.

The person placing the product on the EU market, be it the manufacturer, his authorised representative or, if neither of them is established in the EU, the importer or any other responsible person, must retain at the disposal of the competent authority the EC declaration of conformity. The technical documentation has to be made available on request of the enforcement authorities within a reasonable time (see Annexes III, VI, VIII to the Directive). These documents shall be maintained by such a person at the disposal of the competent authorities for ten years after the last item has been manufactured. This applies to products manufactured in the EU as well as those imported from a non-EU country.

3.2 Putting ATEX products into service

This means the first use of products referred to in Directive 94/9/EC in the EU territory, by its end user.

Comments:

Products covered by Directive 94/9/EC are put into service at the moment of first use.

However, a product which is ready for use as soon as it is placed on the market and which does not have to be assembled or installed, and where the distribution conditions (storage, transport, etc.) makes no difference to the performance or safety characteristics of the product with reference to the EHSRs of Directive 94/9/EC, is considered to have been put into service as soon as it is placed on the market, if it is impossible to determine when it is first used.

3.3 Manufacturer

This is any natural or legal person who manufactures a product or has a product designed or manufactured, responsible for the design and construction of products covered by ATEX Directive 94/9/EC, and markets that product with a view to placing it on the EU market under his own name or trademark.

The manufacturer may design and manufacture the product itself, or alternatively may use bought-in items, third-party subcontractor services or components, CE marked or not, to assist in the manufacture of the product.

Whoever substantially modifies a product resulting in an "as-new" product[11], such that its health and safety characteristics (and/or performance) are in any way affected, with a view to placing it on the EU market, also becomes the manufacturer.

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[10] See Article 2.3 of the Directive. Whilst the demonstration of such non-compliant products under the above conditions is permitted national provisions ensure that such demonstrations do not result in unsafe situations.

3.3.1 *Use of subcontractor services by a manufacturer*

The manufacturer may have the product designed, manufactured, assembled, packaged, processed or labelled by subcontractors, with a view to placing the product on the market under its own name, and thus presenting itself as the manufacturer, disregarding its involvement in the physical/actual manufacturing processes.

Where subcontracting of this type takes place, the manufacturer must retain the overall control for the product and ensure that it receives all the information that is necessary to fulfil the responsibilities of a manufacturer according to the Directive.

In such cases, it cannot discharge itself from its responsibilities as a manufacturer, as it is responsible for the application of relevant conformity assessment procedures, including engaging a Notified Body where required to do so by the Directive, for example to approve and carry out periodic surveillance of the manufacturer's quality management system.

3.3.2 *Conformity Assessment Procedures based on quality assurance (Annex IV, Annex VII)*

Due to the use of subcontractors, the manufacturer may not be able to demonstrate (to a Notified Body) that its own quality assurance system ensures the product complies with the requirements of the Directive. The production quality assurance (Annex IV) or the product quality assurance (Annex VII) system at the actual manufacturing plant premises, of the manufacturer itself and/or of subcontractors, need to be the subject of an assessment by a Notified Body, including periodic audit visits.

The manufacturer may not rely on the Notified Body audits of the third-parties to discharge its responsibilities under the Directive. The Notified Body shall not issue the subcontractor with a QA Notification for this purpose, unless the subcontractor holds its own EC Type Examination certificate for the same product.

In case the manufacturer uses a subcontractor for the production or labelling of a product, which places the same product on the market under its own name, it is sufficient for the manufacturer to apply for a second certificate based on the certificate of the subcontractor. The manufacturer will be expected to submit:

- the original certificate,

- a declaration by the original manufacturer that the equipment to be produced under the name of the trade agent will be identical with the originally certified equipment,

- a declaration by the trade agent that the equipment brought to the market will be identical to that originally certified, and

- a copy of the contractual agreement between A and B.

See also the Consideration Paper by the ATEX Standing Committee "Certificates and CE marking without the name of the original manufacturer" (http://ec.europa.eu/enterprise/sectors/mechanical/documents/guidance/atex/standing-committee/ce-marking).

Comments:

The manufacturer bears responsibility for:

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11 See chapter 7 of this Guide.

- undertaking an analysis to conclude if his product is subject to Directive 94/9/EC and which requirements apply (as further explained in chapter 4);
- design and construction of the product in accordance with the Essential Health and Safety Requirements laid down in the Directive;
- following the procedures for the assessment of the conformity of the product with the Essential Health and Safety Requirements laid down in the Directive (see Article 8);
- signing the Declaration or Attestation of Conformity;
- providing marking and instructions for safe use, maintenance etc. as described in Annex II to the Directive.

The manufacturer has sole and ultimate responsibility for the conformity of his product to the applicable directives. He must understand both the design and construction of the product to be able to declare such conformity in respect of all applicable provisions and requirements of the relevant directives.

Articles 8 and 10 and their associated annexes of the Directive 94/9/EC define the obligations incumbent on the manufacturer with regard to conformity assessment, CE marking, the EC declaration of conformity, written attestation of conformity (if relevant) and the arrangements for holding the EC declaration of conformity, together with the technical documentation, at the disposal of the competent authorities for a period of ten years after the last product has been manufactured.

3.4 Manufacturing of ATEX products for own use

Whoever puts into service products covered by the Directive, which he has manufactured for his own use, is considered to be a manufacturer. He is obliged to conform to the Directive in relation to putting into service.

3.5 Authorised representative

This is the person or persons expressly appointed by the manufacturer by a written mandate to act on his behalf in respect of certain manufacturer's obligations within the EU. The extent to which the authorised representative may enter into commitments binding on the manufacturer is restricted by the relevant Articles of the Directive and determined by the mandate conferred on him by the latter.

As an example, he could be appointed to undertake the testing in the EU territory, sign the EC Declaration of Conformity, affix the CE marking and hold the EC Declaration of Conformity and the technical documentation within the EU at the disposal of the competent authorities.

The quality assessment system of the authorised representative/responsible person shall not be subject to assessment by a Notified Body, but the quality assessment system of the actual manufacturer. It would not be reasonable to assess a quality assessment system of a facility that is not producing the product. However, if the authorised representative is carrying out tests and/or verifications required by the Directive to determine conformity with the Essential Health and Safety Requirements, he shall be subject to quality assurance assessment.

Comments:

Articles 8 and 10 together with Annexes 3 - 9 to the Directive 94/9/EC define the obligations incumbent on the authorised representative established within the EU with regard to conformity assessment, CE markings, EC Declaration of Conformity and the arrangements for holding this EC Declaration of Conformity, together with the technical documentation, at the disposal of the competent authorities for a period of ten years after the last product has been manufactured.

3.6 Other persons responsible for placing on the market

Where neither the manufacturer, nor the authorised representative is established within the EU, any other person resident in the EU who places the product on the EU market has obligations under the scope of the Directive. The only obligation is to keep available the necessary documentation at the disposal of the competent authorities for ten years after the last product has been manufactured. In their capacity as "person responsible for placing on the market" they are not entitled to assume other responsibilities which are solely reserved to the manufacturer or his authorized representative (e.g. signing the EC Declaration of Conformity).

3.7 Equipment[12]

Equipment[13], as defined in Directive 94/9/EC, means machines, apparatus, fixed or mobile devices, control components and instrumentation thereof and detection or prevention systems which, separately or jointly, are intended for the generation, transfer, storage, measurement, control and conversion of energy and/or the processing of material and which are capable of causing an explosion through their **own** potential sources of ignition[14].

3.7.1 Potentially explosive atmosphere

Equipment is only considered to be within the scope of the Directive if it is intended (either in whole or in part) to be used in a potentially explosive atmosphere.

If a product containing an intended potentially explosive atmosphere, for example a vessel, itself contains equipment as defined in the Directive, then the latter equipment is in effect in a potentially explosive atmosphere, albeit one which is contained by the vessel, and is therefore subject to the Directive.

If equipment containing a potentially explosive atmosphere can, due to its construction, operation etc. create a potentially explosive atmosphere itself, which wholly or partially surrounds it, then such equipment is in effect in a potentially explosive atmosphere, and is therefore subject to the Directive.

A third scenario is that there may not only be a surrounding potentially explosive atmosphere but also a process that requires such a mixture to enter and/or be released from the product. The interface between the equipment and the process input/ output will also require consideration. This may, in some cases, lead to equipment having more than one Category, one (or more) for the external atmosphere and another for the process atmosphere.

3.7.2 "Own" ignition source

Another defining element of equipment in the sense of the Directive is that it has to have its own potential source of ignition.

[12] It has become evident that a number of language versions of the ATEX Directives interpret some definitions in different ways. The information provided here is intended to inform interested parties throughout the EEA on the common approach agreed by the Member States. It does not, however, impact in any way on the different versions as implemented in relevant national legislation, nor the right of the manufacturer to choose this route should he/she so desire.

[13] Article 1.3(a) of the Directive.

[14] Following discussions in the Standing Committee and the standardisation bodies it should be noted that intrinsically safe electrical equipment is included in the scope of the Directive.

Potential sources of ignition could be: electric sparks, arcs and flashes, electrostatic discharges, electromagnetic waves, ionising radiation, hot surfaces, flames and hot gases, mechanically generated sparks, optical radiation, chemical flame initiation[15], compression.

In some cases a product may only contain a potentially explosive atmosphere which is deliberately ignited. It is clearly not the intention that these fall under the scope of Directive 94/9/EC unless other relevant hazards exist. Most equipment made to the Gas Appliances Directive 90/396/EEC will fall into this category.

Equipment can be said to have its own potential source of ignition, if, when operated as intended (including malfunctions, etc. to an extent depending on its category - see Annex I to the Directive) in a potentially explosive atmosphere, it is capable of igniting the latter unless specific safety measures are taken. Therefore, equipment must ensure the required level of protection.

To ensure this required level of protection various techniques can be applied, e.g.: intrinsic safety, pressurisation, increased safety, etc.

Many common items are made from plastics (polymers) with very low electrical conductivity. These can become charged, e.g. if they are rubbed, or if dust or a liquid flows over the surface. However, in most cases this may be controlled by the user, and if they are used in hazardous areas it shall be *assessed and controlled* according to the requirements of relevant national or community legislation (e.g. Directive 1999/92/EC[16]). In any case the user of such equipment has to consider these ignition sources when undertaking a risk assessment in the workplace.

Examples are plastic containers used for transporting chemicals, polyethylene pipes, buckets and chairs.

If the only source of electrostatic charging comes from the process, such items are not considered to have their own source of ignition, and they are not in scope of Directive 94/9/EC. In these cases they should not be Ex or CE marked according to Directive 94/9/EC.

If the polymeric item is intended to be incorporated into ATEX equipment, and could become charged by the movement of the equipment (for example a fan blade) or by the intended use of the equipment, they may be classed as ordinary parts of the equipment with specific properties (e.g. to be electrostatically dissipative) or as ATEX components if they are placed on the market specifically for this intended use.

3.7.3 Non-Electrical Equipment

If non-electrical equipment has a potential ignition source, in most cases this is due to moving parts able to create a potential ignition risk either from hot surfaces, or friction sparks. Examples are: gears, fans, pumps, compressors, mixers, brakes. Mechanical equipment of this type usually has to be connected to a power source, such as an electric motor. Together placed on the market in this form, it might be an assembly, see section 3.7.5.

Mechanical equipment may be fitted with a thermocouple or similar measuring device that generates only very low voltages and currents. If these measuring devices can be considered as 'simple apparatus' as described in section 5.2.1 and there are no other electrical parts, the equipment should follow the conformity assessment procedures for non-electrical equipment. If the equipment contains electrical apparatus that can be clearly separated, the conformity assessment procedure for non-electrical parts can be made separately if the conditions under 3.7.4 (e.g. pump) apply. If the electrical equipment fitted to the non-electrical equipment is not "simple apparatus", the product is usually considered as an assembly (see assemblies chapter).

15 Account needs to be taken of the specific exclusion at Article 1 (4) of the Directive 94/9/EC of equipment where explosion hazards result exclusively from the presence of explosive substances or unstable chemical substances.

16 See footnote 5.

All potential ignition sources should be considered for equipment that is within the scope. For a list of potential ignition sources, see the relevant harmonised standards for equipment. In many cases the equipment will also be machinery within scope of Directive 2006/42/EC, see section 6.

Many mechanical items move very slowly, or have very low power input. Such equipment may be incapable of forming hot surfaces or other ignition sources, even in cases of rare malfunction. The manufacturer should assess if such equipment is potentially capable of igniting an explosive atmosphere, and if it is not, it shall not be classed as ATEX equipment nor be marked according to Directive 94/9/EC (see also chapter 5.2.1).

3.7.4 Electrical Equipment

Directive 94/9/EC does not define "Electrical Equipment". However, because such equipment is subject to its own conformity assessment procedure it may be useful to provide a definition, which has been generally accepted by the majority of Member States, as follows:

Electrical Equipment: equipment containing electrical elements, used for the generation, storage, measurement, distribution and conversion of electrical energy, for controlling the function of other equipment by electrical means or for processing materials by the direct application of electrical energy. It should be noted, that a final product assembled using both electrical and mechanical elements may not require assessment as electrical equipment provided the combination does not lead to additional ignition hazards for this assembly (for further details see section 3.7.5).

3.7.5 Assemblies

From the term 'jointly' in the definition of equipment in the Directive it follows that an assembly, formed by combining two or more pieces of equipment, together with components if necessary, has to be considered as a product falling under the scope of Directive 94/9/EC (see footnote 1), provided that this assembly is placed on the market and/or put into service by a responsible person (who will then be the manufacturer of that assembly) as a single functional unit.

Such assemblies may not be ready for use but require proper installation. The instructions (Annex II, 1.0.6.) shall take this into account in such a way that compliance with Directive 94/9/EC is ensured without any further conformity assessment provided the installer has correctly followed the instructions.

In the case of an assembly consisting of different compliant pieces of equipment as defined by Directive 94/9/EC which were previously placed on the market by different manufacturers these items of equipment have to conform with the Directive, including being subject to proper conformity assessment, CE-marking, etc. The manufacturer of the assembly may presume conformity of these pieces of equipment and may restrict his own risk assessment of the assembly to those additional ignition and other relevant hazards (as defined in Annex II), which become relevant because of the final combination. If there are additional ignition hazards, a further conformity assessment of the assembly regarding these additional risks is necessary. Likewise, the assembler may presume the conformity of components which are accompanied by a written attestation of conformity issued by their manufacturer (Article 8.3, see also chapter 10).

However, if the manufacturer of the assembly integrates parts without CE-marking into the assembly (because they are parts manufactured by himself or parts he has received from his supplier in view of further processing by himself) or components not accompanied by the above mentioned certificate, he shall not presume conformity of those parts and his conformity assessment of the assembly shall cover those parts as required.

Note that the manufacturer's own risk assessment does not necessarily preclude the use of Notified Bodies in the applicable conformity assessment procedure(s).

In order to clarify the concept of "assembly" in the sense of Directive 94/9/EC, a pump/electric motor combination intended for use in potentially explosive atmospheres can be used.

1. For the purposes of Directive 94/9/EC, a *split tube motor pump* constitutes a single item of equipment with respect to the ignition hazard, i.e. the pump and electric motor cannot be considered separately for the purposes of assessing explosion risk(s). In this case, the unit as a whole has to undergo the conformity assessment procedure of electrical equipment. The same applies e.g. for an electrical ventilating fan where the fan is an integral part of the motor.

2.a) In some cases the pump and electric motor can be considered separately although they form a functional unit. If in this case there is no additional ignition hazard as a result of assembling the pump and motor, **this functional unit as a whole** does not constitute a single item of equipment which falls within the scope of Directive 94/9/EC. It is then to be considered a combination of "individual items of equipment" in terms of explosion protection. In this case, therefore, the manufacturer of pump and electrical motor must supply an EC declaration of conformity for each of both items.

2.b) A manufacturer may nevertheless choose to supply pump and motor as described in 2.a) with one declaration of conformity for the assembly as a whole. In this case further clarification is required as to the obligation of the assembler where only ATEX CE compliant products (such as equipment and autonomous protective systems) are used. Here it is clear that the assembler needs to undertake an ignition risk assessment to ensure that the nature of the incorporation and assembly has not altered the explosion characteristics of the products with respect to the Essential Health and Safety Requirements. If the assembler is in any way uncertain as to how to undertake such an assessment, **technical advice should be sought and taken into account! This might be the case, for example, if a manufacturer of mechanical equipment needs to connect different pieces of ATEX electrical equipment together as part of the assembly**. Once the assembler has successfully undertaken such an assessment and no additional ignition risk has been identified, the general agreement is that he then draws up a technical file, affixes the CE and Ex marking according to Annex II 1.0.5 of the Directive to the assembly, indicating intended use, signs the EC Declaration of Conformity covering the whole of the assembly indicating the technical specifications/ standards applied (for example, for electrical inter-connection) and provide instructions for safe use. The assembler therefore takes complete responsibility for the assembly. This procedure does not require the involvement of a Notified Body.

2.c) If there is an additional ignition hazard as a result of assembling pump and motor, or if one item is not already in full conformity with the Directive, the assembly has to undergo the complete conformity assessment procedure appropriate for the category.

Assemblies may be placed on the market in different ways:

3.7.5.1 Assemblies, which are fully specified configurations of parts

In this case the manufacturer has already defined one or more invariable combination(s) of parts and places them on the market as a single functional unit / single functional units.

An example could be instrumentation consisting of a sensor, a transmitter, a Zener barrier and a power supply if provided by one manufacturer.

The above mentioned parts are put together by the same person (the manufacturer of the assembly), and placed on the market as a single functional unit. This person assumes responsibility for the compliance of the integral assembly with the Directive.

The EC declaration of conformity, as well as the instructions for use must refer to the assembly as a whole. It must be clear (e.g. by enclosing a list of all parts and/or a list of the safety related data) which is/are the combination(s) that form(s) the assemblies. The manufacturer assumes responsibility for compliance with the Directive, and must therefore, in accordance with Annex II

1.0.6, provide clear instructions for assembly/installation/operation/maintenance etc. in the instructions for use.

3.7.5.2 Assemblies with various configurations

Here the manufacturer has defined a whole range of different parts, forming a "modular system". Either he or the user/installer selects and combines parts out of this range to form an assembly, which serves the specific task.

An example could be a modular system for flameproof switch- and control gear, consisting of a range of flameproof enclosures of different size, a range of switches, terminals, circuit breakers etc.

Although in this case the parts are not necessarily put together by the manufacturer of the assembly, and placed on the market as a single functional unit, the manufacturer is responsible for the compliance of the assembly as long as the parts are chosen from the defined range and selected and combined according to his instructions.

The EC Declaration of Conformity, as well as the instructions for use must refer to the "modular system" as a whole. It must be clear which the parts that form the modular system are, and how they are to be selected to form a compliant assembly. Therefore the manufacturer must, in accordance with Annex II 1.0.6, provide clear instructions for selection of parts and their assembly /installation /operation /maintenance etc. in the instructions for use.

The conformity assessment of such modular systems may be done (as a minimum) by means of the assessment of those intended configurations which are the most unfavourable regarding the relevant risks (worst cases). If those configurations are considered compliant to the EHSRs of Directive 94/9/EC the manufacturer may conclude conformity of all other intended configurations as well. If later on other parts are to be added to the "modular system" it may of course become necessary to identify and assess the worst case scenario again.

The table on the following page gives a condensed overview of the various situations regarding assemblies.

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Table 1: Summary of Requirements for Assemblies

SITUATION: **1. Parts:** **Assembly is composed of…**	Equipment, protective systems, devices (Art. 1.2) all CE-marked (accompanied by a certificate of conformity) and components accompanied by a written attestation (Art. 8.3). (parts with proven conformity) **(*)**		Equipment, protective systems, devices (Art. 1.2), including non CE-marked, and components not accompanied by a written attestation (Art. 8.3). (parts without proven conformity)	
2. Configuration: **Assembly is placed on the market as…**	Exactly defined configuration(s)	A "modular system" of parts, to be specifically selected and configured to serve a specific purpose, maybe by the user/installer.	Exactly defined configuration(s)	A "modular system" of parts, to be specifically selected and configured to serve a specific purpose, maybe by the user/installer.
3. RESULT: **Manufacturer may presume conformity for…**	All parts	All parts	Only parts with proven conformity	Only parts with proven conformity
4. Conformity Assessment (CA)	CA has to cover the whole configuration regarding all risks, which might arise by the interaction of the combined parts, with respect to the intended use. See also Note **(*)**	CA has to cover at least those of the possible and useful configurations, which are assessed to be the most unfavourable regarding all risks, which might arise, by the interaction of the combined parts, with respect to the intended use. See also Note **(*)**	CA has to cover: - all parts without proven conformity regarding all risks, and - all configuration(s) regarding all risks which might arise by the interaction of the combined parts, both with respect to the intended use.	CA has to cover: - all parts without proven conformity which are part of the "modular system", regarding all risks, and - at least those of the possible and useful configurations, which are assessed to be the most unfavourable regarding all risks which might arise by the interaction of the combined parts, both with respect to the intended use.
5. Information to be provided: **a) by EC-Declaration of Conformity** **b) by instructions for installation and use**	a) identification of the items in the assembly that are ATEX equipment in their own right, and which have been separately assessed; b) instructions for installation and use, sufficient to ensure that resulting assembly complies with all relevant EHSRs of Directive 94/9/EC.	a) identification of the items in the "modular system" that are ATEX equipment in their own right, and which have been separately assessed; b) instructions for the selection of parts, to be combined to fulfil the required purpose, and instructions for installation and use, sufficient to ensure that resulting assembly complies with all relevant EHSRs of Directive 94/9/EC.	a) identification of the items in the assembly that are ATEX equipment in their own right, and which have been separately assessed; b) instructions for installation and use, sufficient to ensure that resulting assembly complies with all relevant EHSRs of Directive 94/9/EC.	a) identification of the items in the "modular system" that are ATEX equipment in their own right, and which have been separately assessed; b) instructions for the selection of parts, to be combined to fulfil the required purpose, and instructions for installation and use, sufficient to ensure that resulting assembly complies with all relevant EHSRs of Directive 94/9/EC.

(*) Note: A **written attestation of conformity** for a component can not guarantee, in general, the safety of the equipment into which the component is to be incorporated, as for a component, all possible use can not be foreseen. In this case, **further investigation and evaluation by a Notified Body shall be carried out in the assembly**, when required.

3.8 Protective Systems

Protective Systems[17] means devices other than components of the equipment defined above which are intended to halt incipient explosions immediately and/or to limit the effective range of an explosion and which are separately placed on the market for use as autonomous systems.

Examples of autonomous protective systems are:

- flame arresters;
- explosion relief systems (using e.g. bursting discs, vent panels, explosion doors, etc.);
- extinguishing barriers;
- explosion suppression systems.

It is clear that certain simple products used in coal mines act as protective systems but cannot be subject to the provisions of the Directive (e.g. chalk dust on planks).

From its intended function it is obvious that a protective system will, at least partially, be installed and used **in** a potentially explosive atmosphere.

Because a protective system has the function to eliminate or reduce the dangerous effects of an explosion (a safety function) it is subject to the Directive regardless as to whether it has its own potential source of ignition or not. In this first case it would have to comply with the specific EHSRs for equipment as well.

According to Article 1.3.(b) protective systems are placed on the market separately for use as autonomous systems[18]. Consequently their conformity with the relevant EHSRs of Annex II has to be assessed according to Article 8(2) and they have to be marked according to Article 10(2).

Of course 'protective systems' may also be placed on the market as an integral part of equipment. Technically speaking these remain 'protective systems' because of their function, but are not considered as autonomous protective systems in the sense of the Directive regarding conformity assessment and marking. In such cases their conformity is assessed in the course of the conformity assessment of the equipment they are integrated into, using the procedures foreseen in Article 8 according to the Group and Category of that equipment. They are not separately marked.

It is, however, important to note that the specific EHSRs of Annex II.3 also apply for integrated "protective systems".

3.9 Components

The two defining elements for components[19] are that they,

- are essential to the safe functioning of equipment and protective systems with respect to explosion protection (otherwise they would not need to be subject to the Directive);
- with no autonomous function (see 3.8) (otherwise they would have to be regarded either as equipment, protective system or as device according to Article 1(2)).

A product is considered to have an autonomous function if it can be safely used to deliver, or contribute towards the delivery of, one or more of the intended functions of Article 1.2 or Article 1.3.a) or b), without the need to add any further parts. This does not preclude that specific instructions for installation and use are to be followed.

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[17] Article 1.3(b) of the Directive.
[18] See Corrigendum to the English language version of Directive 94/9/EC (OJ L 21, 26.1.2000).
[19] Article 1.3(c) of the Directive.

Some kind of products may, depending on the extent of the conformity assessment already undertaken before being placed on the market and/or put into service, be considered either as with or without autonomous function.

If the function of the product can be delivered without further parts then, where relevant, it cannot be considered a component.

Components intended for incorporation into equipment or protective systems which are accompanied by an attestation of conformity including a statement of their characteristics and how they must be incorporated into products (see Article 8(3)), are considered to conform to the applicable provisions of Directive 94/9/EC. Ex-components as defined in the European standards harmonised under Directive 94/9/EC are components in the sense of the ATEX as well. **Components must not have the CE marking affixed** unless otherwise required by other directives (e.g. the EMC Directive 2004/108/EC).

Examples for items which could be placed on the market as components, if they are explicitly intended to be incorporated into ATEX products:

- terminals;
- push button assemblies;
- relays;
- empty flameproof enclosures;
- ballasts for fluorescent lamps;
- encapsulated relays and contactors, with terminals and/or flying leads;
- machinery brakes designed to be part of ATEX equipment;
- a pressurised container including suppressant powder forming part of an explosion suppression *system;*
- conveyor belting for a conveyor transporting combustible dusts;
- non-autonomous protective systems;
- suction hoses used on vacuum cleaners;
- forks for forklift trucks.

According to Article 8.3 the conformity of components has to be assessed by means of the same procedures as the equipment, protective systems or devices according to Article 1(2) into which they are to be integrated. Some components may be assigned a category, in which case they will always be used in equipment of that category. Other components may be more widely used, and no category can be defined. In addition, components for e.g. autonomous protective systems do not need to bear a category as the protective systems themselves are not categorised. It depends on the detail that is given in any documentation provided (e.g. where relevant by means of a written attestation of conformity).

For example, drive-belts, bearings, mechanical seals, Zener diodes, etc. are not usually placed on the market with the explicit intention to be incorporated into equipment, protective systems or devices according to Article 1.2 but for general engineering purposes. Their conformity (i.e. their suitability for the intended purpose as regards safety of the product they are integrated into) has to be assessed in the course of the conformity assessment of the integral product.

If components are to be placed on the market with the explicit intention of incorporation into equipment, protective systems or devices according to Article 1.2 (as e.g. increased safety terminal blocks, flameproof enclosures, etc.), they shall be assessed separately according to Article 8.3 and accompanied by a written attestation of conformity as referred to in Article 8.3. Otherwise, Member States can prohibit, restrict or impede their placing on the market (Article 4.2) and cannot presume their conformity (Article 5.1).

If a component is subject to a conformity assessment procedure under which a Notified Body issues a Type Examination Certificate, the Certificate must detail those requirements of Annex II that have been assessed.

3.10 Safety, controlling or regulating devices as defined in Article 1.2

Devices in the scope of Article 1.2

1. **Safety devices**, **controlling devices** and **regulating devices**, if they contribute to or are required for the safe functioning of equipment or protective systems with respect to the hazards of ignition or - respectively - with respect to the hazard of uncontrolled explosion are **subject to the Directive**;
2. These devices are covered **even if** they are intended for use **outside the potentially explosive atmosphere**. Those devices are not classified into categories according to Article 1.
3. Safety instrumented systems (e.g. a sensor, PLC and an actor) in the sense of items 1. and 2.. The whole system must be considered as a safety device in the sense of Article 1.2. Parts of this safety device may be located inside (e.g. a sensor) or outside (e.g. PLC) potentially explosive atmospheres.

For such devices, the essential requirements shall only apply so far as they are necessary for the **safe and reliable** function and operation of those devices with respect to the hazards of ignition or - respectively - with respect to the hazard of uncontrolled explosion (Annex II, Preliminary observation B).

Examples:

- a pump, pressure regulating device, backup storage device, etc. ensuring sufficient pressure and flow for feeding a hydraulically actuated safety system (with respect to the ignition hazard);
- overload protective devices for electric motors of type of protection Ex e 'Increased Safety';
- controller units in a safe area, for an environmental monitoring system consisting of gas detectors distributed in a potentially explosive area, to provide executive actions on one or a small number of equipment or protective systems in terms of further avoiding an ignition hazard if dangerous levels of gas are detected;
- controller units connected to sensors measuring temperature, pressure, flow, etc, located in a safe area, used to control (in terms of further avoiding an ignition hazard) electrical apparatus, used in production or servicing operations in a potentially explosive area.

For safety and economic reasons it will be preferable in most cases to install such devices in a non-hazardous area. However, sometimes this might not be possible. In such cases, although the Directive does not explicitly say so, these devices can also be designated as equipment.

Two situations can be identified:

- If the device has its own potential source of ignition then, in addition to the requirements resulting from Article 1.2, the requirements for equipment will apply;
- If the device does not have its own potential source of ignition then the device shall not be regarded as equipment but, evidently, the requirements resulting from Article 1.2 will still apply.

Devices outside the scope of Article 1.2

1. Devices other than safety, controlling and regulating devices.
2. **All devices**, including safety, controlling and regulating devices**, neither contributing** to **nor required** for the safe functioning with **respect to the** hazards of ignition or with respect to the hazard of uncontrolled explosion;
3. Even **safety, controlling and regulating devices** contributing to or required for the safe functioning but **with respect to hazards other than the** hazards of ignition or - respectively - with respect to the hazard of uncontrolled explosion**;**

4. **Monitoring devices** providing only an **alarm signal** to protect persons but without control of the equipment inside the hazardous area.

Examples:

- Switchgear, numeric controllers, etc. not related to any safety functions (with respect to the ignition hazard); see 2. above;
- Water spray systems designed to protect plant from fire;
- Blast doors designed to withstand a stated overpressure (these are designed primarily as doors, and they do no more than the walls they are placed in to protect against an explosion;
- Gas detector systems that raise an alarm but have no controlling function on the equipment;
- Emergency ventilation systems which act when gas is detected.

4 IN WHICH CASES DOES DIRECTIVE 94/9/EC APPLY?

The manufacturer, his authorised representative or the person who first places a product on the EU market or puts a product into service in the EU market has to decide whether it is covered by the Directive 94/9/EC and, if so, apply its provisions. The manufacturer (in the broadest sense of the Directive) must therefore make an ATEX analysis on the basis of Directive 94/9/EC.

4.1 ATEX Analysis

4.1.1 What is a potentially explosive atmosphere in the sense of Directive 94/9/EC?

Directive 94/9/EC is a directive following the "New Approach" and therefore is intended to enable the free movement of goods within the EU. This is achieved by harmonisation of legal safety requirements, following a risk-related approach. Its objective is also to eliminate or at least minimise the risks resulting from the use of certain products **in or in relation to** a potentially explosive atmosphere. The manufacturer has to make assumptions about the intended use of his product including the contact with potentially explosive atmospheres.

An **explosive atmosphere** for the purposes of Directive 94/9/EC is defined as a mixture

i) of **flammable substances** in the form of gases, vapours, mists or dusts;

ii) with **air;**

iii) under atmospheric conditions[20];

iv) in which, after ignition, the combustion spreads to the entire unburned mixture (It has to be noted that sometimes (mainly with dusts) not always the whole quantity of the combustible material is consumed by the combustion).

An atmosphere, which could become explosive due to local and/or operational conditions, is called a **potentially explosive atmosphere**. It is only this kind of potentially explosive atmosphere which products falling under the Directive 94/9/EC are designed for (see as well chapter 4.3 'Risk Assessment').

It is important to note, that products **are not covered by Directive 94/9/EC** where they are intended for use in or in relation to mixtures which might potentially be explosive, but one or more of the **defining elements i) to iv) above are not present**.

For example:

- A product within a potentially explosive mixture without the presence of air is not in the scope of the Directive[21]. Special processes of this type require equipment that has been specially

[20] The Directive 94/9/EC does not define atmospheric conditions. However, a surrounding temperature range of –20°C to 60°C and a range of pressure between 0.8 bar and 1.1 bar may be appropriate as a basis for design and intended use of products. This does not preclude that products may be specifically designed and assessed for operation occasionally outside these conditions. It should be noted that electrical products are normally designed and tested for use in the ambient temperature range –20°C to 40°C in conformity with the harmonised standards. Products designed for use outside of this range will require additional marking to be added and further testing as appropriate. This will normally require agreement between the manufacturer and intended user.

[21] Examples for such atmospheres could be: mixtures which are explosive without air (e.g. H_2 mixed with Cl_2), mixtures of flammable substances with other oxidants than air, pressure and/or temperature conditions outside the atmospheric range, etc.

designed for the risks, as equipment intended for use in potentially explosive atmospheres may pose an ignition hazard for mixtures under non-atmospheric conditions.

- Conveying equipment where some parts but not all are under atmospheric pressure with internal pressures different from atmospheric pressure can fall under the scope of Directive 94/9/EC. When performing a risk assessment it will become evident that although parts of the described equipment are outside the scope of Directive 94/9/EC during normal operation (pressure oscillates between too low and too high values in relation to "atmospheric conditions") some parts or spaces still are under the scope and that the whole equipment during start-up and shut-down is under the scope, at least.
  So, both the following examples fall under the scope of Directive 94/9/EC:
  a) A vapour recovery pump for petrol stations is connected at its inlet and outlet to a potentially explosive atmosphere in the sense of Directive 94/9/EC.
  b) A vacuum pump sucking from a vacuum container and conveying the mixture into a pressure vessel or pressure line. In this case the inner parts of the pump are not connected to a potentially explosive atmosphere in the sense of Directive 94/9/EC.
  Note: The manufacturer may wish to sell this equipment for use under atmospheric conditions of the inlet and outlet side additionally, and then case a) applies. In any case, the complete working cycle needs to be considered, including start-up and shut-down, which may cause an atmospheric pressure to exist. If the equipment is not intended for atmospheric use, the Directive does not apply. Risk assessment must be carried out according to Directive 1999/92/EC.

As long as the user is not able to ensure the absence of a potentially explosive atmosphere, start-up and shut-down <u>are</u> relevant to determine the application of the Directive.

4.1.2 Which kinds of products are covered by Directive 94/9/EC?

To be within the scope of the Directive, a product has to be:

a) equipment, as defined in Article 1.3.(a); or

b) a protective system, as defined in Article 1.3.(b); or

c) a component, as defined in Article 1.3.(c); or

d) a safety, controlling or regulating device as defined in Article 1.2.

In some specific circumstances clarification is needed, in order to decide whether a certain product falls within the scope of Directive 94/9/EC or not. This will be clarified using the example of "Inerting Systems" (section 4.1.2.1) and "Paint Spray Booths" (section 4.1.2.2). In addition, two frequently arising questions concern:

- the place of installation of equipment and protective systems (section 4.1.2.3), and
- the existence of interfaces to different potentially explosive atmospheres (section 4.1.2.4).

4.1.2.1 Inerting Systems

When looking for the application of Directive 94/9/EC to inerting systems one has to consider three different cases:

1. Preventing an explosive atmosphere

Inerting systems are aimed at reducing or completely preventing the existence of an explosive atmosphere in specific areas. Inerting systems are not, however, intended to stop or restrain incipient explosions; hence they are not protective systems within the meaning of Directive 94/9/EC. The goal of inerting systems is different from those of explosion suppression systems, which may sometimes have similar parts, but are aimed at restraining an incipient explosion.

In broad terms: inerting systems **used during operation of plants** etc. are normally **not** in scope of Directive 94/9/EC.

Example:

The intended effect of an inerting system applied to inert a tank can only be assessed after knowing all operational parameters of the volume to be inerted. This assessment and the functional aspects of such systems are not covered by Directive 94/9/EC but a duty to be considered by the user and has to be laid down e.g. in the explosion protection document under the scope of the Directive 1999/92/EC and its national transpositions.

2. Inerting systems as equipment

An inerting system may (in part) also consist of parts which are intended for use **within** an explosive atmosphere and which have a potential ignition source of their own. These parts come – individually or possibly combined – under the scope of Directive 94/9/EC as "equipment". Also in this case their function of preventing an explosive atmosphere by inerting is not to be assessed within the meaning of this Directive.

3. Inerting systems as part of the ignition protection concept

In some cases, such systems may be part of the ignition protection concept of "explosion protected" equipment to fulfil the requirements of Annex II to Directive 94/9/EC, i.e. if they work as a means to protect potential ignition sources of the equipment from coming into contact with an existing potentially explosive atmosphere. This equipment, including its inerting system, comes as part of the equipment under the scope of Directive 94/9/EC. This inerting system is not a protective system according to Article 1(1). Its parts may be safety, controlling and regulating devices according to Article 1(2) of Directive 94/9/EC when separately placed on the market.

In broad terms: Directive 94/9/EC **applies** to an inerting system, if this system is – or is intended to be – integrated into the ignition protection concept of the equipment and thus serves to avoid ignition sources of the equipment.

Example:

Where the manufacturer of equipment intended for use in potentially explosive atmosphere wants to protect the ignition sources of this equipment, he may use the type of protection "pressurisation" according to EN 50016. This type of protection may include the use of inert gases as protective gases. In this case the inerting system is part of the equipment and as such within the scope of Directive 94/9/EC. The following case may occur in practice: Equipment according to Article 1 of Directive 94/9/EC contains an enclosure or a vessel containing sources of ignition. In order to prevent an explosive atmosphere from coming into contact with the ignition sources, an inerting system, which has been assessed in accordance with the 94/9/EC Directive as a safety device, can be applied to this equipment.

4.1.2.2 Paint Spray Booths

These products are an enclosed area, where an operator may work inside or outside, and may be described as a "simple box". The "box", with no ignition source and not intended for use in a potentially explosive atmosphere, does not fall within the scope of the ATEX Directive 94/9/EC.

Under operating conditions a potentially explosive atmosphere is created and the enclosed area, openings and recovery systems are normally **assessed with regard to the explosion risk**. The equipment, protective systems and components intended for use in this **assessed** potentially explosive atmosphere including safety and controlling devices outside, but contributing to their safe functioning, are within the scope of the ATEX Directive 94/9/EC.

In summary, paint spray booths, as an integral whole, do not fall under scope of the ATEX Directive 94/9/EC and as such cannot be affixed with the special marking for explosion protection and other marking detailed at Annex II, EHSR 1.0. of the Directive.

4.1.2.3 Place of intended use

Manufacturers of explosion protected equipment (e.g. in cases where potentially explosive atmospheres are conveyed) sometimes feel unsure whether and to what extent their products are covered by Directive 94/9/EC (see chapter 3.7.1). This applies especially to cases where only parts of the equipment are in contact with the explosive atmosphere.

Directive 94/9/EC deals with the special risk of explosion and has one major aim to prevent "own potential sources of ignition" (Art. 1(3)a) of equipment and protective systems (as far as it has an own potential source of ignition) from becoming active. Beside Art. 1(4) no restrictions are made with regard to local and technical conditions.

The probability of occurrence of the potential source of ignition determines the category. The technical requirements are summarised in Annex II 1.0.1; especially the 2nd indent describes the importance of the potential of the source of ignition. For this effect the place of installation is not decisive (see Art. 1(2) safety-, controlling-, regulation devices), but the possible effect of the potential source of ignition on a potentially explosive atmosphere.

In the light of these ideas the place of installation "in, at or beside" a potentially explosive atmosphere is not decisive for the application of Directive 94/9/EC. The decisive fact is whether the potential sources of ignition of an equipment are in contact – or have an interface – to a potentially explosive atmosphere, with the effect that the combustion may spread to the entire unburned mixture (see definition "explosive mixture"). In this case the potential source of ignition is in the potentially explosive atmosphere.

Equipment may have an internal explosive mixture (without limitation to dangerous quantities), which has an interface in the sense of a spreading of the combustion to a potentially explosive atmosphere even in the case it is not installed completely inside a potentially explosive atmosphere. An example could be an extraction system installed outside the potentially explosive atmosphere with a ventilator – own potential source of ignition – which exhausts explosive atmosphere out of a storage tank, or another potentially explosive atmosphere, via a pipe acting as connecting interface to the potentially explosive atmosphere.

It is important to underline in this context how machinery having a potentially explosive atmosphere inside under operating conditions, but having no interface to external potentially explosive atmospheres has to be considered. Such machines, as an integral whole, do not fall under scope of the ATEX Directive 94/9/EC (see also chapter 4.1.2.2 and 4.1.2.4).

The Machinery Directive 2006/42/EC, however, requires that:

"*Machinery must be designed and constructed in such a way as to avoid any risk of explosion posed by the machinery itself or by gases, liquids, dust, vapours or other substances produced or used by the machinery.*
Machinery must comply, as far as the risk of explosion due to its use in a potentially explosive atmosphere is concerned, with the provisions of the specific Community Directives." (Annex I, § 1.5.7)

See also the "Guide to application of the Machinery Directive 2006/42/EC", § 91 and § 228.

It is therefore evident that equipment, protective systems and components intended for use *in this potentially explosive atmosphere* – and safety and controlling devices outside, but contributing to their safe functioning – are within the scope of the ATEX Directive 94/9/EC. It is understood that the latter applies provided that "atmospheric conditions" in the sense of Directive 94/9/EC are present in the machine.

In this context the following questions have arisen:

1. Has the manufacturer the obligation to perform a zone classification inside this machinery?

It has been considered that:

- The manufacturer has to carry out a risk analysis, including the risk of explosion;
- Annex I to the ATEX Directive 94/9/EC contains clear and unambiguous definitions concerning the place where they are intended to be used for every single equipment-group and category;
- as opposed to the fully harmonising scope of the Machinery Directive, the zone concept applied in the framework of the ATEX "user" Directive 1999/92/EC allows member states to apply more stringent requirements than those defined in this Directive.

In order to avoid a non harmonised approach in the framework of a fully harmonised field like the Machinery Directive, it is not necessary to apply the *zone concept* as it is defined in Directive 1999/92/EC. Instead, the manufacturer should:

- Carry out the risk assessment;
- Define the requirements of the equipment to be used inside the potentially explosive atmosphere – and of safety and controlling devices outside, but contributing to their safe functioning – in order to ensure full compliance of the machinery with the requirements of the Machinery Directive;
- Purchase or produce the equipment having those requirements, i.e. intended to be used under the conditions defined during the risk analysis, and in conformity to Directive 94/9/EC.

2. Must the 'non-electrical' equipment used inside this machinery be also in conformity to 94/9/EC?

The equipment used inside must be in conformity to the applicable legislation. When the original Machinery Directive 89/392/EEC was drafted, European Directives regulated only electrical equipment for use in potentially explosive atmospheres; therefore non-electrical equipment was not mentioned.

It is nevertheless common understanding of the Standing Committee that after the date of application of Directive 94/9/EC, both electrical and non-electrical equipment used in machinery having a potentially explosive atmosphere inside must comply with Directive 94/9/EC. This position is also reflected in the Machinery Directive 2006/42/EC.

4.1.2.4 Interface to different potentially explosive atmospheres

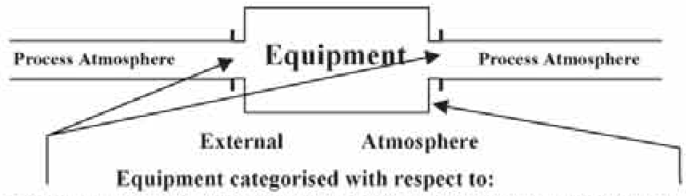
This paper seeks to provide guidance on the application of ATEX Directive 94/9/EC to equipment[22] intended to operate with interfaces to different potentially explosive atmospheres.

At this point it is necessary to note that equipment that contains a potentially explosive atmosphere but is neither connected to, nor intended for use in, an external or process related potentially explosive atmosphere does not fall under the scope of Directive 94/9/EC. However, any equipment inside this "container" will, so long as it fulfils the criteria for inclusion in scope, need to comply with the relevant provisions.

The categorisation of equipment is to be determined on the basis of the ignition risk assessment[23] by the manufacturer or his authorised representative and the equipment's relationship with respect to its interface with its process atmosphere and any external atmosphere.

[22] Equipment here is taken to mean all products within scope of Directive 94/9/EC

The following diagram illustrates this point:



Equipment categorised with respect to:
connections to process atmosphere (inside) and to external atmosphere

For example, the inside or process side of a pump for flammable liquid which normally runs full but occasionally contains an explosive atmosphere may, **depending on the actual situation**, be considered Zone 1[24] if no other measures have been taken to prevent the pump running dry. If it has been decided that the surroundings or external explosive atmosphere is Zone 2 then a pump conforming to Category 2 inside and Category 3 outside must be used to meet the Essential Health and Safety Requirements.

Note: the process atmosphere zone (and the respective category) need not necessarily to be the same for the two connections to the process atmosphere.

The following guidelines may help in the selection of an appropriate category:

The category (or categories) assigned to equipment shall be determined for each part of the equipment which comes into contact with, or is connected to, a Zone with a potentially explosive atmosphere (see Directive 1999/92/EC).

The category assigned to a piece of equipment intended to contain a potentially explosive atmosphere not connected to the outside of that equipment is determined by the ignition risk associated with the outside parts of the equipment, not by its internal atmosphere i.e. only the part of the equipment which is intended to come into contact with a Zone is relevant for the assignment of the appropriate category.

The category (or categories) assigned to the process connecting points of equipment containing an explosive atmosphere cannot be higher than that appropriate to the ignition risk.

For example, consider the case of a fan conveying an explosive gas atmosphere over its rotating blades, or a powder mill producing an explosive dust atmosphere inside the mill. Each having an outlet connected to an external potentially explosive atmosphere. The ignition risk assessment for both these items of equipment has shown for these specific examples that an effective ignition source (for the explosive atmosphere connected to them) is not present in normal operation but may be present in the case of an expected malfunction. If such equipment/assembly is placed on the

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23 The category classification is performed by the person responsible for making the EC Declaration of Conformity according to directive 94/9/EC.

24 "Zoning" is not a concept to be found in Directive 94/9/EC but in Directive 1999/92/EC dealing with employer's obligations with respect to employees operating in hazardous atmospheres. It is not the responsibility of the manufacturer to "zone" but evidently this it is helpful to give an example of the area of intended use.

market without additional ignition protection or a protective system it can only be classified as category 3[25].

Such equipment can only be used when it is connected to an explosive atmosphere which is present continuously (i.e. Zone 0/20) if additional ignition protection or a protective system is fitted (see Directive 1999/92/EC).

Where a piece of equipment is fitted with an autonomous protective system such as flame arresters, or a suppression system which is already compliant to Directive 94/9/EC, additional testing and conformity assessment of the resulting assembly, i.e. equipment together with the protective system, is not required provided the protective system is used within its intended design capabilities covering the specific case, is installed in accordance with the manufacturer's instructions and no new ignition hazards are introduced. However, an ignition risk assessment will be required and relevant action taken (see section 3.7.5 on assemblies) if additional hazards are identified.

Similarly, Directive 94/9/EC does not require that the pressure resistance of a vessel or container protected against the effects of an explosion by an autonomous protective system be tested, if it has been demonstrated that the autonomous protective system successfully detects and suppresses an explosion and if the vessel can withstand the residual pressure peak of the suppressed explosion.

Example

NOTE: The following is one of many examples that can be used to illustrate the above points. The assumptions made in this example should not be taken as the only possible situation. The categorisation of a particular piece of equipment will depend on the specific ignition hazard assessment that is made of the equipment and its intended use together with any ignition protection measures applied. The example only considers the inside and connecting explosive atmospheres, i.e. the process side. A separate ignition hazard assessment and categorisation must be made of the outside if the equipment is to be used in potentially explosive atmosphere.

Consider a powder mill as shown in the following figure:

The ignition hazard assessment carried out by the manufacturer has identified that in this case:

- there is no ignition source inside the mill which can become effective in normal operation[26];
- there is an ignition source inside the mill which can become effective during expected malfunctions.

25 Additional measures to cover expected malfunctions may provide Category 2; if two faults or one rare fault are dealt with, Category 1 can be reached.

26 It is clear that for some milling technologies an ignition source may be unavoidable.

The highest category that can be assigned to the mill is therefore Category 3 when it is placed on the market as shown. The outlet from the mill in this case produces fine dust in the form of a potentially explosive dust cloud which is continuously present in normal operation, i.e. Zone 20. The manufacturer's instructions must therefore make clear that the mill can only be used with additional explosion prevention or protection measures.

Analysis

Directive 94/9/EC defines equipment as follows:

- intended for use in potentially explosive atmospheres;

- and/ or for the processing of material;

- capable of causing an explosion through their own potential sources of ignition.

This definition applies to the grinding assembly of a mill for combustible materials of the food and fodder industry. Therefore, these are within the scope of Directive 94/9/EC.

The intended purpose of a grinding assembly in a mill is the grinding of combustible materials whereby the content of fine particles is increased considerably.

According to the risk assessment the grinding installation should fulfil the requirements for category 1, but in the best case it will meet category 3. Despite all construction measures to prevent ignition sources, the occurrence of dust explosions can not be excluded definitely. Therefore, the mill when fully installed must be provided with additional protection measures, which reduce the effect of a dust explosion for people and goods to below a dangerous level.

These measures are essential for the grinding system to fulfil the requirements of Directive 94/9/EC.

Consequently:

- all requirements on the construction of the grinding assembly *(e.g. suitable selection of material and bearings, minimum distances between rotating and fixed parts)*, on certain equipment of the mill *(e.g. foreign particles separator, overload protection, temperature detector at the bearings)*

and

- all construction measures of the mill *(explosion pressure resistant design for the maximum explosion pressure, or explosion pressure resistant design for the reduced explosion pressure in combination with explosion pressure relief or explosion suppression, and in most cases additional explosion decoupling for connected installations)*

are necessary to make the grinding operation safe.

4.2 Defining Group and Category

The Directive divides equipment into two groups. In order to determine the appropriate conformity assessment procedure, the manufacturer must first come to a decision based on the intended use, as to which Group and Category the product belongs.

Note: devices have to follow the conformity assessment procedure according to the category of the equipment or protective system they are required for or contribute to. Devices and components may be suitable for one or more category or group of equipment.

Group I comprises equipment intended for use in the underground parts of mines, and to those parts of surface installations of such mines, likely to become endangered by firedamp and/or combustible dust;

Group II comprises equipment intended for use in other places likely to become endangered by explosive atmospheres.

These Groups are sub-divided into Categories, as shown below. The way in which this categorisation has been developed highlights one of the main distinctions of Group I and II. For Group I, the categorisation depends on (amongst other factors) whether the product is to be de-energised in the event of an explosive atmosphere occurring. For Group II, it depends where the product is intended to be used in and whether a potentially explosive atmosphere, is always present, or is likely to occur for a long or a short period of time.

4.2.1 Group I

Category M1

Products of this Category are required to remain functional for safety reasons when an explosive atmosphere is present and is characterised by integrated explosion protection measures functioning in such a way that:

- in the event of failure of one integrated measure, at least a second means of protection provides for a sufficient level of safety; or,
- in the event of two faults occurring independently of each other, a sufficient level of safety is ensured.[27]

Category M2

These products are intended to be de-energised in the event of an explosive atmosphere.

It is nonetheless foreseeable that explosive atmospheres could occur during the operation of Category M2 equipment, as the equipment might not be de-energised immediately. It is therefore necessary to incorporate protection measures, which provide a high level of safety. The protection measures relating to products of this Category provide a sufficient level of safety during normal operation even in the event of more severe operating conditions arising, from rough handling and changing environmental conditions.[28] This normally includes also the requirement to provide equipment with a sufficient level of safety in the event of operating faults or in dangerous operating conditions which normally have to be taken into account.

4.2.2 Group II

Category 1 comprises products designed to be capable of remaining within its operational parameters, stated by the manufacturer, and ensuring a very high level of protection for its intended use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours, mists or air/dusts mixtures are **highly likely** to occur and are present continuously, for long periods of time or frequently.

Equipment of this Category is characterised by integrated explosion protection measures functioning in such a way that:

- in the event of a failure of one integrated measure, at least a second independent means of protection provides for a sufficient level of safety; or,

[27] Products relating to this Category must also comply with the supplementary requirements as detailed at Annex II, paragraph 2.0.1 to Directive 94/9/EC.

[28] Products relating to this Category must also comply with the supplementary requirements as detailed at Annex II, paragraph 2.0.2 to Directive 94/9/EC.

- in the event of two faults occurring independently of each other a sufficient level of safety is ensured[29]

It is also considered that equipment may be classed as category 1, if the manufacturer provides a combination of protective measures to prevent an ignition source becoming active under fault conditions, and in addition an integrated protective system (see chapter 3.8) which will control the ignition hazard from a rare malfunction of the equipment.

Category 2 comprises products designed to be capable of remaining within their operational parameters, stated by the manufacturer, and based on a high level of protection for their intended use, in areas in which explosive atmospheres caused by mixtures of air and gases, vapours, mists or air/dust mixtures are **likely** to occur.

The explosion protection relating to this Category must function in such a way as to provide a sufficient level of safety even in the event of equipment with operating faults or in dangerous operating conditions which normally have to be taken into account[30].

Category 3 comprises products designed to be capable of keeping within its operational parameters, stated by the manufacturer, and based upon a normal level of protection for its intended use, considering areas in which explosive atmospheres caused by mixtures of air and gases, vapours, mists or air/dust mixtures are **unlikely** to occur and if they do occur, do so infrequently and for a short period of time only.

The design of the products of this category must provide a sufficient level of safety during normal operation[31].

4.2.3 Levels of Protection for various Categories of Equipment

The various categories of equipment must be capable of functioning in conformity with the operational parameters established by the manufacturer to a certain level of protection.

Table 3: Levels of Protection

LEVEL OF PROTECTION	CATEGORY		PERFORMANCE OF PROTECTION	CONDITIONS OF OPERATION*
	GROUP I	GROUP II		
Very High	M 1		Two independent means of protection or safe even when two faults occur independently of each other.	Equipment remains energised and functioning when explosive atmosphere present
Very High		1	Two independent means of protection or safe even when two faults occur independently of each other.	Equipment remains energised and functioning in Zones 0,1,2 (G) and/or 20, 21, 22 (D)
High	M 2		Suitable for normal operation and severe operating conditions. If applicable also suitable for frequently occurring disturbances or for faults which are normally taken into account.	Equipment de-energised when explosive atmosphere is recognised
High		2	Suitable for normal operation and frequently occurring disturbances or	Equipment remains energised and functioning in Zones 1,

[29] Products relating to this Category must also comply with the supplementary requirements as detailed at Annex II, paragraph 2.1 to Directive 94/9/EC.
[30] Products relating to this Category must also comply with the supplementary requirements as detailed at Annex II, paragraph 2.2 to Directive 94/9/EC.
[31] Products relating to this Category must also comply with the supplementary requirements as detailed at Annex II, paragraph 2.3 to Directive 94/9/EC.

			equipment where faults are normally taken into account.	2 (G) and/or 21, 22 (D)
Normal		3	Suitable for normal operation.	Equipment remains energised and functioning in Zone 2 (G) and/or 22 (D)

* *Note:* see as well the directives on minimum requirements for improving the safety and health protection of workers operating in potentially explosive atmospheres, e.g. those indicated in footnote 5. The equipment in the various categories must also comply with the relevant essential and supplementary requirements detailed in Annex II to the Directive (Essential Health and Safety Requirements).

4.3 Risk Assessment for Products

In general it can be stated that compliance with the Essential Health and Safety Requirements of Directive 94/9/EC is imperative in order to ensure the explosion proofing of equipment and protective systems. The requirements are intended to take account of existing or potential hazards deriving from the design and construction. However, following the philosophy of ATEX Directive 94/9/EC the notion of intended use is of prime importance too. It is also essential that manufacturers supply full information.

To meet the requirements of Directive 94/9/EC it is therefore absolutely necessary to conduct a risk assessment process. According to Annex II, 1.0.1 manufacturers are under an obligation to design equipment and protective systems from the point of view of integrated explosion safety. Integrated explosion safety is conceived to prevent the formation of explosive atmospheres as well as sources of ignition and, should an explosion nevertheless occur, to halt it immediately and / or to limit its effects. In this connection, the manufacturer must take measures with respect to the risks of explosion. However, in most cases he will not be in the position to understand the possible extent of the adverse consequences of an explosion (as part of the overall explosion risk) since this is solely dependant on the particular circumstances at the users' premises. So the manufacturer's risk assessment will in general be restricted and be focussed to the assessment of the ignition hazard (again part of the explosion risk) or the explosion control function for a protective system and safety devices. In addition, as required in Annex II, 1.0.2 to the Directive, equipment and protective systems must be designed and manufactured after due analysis of possible technical and operating faults in order as far as possible to preclude dangerous situations.

Bearing in mind the commitments resulting from the relevant requirements of Directive 94/9/EC, a methodology on risk assessment, i.e. here ignition hazard assessment, should not only deal with designing and construction aspects but also provide a common format or language between designers and users.

Methods and/or techniques that could be applied

There are many possible methods and/or techniques for risk assessment, especially for hazard identification. They can easily be adopted for the ignition hazard assessment explained above as follows:

A good identification technique has the following attributes:

- it is systematic, i.e. it guides the parties concerned so that all parts of the system, all phases of use and all reasonably anticipated hazards are considered;
- it employs brainstorming.

By using more than one technique the possibility of overlooking any relevant hazard is minimised. However, the additional time employed in using more than one technique needs to be balanced against the increased confidence in the results. The main output from the hazard identification stage is a numbered listing of hazardous events, which could result from the products involved as an input to the risk estimation stage.

Hazard assessment methodology should comprise the hazard profiles including the accidental parameters that can reasonably be anticipated. These aspects become subject to a hazard assessment as a "series of logical steps to enable, in a systematic way, the examination of the hazards associated with products".

In principle the hazard assessment comprises of four steps[32]:

a) **Hazard identification**: A systematic procedure for finding all of the hazards, which are associated with the products. Once a hazard has been recognized, the design can be changed to minimise it, whether or not the degree of risk has been estimated. Unless the hazard is recognized it cannot be addressed in the design.

b) **Hazard estimation**: Determination of the Probability of occurrence of the identified hazards (and of the levels of severity of the possible harm of the considered hazards, see as well EN 1050).

c) **Hazard evaluation**: Comparison of the hazards estimated with criteria in order to decide whether the risk is acceptable or whether the product design must be modified in order to reduce the risk.

d) **Hazard reduction option analysis**: The final step of hazard assessment is the process of identifying, selecting and modifying design changes which might reduce the overall risk from products. Although risks can always be reduced further they can seldom be reduced to zero except by eliminating the activities.

Options, which address the hazardous events that make the greatest contributions to the total risk, have the greatest potential to reduce risk. Effectiveness in reducing risk always starts with changes to the design concept, i.e. inherently safe design.

[32] For further information on risk assessment, see EN 1127-1 Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology. For worked examples see EN 13463-1.

5 EQUIPMENT NOT IN THE SCOPE OF DIRECTIVE 94/9/EC

5.1 Exclusions based on Article 1.4 of Directive 94/9/EC

- medical devices intended for use in a medical environment;
- equipment and protective systems where the explosion hazard results exclusively from the presence of explosive substances or unstable chemical substances;
- equipment intended for use in domestic and non-commercial environments where potentially explosive atmospheres may only rarely be created, solely as a result of the accidental leakage of fuel gas. The question has also been discussed as to whether this implicitly conveys the meaning that equipment intended for use in domestic and non-commercial environments, where the leakage is not fuel gas, are included within scope. It was agreed by the ATEX Standing Committee as a general rule such types of equipment are excluded from Directive 94/9/EC as they are not intended for use in a potentially explosive atmosphere;
- personal protective equipment covered by Directive 89/686/EEC[33]. There are occasions where personal protective equipment with its own potential sources of ignition is intended for use in potentially explosive atmospheres. This type of personal protective equipment should follow the procedures laid down in Directive 94/9/EC to provide the necessary level of explosion safety (see as well chapter 6);
- seagoing vessels and mobile offshore units together with equipment on board such vessels or units, as they are already covered by the IMO Convention.
- means of transport i.e. vehicles and their trailers intended solely for transporting passengers by air, road, rail or water networks, as well as means of transport in so far as such means are designed for transporting goods by air, by public road or rail networks or by water. **Means of transport intended for use in a potentially explosive atmosphere are not excluded**;
- equipment covered by Article 296 (1)(b) of the EC Treaty, i.e. designed and manufactured specifically for use by the armed forces or in the maintenance of law and order. Dual-purpose equipment is not excluded.

5.2 Examples for equipment not covered by Directive 94/9/EC

5.2.1 "Simple" products

For "simple" electrical products, European harmonised standards provide a good basis to assess the effectiveness of electrical ignition source and, consequently, to determine whether or not these can be considered effective or not.

In general, many simple mechanical products do not fall under the scope of Directive 94/9/EC as they do not have their own source of ignition (see chapter 3.7.2). Examples without own source of ignition are hand tools such as hammers, spanners, saws and ladders.

Other examples that in most cases have no potential ignition source are given below. However, the manufacturer will need to consider each item in turn with respect to potential ignition hazard to consider whether Directive 94/9/EC applies (see also chapter 3.7.3):

- Clockwork time pieces; mechanical camera shutters (metallic);

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33 OJ No L 399, 30.12. 1989, amended by Directive 93/95/EEC, OJ No L 276, 9.11.1993 and Directive 93/68/EEC OJ No L 220, 30.8.1993.

- Pressure relief valves, self-closing doors;
- Equipment moved only by human power, a hand operated pump, hand powered lifting equipment, hand operated valves.

The issue of hand operated valves has also been discussed. Given that these will move slowly, with no possibility of forming hot surfaces, as discussed in section 3.7.3 they are not in scope of the Directive. Some designs incorporate polymeric parts, which could become charged, but this is no different from plastic pipes. Given that it is clear that the latter is outside of the scope of Directive 94/9/EC it has been accepted that such valves do not fall within scope.

Some manufacturers have argued that their valves are specially adapted for ATEX, in that they have either selected more conductive polymers, or taken steps to ensure that no metal parts could become charged because they are unearthed. Other manufacturers state that all their valves meet this requirement simply by the way they are constructed, and they see no distinction from valves used to process non-flammable materials. To avoid confusion between those who claim correctly that their valves have no source of ignition, and are out of scope, and those who claim that they have done some very simple design change and wish to claim that their valves are now category 2 or even 1, it has been agreed that valves having characteristics as described above are out of scope. Nevertheless, as discussed in section 3.7.3, where potentially flammable atmospheres exist, users must always consider the electrostatic ignition risks.

5.2.2 Installations

The Directive does not regulate the process of installation. Installing such equipment will generally be subject to legal requirements either workplace directives (see footnote 5) or the domestic legislation of the Member States.

However, the question is frequently asked to distinguish between the responsibilities of manufacturers, building a piece of equipment or an assembly under the ATEX Directive 94/9/EC and those responsibilities of an end user, buying in equipment parts to build an installation. (One might use the analogy of the difference between the manufacturing a discreet piece of equipment which can be placed on the market, such as a television (LVD 2006/95/EC), and equipping a house with all its utilities built into which a range of products will be installed and connected, this would clearly be an installation and come under Workplace Directive 89/391/EEC or other directives concerning workplace safety.)

A common situation is that pieces of already compliant equipment are placed on the market independently by one or more manufacturer(s), and are not placed on the market by a single legal person as a single functional unit (as described in 3.7.5.1). Combining such equipment and installing at the user's premises is not considered as manufacturing and thus does not result in equipment; the result of such an operation is an installation and is outside the scope of Directive 94/9/EC. The installer has to ensure that the initially compliant pieces of equipment still comply when they are taken into service. For that reason he has to carefully follow all installation instructions of the manufacturers. The Directive does not regulate the process of installation. Installing such equipment will generally be subject to legal requirements of the Member States. An example could be instrumentation consisting of a sensor, a transmitter, a Zener barrier and a power supply if provided by several different manufacturers installed under the responsibility of the user.

It is understood that there is not always a clear line between an installation and an assembly.

For assemblies and installations the responsibilities will either fall on the person who places the assembly on the market, or the end-user. Each must draw up a technical file setting out how they have complied with the relevant legislation. Much of the technical content will be the same.

The plant will **usually** be an **installation** if:

- The end user, or an installer purchases parts (including ATEX components or equipment) from different manufacturers and they are installed under his responsibility after a full risk assessment has been undertaken;
- The user carries out a whole series of different processes requiring the integration of mainly ATEX compliant equipment and parts on site, and they are installed according to a unique layout;
- The end-user commissions the building of parts of his installation off-site, which may be unique, but certainly not a production run, and which is done under his direct responsibility, or indirectly through a contractor, working under contract to him;
- Commissioning tests or adjustments are needed once the plant is built and are carried out under the final responsibility of the end user.

6 APPLICATION OF DIRECTIVE 94/9/EC ALONGSIDE OTHERS THAT MAY APPLY

In principle if a product is within the scope of other directives at the same time, all directives have to be applied in parallel to fulfil the provisions of each directive.

6.1 Electromagnetic Compatibility 2004/108/EC (EMC)

In the case of Directive 94/9/EC and the Directive relating to **Electromagnetic Compatibility 2004/108/EC (EMC)**, the Directive 94/9/EC has to be applied to fulfil the requirements concerning "explosive atmospheres" safety requirements. The EMC Directive must also be applied so as to ensure that the product does not cause electromagnetic disturbance and that its normal operation is not affected by such disturbances. There will be some applications, where the "normal" level for electromagnetic immunity provided by Directive 2004/108/EC might not be sufficient for granting the necessary immunity level for safe performance under the scope of Directive 94/9/EC. In this case the manufacturer is required to specify the electromagnetic immunity achieved by his products according to Annex II 1.2.7 to Directive 94/9/EC. For example, protective systems where the performance of data acquisition and data transmission may have direct influence on explosion safety.

6.2 Low Voltage 2006/95/EC (LVD)

Products for use in potentially explosive atmospheres are explicitly excluded from the scope of the **Low Voltage Directive 2006/95/EC (LVD)**. All "Low Voltage essential objectives" have to be covered by the Directive 94/9/EC (see Annex II 1.2.7). The standards published in the Official Journal of the European Union with reference to Directive 2006/95/EC may be listed in the EC declaration of conformity to fulfil the requirements 1.2.7 of Annex II to Directive 94/9/EC. Not excluded from the scope of the LVD are the safety, controlling and regulating devices mentioned in Article 1(2) of the Directive 94/9/EC which are intended for use outside potentially explosive atmospheres but required for or contributing to the safe functioning of equipment and protective systems. In such cases both Directives shall be applied.

6.3 Machinery 2006/42/EC (MD)

The relation between Directive 94/9/EC and the **Machinery Directive 2006/42/EC** is different. The Directive 94/9/EC, which is a "specific Directive" within the meaning of Article 3 of the Machinery Directive, contains very specific and detailed requirements to avoid hazards due to potentially explosive atmospheres, while the Machinery Directive itself contains only very general requirements against explosion hazards (Annex I, 1.5.7 MD). With regard to explosion protection in a potentially explosive atmosphere Directive 94/9/EC takes precedence and has to be applied. So equipment that complies with ATEX, and which is also a machine can be assumed to comply with the specific essential safety requirements concerning ignition risk with respect to explosive atmospheres in the Machinery Directive. For other relevant risks concerning machines, the requirements of the Machinery Directive also have to be applied.

See also § 4.1.2.3.

6.4 Transport of dangerous goods by road 94/55/EC and 98/91/EC (ADR)

In order to avoid possible overlapping with **Directives 94/55/EC and 98/91/EC on transport of dangerous goods by road** most means of transport have been excluded from the scope of Directive 94/9/EC (Art. 1 (4)). Generally, those vehicles still included in 94/9/EC do not leave the user's premises. Typical examples are means of transport on rails used in "gassy" mines, forklift trucks and other mobile machinery where the internal combustion engine, braking systems and electrical circuits may be potential sources of ignition.

It is possible for both Directives to be applied in parallel. For example, where the manufacturer designs and constructs a means of transportation intended for transporting dangerous (in this case flammable) goods on public roads as well as for use in areas where explosive atmospheres may exist.

The criteria for application of Directive 94/9/EC are that the vehicle would need to:

- be defined as an equipment, a protective system or safety device according to Article 1(2) of the Directive;
- have its own potential source of ignition;
- be intended for use in a potentially explosive atmosphere34.

In order to determine under which intended conditions both Directives will apply the exclusion at Article 1(4) of Directive 94/9/EC needs to be considered.

This exclusion explicitly determines that "means of transport" except those "intended for use in a potentially explosive atmosphere shall not be excluded".

The definition of "means of transport" is given further detail at Article 2 of Directive 98/91/EC and, in broad terms, is interpreted to be an activity on a public highway or space including unloading and loading operations.

The ATEX Standing Committee therefore considered that, as described in the Commission guidance, a vehicle under the scope of Directive 98/91/EC might also be covered by the ATEX Directive 94/9/EC.

Where such a vehicle is intended for use in a potentially explosive atmosphere both Directives will apply. However, this does not include where such environments are likely to occur solely as a result of loading and unloading operations as described in 98/91/EC. An example of this is a road tanker transporting petrol when the loading/unloading site is such that it is not initially considered to have a potentially explosive atmosphere because of its location with respect to the storage facility. As noted above, if this environment becomes potentially explosive because of the loading/unloading operation, only the requirements of Directive 98/91/EC need be applied.

In addition, it was agreed that the conformity assessment and technical requirements of 94/55/EC as further defined by 98/91/EC may not fully align with those required for compliance to Directive 94/9/EC.

In this context the question arose whether manufacturers of internal monitoring or other devices attached to or inside a vehicle such as a petrol tanker have to apply the ATEX Directive 94/9/EC and to affix CE marking? The following has been concluded:

1. Based on Article 75 of the EC Treaty and transposing the ADR, Directive 94/55/EC fully harmonises rules for the safe transport of dangerous goods by road.

2. Additionally, based on Article 95 of the EC Treaty, Directive 98/91/EC provides for full harmonisation regarding technical requirements for the following categories of vehicles intended for the transport of dangerous goods by road as follows:

- Category N: Motor vehicles having at least four wheels when the maximum weight exceeds 3.75 metric tons, or having three wheels when the maximum weight exceeds 1 metric ton, and used for the carriage of goods.
- Category O: Trailers (including semi-trailers).

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34 Unless it is a safety device as defined under Article 1(2) of Directive 94/9/EC.

According to Article 4, if the requirements of the Annexes of this Directive are fulfilled for the completed vehicle, Member States may not refuse to grant EC type approval or to grant national type approval, or prohibit the registration, sale or entry into service of those vehicles on grounds relating to the transport of dangerous goods.

3. Directive 98/91/EC contains, by reference to Directive 94/55/EC, requirements covering both electrical (e.g. wiring, batteries) and non electrical equipment (e.g. heat protection of engine, combustion heaters) of vehicles designed for the carriage of dangerous goods, which may contribute towards the formation of explosive atmospheres.

4. Provided that:

- Such vehicles are not intended for use in a potentially explosive atmosphere other than that caused temporarily by loading or unloading.

- The goods, which shall be transported, are substances and articles as defined in Article 2 of Directive 94/55/EC.
- The exemptions of Annex A, paragraph 1.1.3, of Directive 94/55/EC and the ADR agreement are not pertinent.

Under these circumstances the exclusion at Article 1(4) of Directive 94/9/EC applies to the WHOLE of the vehicle including ALL associated equipment necessary for the carriage of dangerous goods (e.g. "breather valves" of manhole covers, vehicle tracking systems).

In all other cases Directive 94/9/EC may apply.

Note 1: At some sites tankers may have to access a zone (e.g. zone 1). In this case users responsible for that site may demand the supplier to use tankers with ATEX compliant products.

Note 2: Even if the vehicle or parts of it are intended to be permanently used in a potentially explosive atmosphere, devices like "breather valves" of manhole covers normally would not fall within the scope of Directive 94/9/EC. Normally these devices have no own ignition source, are no safety devices in the sense of ATEX and are normally not provided with a protective system, such as a flame arrester.

6.5 Personal Protective Equipment 89/686/EEC (PPE)

The equipment covered by the **Personal Protective Equipment (PPE) Directive 89/686/EEC** is specifically excluded from Directive 94/9/EC. However, the manufacture of PPE for use in explosive atmospheres is covered by Basic Health and Safety Requirement 2.6 in Annex II to the PPE Directive. PPE intended for use in explosive atmospheres must be so designed and manufactured that it cannot be the source of an electric, electrostatic or impact-induced arc or spark likely to cause an explosive mixture to ignite. Following the EHSRs in Directive 94/9/EC is one way to demonstrate compliance.

6.6 Pressure Equipment 97/23/EC (PED)

Pressure Equipment Directive (PED) 97/23/EC is a single market directive similar to Directive 94/9/EC. Relatively few items of pressure equipment have their own source of ignition. There are a small number of examples of safety accessories which may be autonomous protective systems or, possibly, equipment. Flame arrestors have been judged to be pressure accessories in the sense of the PED. There are no additional requirements for the flame arrester element under the PED. PED specifically excludes from its own scope equipment classified no higher than category I under Article 9 of PED but inside the scope of ATEX.

6.7 Simple Pressure Vessels 87/404/EEC

Simple Pressure Vessel Directive 87/404/EEC applies to a limited range of equipment for holding air or nitrogen under pressure. ATEX equipment may incorporate a simple pressure vessel in an assembly, but it is considered that there are relatively few occasions when both Directives will apply to the same product.

6.8 Gas Appliances 90/396/EEC (GAD)

Gas Appliances Directive (GAD) 90/396/EEC applies to equipment for domestic and non commercial use but does not apply to equipment designed for industrial processes. Most equipment within scope of GAD is capable of igniting a surrounding explosive atmosphere and cannot comply with ATEX.

It should also be noted that the Directive 94/9/EC contains the following exclusion:

"- equipment intended for use in domestic and non-commercial environments where potentially explosive atmospheres may only rarely be created, solely as a result of the accidental leakage of fuel gas;"

The question has been raised as to whether this implicitly conveys the meaning that such equipment, where the leakage is not fuel gas, are included in the scope of ATEX Directive 94/9/EC.

It was agreed that, as a general rule, such types of equipment are excluded from the Directive as they are not intended for use in a potentially explosive atmosphere.

6.9 Construction Products 89/106/EEC (CPD)

Besides the above Directives it is necessary to mention the relationship between Directive 94/9/EC and the **Construction Products Directive (CPD) 89/106/EEC**. During the standardisation work for both Directives it was identified that (in a few areas) the scopes of both Directives could overlap. The areas already identified where:

- explosion protection systems and fire suppression systems using the same media;
- both areas are using common hardware for distribution systems such as pipes, pipe hangers, nozzles, etc.

In general, it can be stated that in cases of doubt the Construction Products Directive is applicable if the subject under discussion is fixed to a building and becomes then a part of the building or if it can be seen as a building itself (e.g. a silo). In such instances the CPD and the ATEX Directive 94/9/EC apply in parallel. Compliance with the EHSRs of Directive 94/9/EC will in general show compliance with the EHSRs of the CPD regarding ignition hazards.

In this context it is important to note, that a Notified Body is only allowed to cover aspects related to two or more directives if the Body is notified under all directives with an appropriate scope.

7 USED, REPAIRED OR MODIFIED PRODUCTS AND SPARE PARTS [35]

7.1 General

As a general rule, manufacturers need to consider whether the product is being placed onto the EU market or taken into service for the first time, or if the modifications are such that the intention or the result is to place a product onto the market, which has to be considered as a new product. If the answer to either of these questions is "yes", then Directive 94/9/EC fully applies. In all other cases the Directive 94/9/EC does not apply and the responsible person will have to ensure that any other relevant national or EU legislation are considered as appropriate.

Within this context two points should be made:

- In the following paragraphs, these Guidelines refer only to products for which Directive 94/9/EC is potentially applicable. Products not subject to Directive 94/9/EC are therefore excluded from these discussions.

- The application of Directive 94/9/EC to an "as new" product is without any prejudice to intellectual property legislation.[36]

With regard to the information to be provided for repair of equipment, see § 10.1.3 "Documents accompanying the product".

7.2 Definitions

Used product and second hand product: a product which has been placed on the EU market prior to the coming into force of Directive 94/9/EC and put into service on the EU territory. This product was in compliance with the then applicable legislation: national or EU, depending on the date. **The ATEX Directive 94/9/EC does not apply.**

Used products that were on the market and used in the EU before the date of entry into force of Directive 94/9/EC are not covered by it. These products have been marketed and used in accordance with the regulations in force at that time. They circulate in the EU based on Articles 28/30 of the EC Treaty unless they are modified so that health and safety characteristics have been affected.

***For used* products imported from a non EU country and** made available for the first time in the EU after 30 June 2003 for the purpose of distribution and/or use in the EU **Directive 94/9/EC shall apply.**

7.3 Reconditioned (or refurbished[37]) products

These are used products which were on the market and used in the EU but whose performance has changed over time (due to ageing, obsolescence, etc.), and which have been modified so as to be **restored.** The case of products whose external appearance has been modified and improved by a cosmetic or aesthetic operation after they have been placed on the market and put into service is a

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[35] The application of the ATEX Directive to "as-new equipment" is without any prejudice to intellectual property legislation. See Directive 89/104/EEC relating to the marks and the decision of the European Court of 11th July 1996, C427/93, 429/93, 436/93 Bristol Meyer Squibb.

[36] See Directive 89/104EEC relating to the marks and the decision of the European Court of Justice of 11 July 1996 in Joined Gases C-427/93 and C-436/93 Bristol Meyer Squibb.

[37] Both terms, reconditioned/refurbished, as well as reconditioning/refurbishment are used interchangeably in this chapter.

particular form of refurbishment aimed at restoring the external appearance of the product. If this occurs **with no substantial modification Directive 94/9/EC does not apply.**

7.4 Reconfigured products

Reconfigured products are used products which were on the market and used in the EU but whose configuration has been modified, by the addition (upgrading) or the removal (downgrading) of one or more parts (components, sub-assemblies such as plug-in cards or modules, etc.). If this occurs **with no substantial modification Directive 94/9/EC does not apply.**

7.5 Substantially modified products

In general, the relevant text of the "Guide to the Implementation of Directives Based on New Approach and Global Approach" (Blue Guide), chapter 2.1. "Products submitted to directives" applies. In the sense of Directive 94/9/EC it is any modification affecting one or more of the health and safety characteristics covered by EHSRs (e.g. temperature) or the integrity of a type protection. In this case **Directive 94/9/EC has to be applied. This does not preclude the application of other relevant directives.**

The general principle is that Directive 94/9/EC re-applies to a modified product where the modification is considered to be substantial and if it is intended to be placed again on the EU market for distribution and/or use.

7.6 Repaired products

These are products whose functionality has been restored following a defect without adding new features or any other modification. As this occurs after the product has been placed on the market and the product is not to be sold as a new product:

The ATEX Directive 94/9/EC does not apply.

This does not preclude that national regulations of the Member States on the working environment may require some kind of assessment of the repaired product as well.

7.7 Spare parts

These are items intended to replace a defective or worn out part of a product previously placed and put into service on the EU market. A typical repair operation would be replacement by a spare part.

The manufacturer of the spare part is normally not required to comply with Directive 94/9/EC unless the spare part represents an equipment or component as defined by the Directive. If so, all obligations laid down in the Directive have to be fulfilled.

If the manufacturer of the original spare part offers a new, different one in its place (due to technical progress, discontinued production of the old part, etc.), and it is used for the repair, the **repaired product** (as long as no substantial modification of the repaired product takes place) **does not need to be brought into conformity at this time with** Directive 94/9/EC as the repaired product is not then placed on the market and put into service.

This can involve a modification of the electrostatic characteristics. The use of different materials or different external dimensions of the product might adversely change its ATEX performances. For example, a plastic enclosure may provide much lower electrostatic protection than a metallic enclosure.

http://ec.europa.eu/enterprise/newapproach/legislation/guide/index.htm

8 CONFORMITY ASSESSMENT PROCEDURES

8.1 Products conforming to Directive 94/9/EC

Article 8 of the Directive describes the procedures whereby the manufacturer or his authorised representative established within the EU ensures and declares that the product complies with Directive 94/9/EC. For assemblies further guidance is given in chapter 3.7.5.

Article 8.1(a) describes the procedures in the case of equipment; autonomous protective systems; for safety devices for such equipment or systems; and for components for such equipment, systems or devices, under Groups I and II, Categories M1 and 1. The options are either:

i) EC-Type examination[40] (Module B)[41] followed by:

production quality assurance[42] (Module D) or,

product verification[43] (Module F);

ii) Unit verification[44] (Module G).

Article 8.1(b) describes the procedure in the case of equipment, for safety devices as described in article 1(2) for such equipment and for components of such equipment or devices, under Groups I and II, Categories M2 and 2. The options are either:

For electrical equipment and internal combustion engines of Categories M2 and 2:

i) EC-Type examination (Module B) followed by:

conformity to type[45] (Module C) or,

product quality assurance[46] (Module E)

ii) Unit verification (Module G).

For other equipment of Categories M2 and 2:

i) Internal control of production (Module A) and deposit the technical documentation[47] with a Notified Body[48], or,

ii) Unit verification (Module G).

Article 8.1(c) describes the procedure in the case of equipment; for safety devices for such equipment; and for components for such equipment and devices under Group II, Category 3. The options are either:

i) Internal control of production (Module A) or,

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40 See Annex III to the Directive.

41 See Council Decision 93/465/EEC of 22 July 1993 concerning the modules for the various phases of the conformity assessment procedures and the rules for the affixing and use of the CE conformity marking, which are intended to be used in the technical harmonisation directives (OJ No L 220 30.8.1993)

42 See Annex IV to the Directive.

43 See Annex V to the Directive.

44 See Annex IX to the Directive.

45 See Annex VI to the Directive.

46 See Annex VII to the Directive.

47 See paragraph 3 of the Annex relating to the internal control of production.

48 Conditions of storage of documents shall be agreed between the Notified Body and its client.

ii) Unit verification (Module G).

For safety, controlling and regulating devices:

Safety, controlling and regulating devices have to comply with the requirements of Annex II, clause 1, especially clause 1.5.

The formal conformity assessment procedures of Article 8 apply and the safety devices are assessed according to the equipment group and category of the system consisting of the safety device and the equipment under control. In some cases it is necessary to perform the assessment for the combination (e.g. inverter fed motors), but generally the assessment for a group of equipment and the appropriate safety devices can be done separately (e.g. type "e" motor).

Example:
A type "e" motor of category 2 is controlled by an overload protection device located outside the explosive atmosphere. The conformity assessment procedure of equipment group II and category 2 is applied for the safety device.

In brief, the different conformity assessment procedures are:

EC Type Examination (Annex III):

Provides a specimen of the envisaged production to a Notified Body which undertakes the necessary evaluation to determine that the "type" meets the essential requirements of Directive 94/9/EC and issues an EC Type Examination Certificate.

Production Quality Assurance (Annex IV):

Operates a quality system approved by a Notified Body for production, final equipment inspection and testing and is subject to on-going surveillance.

Product verification (Annex V):

Examination and tests by a Notified Body of every product to check the conformity of the equipment, protective system or device with the requirements of Directive 94/9/EC and draw up a certificate of conformity.

Conformity to type (Annex VI):

Tests carried out by a manufacturer on each piece of equipment manufactured to check the explosion protection aspects of the design. Carried out under the responsibility of a Notified Body.

Product Quality Assurance (Annex VII):

A quality system approved by a Notified Body for the final inspection and testing of equipment subject to on-going surveillance.

Internal Control of Production (Annex VIII):

Product and quality system assessment procedure carried out by the manufacturer and retention of documentation.

Unit verification (Annex IX):

Notified Body examines individual equipment or protective system and carry out tests as defined in the harmonised standards, if they exist, or otherwise in European, international or national standards or conduct equivalent tests to ensure conformity with the relevant requirements of Directive 94/9/EC and draw up a certificate of conformity.

Internal Control of Production + Retention of documentation by a Notified Body (Article 8.1((b)(ii):

Product and quality system assessment procedure carried out by the manufacturer and retention of documentation by a Notified Body.

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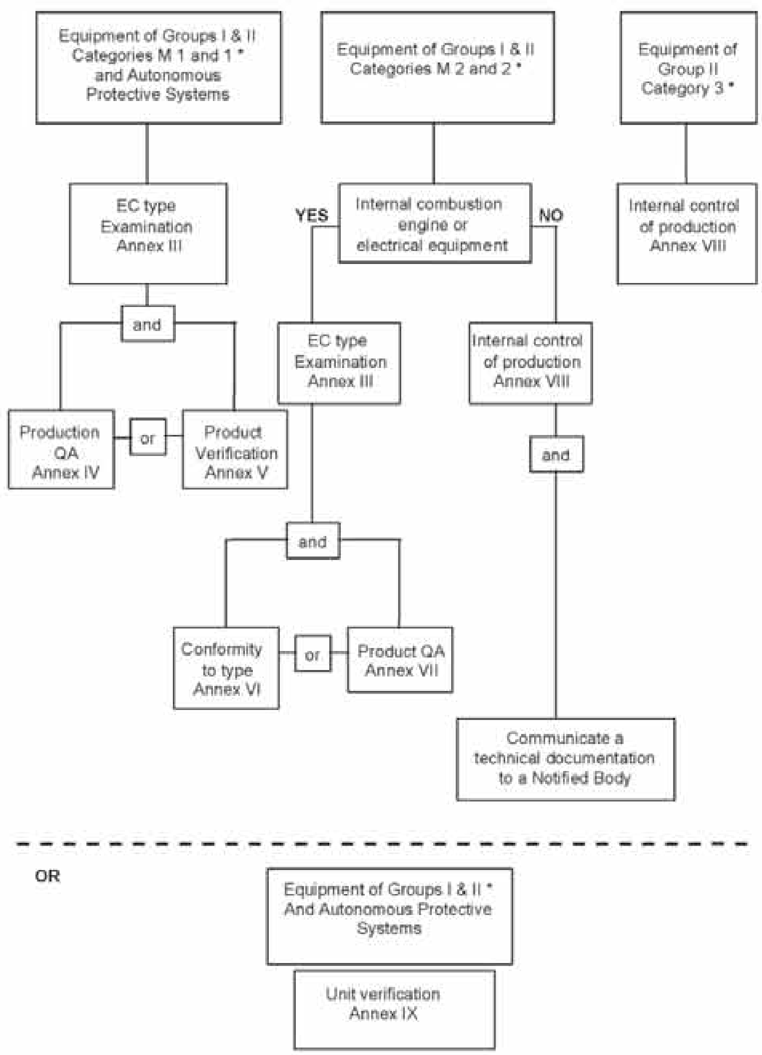
A chart showing the appropriate procedure is provided overleaf:

Conformity Assessment Procedures



(*) and their components and devices according to Art. 1(2), if separately assessed

Note: According to Article 8.4 for all equipment and protective systems of all groups and categories conformity to 1.2.7 of Annex II of the Directive (protection against other hazards) can be fulfilled by following the procedure of internal control of production (Annex VIII).

Which conformity assessment procedures have to be performed in the case of different categories within one product, or mixes of equipment and protective systems according to Article 1.3 b ?

If a product is made of parts which are assigned to different conformity assessment procedures it will be up to the manufacturer to decide how these parts and the whole product shall be placed on the market. The manufacturer can decide to realise the appropriate conformity assessment procedures for each part or for the whole product, even if he decides to place the product as an entity on the market. In the case of separate conformity assessment procedures for each part of the assembled equipment (called assembly in the Guidelines to Directive 94/9/EC), the manufacturer may presume conformity of these pieces of equipment and may restrict his own risk assessment of the assembly to those additional ignition and other hazards, which become relevant because of the final combination. If additional hazards are identified a further conformity assessment of the assembly regarding these additional risks is necessary.

If the manufacturer explicitly asks a Notified Body to assess the entire product, then that conformity assessment procedure has to be applied, which covers the highest requirements. The Notified Body shall include into the EC-Type examination (if relevant) all aspects of the product. Existing conformity declarations of the manufacturer for parts of the product should be given due consideration.

The Notified Body should inform the manufacturer about the possibilities of separate conformity assessment procedures for each part of the assembly as pointed out by the Guidelines to Directive 94/9/EC.

Any certificate issued by the Notified Body should make clear which aspects of the product have been assessed by the NB, and which have been assessed by the manufacturer alone.

Example: Vapour recovery pump for petrol stations

(a) The pump is sucking the petrol vapour-air mixture from the atmosphere and conveying it in pipe-work attributed to zone 0. Accordingly it is connected at its inlet and outlet to a potentially explosive atmosphere classified as zone 0. The pump itself is placed in a zone 1 environment.

With regard to the inlet and outlet connection the pump then has to comply with the requirements for category 1 equipment. The corresponding EC-type examination (equipment) has to be carried out by a Notified Body. With regard to the remaining (outer) body and integrated parts of the pump the Notified Body includes the necessary category 2 assessment into the certification, even if there are only non-electrical ignition sources to be considered.

Both categories shall be indicated in the EC-type examination certificate, making clear which aspects of the product have been assessed by the NB, and which have been assessed by the manufacturer alone, and in the marking. For those category 2 parts of the pump, which show only non-electrical ignition sources and which are placed separately on the market, and for which the technical documentation has been communicated to a Notified Body, an EC declaration of conformity (for equipment) or a written attestation of conformity (for components) of the manufacturer are sufficient.

(b) Often the pump is expected to prevent the passage of a deflagration flame from the inlet to the outlet connection, as typical vapour recovery pumps contain flame arresters in the inlet and outlet pipe. In this case the pump simultaneously may qualify as a protective system (in-line deflagration arrester).

A Notified Body – after having carried out a corresponding assessment of the flame arresting capability – may then issue a separate EC-type examination certificate for the pump as a protective system. In case that both aspects (equipment and protective system) have been assessed by the same Notified Body, only one EC-type examination certificate may be issued.

8.2 Exceptional derogations of the Conformity Assessment Procedures

All equipment and protective systems referred to in Article 1 (1) including components and the devices referred to in Article 1 (2) are covered by the provisions of Article 8 (5).

This article gives the competent authority of the relevant Member State the possibility, in exceptional circumstances, to authorise the placing on the market and putting into service products where the Conformity Assessment Procedures have not been applied. This exception is possible:

- following a duly justified and successful request to the competent authority of the relevant Member State; and,
- if the use of the product is in the interests of protection of health and safety, and where, for example, such interests would be hindered by the delay associated with Conformity Assessment Procedures; and,
- is restricted to the territory of the Member State concerned.

This provision may be applied in safety relevant cases, in which the products in question are needed urgently and there is insufficient time to undergo the complete Conformity Assessment Procedures (or to complete these procedures). The intention is to give Member States (in the interest of health and safety) the possibility to allow the placing on the market and putting into service innovative products without delay. Even in such cases the essential requirements of the Directive must be fulfilled.

With regard to the restrictive application conditions it has to be emphasised that the use of this clause has to remain exceptional and must not become a normal procedure. In the interests of transparency and to assist administrative co-operation Member States are encouraged to provide the competent Commission services with details of any use of Article 8(5).

9 NOTIFIED BODIES

9.1 Designation

Annex XI to Directive 94/9/EC defines the criteria that these bodies must fulfil. Bodies which are able to provide proof of their conformity with Annex XI by presenting to their Competent Authorities a certificate of accreditation and evidence that all additional requirements have been met or other means of documentary proof as defined below, are considered notifiable and in this respect they conform to Annex XI of the Directive. The appropriate (voluntary) harmonised standards provide useful and appropriate mechanisms towards presumption of conformity to Annex XI. However, this does not rule out the possibility that bodies not conforming to the harmonised standards may be notified, on the grounds that compliance is obligatory only with respect to the criteria set out in Annex XI to the Directive.

Notified Bodies provide the professional and independent judgements, which consequently enable manufacturers or their authorised representatives to fulfil the procedures in order to presume conformity to Directive 94/9/EC. Their intervention is required:

- for issuing of EC-type examination certificates, and for inspection, verification and testing of equipment, protective systems, devices and components before they can be placed on the market and/or put into service;
- for the assessment of manufacturer's quality assurance system in the production phase.

The bodies responsible for undertaking the work referred to in Article 8 of the Directive must be notified by the Member State under whose jurisdiction they fall, on their own responsibility to the Commission and the other Member States of the EU. This notification also includes the relevant scope of competence for which that body has been assessed as technically competent to certify against the Essential Health and Safety Requirements as shown in the Directive. For the Member States of the EU, this responsibility of notification involves the obligation to ensure that the Notified Bodies permanently maintain the technical competence required by Directive 94/9/EC and that they keep their notifying authorities informed on the performance of their tasks.

Therefore, a Member State of the EU, which does not have a technically competent body under its jurisdiction to notify, is not required to make such a notification. This means that a Member State of the EU which does not have such a body is not required to create one if it does not feel the need to do so. A manufacturer always has the choice of contacting any body with the appropriate scope of technical competence, which has been notified by a Member State.

On their own responsibility Member States reserve the right not to notify a body and to remove an appointment. In the latter circumstance the relevant Member States shall inform the Commission and all other Member States.

For further information concerning Notified Bodies, e.g. responsibilities, conformity assessment, testing, inspection facilities and sub-contracting, please see the "Guide to the implementation of Directives based on New Approach and Global Approach" (see footnote 4).

9.2 Co-ordination and Co-operation

All Notified Bodies are asked to participate in Notified Body co-ordination activities. The Group of Notified Bodies established under Directive 94/9/EC, the so-called ExNBG, normally meets annually and is made up of representatives of Notified Bodies with observers from the Commission, manufacturers and users trade associations, standards making bodies and other invitees. Attendance at each meeting is by invitation and any party wishing to be considered should contact the Chairman of the Group either through the Commission or via a Notified Body of your country. The group is responsible for discussing issues of a technical nature to ensure that the technical provisions of the Directive and harmonised standards are applied in a uniform way. The group issues "Clarification Sheets" where ambiguities exist in technical procedures and also issues technical guidance documents where less detailed specifications require amplification.

Clarification Sheets and guidance documents are noted by the Standing Committee and published on the internet (http://ec.europa.eu/enterprise/sectors/mechanical/documents/guidance/atex/clarification).

9.3 Subcontracting

It has been agreed that Notified Bodies are to keep a register of any subcontracting to allow effective monitoring by the responsible member state in order to ensure activities are being conducted properly. The register is to be updated systematically. The register contains information about the name and location of the subcontractor, the nature and scope of work undertaken, the results of regular evaluations of the subcontractor, including evidence that details of tasks are monitored as well as evidence that the subcontractor is competent and maintains competence for the tasks specified and evidence that a direct private law contract exists.

A Notified Body may engage experts in support of its assessment activities but the experts' activities are to be controlled as if the expert were directly employed by the Notified Body under the same contractual obligations and operate within the Notified Body's own quality system.

The ExNBG has concurred that further (serial) sub-contracting by any sub-contractor is strictly prohibited.

Although assessment can be sub-contracted including assessment against the requirements of EHSRs, the Notified Body remains entirely responsible for the whole operation and shall safeguard impartiality and operational integrity.

Procedures for reviewing and accepting the work of any sub-contractor will ensure that the sub-contractor has not offered or provided consultancy or advice to the manufacturer, supplier, authorised representative or their commercial competitor with respect to the design, construction, marketing or maintenance of the products which are the subject of the sub-contracted task.

9.4 Retention of documentation

Under Article 8.1 (b)(ii) of the ATEX Directive 94/9/EC the manufacturer is required to undertake the conformity procedure at Annex VIII and then.

"communicate the dossier provided for in Annex VIII, paragraph 3 to a Notified Body which shall acknowledge receipt of it as soon as possible and shall retain it".

Bodies notified for this procedure should be so according to Article 8.1 (b)(ii) and not to Annex VIII as this latter procedure does not involve a Notified Body.

This dossier is not returned to the manufacturer on request (but may be added to), and in general it is retained for a period of ten years following the last placing of the product onto the market. The intention is that market surveillance authorities in the different member states should be given access to this dossier, in cases where there is a need to investigate the design or manufacturing details of a particular product.

With respect to the media used, it is accepted that this dossier may be in electronic format so long as it is legible and "readable" over the period concerned.

9.5 Notified Bodies having knowledge of faulty products* on the market

Also a Notified Body which gets knowledge of faulty products, but is neither engaged in the module for EC-type examination nor in a module for surveillance of the manufacture, should take some action.

If there is no immediate danger, if after contact with the responsible Notified Body for EC-Type examination and with the Notified Body responsible for surveillance of the production of the faulty product no satisfactory solution after appropriate time is reached, the Notified Body should inform his own authorities in charge of market surveillance to initiate the adequate measures.

In the case of immediate danger, the Notified Body should inform his own authority in charge of market surveillance, the Notified Body for EC-Type examination and the Notified Body for surveillance of the production without delay.

* see Note 1 of the Guidelines

10 DOCUMENTS OF CONFORMITY

10.1 Documents issued by the manufacturer

10.1.1 EC Declaration of Conformity[49]

Once the manufacturer has undertaken the appropriate procedures to assure conformity with essential requirements of the Directive it is the responsibility of the manufacturer or his authorised representative established in the EU to affix the CE marking and to draw up a written EC Declaration of Conformity.

The manufacturer or his authorised representative established within the EU keeps a copy of this EC Declaration of Conformity for a period of ten years after the last equipment has been manufactured.

Where neither the manufacturer nor his authorised representative is established within the EU, the obligation to keep the copy of the EC Declaration of Conformity available is the responsibility of the person who places the product on the EU market.

In respect of the Notified Bodies possibly involved in the conformity assessment procedure the EC Declaration of Conformity must contain, where appropriate, the name, identification number and address of the Notified Body and the number of the EC-Type Examination Certificate. The name and address of a Notified Body involved in the production phase, where relevant, is not a mandatory requirement.

As far as assemblies of ATEX equipment are concerned, if an assembly is to be treated as a new item of ATEX equipment the EC Declaration of Conformity needs only to identify the unit and the related information. Details of the items of equipment making up the assembly will be included on the technical file. However, there is a duty on all those in the supply chain to pass on the relevant information relating to the items of equipment where these have been previously placed on the market accompanied by their own EC Declaration of Conformity and instructions.

Annex X.B of the Directive states what the EC Declaration of Conformity must contain. Further information can be found in section 5.4 of the "Blue Guide". As a general rule, the content of the EC Declaration of Conformity contains the following:

a) Name or identification mark and the address of the manufacturer or his authorised representative in the European Union	Straightforward, noting that the name on the product places the named organisation in the position of manufacturer (or authorised representative).
b) A description of the equipment, etc.	A descriptive product designation e.g. Motor Control Unit Type ABC 123 and its intended use. For an assembly it should list the items in the assembly that are ATEX equipment in their own right, and which have been separately assessed.
c) All relevant provisions fulfilled by the equipment, etc.	The marking included on the product e.g. Equipment Group II, category 2 G (IIB T4).

continued

[49] See Annex IV paragraph 1, Annex V. paragraph 2, Annex VI paragraph 1, Annex VII paragraph 1, Annex VIII paragraph 1, Annex IX paragraph 1 of the Directive.

continues

d) Where appropriate, the name, identification number and address of the Notified Body and the number of the EC-Type Examination Certificate	Name and number of the Notified Body (or Bodies) conducting the EC-type examination. In the case of Category 2 non-electrical equipment, it should refer to the Notified Body holding the copy of the technical documentation file. Where relevant, if the body responsible for oversight of the QA regime is not the same as the one issuing the original certificate, it should be named separately. However, the name and address of a Notified Body involved in the production phase is not a mandatory requirement. **There shall be no reference to a Notified Body certificate unless it is one coming within the scope of the Directive**. Certificates issued by bodies in their "private" capacity as certification bodies should be included in the technical documentation file as part of the evidence of conformity but should not be quoted on the declaration of conformity.
e) Where appropriate, reference to the harmonized standards	The harmonised standards quoted in the technical documentation file should be listed here.
f) Where appropriate, the standards and technical specifications used	Other standards and technical specifications quoted in the technical documentation file should be listed here
g) Where appropriate, references to other EU Directives which have been applied	If this is a multi-directive declaration, it should already be clear from the heading which directives the product conforms to.
h) Identification of the signatory who has been empowered to enter into commitments on behalf of the manufacturer, etc.	The signatory needs to be a responsible officer of the manufacturer or of the authorised representative.

10.1.2 Written Attestation of Conformity for Components

The EC declaration of conformity should not be confused with the written attestation of conformity for components mentioned in Article 8(3) of Directive 94/9/EC. In addition to declaring the conformity of the components with the provisions of the Directive, the written attestation of conformity has to state the characteristics of the components and how the components are to be incorporated into equipment or protective systems to ensure that the finished equipment or protective system meets the applicable Essential Health and Safety Requirements of Directive 94/9/EC.

10.1.3 Documents accompanying the product

According to Articles 4(2) and 5(1) of Directive 94/9/EC and for the purposes of market surveillance the EC Declaration of Conformity / the written Attestation of Conformity must accompany the information given with each single product, or each batch of identical products delivered for the same end user.

The product is also accompanied by instructions for safe use (see EHSR 1.0.6 of Annex II to the ATEX Directive 94/9/EC). The manufacturer shall provide to the user written instructions that include the necessary information for repair, maintenance and/or overhaul of the equipment concerned. The manufacturer does not have to provide the full technical file.

The user takes into account the instructions issued by the manufacturer to carry out repair, maintenance and/or overhaul on the basis of the requirements of the applicable directives (*as*

2009/104/EC - Use of work equipment by workers at work and 1999/92/EC - Protection of workers potentially at risk from explosive atmospheres) and of relevant specific national legislation that regulates the repair, maintenance and overhaul of used equipment. The instructions must contain drawings and diagrams necessary for repair of the equipment. Applicable and technically accepted standards can also be used, for example *EN 60079-19 - Explosive atmospheres - Equipment repair, overhaul and reclamation.*

However, where necessary, the manufacturer can include in his documentation a statement that specific repair, maintenance and/or overhaul of the equipment shall only be conducted by the manufacturer himself, or by a repairer he has qualified or authorized.

With respect to assemblies, it is important to the safe installation, operation and maintenance of the assembled unit that all relevant information is passed to the end user. The manufacturer of the assembled unit should do this by including all related information in a package supplied to the end user.

10.1.4 Retention of documentation - Quality assurance

According to Annex IV, paragraph 5 of the ATEX Directive 94/9/EC the manufacturer, or where relevant, the authorised representative or importer) shall, for a period ending at least 10 years after the last piece of equipment was manufactured, be able to make available to the national authorities:

- the documentation of the quality system;
- updating of the quality system;
- audit reports and certificates of the Notified Body.

Larger organisations have a certified quality management system according to the ISO 9000 standards. For these manufacturers it is recognised that it is difficult to keep all quality documents and all changes to the quality system for such a long period. It is the opinion of the ATEX Standing Committee that the requirements in Annex IV, paragraph 5 of the ATEX Directive 94/9/EC are fulfilled if the manufacturer keeps at the disposal of the national authorities at least the actual quality management system documents + the following documents which have to be kept for a period ending at least 10 years after the last piece of equipment was manufactured:

- audit reports and certificates of the ISO 9000 certifier. This will be one or two audit reports per year that include the actual state at that moment of the quality system with changes;
- audit reports and notifications of the Notified Body that issued the Production Quality Assurance Notification.

The above consideration is against the background that this documentation shall always be sufficient so as to enable surveillance authorities to determine that the relevant conformity assessment procedure(s) was/were applied in a satisfactory manner and that the relevant obligations of the ATEX Directive 94/9/EC were fulfilled.

10.1.5 Acceptance of test results of manufacturers by a Notified Body

Test reports can be a part of the technical documentation the manufacturer has to present to the Notified Body and the latter may take them into consideration appropriately.

Concerning safety relevant aspects in connection with Annex III (EC-Type Examination) and Annexes V (Product verification) and IX (Unit verification) to Directive 94/9/EC, a Notified Body's independent and transparent intervention vis-à-vis the client and all interested parties (e.g. Member States, European Commission, manufacturers, Notified Bodies) is required legally. Therefore a Notified Body only may accept test reports of manufacturers under certain conditions. The requirements included in the standard EN ISO/IEC 17025:2005 "General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)" shall be used as basis for acceptance of test results.

The Notified Body has to state the acceptance of test results in his test report.

In any case the Notified Body remains fully responsible for accepted test results and for the EC-Type Examination Certificate (Annex III) or Certificate of Conformity (Annexes V and IX) based on them.

10.2 Documents issued by the Notified Body

The Notified Body issues the following documents according to the provisions of the relevant conformity assessment procedures:

- EC-Type Examination Certificate;
- product and production quality assurance notification;
- conformity to type notification;
- product verification, certificate of conformity;
- unit verification, certificate of conformity.

These documents need not accompany the product.

It is not possible to issue an EC-Type Examination Certificate for products of Category 2 nonelectrical equipment and of Category 3, as mentioned in Article 8(1)(b)(ii) and 8(1)(c). Further, it is also not permissible to list such goods on an EC-Type examination certificate issued for goods of categories other than these. This is because an EC-Type examination certificate is an attestation that the goods listed on it have undergone the necessary conformity assessment procedures that result in the issuing of an EC-Type examination certificate; it is not necessary for such goods to undergo such conformity assessment procedures.

Where a single item is covered by more than one category, it may be permissible to issue an EC-Type Examination Certificate. Under such circumstances, these items need to comply with the highest applicable conformity assessment requirements (see section 8.1). If this requirement results in an EC-Type Examination Certificate being issued, these goods are permitted to be listed on an EC-Type Examination certificate.

A typical example of this is found in the semiconductor fabrication industry where a high vacuum pump is used to extract hydrogen but cannot meet the physical clearances necessary to justify Category 2. Category 3 is adequate for the process as the pump is normally filled with pure hydrogen at low pressure, so there is no ignition risk except during the very brief transitions between operation and non-operation.

In this case, it is only the electrical part that is truly subject to EC-Type Examination but it is already established that a mechanical part can be considered along with the electrical part if they are integral with each other, rather than a mere assembly.

In such cases, it is not unreasonable to mention such items in the same set of documentation i.e. the goods have an EC-Type examination certificate issued for them.

However, where the goods are discrete items e.g. two different type categories of a hand-held radio, one of which is Category 2 and the other Category 3, a single EC-Type examination certificate should never be issued; the Category 3 goods should be listed on a separate document that in no way implied it was an EC-Type Examination Certificate. The same should be true for components of items.

However, the voluntary issue of a certificate for goods that are not permitted to be listed on an EC-Type Examination Certificate is possible. The certification body may not give an indication on the certificate that it is a Notified Body because it would not be acting in that capacity. Therefore, the number of the Notified Body must not be affixed. Further, it is not permissible to affix the CE marking to such certificates. There is no objection for the hexagon (Ex mark) to be used or to make reference to Directive 94/9/EC.

Provision of evaluation and test results with EC-Type Examination Certificates: although being a separate document, the report describing how the equipment fulfils the Essential Health and Safety Requirements of the Directive is considered to be integral to the provision of a certificate. Evaluation and test results supporting the decision to issue a EC-Type Examination Certificate should accompany the certificate from the Notified Body to the manufacturer.

10.3 EC-Type Examination Certificate and the responsibilities of stakeholders

A Type Examination Certificate attests that a specimen (including instructions, as appropriate) representative of the production envisaged by the manufacturer fulfils the relevant applicable provisions of the Directive, in particular the Essential Health and Safety Requirements (EHSRs).

The question arises as to the actions that need to be taken when the "generally acknowledged state of the art" has developed. It is clear that the original specifications applied may continue to show fulfilment of the EHSRs and the Type Examination Certificate then remains valid.

However, over time the "generally acknowledged state of the art" can develop substantively **such that the specifications originally applied no longer ensure the type examined complies with the EHSRs**. It should be noted that the question of whether there has been substantive development of the state of the art is not left to discretionary interpretation by the Notified Body, but has equally to be generally acknowledged by the technical community of the stakeholders. The publication of a revised harmonised standard would be one way to recognise a development in the state of the art: in this case, the responsible European Standardisation Organisation (ESO) shall determine whether the state of the art concerning the EHSRs has changed, and if so, in what respects. The ESO shall indicate this in the foreword of each standard.

In such cases, if the specifications and evaluation criteria originally applied to a product no longer ensure that it complies with the latest state of the art, the Type Examination Certificate is no longer valid and further action is required. Given reasonable transition periods and knowledge of current developments, it is expected that the manufacturer will have sufficient time to contact a Notified Body to undertake the necessary re-evaluation so that there is a smooth transition from one set of applied specifications to another. Notified Bodies, who are expected to maintain a good knowledge of developments in the state of the art, should make arrangements to alert the holders of their EC-Type Examination Certificates to the revision of harmonised standards.

It should be noted, however, that the issuing of a new Type Examination Certificate will have no retroactive effect and, therefore, will not affect products placed on the market and/or put into service whilst the manufacturer was in possession, where appropriate, of a valid Certificate.

It should also be re-affirmed that the overall responsibility for compliance of the product rests with the manufacturer who, where required, must ensure that a valid Certificate is in his possession, as well as that all relevant conformity documents correspond to the current state of the art. In parallel, the Notified Body must provide all the relevant information for the manufacturer in order to ensure that the existing Certificate is correct in its evaluation that the type continues to meet the EHSRs.

11 MARKING

11.1 CE Marking

As a general rule New Approach directives including Directive 94/9/EC provide for the affixing of the CE marking as part of the conformity assessment procedures in the perspective of total harmonisation. The conformity assessment procedures to be applied are described in the relevant New Approach directives, based on the conformity assessment procedures as defined by Council Decision 93/465/EEC. **Where a product is subject to several directives, which all provide for the affixing of CE marking, the marking indicates that the product is presumed to conform to the provisions of all these directives.** During the transitional period of a New Approach directive the manufacturer has the choice to either meet the requirements of this directive or the previous relevant regulations. The option chosen, and hence the extent of the conformity expression enshrined in the CE marking, must be indicated by the manufacturer in the accompanying documents.

Any misleading marking in the sense of the any of these directives is forbidden.

As this guide has been especially drafted to facilitate the application of Directive 94/9/EC, the following explanations refer only to this Directive. If other directives are applicable in parallel, their provisions have to be taken into account in addition to those of Directive 94/9/EC.

CE marking is used by the manufacturer as a declaration that he considers that the product in question has been manufactured in conformity with all applicable provisions and requirements of Directive 94/9/EC and that the product has been the subject of the appropriate conformity assessment procedures.

The CE marking is mandatory and must be affixed before any equipment or protective system is placed on the market or put into service. As stated in Article 8 (3) components are excluded from this provision. Instead of being CE marked, components have to be delivered with a written attestation stating the conformity with the provisions of the Directive, stating their characteristics and indicating how they must be incorporated into equipment or protective systems. This separate statement goes along with the definition of components, which have as structural parts no autonomous function.

In general the CE marking must be affixed during the production control phase by the manufacturer or his authorised representative established within the European Union. In certain cases it is possible to affix the CE marking earlier, e.g. during the production phase of a complex product (e.g. a vehicle). It is then necessary that the manufacturer formally confirms the compliance of this product with the requirements of the Directive in the production control phase. The CE marking must consist of the initials "CE" taking the form described in Annex X to Directive 94/9/EC. In general the CE marking must be affixed to the product or to its data plate. However, although it is not a requirement in Directive 94/9/EC, it is considered reasonable to affix the CE marking to the packaging and to the accompanying documents if it is not possible to affix it to the product because of the product's size or nature.

It would be sensible, but it is not mandatory, to affix the CE marking to more than one place, for example, marking the outer packaging as well as the product inside, would mean that the marking can be ascertained without opening the package.

The CE marking shall be affixed distinctly, visibly, legibly and indelibly. It is prohibited to affix any marks or inscriptions that are likely to mislead third parties as to the meaning and form of the CE marking. The requirement for visibility means that the CE marking must be easily accessible for market surveillance authorities as well as visible for customers and users. For reasons of legibility a minimum height of 5 mm of the CE marking is required. This minimum dimension may be waived for small-scale products. The requirement for indelibility means that the marking must not be removed from the product without leaving traces noticeable under normal circumstances.

Depending on the conformity assessment procedure applied, a Notified Body may be involved in the design phase (Annex III), the production phase (Annexes IV, V, VI, VII, IX) or in both phases. The identification number of the Notified Body only has to accompany the CE marking if the Body is involved in the production control phase (see Article 10(1) of Directive 94/9/EC). It is necessary to avoid any misleading information on equipment, for example the number of the Notified Body, **where this is <u>not foreseen by the Directive</u>**. Hence, the product should not have the number of a Notified Body affixed, if falling under category 3 (other than Unit verification), as well as some Category 2 equipment, and for any voluntary certification.

The CE marking and the identification number of the Notified Body do not necessarily have to be affixed within the territory of the EU. These can be affixed in a third country if the product, for example, is manufactured there and the Notified Body either performed tests on the product type or assessed the quality assurance system of the manufacturer in that country. The CE marking and the identification number can also be affixed separately, so long as the CE and body-number remain combined. In case of components only the identification number of the Notified Body has to be affixed.

Where equipment that has already been placed on the market is incorporated into a product (e.g. an assembly according to 3.7.5.1), the integrated equipment must bear the CE marking and, if appropriate, the identification number of the Notified Body.

Whilst it is recognised that sub assemblies may have CE marking affixed in their own right these might not be visible following construction of the final product. This is acceptable as this information can be found elsewhere. However, the <u>final</u> product must have a single label clearly relating to its final assembly prior to it being placed on the market and/or taken into service. In affixing the CE marking to the final product the manufacturer or his authorised representative accepts full responsibility for the conformity of the final product to the applicable Essential Health and Safety Requirements of Directive 94/9/EC and all other relevant directives.

11.2 Supplementary/Specific Marking

It is the intention of Directive 94/9/EC that the design of the specific marking Ex follows the design, as specified in Directive 84/47/EEC. Although there is no requirement in Directive 94/9/EC it is recommended to continue to use the established design (see Annex to these Guidelines). This marking has to be followed by the symbol of the Group and Category (on devices according to Article 1(2) of Directive 94/9/EC the category should be indicated in brackets) and, relating to Group II, the letter 'G' (concerning explosive atmospheres caused by gases, vapours or mists) and/or D (concerning explosive atmospheres caused by dust). **User instructions shall explain in detail the meaning of the marking on the product**. However it is recommended to use the format provided in the following examples, where

" .. / .. " means the product has two different categories

" .. - .. " means that a part of the product is not conforming to the Directive and not intended to be used in a potentially explosive atmosphere.

Moreover, devices according to Article 1.2 of the Directive, and separately placed on the market, shall be marked with the category of the equipment under control in round brackets, and such devices which contain an own potential ignition source intended for use in a potential explosive atmosphere shall be marked as equipment according to Annex II clause 1.0.5.

Ex I M2	Mining products, Group I, Category M2
Ex II 1 G	Non-Mining products, Group II, Category 1 for use in gas/vapour/mist – atmospheres
Ex II 1 D	Non-Mining products, Group II, Category 1 for use in dust – atmospheres
Ex	Protective system, for use in gas/vapour/mist/dust - atmospheres
Ex II (1) G D	Device according to Article 1(2) of Directive 94/9/EC in the non-hazardous area with intrinsically safe circuits of category "Ex ia", which can be connected e.g. to category 1 equipment
Ex II 2 GD	Category 2 equipment for use in potentially explosive atmosphere containing gases or dust
Ex II (2)/2 (1)/1 G	An assembly, such as a gas detection system with more than one detection head, that is partly category 1 and partly category 2 formed by a safety device and an equipment. The safety device is intended for use outside the hazardous area and the equipment is intended for use inside hazardous area.
Ex II 2(1) G	Category 2 equipment containing a safety device for a category 1 equipment
Ex II 2(1) GD	Same equipment for gas or dust potentially explosive atmospheres
Ex II (2) G (1) G	A safety device alone which ensures the safety against explosion for category 1 equipment and for another category 2 equipment.
Ex II 3/3 D	a blower exhausting out of zone 22 and to be installed in zone 22

Examples for marking of equipment having different categories are:

Ex II 1/2 G	level gauge installed in the tank wall between zone 0 and zone 1
Ex II (2) 3 G	an electrical field bus device affecting category 2 equipment installed in zone 2
Ex II 2/- G	a ventilator exhausting out of zone 1 but to be installed outside potentially explosive atmospheres. The Directive has no provisions for marking in case of installation outside potentially explosive atmospheres.
Ex II 2/3 G	a ventilator extracting out of zone 1 but to be installed in zone 2
Ex II 3/- D	a screw conveyor conveying dust out of a zone 22 but installed outside potentially explosive atmospheres. The Directive has no provisions for marking in case of installation outside potentially explosive atmospheres.
Ex II -/2 D	blower conveying no explosive atmosphere but to be installed in zone 21

All products must be marked with the name and address of the manufacturer, designation of series or type, serial number (if any) and the year of construction. The product must be accompanied with written information explaining the different categories and the consequences for the intended use.

Where a product is covered by more than one New Approach directive, CE marking denotes compliance with the appropriate provisions of all relevant directives. However, where one or more of these directives are in their transitional period and, as a consequence, allow the manufacturer to choose which arrangements to apply, the CE marking indicates conformity only to those directives where application is mandatory and others which are so applied. In the case of these latter directives particulars must be given in the documents, notices or instructions accompanying the product or, where appropriate, on the data plate.

11.3 Additional Marking for standards

Because of the special importance for the safety of products intended for use in potentially explosive atmospheres and in order to avoid any misunderstandings Directive 94/9/EC provides for additional markings (see Annex II 1.0.5. Marking).

It is stated in Annex II 1.0.5 to the Directive that equipment, protective systems and components must furthermore be marked with all necessary information essential to the safe use. According to this requirement European standards for electrical and non-electrical products for potentially explosive atmospheres foresee a supplementary marking. For detailed and complete information about this marking it is necessary to use these standards.

11.4 Marking of components

The person responsible for the placing on the market and/or the putting into service of a product has to mark it with the name and the address of the manufacturer, according to Annex II to Directive 94/9/EC, clause 1.0.5. The Directive leaves it free to choose between trademark and company name if there is a difference. The address must be shown on the marking. This address can be simplified if there is not really enough room on small products, as long as the responsible person can always be identified. In any event, the address on the plaque must be sufficient for mail to reach the company. An internet address is not sufficient but the postal address has to be given. In some countries a unique postal code identifies an address. The use of this postal code is sufficient with the country.

The question has arisen, whether the marking of components is mandatory.

Strictly speaking, Directive 94/9/EC explicitly requires marking in Annex II, clause 1.0.5., only for equipment and protective systems. The question, whether components should nevertheless be marked in order to facilitate the implementation to the Directive, has particular practical relevance in cases

- where it is difficult to recognise the difference between ATEX components and standard components, and
- where a manufacturer who wanted to use a component might have serious problems undertaking his risk assessment, if there is no indication about the category of the component.

Apart from the question of marking, the Directive requires an attestation of conformity for components. The latter shall give all the necessary information stating the characteristics. This normally occurs assigning to the component an explosion classification according to relevant harmonised standards, which looks like a marking (e.g. Ex II 1/2 GD cb Tx or Ex II 1 GD c Tx).

For components having an own potential ignition source or which are clearly correlated (with respect to the properties of the component) to equipment with a given category, it has been considered that without the definition of group and category, the necessary conformity procedure of the equipment, which the component will be incorporated to, cannot be performed.

In some cases the conformity procedure can only be performed, if the equipment, which the component will be incorporated to, is defined, and if this incorporation is a matter of the conformity procedure.

Therefore, it is recommended to mark components, as long as these can be assessed with respect to a certain category and group of equipment, indicating this category and group in the marking.

Moreover, it is recommended to mark components for autonomous protective systems, which can be assessed with respect to the characteristic properties of the latter, as far as reasonable indicating these characteristics in the marking.

It has also to be considered that size is a problem impeding marking on a product. In these cases, the information should be given in the accompanying documentation and on the packaging of the component subject to marking.

Finally, it is recalled that, according to Directive 94/9/EC, **ATEX components shall not bear the CE-marking**.

11.5 Marking of small products

In accordance with the guidance given to the CE marking of products, it is also considered reasonable to affix all other marking to the packaging and the accompanying documents if it is not possible to affix it to the product because of the product's size or nature.

On very small products where a reduction in the marking is unavoidable, the following information is nevertheless required:

- CE marking (not for components),
- Ex marking,

the name or registered trade mark of the manufacturer.

11.6 Marking of assemblies

The marking of assemblies is identical to the marking of equipment, in particular equipment having different categories. An assembly may consist of a large number of assessed and compliant items (equipment, protective systems, safety devices) with their own specific marking, potentially of different categories. In such cases it would not be helpful to show all of these the individual markings in the marking of the complete assembly. Nevertheless, the marking of the assembly has to display all relevant information required by Annex II, 1.0.5, of Directive 94/9/EC necessary for the intended use of the assembly as a whole. The marking shall be placed in such a way – e.g. on the outer housing of the assembly – so that there is no doubt that it shows the characteristics of the whole assembly and not just one part.

Assemblies may consist of parts of different categories and be intended for potentially explosive atmospheres having different physical characteristics. The marking of the assembly as a whole with group, categories and additional information essential for the safe use of the assembly (temperature class, etc.) may fall under one of the two following scenarios:

Case 1: The assembly as a whole is intended for use in one potentially explosive atmosphere of one specific zone

Where the individual parts of the assembly are marked for potentially explosive atmospheres having different characteristics, the part with the lowest level of safety defines the marking of the whole assembly. That means that the category, temperature class, explosion group etc with the lowest requirement for the equipment has to be used for the marking of the whole assembly.

Case 2: Parts of the assembly are intended for use in potentially explosive atmospheres having different physical characteristics and/or different zones

If it is essential for that intended use, the marking of the assembly shall contain all groups, categories and additional markings (temperature class, etc.) necessary for the intended atmospheres.

In this case, the instructions for use, installation etc. will indicate the different atmospheres/zones intended (and/or provided by constructional measures) in or around different parts of the equipment.

Examples (only categories and additional markings essential for safe use are given in these examples):

Examples for case 1:

- An assembly consisting of parts marked with T3 and other parts with T6 shall be marked T3 to indicate, that it is, as a whole, intended for use in T3 atmospheres.
- A pump unit consisting of a liquid pump (non flammable liquid) and driving electric motor. The pump is marked II 2 G T6, the motor II 2 G IIB T4. The whole assembly shall be marked II 2 G IIB T4, as the motor is the part that meets the lower requirements.
- A similar pump unit with a pump conveying hot liquid (non flammable). The pump is marked II 2 G T3, the motor II 2G IIB T4. In this case the assembly shall be marked II 2 G IIB T3.

Examples for case 2:

- A fan conveying a IIA T3 explosive atmosphere (zone 1), the fan fitted with an electric motor and some control devices placed in a zone 2, the fan accordingly marked II 2/3 G IIA T3. The motor is marked II 3 G T3, the intrinsic safe control device II 2 G IIC T6. As the intrinsic safe control device is placed in the same atmosphere as the motor, the part meeting the lower requirements (in this case the motor) is the decisive item. Accordingly the marking of the whole assembly is II 2/3 G IIA T3.
- A similar fan assembly, but with the motor placed outside the hazardous area. The marking of the whole assembly is II 2/3/- G IIA T3.

12 SAFEGUARD CLAUSE[50] AND PROCEDURE

The safeguard clause referred to in Article 7 of the Directive is the EU procedure whereby any measure taken by a Member State, on the grounds of non-compliance with the Essential Health and Safety Requirements and **where it is deemed that equipment is liable to endanger persons, animals or property** for the purpose of withdrawing from the market, prohibiting the placing on the market or restricting the free movement of equipment accompanied by one of the means of attestation provided for in the Directive and therefore bearing the CE marking, must be immediately notified to the Commission by the Member State which has taken it.

In considering whether the safeguard clause should be triggered, Member States and the respective enforcement authorities will need to consider whether the non-compliance is substantial or can be considered a non-substantial non-compliance to be resolved without recourse to the procedures enabled via the safeguard mechanism.

For example, a non-substantial non-compliance could consist of illegibility of the CE marking. In such cases, the Member State could issue a compliance notice to the manufacturer or authorised representative or take other actions allowed by national legislation to encourage the responsible person(s) to take appropriate corrective action.

Member States will need to consider in each case whether the non-compliance is liable to endanger persons, animals or property and if the safeguard clause is the most effective means of ensuring the safety of persons, animals or property, which remains paramount under this section of the Directive.

Any notification, which fulfils the criteria of invoking the safeguard clause, is followed by a process of consultation between the Commission and the "parties concerned". The "parties concerned" primarily means all Member States of the EU, the manufacturer or his authorised representative established within the EU or, failing them, the person who placed the product on the EU market.

The consultation procedure enables the Commission, on the basis of the above reasons, to assess whether the restrictive measure is justified. This means that the measures notified to the Commission must be accompanied by detailed information specifying in particular the reasons why the Essential Health and Safety Requirements laid down in the Directive have not been complied with by the product concerned.

Where the Commission finds, following such consultation, that the measures are justified, it immediately informs the Member State which took the initiative and the other Member States. In the Commission's view, the objective of informing the other Member States is to prompt these Member States to take appropriate measures in accordance with Article 3 of the Directive.

Where the Commission finds that the measures, adopted by the Member State are not justified, it will ask that Member State to withdraw its measures and immediately to take the appropriate action to re-establish the free movement of the products in question on its territory. If a Member State refuses to follow the Commission's position the Commission reserves the right to proceed under Article 226 of the EC Treaty.[51]

In order to ensure transparency and the proper uniform application of the safeguard clause, Article 7.4 states that "the Commission shall ensure that the Member States are kept informed of the progress and outcome of this procedure".

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50 For a detailed analysis of the "Safeguard clause", see the "Guide to implementation of the Community harmonisation Directives based on the New Approach and the Global Approach", sheet I/E, Chapters 2, 3, 4.

51 Article 226 of the EC Treaty: if the Commission considers that a Member State has failed to fulfil an obligation under this Treaty, it shall deliver a reasoned opinion on the matter after giving the State concerned the opportunity to submit its observations. If the State concerned does not comply with the opinion within the period laid down by the Commission, the latter may bring the matter before the Court of Justice.

In addition to this provision the Directive foresees in Article 6 (1) a specific Standards Safeguard Clause. Where a Member State or the Commission considers that a harmonised standard does not fully meet the Essential Health and Safety Requirements of the Directive they shall bring the matter before a special Committee set up under Directive 98/34/EC[52]. The Committee shall examine the case and deliver an opinion to the Commission. In the light of this opinion the Commission shall inform Member States whether or not it is necessary to withdraw the references to those standards from the published information.

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[52] Directive 98/34/EC of the European Parliament and the Council laying down a procedure for the provision of information in the field of technical standards and regulations; OJ No L 204, 21.7.1998, p. 37-48, as amended by Directive 98/48/EC.

13 EUROPEAN HARMONISED STANDARDS[53]

Directive 94/9/EC provides manufacturers with the option of complying with its requirements by designing and manufacturing directly in accordance with the Essential Health and Safety Requirements, or to harmonised standards which are developed specifically to allow a presumption of conformity with those requirements. In other words, in the case of a challenge, the responsible national authorities will have to prove that the equipment is not in conformity with the Essential Health and Safety Requirements of the Directive.

The presumption of conformity is conferred, in regulatory terms, only by the use of the national standards transposing a harmonised standard the reference of which is published in the OJEU. Where the relevant national standardisation body has not transposed the standard, use of the original harmonised standard or of a transposed standard in another Member of the EU confers the same presumption of conformity. However, such transposition must have taken place into the national standards collection of at least one of the Member States of the European Union.

Industry and many Notified Bodies are involved in the development of these standards and it is likely that these standards will be the preferred option for demonstrating compliance once they become available.

Voluntary harmonised standards are the only documents the application of which provides for presumption of conformity. Manufacturers may also decide to use existing European, national and other technical standards and specifications regarded as important or relevant to cover the relevant essential health and safety requirements, together with additional controls addressing those other requirements not already covered.

Standards are amended and updated in response to new technical knowledge. During the process of updating, a manufacturer may continue to use a current harmonised standard to claim full compliance with the Directive, even though it is clear that the standard will change in time.

13.1 European Harmonised Standards published in the Official Journal

By way of information, a reference list of European Harmonised Standards can be found on the European Commission's website[54].

European standards for ATEX are available from the European Standardisation Organisations:

- European Committee for Standardization (CEN): avenue Marnix 17, B-1000 Bruxelles; tel. (32-2) 550 08 11; fax (32-2) 550 08 19 (http://www.cen.eu)
- European Committee for Electrotechnical Standardization (CENELEC): avenue Marnix 17, B-1000 Brussels; tel. (32-2) 519 68 71; fax (32-2) 519 69 19 (http://www.cenelec.eu).

National transpositions of Harmonised Standards are available from the national standardisation bodies.

13.2 Standardisation Programme

Two standardisation programmes addressed to the European standardisation bodies. Each one is the subject of a standardisation mandate drawn up by the European Commission.

53 See also http://ec.europa.eu/enterprise/policies/single-market-goods/documents/blue-guide ("Blue Guide")

54 http://ec.europa.eu/enterprise/policies/european-standards/documents/harmonised-standards-legislation/list-references/index_en.htm

The European Commission has granted a mandate to CEN/CENELEC to produce European standards. The mandate covers the standardisation work necessary for the optimum functioning of the Directive in both the electrical and mechanical field.

The mandate requires intensive co-operation between CEN and CENELEC to carry out the following work:

1. to review and, where appropriate, modify existing standards with a view to aligning them with the Essential Health and Safety Requirements of the Directive;

2. to establish the new standards required, giving priority to horizontal standards, which apply to broad ranges of products, rather than to specific products, with the need for them to be demonstrated on a case-by-case basis.

To carry out their mandate CEN established a technical committee CEN/TC 305 "Potentially explosive atmospheres - Explosion prevention and protection". Several Working Groups carry out the detailed work.

To carry out their mandate CENELEC allocated the work to TC 31 "Electrical Apparatus for Explosive Atmospheres", and its sub-committees. These Committees have been working in the potentially explosive atmosphere field for a considerable number of years and have produced a series of Standards under the Old Approach directive.

CENELEC and CEN are responsible for the preparation of standards of the electrical and non-electrical sectors of industry respectively. They have the responsibility to ensure that:

- there is uniform interpretation of the New Approach directive for potentially explosive atmospheres, and other relevant directives;
- safety requirements for the electrical and non-electrical sectors are compatible where they overlap, and the levels of safety sought are equivalent;
- The preparation of standards in the future by one of the organisations satisfactorily reflects the needs of the other, and vice versa.

14 USEFUL WEBSITES

Equipment and protective systems for Potentially Explosive Atmospheres - ATEX website on EUROPA: http://ec.europa.eu/enterprise/sectors/mechanical/atex

Directive 94/9/EC:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/legislation/atex

ATEX - Management of the Directive:
http://ec.europa.eu/enterprise/sectors/mechanical/atex/directive-management/index_en.htm

Guidance documents:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/guidance/atex/index_en.htm

Considerations papers by the ATEX Standing Committee:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/guidance/atex/standing-committee

Transposition into national law:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/legislation/atex/transposition/index_en.htm

ATEX competent authorities for Market Surveillance:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/contacts/atex-competent-authorities

ATEX contact points in Member States, candidate and EEA countries:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/contacts/atex-candidate-countries

Notified Bodies:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/legislation/atex/notified-bodies/index_en.htm

Standardization:
http://ec.europa.eu/enterprise/sectors/mechanical/documents/standardization/atex

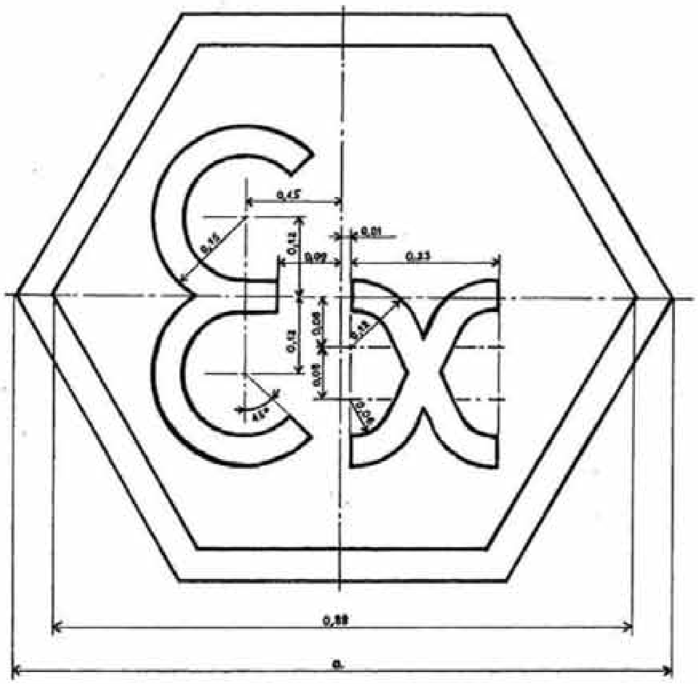
ATEX Directive interest group on CIRCA:
http://circa.europa.eu/Members/irc/enterprise/atex/home

ATEX Administrative Co-operation (AdCo) interest group on CIRCA:
http://circa.europa.eu/Members/irc/enterprise/atexms/home

ATEX group of Notified Bodies (ExNBG) interest group on CIRCA:
http://circa.europa.eu/Members/irc/nbg/exnbg/home

Industry associations and international organisations:
http://ec.europa.eu/enterprise/sectors/mechanical/links

ANNEX I: DISTINCTIVE COMMUNITY (EX) MARK DRAWN FROM DIRECTIVE 84/47/EEC



All values related to 'a'

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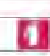
ANNEX II: BORDERLINE LIST - ATEX PRODUCTS

BORDERLINE LIST - ATEX PRODUCTS

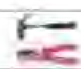
The List has been confirmed during the Directive 94/9/EC ATEX Working Group meeting 25 June 2008

Note that the list is not complete, it only clarifies some common inquires and provide examples of products within or outside the scope of the "ATEX" Directive 94/9/EC. The List does not replace the vital risk assessment of each product and in addition ignition sources and explosion hazards related to the use of all the products shall also always be considered.

Equipment	Scope of 94/9/EC	Examples of equipment	Comments
Equipment	(El. = Electrical)		
Clockworks	-		See 5.2.1 in ATEX Guidelines.
Computers	Yes (El.)		
Earthing clamps with and without cord	No/Yes		Should be assessed on a case-by-case basis to determine if the design of the equipment contains any potential ignition sources.
Electrical motors	Yes (El.)		El. equipment with potential ignition sources like heat and sparks of electrical origin (e.g. windings, connections) and mechanical origin (e.g. bearings).
Electrical pump with integrated electrical motor (e.g. canned or split tube motor pump; petrol pump/dispensers for petrol filling)	Yes (El.)		El. equipment with potential ignition sources like heat and sparks of electrical origin (e.g. motor circuit) and mechanical origin (e.g. pump impeller).
Electrical fan with integrated electrical motor (e.g. electrical axial fan)	Yes (El.)		El. equipment with potential ignition sources like heat and sparks of electrical origin (e.g. motor circuit) and mechanical origin (e.g. fan blades).
Non-electrical fan with integrated air motor (e.g. non-electrical axial fan)	Yes (Non El.)		Non-el. Equipment with potential ignition sources like frictional heat and sparks of mechanical origin (e.g. bearings, fan blades).
Hand operated valves	No		See 5.2.1 in ATEX Guidelines.
Heating cables	Yes (El.)		Heating cables transforms electricity into heat while cables "only" transports electricity
Mechanical brakes	Yes (Non El.)		Non-el. Equipment with potential ignition sources like frictional heat of mechanical origin.
Mechanical gears	Yes (Non El.)		Non-el. Equipment with potential ignition sources like frictional heat and sparks of mechanical origin.
Phones and similar equipment e.g. walkie-talkies, head phones etc.	Yes (El.)		El. equipment with potential ignition sources like heat and sparks of electrical origin.
Plugs and socket outlets	Yes (El.)		El. equipment with potential ignition sources like sparks of electrical origin (e.g. when connected or disconnected). Note that all countries have special requirements on plugs and socket outlets for domestic use.
Switches for fixed electrical installations	Yes (El.)		El. equipment with potential ignition sources like sparks of electrical origin (e.g. when switched on or off).
Torch	Yes (El.)		El. equipment with potential ignition sources like heat and sparks of electrical origin (e.g. sparks from a switch or heat in a bulb or battery).
Protective Systems			
Fire extinguisher	No		Intended to be used after an explosion.
Vent panels (for explosion pressure relief)	Yes		Intended to be used to limit the effects of an explosion.

1 (2)

- 68 -

Components			
Cables / Cable ladder systems for cable management	No		No autonomous function; not essential to safe functioning of ATEX equipment or protective system.
Conduits/pipes: e.g. Fume extraction arms and conduits for electrical installations (except for conduits intended to be used between the flameproof enclosures and the conduit sealing devices)	No		No autonomous function; not essential to safe functioning of ATEX equipment or protective system.
Cable lugs/shoes with and without cord	No		No autonomous function; not essential to safe functioning of ATEX equipment or protective system.
Electro Static Discharge (ESD) - Protections: e.g. wrestles, shoes, standing mats, antistatic bags	No		No autonomous function; not essential to safe functioning of ATEX equipment or protective system.
Enclosures	Yes (El.)		Intended to be used for electrical equipment with potential ignition sources.
Magnetic catches for doors etc.	No		No autonomous function; not essential to safe functioning of ATEX equipment or protective system.
PT 100 sensor	No/Yes		No when used in a intrinsic safe system together with e.g. a barrier. In all other situations is it to be decided on a case by case assessment.
Spark arrestor	Yes (Non El.)		Intended to prevent an explosion; not to limit it. It is an ATEX component if intended to be built into ATEX equipment or protective systems.
Safety, Controlling or Regulating devices			
Devices controlling the regular safety limits of an industrial process handling flammables, like pressure, level and temperature transmitters	No		Shall be protected as potential ignition sources themselves if placed inside hazards areas, but safety devices with respect to risks other than ignition hazards + monitoring devices providing only an alarm signal, but without direct control function, are outside scope of the directive (with respect to reliability and functional requirements acc to ESHR clause 1.5. and 1.6.)
Overload or temperature protective devices, inhibiting ignition sources from becoming active (e.g. current-dependent device for Exe motor) + Initiator devices for explosion protective equipment systems, i.e. suppression systems (trigging)	Yes (El.)		Both categories of devices are within 94/9/EC article 1.2., with respect to functional and reliability requirements according to the ESHR, clause 1.5. and 1.6.
Other products			
Doors	No		No own source of ignition.
Ladders, irrespective of the material	No		No own source of ignition.
Paint	No		No own source of ignition.
Tank	No		No own source of ignition.
Tools: e.g. hammers, tongs	No		No own source of ignition.

Note 1: Additional information can be obtained in the ATEX Guidelines and Standing Committee Considerations to directive 94/9/EC but also in the Non-binding guide to directive 1999/92/EC.

Note 2: Equipment, protective systems, components, safety, controlling, regulating devices and/or other products indicated as not falling within the scope of ATEX 94/9/EC, ignition sources and explosion hazards related to the use shall be considered. Friction impacts and abrasion processes involving rust and light metals (e.g. aluminum and magnesium) and their alloys may initiate an aluminothermic (thermite) reaction, which can give rise to particularly incentive sparking.

2 (2)

European Commission
Enterprise and Industry

- What's new
- Contracts & Grants

Mobile air-conditioning systems (MACs)

The European Directive on mobile air-conditioning systems (MACs) aims at reducing emissions of specific fluorinated greenhouse gases in the air-conditioning systems fitted to passenger cars (vehicles of category M1) and light commercial vehicles (category N1, class 1)

The main objectives of the Directive are:

- the control of leakage of fluorinated greenhouse gases with a global warming potential (GWP) higher than 150 in MACs;
- the prohibition from a certain date of MACs using those gases

The Directive is enforced in two phases:

1. The first phase: as from 21 June 2008 the manufacturers have been unable to obtain a type approval for a new type of vehicle if it is fitted with MACs designed to contain F-gases with a GWP higher than 150 leaking more than 40 grams per year (one-evaporator systems) and 60 grams per year (dual evaporator systems). As from 21 June 2009 this also applies for all new vehicles having been type-approved in the past.
2. The second phase is the complete ban of MACs designed to use the above mentioned gases. This ban is effective as from 1 January 2011 for new types of vehicles (the manufacturers are unable to obtain a type approval for a new type of vehicle if it is fitted with this kind of systems) and as from 1 January 2017 for all new vehicles. From that date on, new vehicles with these systems cannot be registered, sold and enter into service.

In practical terms, the use of the gas that is currently used for filling MAC systems (HFC-134a) is not permitted for newly type-approved vehicles since January 2011. The Commission is informed that automotive manufacturers have decided, in 2009, on the use of refrigerant HFO-1234yf as the technical solution to comply with the Directive's targets. In April 2012, and in light of the exceptional circumstances and exclusively with respect to supply problems of HFO-1234yf, the European Commission accepted to refrain from launching infringement procedures in cases where vehicle production would continue to be done with the gas HFC-134a until 31 December 2012. This solution was inextricably linked to the exceptional circumstances of lack of supply of the refrigerant. Since that problem has been solved, as expected, in the last quarter of 2012, there will be no extension of this solution. Vehicles that have been type-approved for the use of gas HFO 1234yf cannot be registered if they use gas HFC-134a, given that, according to Framework Directive 2007/46/EC, it is not possible for motor vehicles to be registered and marketed in the EU if they are not in conformity with the relevant legislation.

- The Technical Committee on Motor Vehicles supports the European Commission approach to the MAC affair - 17.07.2013
- Statement of Vice-President Tajani on the respect of the MAC Directive - 16.07.2013 de fr it
- Implementation of Directive 2006/40/EC - State of play [74 KB] de – 21.06.2013
- Note from the Commission to the Technical Committee of Motor Vehicles (TCMV): Application of Directive 2006/40/EC [126 KB] - 12.02.2013
- Declaration by the European Commission regarding Point 9 of the agenda of the 31st meeting of the 'Technical Committee - Motor vehicles' (TCMV): State of Play of the EU Mobile Air-Conditioning directive (2006/40/EC) [29 KB] - 20.12.2012
- Note from the Commission to the Technical Committee of Motor Vehicles (TCMV): The supply shortage of an essential component in mobile air conditioning systems and its impact to the application of Directive 2006/40/EC in the automotive industry [271 KB] - 18.04.2012
- Communication to the Commission: The supply shortage of an essential component in mobile air conditioning systems and its impact to the application of Directive 2006/40/EC in the automotive industry [54 KB] de fr - 30.03.2012
- Note from the Commission services: Questions concerning Community legislation on mobile air-conditioning systems [22 KB]
- Presentation at the SAE 8th Alternate Refrigerant Systems Symposium, 17-19 July 2007: The Regulatory Approach to MACs in the European Union - Current Status and Future Initiatives [111 KB]
- Directive 2006/40/EC relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC

Share:

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Part 7
Auxiliary Equipment Providers

7

The information provided herein is for informational purposes only and Honeywell does not endorse, guarantee, warrant or recommend any of the products or services offered by third parties.

CATEGORY LISTING

Hoses and Connections
- CPS Gauges and Fittings
- Errecom Hoses
- Mastercool Gauge Manifold
- Yellow Jacket (CGA 166 LH Adapter)

Leak Detection
- CPS Leak Detector
- Robinair Leak Detector
- RTI Leak Detector
- Techno Tools Leak Detector
- Yellow Jacket Leak Detector

Pumps
- Haskel Pump for Hose Recovery

Recovery, Recycle, Recharge (RRR) Machines
- CPS RRR Machine
- Ecotechnics ECK Twin
- Launch UK RRR System
- Robinair Service Equipment
- RTI Mahle RRR Machine

Refrigerant Identification
- Neutronics Refrigerant Identifier

SUPPLIER WEBSITES

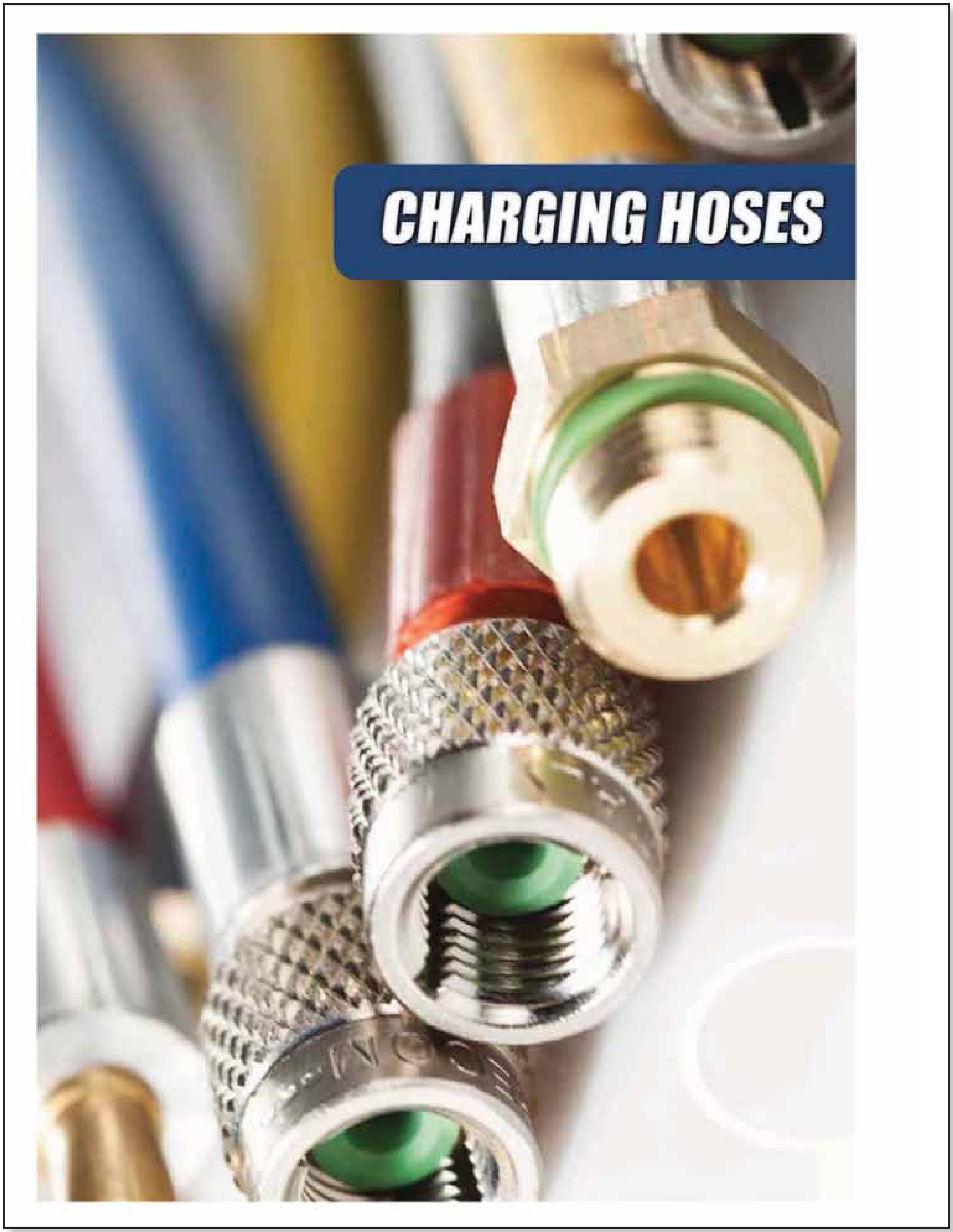
This is a partial list of equipment suppliers.

Beissbarth	www.beissbarth.com/bbcms/cms.php
Brain Bee	www.brainbee.it
CPS	www.cpsproducts.com
Ecotechnics	www.ecotechnics.it
Errecom	www.errecom.it/ENG/
Fral Oksys	www.fral-arm.com
Haskel	www.haskel.com
Hella Nussbaum	www.hella-nussbaum.com
Launch UK	www.launchtech.co.uk
Luvata	www.luvata.com
Mastercool	www.mastercool.com
Motorscan KS electronics	www.motorscan.com
Neutronics	www.neutronicsinc.com
Robinair	www.robinair.com
RTI	www.rtitech.com
Snap On	www.snapon.com
SPX	www.spx.com/en/
Techno Tools	www.techno-tools.com
Tecnomotor	www.tecnomotor.it
TEXA	www.texa.com
Waeco	www.airconservice.eu
WIGAM	www.wigam.it
Yellow Jacket	www.airconservice.eu

Table of Contents

Hoses and Connections


FULLY AUTOMATIC
MULTI REFRIGERANT
RECOVER / RECYCLE / RECHARGE
The FA1234 is a patented, multi refrigerant Convert-able R / R / R machine that can be converted for use with any of the following refrigerants in 5 minutes or less: R-134a, HFO-1234yf, R22 and R407C. This R / R / R convert-able unit is the only machine in the world to recover without fear of cross contamination when converted back and forth.
MACH 7
FA1234
SEMI-AUTOMATIC
MULTI REFRIGERANT
RECOVER / RECYCLE / RECHARGE
The AR2700M is a semi-automatic recovery, evacuate and recharge machine for both trucks and reefers. A wide selection of refrigerants could be used; HFO-1234yf R-12, R-22 R-134a, R-401a, R-402a, R-404a, R-407c, R-409a and R-502. Incorporated into the unit is a non-restrictive ball valve control system, which allows for faster recovery and charging.
AR2700: Single refrigerant unit.
AR2700M: Multi-refrigerant unit with pump down valve.
AR2700M
CPS®
Innovations in Design™
INTRODUCING
2012
HFO-1234yf Product Line
MTHF0134
Pro-Set® Workingman's Choice™
Manifold Set with 6' hoses, Dual R-134a & HFO-1234yf complete with HFO manual couplers and R-134a snap couplers
MGHF0134
Ball Valve
Manifold Set with 6' hoses, Dual R-134a and HFO-1234yf with HFO-1234yf manual couplers and R-134a snap couplers
QC1214 SET
Manifold Retrofit Kit
Includes: 1 - QC1214 Set
1 - AD88L Tank Adapter
For converting R-134a manifold to HFO-1234yf
QCL1234 / QCH1234
HFO Quick Couplers
AD48L - 1/4" SAE Female x 1/2" LH ACME
AD84L - 1/4" SAE Male x 1/2" ACME Female
AD88L - 1/2" ACME Male x 1/2" LH ACME Female
GLOBAL HEADQUARTERS
1010 East 31st Street
Hialeah, Florida 33013, USA
Tel: 305-687-4121
1-800-277-3808
Fax: 305-687-3743
E-mail: info@cpsproducts.com
www.cpsproducts.com


CHARGING HOSES

Errecom Hoses

REPORT ON LABORATORY TESTS PERFORMED ON ERRECOM CHARGING HOSES

ERRECOM srl declares that its own charging hoses have been tested according to technical specification given by SAE J2196 and SAE J2888 standards.
In particular, ERRECOM charging hoses have passed a set of inspections and laboratory tests, required to verify the full compliance with features stated in the chart below.

TECHNICAL DATA SHEET

Ø external Hose	Ø internal Hose	Internal Core		Material of the internal Core	Type of Braid	Material of the external covering	Burst Pressure	Working Pressure	Min. Bend
		Ø External Hose	Ø Internal Hose						
10.8 mm	5.7 mm	7.4 mm	6.0 mm	Polyamide thermoplastic elastomer alloy	Braid of Strength in Polyester Fiber	Thermoplastic elastomer	300 bar	60 bar	30 mm

In addition to dimensional checks, to visual inspections, to tests for leakage and burst pressure, the charging hoses have undergone two further tests:

- Test of permeability to gas
- Test of resistance to thermal cycles of stress.

TEST OF PERMEABILITY TO GAS

The test of permeability to gas (see chart below) is led according to SAE J2196 and SAE J2888 standards by conditioning in a climatic chamber 4 samples of hose filled with a known mass of Helium gas.

Using an electronic Leak Detector, repeated measurements are performed over the time (24 and 72 hours) to detect the average rate of permeability to gas. The rate is expressed in kg/sqm/year and it does not have to exceed the threshold value of 9,8 kg/sqm/year as required in SAE J2196 and SAE J2888 standards.

REFRIGERANT GAS	UNIT	PERMEABILITY PER METER OF HOSE				
		ERRECOM HOSE		TRADITIONAL HOSE IN ELASTOMER		THRESHOLD VALUE
		After 24 hrs	After 72 hrs	After 24 hrs	After 72 hrs	
R-12	g/year m	12	36	40	119	163
R-134a		8	24	26	79	

TEST OF RESISTANCE TO THERMAL CYCLES OF STRESS

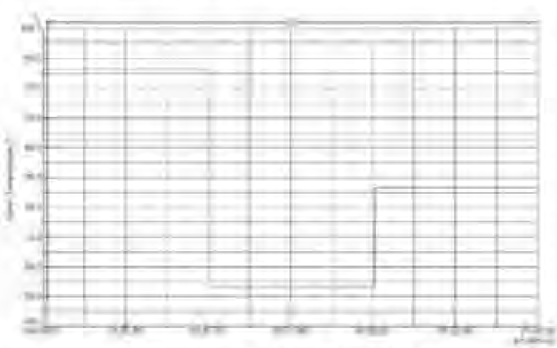
To run this test, reference is made to a methodology developed internally, which consists in subjecting 4 samples of hose to a thermal cycle of stress. This cycle takes 6 hrs. and is repeated 28 times (in total: 168 hrs., 7 days).

The tested charging hoses are initially filled with a liquid mixture of PAG Lubricant (in suspension inside vehicles A/C systems) and fluorescent U/V leak detector dye (typically used to detect possible leaks in A/C systems).

Each sample is pressurized up to 6 bar with refrigerant gas and then pressurized with Nitrogen up to final pressure of 15 bar (at ambient temperature). The thermal cycle includes 3 phases:

The first phase consists in a sudden increase in temperature up to 80°C and the maintenance of this condition for 2 hrs.
The second phase consists in a sudden decrease in temperature down to -30°C and the maintenance of this condition for 2 hrs. more.
The third phase consists in a sudden increase in temperature up to 20°C and the maintenance of this condition for 2 hrs. more.

The cycle, including the three phases above-described, is repeated 28 times until the completion of the 168 hrs. required. In fig. 1 the time-temperature chart related to the test-cycle is shown.



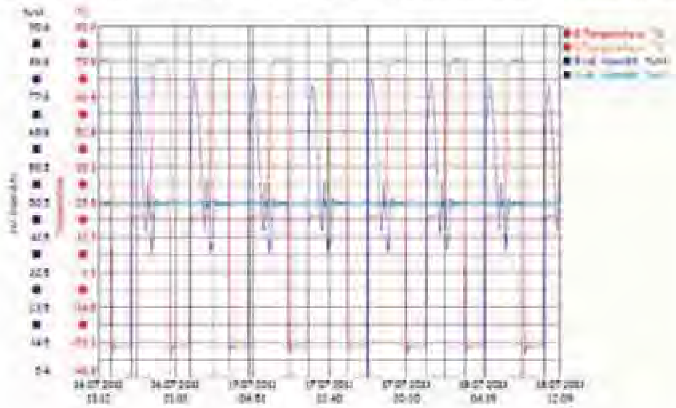
Trend of temperature in climatic chamber during the test-cycle.

During the whole test-cycle, moisture of the air is regulated at 50% thanks to a control system integrated in the climatic chamber.

Only during the refrigeration phase down to -30°C it is not possible to control the relative humidity, as the concentration of water vapor naturally tends to fall to zero.

The chart below shows the trend over the time of relative humidity (in blue) and temperature (in red) during the test.

Refrigeration Charging Hose Test
Camera (no1) prog. Refrigeration Charging 168h arch: avvia Camera 16.7.2011 12:08 Interr.: Admin 25.7.2011 18:51



Trend of relative Humidity and Temperature during the test

The complete overcoming of all tests and inspections described guarantees the high quality, safety and reliability over the time of ERRECOM charging hoses. qualità, sicurezza e affidabilità nel tempo.

TECHNICAL FEATURES ERRECOM CHARGING HOSES
SAE J2196 SAE J2888

Ø external Hose	Ø external Hose	Internal Core		Material of the Internal Core	Type of Braid	Material of the external covering	Burst Pressure	Working Pressure	Min. Bend
		Ø external Hose	Ø internal Hose						
10.8 mm	5.7 mm	7.4 mm	6.0 mm	Polyamide thermoplastic elastomer alloy	Braid of Strength in Polyester Fiber	Thermoplastic Elastomer	300 bar	60 bar	30 mm

MARKING ON THE HOSE

ERRECOM Refrigerant Charging Hose ### SAE J2888 R-1234yf ### WP 60 Bar - MBP 240 Bar ### SAE J2196 R134a R410a R407 R404 R422 R424 ### *Made in ITALY*

TECHNICAL FEATURES GOODYEAR CHARGING HOSES
SAE J2196 SAE J2888

Ø external Hose	Ø external Hose	Material of the internal Core	Type of Braid	Material of the external covering	Burst Pressure	Working Pressure
10,92 ÷ 11,94	5,36 ÷ 6,12	Thermoplastic Elastomer Nylon	Braid of Strength in Polyester Fiber	Thermoplastic Elastomer	275 bar	55 bar

MARKING ON THE HOSE

5.7mm GY5 Low Perm Refrigerant Charging Hose GOODYEAR SAE J2196 WP 5.6 Mpa MBP 28 Mpa R22 R134a R407c R410A R502 Made in EC.

Errecom Hoses

QUICK COUPLERS FOR R134a REFRIGERANT GAS

1/4 SAE MADE-IN-CHINA QUICK COUPLERS

Art.-Nr.	DESCRIPTION		€/Each
RA1008.01	HIGH PRESSURE	01 PC	-
RA1009.01	LOW PRESSURE	01 PC	-

1/4 SAE MADE-IN-CHINA 90° QUICK COUPLERS

Art.-Nr.	DESCRIPTION		€/Each
RA1004.01	HIGH PRESSURE	01 PC	-
RA1005.01	LOW PRESSURE	01 PC	-

3/8 SAE MADE-IN-CHINA 90° QUICK COUPLERS

Art.-Nr.	DESCRIPTION		€/Each
RA1006.02	HIGH PRESSURE	01 PC	-
RA1007.02	LOW PRESSURE	01 PC	-

M14X1,5 MADE-IN-CHINA 90° QUICK COUPLERS

Art.-Nr.	DESCRIPTION		€/Each
RA1006.01	HIGH PRESSURE	01 PC	-
RA1007.01	LOW PRESSURE	01 PC	-

HIGH PRESSURE SPECIAL ADAPTER FOR R134a

FOR BMW 5 - FORD S MAX, GALAXY - VOLVO C30 MERCEDES SLK

Art.-Nr.	DESCRIPTION		€/Each
RA1018.01	HIGH PRESSURE	01 PC	-

QUICK COUPLERS FOR R-1234yf REFRIGERANT GAS

M12X1,5 ERRECOM QUICK COUPLERS (SAE J2888)

Art.-Nr.	DESCRIPTION		€/Each
RA1050.01	HIGH PRESSURE	01 PC	-
RA1051.01	LOW PRESSURE	01 PC	-

M12X1,5 PARKER QUICK COUPLERS (SAE J2888)

Art.-Nr.	DESCRIPTION		€/Each
RA1047.01	HIGH PRESSURE	01 PC	-
RA1046.01	LOW PRESSURE	01 PC	-

M12X1,5 MADE-IN-CHINA QUICK COUPLERS

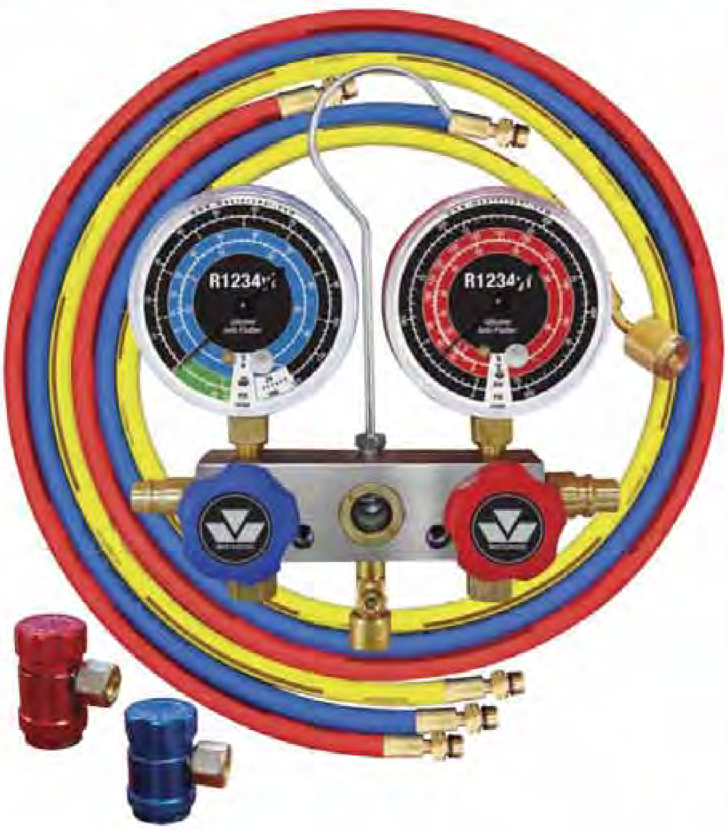
Art.-Nr.	DESCRIPTION		€/Each
RA1048.01	HIGH PRESSURE	01 PC	-
RA1049.01	LOW PRESSURE	01 PC	-

Mastercool® Inc.

"World Class Quality"

1 ASPEN DRIVE, RANDOLPH, NJ 07869
PHONE: 973-252-9119 / FAX: 973-252-2455
WEB: WWW.MASTERCOOL.COM

R1234yf Aluminum Manifold Gauge Set



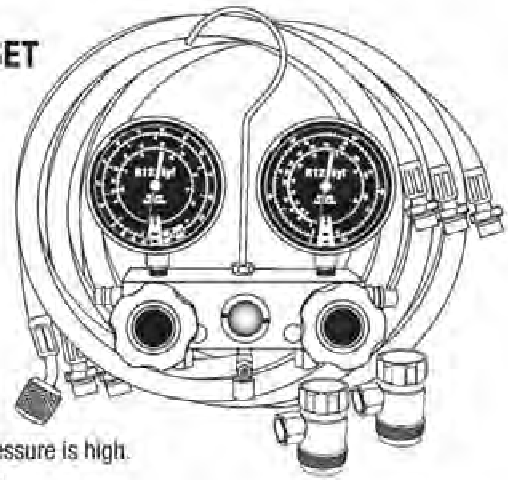
FEATURES & BENEFITS

- Anti-flutter gauges smooth out needle movement
- E-Z to read temperature scales on gauge face
- E-Z to recalibrate gauges to insure accuracy
- Extra large sight glass for visual checks of refrigerant
- Easy grip front-facing knobs
- Piston type free-floating valves reduce o-ring wear
- Manifold block assembled with (3) 12mm-F fittings per SAE J2888
- Red & Blue Nylon barrier hoses with 12mm-M fittings on both sides meets SAE J2888, EPA, SAE & UL standards
- Yellow hose 12mm fitting on one side and 1/2 x 16 LH acme on the other meets SAE J2888
- R1234yf high and low side couplers with extended disconnect protection sleeve meets SAE J639 & J2888

Mastercool Gauge Manifold

OPERATING INSTRUCTIONS

R1234yf MANIFOLD GAUGE SET



⚠ WARNING

Wear Safety Goggles

Avoid Contact with Refrigerant

TROUBLESHOOTING TIPS

- Low side and high side pressure are low.
  Usually indicates a low charge.
- Low side pressure is low and high side pressure is high.
  Usually indicates a blockage in the system.
  (i.e. expansion of valve or orifice tube.)
- Low side pressure is high and high side pressure is low.
  When accompanied by a vibrating gauge needle, usually indicates faulty reed valves in compressor.
- Low side and high side pressures are high.
  Usually indicates an over charged system.

HOOK-UP FOR SYSTEM DIAGNOSIS

- Verify that service ports are clean and free of metal shavings.
- Verify that both valves on the manifold are shut completely.
- Connect blue adapter to low side service port (5).
- Connect red adapter to high side service port (4).
- Start engine. Turn A/C mode selector to HIGH and fan to HIGH.
- Observe pressure on the manifold gauges and refer to your automotive manual for proper diagnosis.

CHARGING REFRIGERANT

a. Verify that both valves on the manifold are shut completely.

b. Turn on car and A/C system, (this will aid in charging of the refrigerant.)

c. Connect the other end of the yellow hose (3) to Refrigerant Gas supply. (*Follow refrigerant manufacturer's instructions for proper dispensing.*)

d. Connect vacuum pump to center tee and remove air from yellow hose and manifold (*vacuum pump hose not included.*)

e. Open manifold low side (blue) valve slowly until pressure reaches 42 psi. Do not exceed 42 psi during the recharging process. Exceeding 42 psi could damage the compressor.

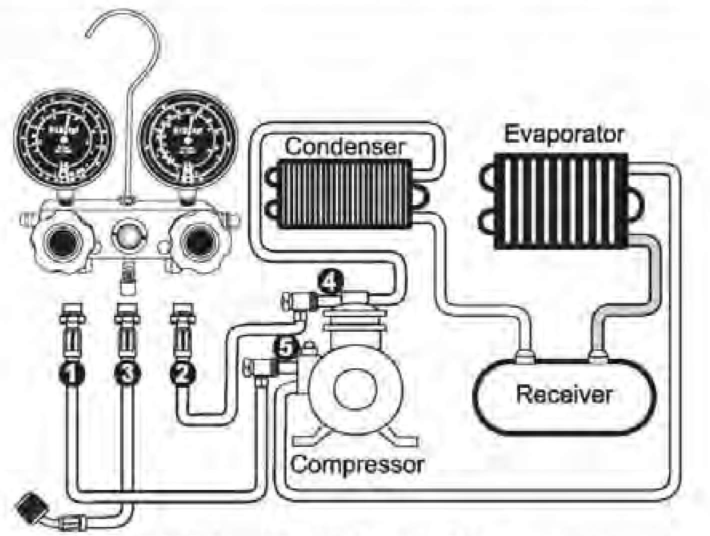
f. When charging is finished, close low side (blue) valve.

SYSTEM SCHEMATIC

1. Low side (blue) hose/adapter.
   (12mm-M fittings on both sides meets SAE J2888, EPA, SAE & UL standards)

Mastercool Gauge Manifold

2. High side (red) hose/adapter.
   (12mm-M fittings on both sides meets SAE J2888, EPA, SAE & UL standards)
3. Service (yellow) hose.
   (Yellow hose 12mm fitting on one side and 1/2 x 16 LH acme on the other meets SAE J2888)
4. Compressor discharge service valve.
   (R1234yf couplers with extended disconnect protection sleeve meets SAE J639 & J2888)
5. Compressor suction service valve.
   (R1234yf couplers with extended disconnect protection sleeve meets SAE J639 & J2888)



High (4) and Low (5) service port locations may vary.

83277 INST

ESPAÑOL FRANÇAIS

Automotive A/C Fittings Couplers

Automotive Fittings and Adapters

Description:

Adapter fittings designed to work with 1/2" Acme or 14mm threads. Made in the USA.

UPC#	Description
19185	Left hand ACME QC x 1/4" Male Flare for R-1234yf Cylinders

Yellow Jacket Part Number **19185**

~$12.00 each, available for shipment

Table of Contents

Leak Detection

CPS Leak Detector

CPS®

Innovations in Design

Patent Pending

Ergonomic design for comfort and ease of use

Rugged carrying case included

KEY FEATURES

Meets all US and International standards for automotive use including SAE J2913 for HFO-1234yf, SAE J2791 for R-134a and European Standard EN14624:2005. Superior sensitivity to all HFC, HCFC, and CFC gases and blends as well as SF6.

New E_MOS™ sensor technology incorporates a proprietary pulse modulation design to increase both battery and sensor life.

For over 30 years CPS has led the industry in portable leak detection technology and has been awarded multiple patents for it's **Innovations in Design**.

CPS®

LDA1000

CPS® Products proudly introduces the all new **LDA1000** automotive Leak-Seeker® featuring **E_MOS** ™ technology. Packed with unique design features the LDA1000 is the best automotive leak detector you can find, anywhere in the world at any price, truly an **Innovation in Design**.

Features:

- Microprocessor controlled sensor electronics utilizing a multi channel signal detection method improves sensitivity while reducing false alarms.
- New **E_MOS**™ sensor technology incorporates a proprietary pulse modulation design to increase both battery and sensor life.
- Software managed sensor rejuvenation mode, initiated at each startup ensures the highest level of sensitivity every use, for up to 500 hours of detecting leaks of less than .1 oz per year.
- Sensitivity remains constant over the life of the sensor.
- Meets all US and International standards for automotive use including SAE J2913 for HFO-1234yf, SAE J2791 for R-134a and European Standard EN14624:2005. Superior sensitivity to all HFC, HCFC, and CFC gases and blends as well as SF6.
- 50+ hour battery life (3 "C" batteries) Auto Off after 10 minutes. Green LED low battery indicator.
- 500+ hours sensor life
- 2 year warranty excluding batteries and sensor
- Both visual and audible leak indicators
- Patent Pending

MADE IN U.S.A.

500+ Hour Sensor Life

WORLD HEADQUARTERS
1010 East 31st Street, Hialeah, Florida 33013, USA
Tel: 305-687-4121, 1-800-277-3808, Fax: 305-687-3743
e-mail: cpssales@cpsproducts.com www.cpsproducts.com

LTLDA1000


REFRIGERANT: 22791
ROBINAIR
INFRARED REFRIGERANT LEAK DETECTOR
Locate the exact location of the leak
Find Leaks Faster
Eliminate countless hours searching for hard to find leaks
LEAK DETECTOR FEATURES
Advanced infrared sensor designed to last a minimum of 10 years.
Three sensitivity levels down to 0.15 oz./year.
Automatically recalibrates in highly contaminated areas to help pinpoint the exact location of the leak
Won't trigger on oil or moisture.
Senses CFC, HFC, HCFC blends and HFO-1234yf refrigerants.
8-hour lithium Ion battery lasts all day long and beyond.
Visual alert and peak button make it easy to find leaks in noisy environments.
Audible alert with mute button.
Magnetic hanger to easily hang the unit during leak repair.
Durable carrying case let's you easily store leak detector and accessories.
Meets NEW SAE J2913 standard for 1234yf and previousSAE J2791 standard for 134A.
Meets NEW SAE J2913 standard for 1234yf.
Leak Detector
Specifications
HIGH 0.15 oz./year and higher
MEDIUM 0.25 oz./year and higher
LOW 0.5 oz./year and higher
www.robinair.com
800 533 6127

ROBINAIR®

No. 22791
Infrared Refrigerant Leak Detector

Operator's Manual
Manual del operador
Manuel de l'opérateur

Product Description

The Robinair No. 22791 uses infrared optics to create a refrigerant leak detector that combines sensitivity, speed, battery life, portability, and ease of use. This unit detects leaks as small as 0.15 oz/year, and meets SAE J1627, J2791, and J2913 standards.

No. 22791 comes with a wall charger and a car charger for its compact lithium-ion battery—which can power the leak detector for up to eight hours of continuous operation before needing to recharge. A choice of three sensitivity settings keep false alarms to a minimum while allowing detection of even the smallest leak in a refrigerant contaminated environment. A 30-second, self-calibration test occurs whenever the unit is powered on to ensure optimal performance. A built-in replaceable filter blocks moisture and particulates, preventing damage to the sensor.

Specifications

Sensing element: enhanced infrared photo optics

Refrigerants: HFC, CFC, HCFC, blends, and HFO-1234yf

Sensitivity level (per SAE J2791 and J2913):

HIGH: 0.15 oz/year and higher
MED: 0.25 oz/year and higher
LOW: 0.5 oz/year and higher

Response time: less than one second

Battery life: up to 8 hours continuous use before recharge

Auto OFF: 10 minutes of inactivity

Battery: 3.7V, 1880 mAH rechargeable, lithium-ion (No. 74364)

Low battery LED: illuminates when 1 hour of battery life remains

Charge time: less than 4 hours @ 500 mA

Operating environment: 32ºF (0°C) to 122ºF (50°C) at <75% RH

Storage environment: <80% RH for detector and battery

For 80% battery recovery:

-4ºF (-20°C) to 140ºF (60°C) less than 1 month
-4ºF (-20°C) to 113ºF (45°C) less than 3 months
-4ºF (-20°C) to 68ºF (20°C) less than 1 year

Accessories included: wall charger, car charger, storage case, battery (installed), and operator's manual.

Safety Precautions

Warning: To prevent personal injury and/or equipment damage,

- **Read, understand, and follow all warnings stated in the *Lithium Battery Care* section of this manual.**
- **DO NOT charge the battery with any charger other than the chargers supplied with the unit.**
- **DO NOT use No. 22791 without a clean filter correctly installed in the tip.**
- **DO NOT draw moisture in through the probe.**

Lithium Battery Care

No. 22791 operates on a lithium-ion type NP-120 battery. For long battery life and safe operation, observe all warnings.

Warning: To prevent personal injury and/or equipment damage,

- **Do not disassemble or attempt to repair the battery or protective circuit.**
- **Never attempt to charge the battery if it has been removed from the unit.**
- **Do not expose the battery to temperatures above 140°F (60°C).**
- **Do not charge the battery near a fire or in a hot vehicle or direct sunlight.**

- **Do not solder directly on the battery.**
- **Do not subject the battery to impact.**

- **Do not expose the battery to moisture or immerse it in fluid.**
- **Do not deform, pierce, or damage the battery.**

- **Do not touch a battery that is leaking electrolytes. If battery fluid should get in your eyes, flush with fresh water, do not rub eyes, and see a physician immediately.**
- **Do not use a battery if it is deformed, smells bad, changes color, or appears abnormal. Send the unit in for a replacement battery immediately.**

Charging the Lithium Battery

Two types of chargers are supplied with No. 22791 leak detector. The AC charger plugs into a wall outlet (100–240 VAC, 50/60 Hz); the car charger plugs into a vehicle cigarette lighter DC plug.

1. BEFORE USING THE UNIT THE FIRST TIME:

   Fully charge the battery. The unit was packaged and shipped from the factory with the battery only partially charged.

2. WHEN THE BATTERY IS LOW:

   The LOW-BATT LED will illuminate in red.

3. TO RECHARGE NO. 22791:

   Plug one end of the charger into the top of the unit, and the other end of the charger into the power source. The LOW-BATT LED will blink while charging until the battery is fully charged.

   NOTE: Always charge within the charging environment specifications of 32°F (0°C) to 122°F (50°C) at <75% RH.

4. AVOID DISCHARGING THE BATTERY COMPLETELY.

   Recharging a partially discharged battery more frequently is better for the life of a lithium-ion battery.

Functions and Settings

ON/OFF Protection

Press and hold the ON/OFF button for one second to turn No. 22791 ON or OFF. This one-second delay protects against accidental ON or OFF.

LED Bar Graph Display

The eight-segment LED display indicates the degree of change in refrigerant concentration. As the concentration of refrigerant in the air increases, the number of illuminated bars on the display increases also.

L/M/H Button (Sensitivity Levels)

Set the unit's sensitivity level by pressing the L/M/H button. Low (L), medium (M), or high (H) sensitivity level is indicated by its respective LED. The higher the background concentration of refrigerant in the air, the lower the sensitivity level should be set. To detect a very small leak in a high refrigerant background, use the Contaminate Mode.

Mute Button

Press the MUTE button to toggle the audio portion of No. 22791 ON or OFF.

Peak Button

The PEAK function stores the highest change in refrigerant concentration achieved while continuing to detect leaks. Press the PEAK button to toggle this function ON and OFF. The PEAK LED illuminates when this function is turned on. Turning the PEAK function off clears the peak information.

Contaminate Mode

To detect even the smallest leak in refrigerant-contaminated environments, press the PEAK button rapidly four times. The green LED will flash rapidly to show contamination mode is on. Press the PEAK button rapidly four times again to turn contamination mode off.

Leak Detection Procedure

1. Press and hold the ON/OFF button for one second. The warm-up and calibration sequence takes approximately 30 seconds. The sensitivity level defaults to HIGH at startup.
2. The most likely place for a refrigerant leak is at soldered joints in refrigerant lines and changes in cross section or direction of these lines. No. 22791 detects changes in concentration of refrigerant, not the absolute concentration of refrigerant. This allows the detection of leaks in locations that may have refrigerant in the air. Use the following “double pass” method to find leaks from the detection of change in refrigerant concentration. Leak test with the engine off.
   A. Charge the system with sufficient refrigerant to have a gauge pressure of at least 340 kPa (50 psi) with the system off. At ambient temperatures below 15°C, leaks may not be measurable because the pressure may not be reached.
   B. Visually trace the entire refrigerant system, and look for signs of air conditioning lubricant leakage, damage, and corrosion on all lines, hoses, and components. Check each questionable area with the detector probe, as well as all fittings, hose-to-line couplings, refrigerant controls,

service valves with caps in place, brazed or welded areas, and areas around attachment points and hold-downs on lines and components. If looking for an apparently larger leak, check first at the 7 g/yr or 14 g/yr position.

C. Always follow the refrigerant system around in a continuous path so no areas of potential leaks are missed. If a leak is found, continue to test the remainder of the system.

D. Recheck service valves with caps removed. Blow shop air over service valve to clear immediate area, and then check with detector on 7 g/yr setting.

E. Move the detector at a rate of no more than 75 mm/sec (3 in/sec) and as close as possible to 9.5 mm (3/8 in) from the surface, completely encircling each test position (switch, sensor, refrigerant tubing connection, etc).

F. Slower movement and closer approach of the probe normally improve the likelihood of finding a leak. However, detectors made to meet this standard are based on air sampling from the 9.5 mm (3/8 in) distance. Retest is advisable when a leak appears to be found at the most sensitive settings, particularly if the probe was in a static position on a joint, or making physical contact with a joint, as it was moving. Repeat with a moving probe test at that location, taking care to maintain the small gap (9.5 mm or 3/8 in) to confirm the leak is of repairable size. Use of the 7 g/yr (0.25 oz/yr) position of the detector, after finding an apparent leak with the 4 g/yr (0.15 oz/yr) setting, may also be helpful.

G. No. 22791 is sensitive and can take up to 30 seconds to clear after detecting a small amount of contaminant. It will typically clear in 2 to 15 seconds.

Caution: Do not use cleaning agents or solvents on or near A/C lines. Wipe away dirt or potential false-trigger chemicals by using a dry towel or shop air.

If the 22791 does false trigger on a chemical listed below, allow the leak detector to clear for a minimum time listed in the table.

SAE J2791 False-Trigger Test Results

Chemical	Detection	Time to Clear (seconds)
Windshield washer solvent	Yes	6
Ford spot and stain remover	No	-
Ford rust penetrant and inhibitor	Yes	5
Ford gasket and trim adhesive	Yes	6
Permatex Natural Blue cleaner and degreaser	No	-
Ford brake parts cleaner	Yes	6
Ford clear silicone rubber	No	-
Motorcraft G-05 antifreeze / coolant	No	-
Gunk Liquid Wrench	Yes	4
Ford pumice / lotion hand cleaner	No	-
Ford Motorcraft DOT-3 brake fluid	No	-
Ford spray carburetor tune-up cleaner	Yes	5
Ford silicone lubricant	No	-
Dexron automatic transmission fluid	No	-
Mineral engine oil	No	-

Accessories and Replacement Parts

Optional Accessories	Order No.
Extension Probe (9 inch)	74367
Rigid Extension Probe	74368

Replacement Parts	Order No.
100–240 VAC Charger	74361
Std. Europe Plug Adapter	74115
Great Britain Plug Adapter	74116
12V DC Charger	74362
Filters (5) and O-rings (3)	74363
Lithium-ion Battery	74364
Sensor Tip	74365

Filter Replacement

A filter, located in the tip of the wand, blocks moisture and other contaminants from the sensor. When this filter becomes wet, it restricts the flow of air and must be replaced.

To replace the filter:

1. Unscrew and remove the tip of the sensor to expose the white filter.
2. Remove and discard the filter.
3. Position a new filter in the tip so the round end of the filter is closest to the tip of the wand.

NOTE: Use only Robinair supplied replacement filters.

Storage

The battery should have a 40%-50% charge during prolonged storage of a month or longer. The correct storage environment is critical to battery life.

Storage environment: <80% RH for detector and battery.

For 80% battery recovery:

-4ºF (-20°C) to 140ºF (60°C) less than 1 month
-4ºF (-20°C) to 113ºF (45°C) less than 3 months
-4ºF (-20°C) to 68ºF (20°C) less than 1 year

NOTE: Battery life will be reduced significantly if the battery is stored with a full charge and/or at high temperatures.

Warranty

This product has been produced to provide unlimited service. Should it become inoperable after the user has performed the recommended maintenance, a no-charge repair or replacement will be made to the original purchaser. This applies to all repairable units that have not been damaged or tampered with. The claim must be made within **ONE YEAR** of the date of purchase.

Garantia

Este producto se produjo para proporcionar servicio ilimitado. Si llegara a dejar de funcionar después de que el usuario ha llevado a cabo el mantenimiento adecuado, se hará un cambio o reparación sin cargo al comprador original. Esto aplica a todas las unidades reparables que no se han dañado ni alterado. El reclamo debe realizarse en el período de **UN AÑO** a partir de la fecha de la compra.

Garantie

Ce produit a été conçu pour offrir un service illimité. Si celui-ci devenait inopérant après que l'utilisateur aie effectué l'entretien recommandé, une réparation ou un remplacement sans frais sera fait au bénéfice de l'acheteur original. Ceci s'applique à toutes les unités réparables qui n'ont pas été endommagées ou trafiquées. La réclamation doit être effectuée en dedans d'**UNE ANNÉE** de la date de l'achat.

ROBINAIR.
655 EISENHOWER DRIVE
OWATONNA, MN 55060 USA
TECH SERVICES: 1-800-822-5561
FAX: 1-866-259-1241
CUSTOMER SERVICE: 1-800-533-6127
FAX: 1-800-322-2890
WEBSITE: WWW.ROBINAIR.COM

550029
Rev. F, May 20, 2013


ArcticPRO
A/C Service Equipment
ACCESSORIES
RTI
Technologies
A Bosch Group Company
LD-2
Dual Mode Refrigerant Gas Leak Detector
Featuring Two Leak Detection Modes:
• Solid Electrolyte Gas Sensor and
• Patented UV System
Detects both R-134a and R-1234yf Refrigerants
Pinpoint Refrigerant Leaks Quickly and Efficiently
The RTI model LD-2 features two detection modes, a solid electrolyte gas sensor, and a Patented UV dye detection system. It has a long life solid electrolyte sensor technology that is designed to detect the more difficult HFC refrigerants such as R-134a and the new HFO refrigerant R-1234yf. The instrument's unique digital leak size indicator takes the guesswork out of determining leak size. The digital display is independent from the audio alarm and sensitivity level, allowing the precise pinpointing of the leak source. The LD-2 is powered by (4) AA Alkaline batteries.
Features and Benefits:
• Patented 3 LED UV Light 395-415 nm wavelength for optimum air conditioning dye fluorescence US Patent 7,145,649
• No UV enhancement eyeglasses needed
• Unique digital alarm with numeric leak size indicator
• Long life, stable sensor
• Automatic calibration and reset to ambient levels
• 3 adjustable sensitivity levels
• True mechanical pump
• Low battery indicator
• SAE J2791 Certified, EN14624 Certified and CE Certified
• Mute feature
• Super durable, garage tough
• Carrying case included
• Visual LED leak alarm near sensor
• Two year warranty on Detector, including sensor
• Made in USA
www.rtitech.com • 800-468-2321

ArcticPRO
A/C Service Equipment
ACCESSORIES

Specifications

Model #:	LD-2	Battery Life:	8 hours continuous
Name:	Refrigerant Leak Detector	Warm-up Time:	<20 seconds
Sensitivity:	.05 oz/yr R134, .0123 oz/yr R1234yf	Probe Length:	17 inches
UV Mode:	3 UV LED's	Weight, lbs:	1.5 lbs
UV Wavelength:	395-415 nanometers	Warranty:	2 years (2 on sensor)
Electronic Sensor Life:	>10 years	Numerical Display:	7 segment digital display (1 to 9)
Response time:	Instantaneous	Alarm near sensor:	Visual probe LED
Power Supply:	4 AA Alkaline batteries (included)		

RTI Technologies
A Bosch Group Company
10 Innovation Drive
P.O. Box 3099
York, PA 17402
USA
Tel: 717-840-0678
TF: 800-468-2321
Fax: 717-755-8304
E-Mail: rti@rtitech.com
Web: www.rtitech.com

Equipment Part Number: 026 80635 00
Document Part Number: 035 80982 00

Equipment for the most productive technicians in the world. 800-468-2321 www.rtitech.com

Techno Tools Leak Detector

Techno Tools Corporation Model D440A Refrigerant Gas Leak Detector

Description

The D440A features a long life solid electrolyte semiconductor sensor technology that is designed to detect the more current and difficult HFC refrigerants such as R-134a, R-410A, R-404A, R-407A, and R-507 in addition to the new HFO-1234yf and all HCFC (R-22) and CFC (R-12) refrigerants including SNAP approved hydrocarbon blends. The D440A's unique digital leak size indicator takes the guesswork out of whether or not to repair a small leak. The digital display is independent from the audio alarm and sensitivity level, allowing the precise pinpointing of the leak source. The D440A does not require rechargeable batteries.

SAE J2791 and J2913 CERTIFIED

EURO STANDARD EN14624

Features:

- Long life, stable sensor
- Unique numeric leak size indicator
- Automatic calibration and reset to ambient levels
- 3 adjustable sensitivity levels
- Visual LED leak alarm located near sensor
- True mechanical pump
- Low battery indicator
- Uses 4 AA alkaline batteries
- Audio mute function
- Comfortable neoprene grip
- CE Certified
- Made in USA
- 2- year warranty includes sensor
- Rugged carrying included
- Euro Standard EN 14624
- SAE J2791 and J2913 Certified

Product Specifications

Model #	D440A
Name	Leak Detector, Refrigerant Gas
Sensitivity	.05 oz/yr R-134a
Sensor Life	> 10 years
Response Time	Instantaneous
Power Supply	4 AA Alkaline batteries
Battery Life	5 hours continuous
Warm up time	< 20 seconds
Probe length	17 inches
Numerical Display	7 segment digital display (1 to 9)
Weight, lbs	1.5 lbs.
Warranty	2 years (includes sensor)

TECHNO TOOLS

Model D-440A
Refrigerant Gas Leak Detector

Detects all CFC, HFC, HCFC
Refrigerants including blends

User Manual

CE

Certified
SAE J2791
EN14624

Made In U.S.A.

Techno Tools Leak Detector

Product Specifications

Model #	D-440A
Name	Leak Detector, Refrigerant Gas
Sensitivity	.05 oz/yr R134a .025 oz/yr R22
Sensor Life	> 300 hours
Response Time	Instantaneous
Power Supply	4 AA Alkaline batteries
Battery Life	8 hours continuous
Warm up time	< 20 seconds
Probe length	17 inches
Numerical Display	7 segment digital display (1 to 9)
Weight, lbs	1.5 lbs
Warranty	2 years (includes sensor)

EN14624/2005 Test Specifications

Minimum/Maximum Sensistivity Threshold (fixed)	1 gm/yr minimum, >50 gm/yr maximum
Minimum/Maximum Sensitivity Threshold (moving)	3 gm/yr minimum, > 50 gm/yr maximum
Minimum Detection Time (1gm/yr)	Approx 1 sec
Clearing Time	Approx 9 seconds after exposure to >50 gm/yr
Minimum Threshold after Maximum Exposure	1 gm/yr
Sensitivity Threshold in Polluted Atmosphere	1 gm/yr
Calibration Frequency	1/yr check with calibrated leak Standard

Cross Sensitivity to Automotive Chemicals

Some automotive solvents and chemicals have similar hydrocarbon properties as R134a and may elicit a positive response (<30 seconds) from the D440A. Before leak checking, clean up any chemicals in the list below that elicit a positive response.

Chemical Name/Brand	Response
Rain-X Windshield Wash Fluid	Y
Ford Spot Remover (Wet)	Y
Ford Rust Inhibitor	Y
Ford Gasket Adhesive (Wet)	Y
Loctite Natural Blue degreaser (diluted)	Y
Ford Brake Parts Cleaner	Y
Ford Silicone Rubber (uncured)	Y
Motorcraft Antifreeze heated to 160 deg F	Y (partial)
Gunk liquid wrench	Y
Ford silicone lubricant	N
Ford Pumice lotion (with solvent)	Y
Ford Motorcraft brake fluid	Y
Ford Carburetor Cleaner	Y
Dextron Transmission fluid heated to 160 deg F	N
Quaker State Motor Oil heated to 160 deg F	N

INTRODUCTION

The D-440A features a long life heated sensor technology that is designed to detect the more current and difficult HFC refrigerants such as R-134a, R-410a, R-404a, R-407c, and R507 in addition to all HCFC (R22) and CFC (R12) refrigerants including SNAP approved hydrocarbon blends.

The D-440A's unique digital leak size indicator takes the guesswork out of whether or not to repair a small leak. The digital display is independent from the audio alarm and sensitivity level, allowing the precise pinpointing of the leak source.

The D-440A does not require rechargeable batteries. An optional detachable UV light will soon be available that clips on to the probe to allow both electronic or UV detection with one tool.

FEATURES

- Unique numeric leak size Indicator
- Long life, stable sensor
- R134a sensitivity .05 oz/yr
- R22 sensitivity .025 oz/yr
- Designed Certified by ACSI to meet SAE 2791
- Automatic calibration and reset to ambient
- Visual LED leak alarm near sensor
- 3 adjustable sensitivity levels
- Low battery indicator
- True mechanical pump
- Audio mute function
- Uses 4 AA alkaline batteries
- CE Certified
- Comfortable Sanoprene grip
- 2- year warranty includes sensor
- Made in USA

D-440A Control Panel

Operating Instructions

1. **TURN ON:** Press the ON/OFF button once to turn on and again to turn off.

2. **WARM UP:** The detector automatically starts heating the sensor. During the heating cycle, the digital leak size indicator will flash 0 and the detector will sound a slow "beep". Warm up is usually less than 20 seconds.

3. **READY:** The detector is ready to begin searching for leaks when the flashing 8 stops and the green sensitivity LED turns on. The audio "beep" increases in frequency and probe LED begins to blink steadily.

2

Leak Size Indicator

The digital leak size indicator remains off normally but once a leak is detected, a number from 1-9 will be displayed for all HFC and HCFC refrigerants *regardless of the sensitivity setting.*

The number will continue to increase or decrease depending on the amount of refrigerant sensed. The maximum value will be displayed once the leak source has been located. The table below can be used to approximate the size of leak:

Maximum # displayed	Leak Size (oz/yr)
1 -3	< 0.1
4-6	0.1 to 0.5
7-9	>0.5

Low Battery Indicator

Replace the 4 AA Alkaline batteries when the red LED on the control panel is lit. Follow battery installation instructions under **Maintenance** section.

Audio Mute Function

To silence or mute the audio beep and alarm signal, press the MUTE button. To restore the audio sound, press the MUTE button again. (Note: a few seconds is required to restore sound if the mute button is pressed in rapid succession.)

Adjusting Sensitivity Levels

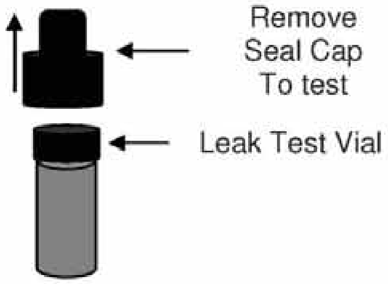
The Leak Detector will default to the NORM sensitivity level automatically once the unit comes out of the warm up cycle and the green LED will turn on.

To change sensitivity levels, press the SENS once for HI sensitivity (red LED will turn on) and again for LO sensitivity (yellow LED will turn on).

Leak Test Vial

The leak detector comes with a Leak Test Vial that allows the user to make sure the detector is performing properly. To test:

1. Remove the plastic seal cap on top of the Leak Test Vial by pulling it off (see fig. below).
2. Turn on the detector and allow the unit to complete the warm up cycle.
3. Place the sensor close to the small hole in the top of the Leak Test Vial. The beep rate should increase and the Digital Leak Size Indicator should display a number from 4-6 indicating that the sensor and electronics are working properly.



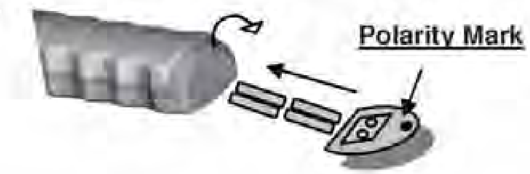
NOTE: Always remember to replace plastic seal cap after leak test is completed. Replace Test Vial when the green color is no longer visible.

4

Maintenance

Batteries:

Install Batteries: Remove screw located at rear end of unit and pull down hinged battery door to open as shown. Always insert all four batteries into the battery compartment in the same direction. Note polarity mark on the inside of the battery door for proper battery orientation.

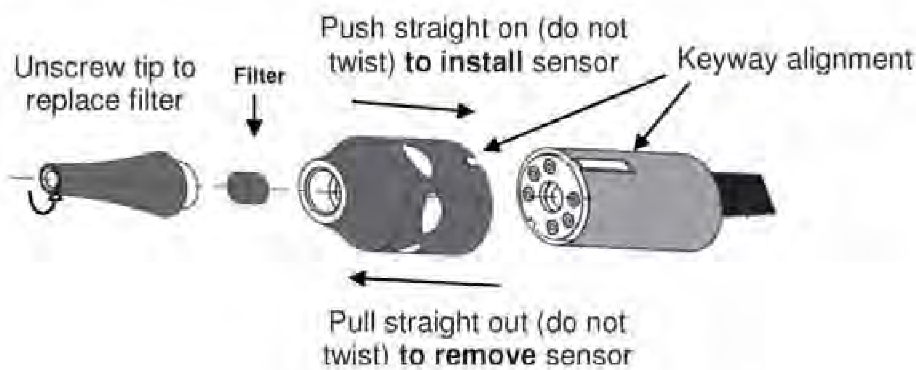


Sensor:

Replace Filter: Unscrew sensor tip as shown to replace filter. Replace filter whenever it becomes visibly dirty or every 2 to 3 months depending on use.

Replace Sensor: Remove sensor by pulling out of socket. Install the new sensor by aligning the notch in sensor cover with the raised keyway on sensor socket holder (see figure below).

Note: Do not force sensor into socket. Misalignment can damage the sensor pins.



Replacement Parts

Item	Part Number
Sensor with Filter	AC-SEN0009A
Sensor filters (5 pack)	AC-FIL0001A
Leak Test Vial	AC-LSA0001A
Parts Kit (includes sensor, test vial, & filter kit)	AC-KIT0004A
Carrying Case	AC-CAS0001A

RETURN FOR REPAIR POLICY

Every effort has been made to provide reliable, superior quality products. However, in the event your instrument requires repair, forward unit to Service Center freight prepaid to the address below with return address, phone number and/or email address.

SERVICE CENTER
2651 W 81st Street
Hialeah, FL 33016

WARRANTY POLICY

The D-440A Refrigerant Gas Leak Detector is warranted to be free of defects in materials and workmanship for a period of two years from the date of purchase. This warranty applies to all repairable instruments that have not been tampered with or damaged through improper use including unauthorized opening of the unit. Please ship warranty units that require repair freight prepaid to Service Center along with proof of purchase, return address, phone number and/or email address.

Call Toll Free: 800-222-0956
Fax: 786-235-1202

YELLOW JACKET®

ACCUPROBE™ UV Leak Detector with Solid Electrolyte Sensor

Use the electrolyte sensor or UV technology (or both at the same time) to detect HFC, HCFC and CFC refrigerants, including SNAP approved hydrocarbon blends

The ultra-sensitive sensor of the YELLOW JACKET® ACCUPROBE™ UV Handheld Leak Detector allows it to detect even the most difficult to detect R-134a, R-404A, R-407C and R-410A refrigerants. Our exclusive solid electrolyte sensor technology reduces heat and gives the sensor longer life than traditional heated anode or heated diode detectors.

The ACCUPROBE UV features low, normal and high sensitivity levels with visual and audible signals, and a 3 LED UV light system that works with 395-415nm wavelength leak tracing dyes. The audible alert, which can also be muted, and the flashing visual alarm indicator at the probe end increase in frequency and duration as concentration increases.

The ACCUPROBE UV is equipped with the advanced digital SmartAlarm™ LED display. This feature takes the guesswork out of whether or not to repair a small leak. Unlike the more traditional LED bar graphs that copy or mimic the audio alarm signal, the SmartAlarm digital leak size indicator measures, registers and displays the leak size independently from both the audio alarm and the sensitivity level.

Features

- Improved, robust, ergonomic design easy to use in close areas and extendable into hard-to-reach areas
- Long life, stable sensor
- Instantaneous response time
- Quick clearing from large amounts of refrigerant
- Automatic calibration and reset to environment
- Low battery indicator
- Microcontroller technology
- Temperature range of 24° to 125°F (-4° to + 52°C)
- Humidity 0 to 95% RH non-condensing
- SAE J2791Certified
- CE Marked
- 18 month limited warranty
- Made in USA

Specifications

Sensitivity: Detects 0.06 oz (1.7g)/yr. of R-134a and 0.03 oz (0.9g)/yr. of R-22
Power: AA alkaline batteries
Battery Life: 4.5 hours continuous
Probe Length: 17 inches (430mm)
Length (body): 10.5 inches (270mm)
Weight: 17 ounces (480g)
Calibration: Automatic
Sensor Life: >300 hours
Response Time: Instantaneous

UPC #	Description
69336	AccuProbe UV
69337	AccuProbe UV - Euro/UK plug
69338	AccuProbe UV - Japanese plug
69339	AccuProbe UV - AU/NZ plug

YELLOW JACKET
RITCHIE ENGINEERING
Bloomington, MN USA 55438-2623
www.yellowjacket.com

YELLOW JACKET®

ACCUPROBE™ UV and ACCUPROBE™ II
Refrigerant Leak Detector with Heated Sensor

Instruction and Operation Manual

Models 69336, 69337, 69338, 69339 and 69354

YELLOW JACKET®

RITCHIE ENGINEERING COMPANY, INC.

Made in U.S.A.

Introduction

The YELLOW JACKET® AccuProbe™ UV and AccuProbe™ II Hand-held Leak Detectors detect all HCFC refrigerants such as R-22 and R-124. The ultra-sensitive long life sensor with Solid Electrolyte Sensor Technology also detects the more current, difficult-to-detect refrigerants such as R-134a, R-1234yf, R-404A, R-407C and R-410A (see page 7 for a more complete chart of detectable refrigerants).

The ACCUPROBE UV is equipped with the unique digital SmartAlarm™ LED display – the first digital leak size indicator in a hand-held heated sensor leak detector. This feature takes the guesswork out of whether or not to repair a small leak. Unlike the more traditional LED bar graphs that copy or mimic the audio alarm signal, the SmartAlarm digital leak size indicator measures, registers and displays the leak size independently from both the audio alarm and the sensitivity level.

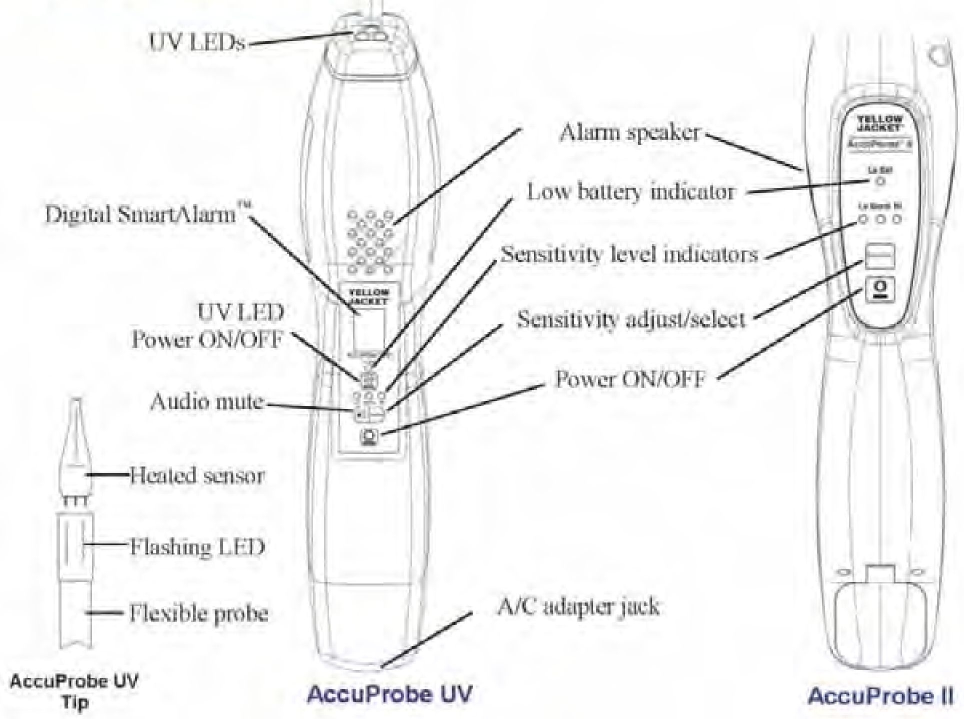
The ACCUPROBE UV also features a 3 LED UV light system that works with 395–415nm wavelength leak tracing dyes. The sleek, ergonomic design of these YELLOW JACKET leak detectors makes them easy to use in close areas and extendable into hard-to-reach areas.

When finding leaks, it is important to note that the AccuProbe responds to changes in concentration of refrigerant. For this reason, the detector will stop alarming even though it is held at or near the source of the leak and will not alarm again until the detector senses a change in concentration. To verify the exact location of the source of the leak, always move the probe away from the area of the leak briefly to allow the sensor to reset at a lower concentration, and then bring it back again until the exact location of the leak source has been verified.

Features

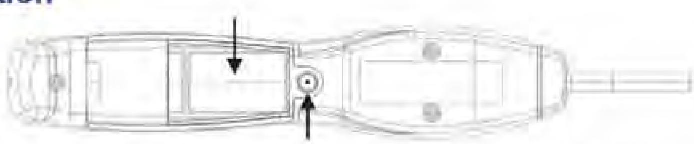
- Advanced digital SmartAlarm™ leak size indicator (AccuProbe UV)
- Flashing visual alarm indicator at probe end (AccuProbe UV)
- Audio mute button (AccuProbe UV)
- Operates on 4 AA alkaline batteries (AccuProbe UV can also use AC power)
- 3 LED UV light system that works with 395-415nm wavelength leak tracing dyes (AccuProbe UV)
- Microcontroller technology
- Ultra-high sensitivity to detect leaks as small as 0.06 oz (1.7g)/yr. of R-134a/R-1234yf and 0.03 oz (0.9g)/yr. of R-22. See insert sheet for certified ratings.
- Automatic calibration and reset to ambient
- Detects HFC, HCFC, CFC and HFO refrigerants (see page 7)
- Long life stable sensor utilizing Solid Electrolyte Sensor technology
- 3 selectable sensitivity level settings
- Sleek ergonomic design
- Low battery indicator
- Temp Range 24° to 125°F (-4° to + 52°C)
- Humidity 0 to 95% RH noncondensing
- CE Marked
- True mechanical pump

Parts and Controls



Battery Installation

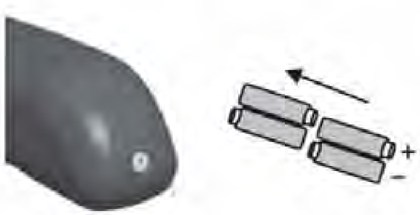
AccuProbe UV



1. Loosen battery door screw located on the bottom of the detector and remove door.
2. Install 4 AA alkaline batteries observing the proper battery polarity as labeled inside the battery compartment and shown above.
3. Reinstall the battery door and tighten the screw.

AccuProbe II

1. Loosen screw located at rear end of unit and pull down hinged battery door to open as shown.
2. Always insert all four batteries with the proper polarity.



Operating Instructions

AccuProbe UV

1. **POWER ON:** The detector is turned ON and OFF by pressing the POWER button (see figure 1 below).

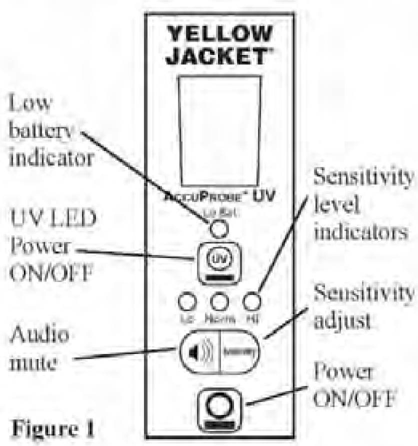
2. **WARM-UP:** The detector automatically starts heating the sensor to condition it for use. While in this WARM UP phase – and until ready – the instrument will signal audibly by beeping slowly and visually by flashing the sensitivity LEDs and the zero (0) in the SmartAlarm™ display window. **Warm up time is usually about 20 SECONDS or less. For maximum sensitivity, wait an additional two minutes after normal warm-up.**

3. **SEARCH:** The detector is ready for leak searching when the sensitivity LEDs stop flashing and the beep rate increases. At this time the zero in the display window stops flashing. When a leak is detected, the beeping sound and flashing LED in the probe will increase in frequency, and the SmartAlarm digital LED display will turn on indicating the leak size. If no leak is detected go to HI sensitivity and continue searching.

SmartAlarm™ Display

The SmartAlarm LED Display is a digital leak size indicator that numerically displays the leak size on a scale of 1 to 9 for all HFC and HCFC refrigerants – regardless of the sensitivity setting. This value helps you decide whether or not the leak is large enough to require repair.

For example, when in the HI sensitivity mode, the detector may sound a full audio alarm but the SmartAlarm Display may show a low number – indicating that the leak is very small. In contrast, when in the LO sensitivity mode, a full audio alarm may not sound but the SmartAlarm may show a high number, indicating that the leak is large.



4 **Figure 1**

SmartAlarm™ DISPLAY	LEAK SIZE DISPLAY (OZ/YR.)*
1 TO 3	< 0.1 (2.8g)
4 TO 6	0.1 to 0.5 (2.8-14g)
7 TO 9	> 0.5 (14.1g)
*HFC and HCFC Refrigerants	

The maximum value displayed, once the source of the leak is located, indicates the leak size. This value helps you decide whether or not a leak is large enough to require repair. The table above shows the leak rates corresponding to the SmartAlarm numerical display.

UV LIGHT OPERATION

⚠ CAUTION: EMITS ULTRAVIOLET RADIATION

⚠CAUTION
ULTRAVIOLET LIGHT HAZARD

- This UV LED during operation radiates UV light
- Avoid direct eye and skin exposure to UV light
- If viewing the UV light is necessary, please use UV filtered glasses to avoid damage by the UV light

Before leak checking with the UV light:

(a) Make sure the A/C system is properly charged with sufficient dye (see manufacturer's specifications for proper dye charge.)
(b) Run the A/C system long enough to thoroughly mix and circulate the dye with the refrigerant and lubricating oil.

1. Turn on UV light by pressing the UV light ON/OFF button (see diagram on left).

2. Holding the leak detector approximately 10" to 14" away, shine the UV light beam slowly over the components, hoses, and metal lines that make up the A/C system.

3. When the UV light shines on the fluorescent dye that has escaped from the system, the dye will glow a bright yellow green.

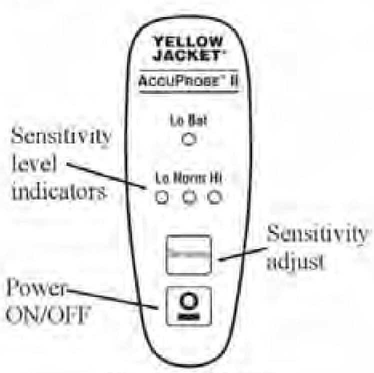
4. The UV LEDs will automatically turn off after five minutes.

Using the SmartAlarm Display

1. The SmartAlarm will not display a number (1 through 9) until a leak is sensed. Once a leak is sensed, the numbers on the display will gradually increase.
2. Use the SmartAlarm display to "zero in" on the leak source by watching the numbers climb higher as the leak source is approached.
3. Once the leak source has been located, always wait for the maximum number to be displayed to determine the size of the leak.
4. Lower numbers (approximately 1 to 3) indicate that the leak size is less than 0.1 oz/yr. and may not require repairing at this time – depending on the amount of gas in system. NOTE: Multiple small leaks in a system are cumulative and may require that all system leaks should be repaired.

AccuProbe II

1. TURN ON: Press the ON/OFF button once to turn on and again to turn off.
2. WARM UP: The detector automatically starts heating the sensor. During the heating cycle, the detector will sound a slow "beep." **Warm up time is usually about 20 SECONDS or less. For maximum sensitivity, wait an additional two minutes after normal warm-up.**
3. READY: The detector is ready to begin searching for leaks when the green sensitivity LED turns on. The audio "beep" increases in frequency.



AccuProbe II Keypad

Adjusting the sensitivity levels

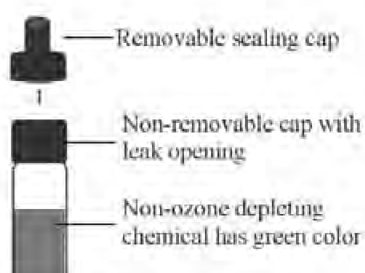
To choose another sensitivity level, press the Sensitivity button. The LED below each level will change indicating the new setting.

The leak detector will default to the NORM sensitivity level automatically once the unit comes out of the warm-up cycle and the green LED turns on.

Using the Leak Standard

Use the leak standard to determine that the leak detector performs to specifications.

1. Lift off the plastic sealing cap on the top of the LEAK STANDARD.
2. POWER ON the unit. After WARM UP and when READY expose the sensor directly to the small hole in the top of the bottle cap. The beep rate should increase to an alarm. For the AccuProbe, the SmartAlarm should display a number greater than 2. If the SmartAlarm fails to display 2 or above, leave the detector on for approximately 15 to 30 seconds longer and retest. This indicates that the sensor and electronic circuit are functioning properly.
3. Replace plastic cap seal after leak test. Note: Replace the leak standard when the green color is no longer visible.



Leak Standard Bottle

Low battery indication

Important: Replace the batteries immediately when the red low battery LED comes on (see page 3). Follow instructions under section titled "BATTERY INSTALLATION" on page 3.

Audio alarm mute (AccuProbe UV)

To silence the audio alarm, press the MUTE button. Press the MUTE button again to restore the audio alarm.

Sensor failure mode

If the sensor is not working correctly, the AccuProbe Leak Detector will not come out of the warm-up mode. (Some competitive units without this function will not alert you that the sensor is malfunctioning or has failed.)

If the AccuProbe detector does not come out of warm-up, first be sure the sensor is plugged in all the way. If that does not correct the situation, replace the sensor.

Maintenance

Batteries: Replace the batteries when the red low battery LED turns on. See "BATTERY INSTALLATION" on page 3.

Sensor filter replacement: Unscrew the sensor tip as shown to replace the filter. For optimum performance, replace filter whenever it becomes visibly dirty with grease or oil or every 2-3 months (depending on use).

Note: Never clean dirty filters with a solvent or soap and water. Always replace with a new filter supplied with the leak detector or they can be re-ordered from your supplier or distributor.

Sensor replacement: Remove sensor by pulling out of socket. Install the new sensor by aligning the notch in the sensor cover with the raised keyway on the sensor socket holder (see Figure 2).

Note: Do not force sensor into socket.

Figure 2

Replacement Parts

AccuProbe UV and AccuProbe II	Parts kit (sensor, filters and leak standard bottle)	69383
	Sensor and filter	69384
	Sensor filters (package of 5)	69385
	Leak standard bottle	69386
AccuProbe UV	A/C Adapter Input: 115V 60Hz **UL listed**	69380
	A/C Adapter—EU/UK Plug Input: 230V 50Hz **CE & TÜV** Approved	69381
	A/C Adapter—AU/NZ Plug Input: 230V 50Hz **CE & TÜV** Approved	69378
	Battery cover and screw	69388
	Carrying case - blow molded with inserts	69387
AccuProbe II	Carrying pouch	69361

Troubleshooting Guide

PROBLEM	CHECK	REPAIR OR REPLACE
No power	• Check for weak or reversed batteries	• Replace batteries
Stays in "warm up" mode	• Sensor not plugged into socket correctly • Sensor open/defective	• Make sure sensor is pushed all the way down into socket • Replace sensor
No detection	• Check sensor with leak standard bottle • Check if the filter is dirty or sensor opening is plugged	• Replace sensor • Replace filter or clean out opening
Slow recovery after detection	• Check if filter is dirty or sensor opening is plugged	• Replace filter or clean out opening
No beeping	• Nothing	• Press mute button (if equipped) to turn speaker back on

Partial list of detectable SNAP* listed refrigerants

R-12 ALTERNATIVES	R-22 ALTERNATIVES
R-134a, R-1234yf, R-401A (MP-39), R-401B (MP-66), R-401C (MP-52), R-406A (GHG)	R-407C, R-410A, R-410B, R-507
R-414A (GHG-X4), R-414B (Hot Shot), R-416A (Frig C, FR-12)	**R-113, R-13B & R-503 ALTERNATIVES**
R-409A (FX-56), Freeze 12, Free Zone, GHG-X5, GHG-HP, IKON 12	R-403B, R-508A, R-508B
R-502, R-500 ALTERNATIVES	**HC REFRIGERANTS** (not SNAP approved)
R-402A&B, R-404A, R-407A, R-408A, R-411A&B, R-507	R-290, R-600A, R-170/R-290, R-600A/R-290

* SNAP (Significant New Alternatives Program) an EPA program for ozone depleting refrigerants for mobile and stationary A/C systems

7

24 MONTH LIMITED WARRANTY

Ritchie Engineering guarantees YELLOW JACKET AccuProbe Leak Detectors to be free of defective material and workmanship that would affect the life of the product under normal use for the purpose for which it was designed. This warranty does not cover items that have been altered, abused, misused, improperly maintained or returned solely in need of field service maintenance. This warranty excludes the sensor, which is warranted for one year.

If found defective, we will upon compliance with the following instructions, credit, replace or repair at our option, the defective leak detector provided it is returned within 24 months of the date of sale. ACCUPROBE leak detectors have a date of manufacture serial number located on the label on the bottom of the unit.

Correction in the manner provided above shall constitute a fulfillment of all liabilities with respect to the quality, material and workmanship of the product.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF QUALITY, WHETHER WRITTEN, ORAL OR IMPLIED.

For tips on searching for leaks, visit www.yellowjacket.com

YELLOW JACKET Products Division
Ritchie Engineering Co., Inc.
10950 Hampshire Avenue South
Bloomington, MN 55438-2623

Telephone: 800-769-8370 or 952-943-1333
Fax: 800-322-8684 or 952-943-1605
E-mail: custserv@yellowjacket.com
Web: www.yellowjacket.com

Printed in U.S.A.

P/N 400399_Rev.D

Pumps

Haskel Pump for Hose Recovery

Haskel Pump for Hose Recovery

Haskel INTERNATIONAL, INC.

PUMPS FOR REFRIGERANT
Recovery or Recharge

R-11*, R-12, R-22, R114, 134A, R-500, R-502

Efficiency – Pump the liquid first… then the vapor… then vacuum to 23"-27" HG with one pump.

High Pressure – Positive displacement, two stage with plenty of "leverage" to condense the common refrigerant without a condenser.

Flexibility – Speed completely variable from zero to maximum lbs/minute. Stall against load. Start against load. Run dry. No need for unloaders or bypass valving. Add gauges and hoses to suit your application.

Cool Operation – No heat generated during liquid transfer. Minor warming during vapor transfer. No refrigerant heating from the motor.

Safety – Pneumatically driven. Operates from an air hose like an air tool. No electrical hazard.

Portability – Each model is an integral pump with linear air motor assembly weighing from 13 to 24 lbs.

Clean – No lubrication required. Nothing is added to the refrigerant, liquid or vapor.

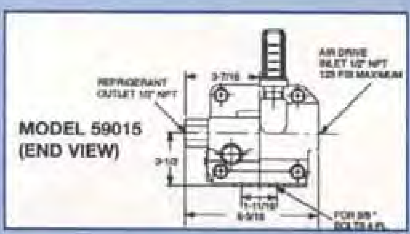
*For R-11 or R-113 specify model number –2 (e.g. 59015-2) Provides change to buna o'rings in wetted section.

MODEL 59020
Close Coupled

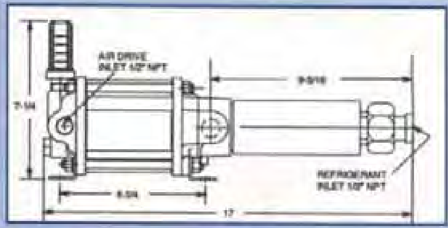
MODEL 59015

MODEL 59025
with Distance Piece

DIMENSIONS AND PORTS



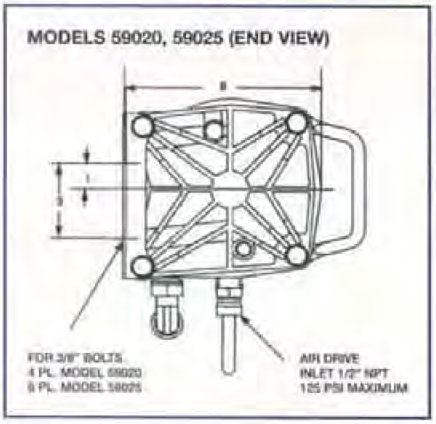
MODEL 59015 (SIDE VIEW)

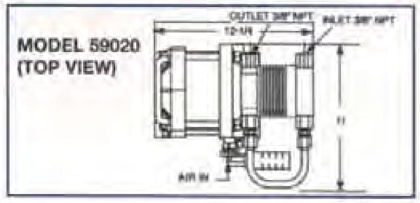


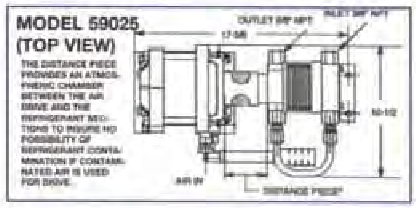
PUMPS FOR REFRIGERANT RECOVERY OR RECHARGE

Haskel Pump for Hose Recovery

PUMPS FOR REFRIGERANT RECOVERY OR RECHARGE





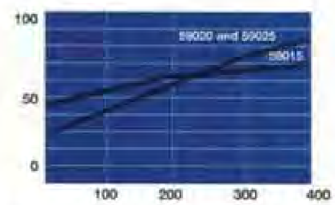


BASIC SPECIFICATIONS

Model	Weight	Pump Displacement per Cycle	Air Drive Bore X Stroke	Seals Pumps	Seals Drive	Wetted Section Metals
59015	13 lbs.	8.9 cu. in.	4 x 2-1/2	Neoprene* and PTFE	Buna	Aluminum and S.S.
59020 59025	23 lbs. 24 lbs.	10 cu. in.	5-3/4 x 2	*Buna optional for R-11, R-113. Add-2 after model number (e.g. 59015-2)		

INDICATIONS–APPROXIMATE PERFORMANCE

Model	Vapor with constant output resistance of 15 psi and inlet falling from 15 psi-0 psi	15 psi and inlet falling from 0 psi-27"HG	250 psi and inlet falling from 50 psi-0 psi	250 psi and inlet falling from 0 psi-23"HG
59015	Averages 1.4 scfm	Averages .11 scfm	Averages 1.5 scfm	Averages .11 scfm
59020 59025	Averages 1.5 scfm	Averages .15 scfm	Averages 1.8 scfm	Averages .14 scfm



NOTE: 1. **Air Driver Input:** [illegible]
2. **Suction of Plumbing:** [illegible]
3. **Safety and Relief Valves** [illegible]

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For further information on Haskel products, visit our website at: **www.haskel.com**

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Printed in USA

Table of Contents

Recovery, Recycle, Recharge (RRR) Machines


FULLY AUTOMATIC
MULTI REFRIGERANT
RECOVER / RECYCLE / RECHARGE
The FA1234 is a patented, multi refrigerant Convert-able R / R / R machine that can be converted for use with any of the following refrigerants in 5 minutes or less: R-134a, HFO-1234yf, R22 and R407C. This R / R / R convert-able unit is the only machine in the world to recover without fear of cross contamination when converted back and forth.
MACH 7
FA1234
SEMI-AUTOMATIC
MULTI REFRIGERANT
RECOVER / RECYCLE / RECHARGE
The AR2700M is a semi-automatic recovery, evacuate and recharge machine for both trucks and reefers. A wide selection of refrigerants could be used; HFO-1234yf R-12, R-22 R-134a, R-401a, R-402a, R-404a, R-407c, R-409a and R-502. Incorporated into the unit is a non-restrictive ball valve control system, which allows for faster recovery and charging.
AR2700: Single refrigerant unit.
AR2700M: Multi-refrigerant unit with pump down valve.
AR2700M
CPS®
Innovations in Design™
INTRODUCING
2012
HFO-1234yf Product Line
MTHFO134
Pro-Set® Workingman's Choice™ Manifold Set with 6' hoses, Dual R-134a & HFO-1234yf complete with HFO manual couplers and R-134a snap couplers
MGHFO134
Ball Valve Manifold Set with 6' hoses, Dual R-134a and HFO-1234yf with HFO-1234yf manual couplers and R-134a snap couplers
QC1214 SET
Manifold Retrofit Kit
Includes: 1 - QC1214 Set
1 - AD88L Tank Adapter
For converting R-134a manifold to HFO-1234yf
QCL1234 / QCH1234
HFO Quick Couplers
AD48L - 1/4" SAE Female x 1/2" LH ACME
AD84L - 1/4" SAE Male x 1/2" ACME Female
AD88L - 1/2" ACME Male x 1/2" LH ACME Female
GLOBAL HEADQUARTERS
1010 East 31st Street
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Fax: 305-687-3743
E-mail: info@cpsproducts.com
www.cpsproducts.com

CONVERT-ABLE™

MULTI REFRIGERANT

RECOVER / RECYCLE / RECHARGE

FULLY AUTOMATIC

The FA1234 is a patented, multi refrigerant Convert-able R / R / R machine that can be converted for use with any of the following refrigerants in 5 minutes or less: **R-134a**, **HFO-1234yf**, **R22** and **R407C**. This R / R / R convert-able unit is the only machine in the world to recover without fear of cross contamination when converted back and forth.

Designed to meet the following SAE standards.

SAEJ2788
R-134a

SAEJ2810
R-134a Recovery only

SAEJ2843
HFO-1234yf

SAEJ2843
HFO-1234yf Recovery only

FA1234

CPS® Innovations in Design™

INTRODUCING **2012**

FEATURES:

- Standard equipment includes a CPS patented high speed 2-cylinder oil-less compressor for fast and complete recovery
- Featuring CPS patented motorized ball valve flow control system, the FA1234 eliminates the worry of working on systems that have been contaminated with sealants, burn outs, etc.
- High capacity, 50 micron 6 CFM vacuum pump
- Equipped with 50 lb recovery tank as standard equipment. Can be easily programmed for 90 lb recovery tanks, or any standard international tank on the market
- Standard equipment includes 8 foot hoses, R-134a couplers, HFO-1234yf couplers, R-134a tank refill adaptors, and HFO1234yf tank refill adaptor.
- The digital display screen features multiple languages – English, French, German, Spanish, and Chinese
- Powder coated steel cabinet built on top of a 1" steel tubular frame for durability in the shop with spare filter storage drawer.
- The FA1234 can be programmed for HI side, LO side or both HI & LO side charges
- Microprocessor controlled mass flow monitoring system keeps track of and displays remaining filter life on screen enabling maximum filter life to be achieved, eliminating unnecessary filter changes. The integrated pressure transducer automatically controls air purge, leak testing, and self calibrates every time the machine is turned on.
- The FA1234 features an International Mode for fast and efficient operation in parts of the world where SAE standards do not apply

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www.cpsproducts.com

LTFA1234

Ecotechnics ECK Twin

Introducing the advanced, fully automatic refrigerant management station for R134a now and HFO-1234yf in the future

autoclimate

Ecotechnics ECK Twin

A solution for the future, past and present of AC servicing

Quick, easy and automatic

The ECK Twin is a reliable, effective and easy-to-use refrigerant management station for servicing both R134a and HFO-1234yf refrigerant systems. It automatically controls the recovery, recycling, vacuum and recharging processes of a/c servicing. With a number of patented designs including hermetic dye/oil cartridges and automatic discharge of non-condensable gases via solenoid valves. This machine delivers both high performance and excellent operational reliability.

Quick switch – quick money

It is easy to switch he ECK twin between R134a or HFO-1234yf, meaning any type of vehicle is quickly serviced, no waiting for the machine to reset. The ECK Twin can also work on hybrid vehicles as standard.

As standard the ECK Twin has an internal refrigerant tank heater. The machine will automatically monitor and manage the temperature of the tank and when recharging is about to occur, will increase the temperature slightly delivering a faster recharge of refrigerant into the customers vehicle.

Need a helping hand?

It is important to ensure your refrigerant management station is well maintained and serviced regularly to ensure best performance and maximum lifespan. Autoclimate has the answer: a network of engineers covering the UK that carry out servicing to the manufacturers standards.

Servicing includes performance checks of the machine, changing the vacuum pump oil and filter and carrying out a calibration of the scales. There is no need to send your machine away, our engineer will come to your site, minimising downtime of the machine.

Technical support

Autoclimate offers helpdesk technical support and engineering services/repairs for all refrigerant management stations that they supply.

Ecotechnics ECK Twin

Fully automatic station for recovering, recycling, and recharging either R134a or HFO-1234yf

ECK TWIN features

- Work on either R134a or HFO-1234yf vehicles
- Fast changeover from one refrigerant to another
- Work on hybrid vehicles
- Automatic functionality – prevents error-prone manual processes
- High precision recovery and recharging
- Automatic vacuum leak test facility
- Automatic UV dye injection - time-controlled release
- Flush-prepared capability
- Built in vehicle database
- 2 compressors (one for R134a and one for HFO-1234yf)
- Built-in printer to aid upselling and record keeping
- Heated refrigerant tank
- Refrigerant tank temperature and pressure sensors
- Automatic taps for simpler use
- Automatic discharge of non-condensable gases via solenoid valves
- Large and readable class 1 gauges to check A/C system pressure
- Large easy to follow touch screen display

For more information ✆ 0345 50 50 900

Ecotechnics ECK Twin

technical summary

Power supply	220-240v AC, 50Hz
Weight	110kg
Dimensions	67 x 62 x 107 cm
Vacuum pump	100 litres/min
Refrigerant tank	12kg (x2)
Hermetic compressor	1/4hp 12cc (x2)
Hoses	3.0m standard (2 pairs)
Recharging scale precision	+/-10gm

purchasing

Standard Pack	ECK Twin, gloves, goggles

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autoclimate

Document Ref: PGECKTWIN v1.0 April 2013

Ecotechnics ECK TWIN

The Eck Twin is a 'fully automatic' dual refrigerant management station designed for servicing R134a and HFO-1234yf vehicles. It automatically controls the recovery, vacuum and recharging processes for oil, UV dye and refrigerant, as well as recycling the recovered refrigerant. The ECK Twin has a built in refrigerant tank heater for speeding up refrigerant charging, integrated vehicle database and an integral printer. The ECK 2500 Twin offers long service life for a/c systems in the workshop and is easily changed quickly between R134a and HFO-1234yf.

specification		
	Power supply	220-240v AC, 50Hz
	Refrigerant	HFO1234yf and R134a
	Weight	110kg
	Dimensions	67cm x 62cm x 107 cm
capacities		
	Refrigerant tank	2 x12kg
	Oil	hermetically sealed collapsible cartridges
	High performance dry filter	2 filters for humidity
	Hermetic compressor	1/4hp 12cc (x2)
	Hoses	3m standard (x2)
performance		
	recharging scale precision	+/-10g
	Oil Scale resolution	5g
	Vacuum pump	100 Ltr/min capacity
operation		
	Modes	Manual - Automatic
	Integral printer	Yes
	Display	Colour graphic touch-screen
	Service gauges	Class one
	Vehicle database	Yes
processes		
	Refrigerant recycling	Automatic
	Vacuum leak test	Automatic
	UV dye injection	Automatic
	Flush prepared facility	Yes
services		
	Installation	Inclusive
	Training	On site training for up to 4 technicians inclusive
	Warranty	24 months
	Helpdesk support	Inclusive

Autoclimate Ltd
Head Office & Development Centre
37 Atcham Business Park
Shrewsbury SY4 4UG

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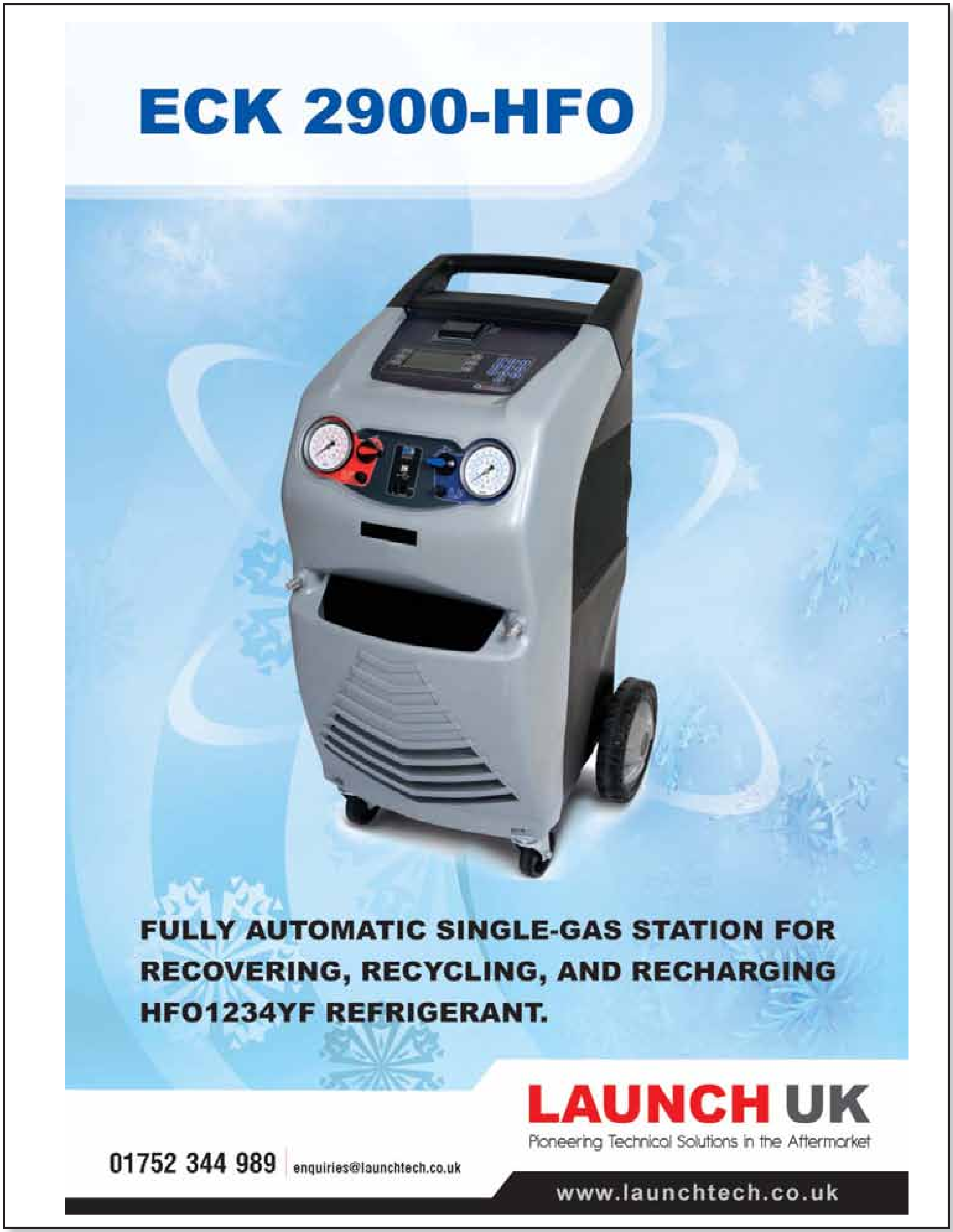
www.autoclimate.com

autoclimate

Document Ref: 3EECKTWIN v1.0 April 2013


ECK 2900-HFO
FULLY AUTOMATIC SINGLE-GAS STATION FOR RECOVERING, RECYCLING, AND RECHARGING HFO1234YF REFRIGERANT.
LAUNCH UK
Pioneering Technical Solutions in the Aftermarket
01752 344 989
enquiries@launchtech.co.uk
www.launchtech.co.uk

Launch UK RRR System

ECK 2900-HFO

AUTOMATIC FUNCTIONS:

RECOVERY | OIL DISCHARGE | VACUUM | TRACER optional | OIL REINTEGRATION | GAS CHARGING

STANDARD FEATURES

- LEAK TEST: automatic during the vacuum phase.
- ONBOARD BOTTLE FILLING: automatic.
- AUTOMATIC DISCHARGE of non-condensable gases from the bottle.
- SERVICE ALARM: acoustic and visual, for maintenance and ☐ lter replacement request.
- USB PORT for software updates.
- REFRIGERANT MANAGEMENT: for creating a customized archive of all refrigerant transactions.
- OPERATOR CODE: for assigning an operator password to protect against unauthorized use of the station.
- DISTRIBUTOR GROUP: built-in, patented unit optimized for top performance and dependability.
- HERMETICALLY-SEALED NEW OIL CARTRIDGE

ECK2900-HFO: K1P0A000000H STANDARD VERSION

Type of refrigerant	HFO1234YF
Service procedure	Fully automatic or manual
Voltage	220-240 V - 50/60 Hz
Scale resolution	10 g
Oil scale resolution	5 g
Working temperature range	11/49°C
Filter system	2 filters for humidity
Vacuum pump	100 liter/min capacity, 0.1 mbar vacuum level
Sealed compressor	12 cc, high-pressure
Recovery speed	300 g/min in liquid phase
Refrigerant bottle	12 litres, refillable
Hoses	3 metres
Overall size	55 x 60 x 105 cm
Weight	90 kg
Thermal printer	Standard equipment
Pressure gauges	Class 1
Display	Graphic
Bottle temperature sensor	Integrated
Bottle heater	Automatic

OPTIONS

SANIFLUX

AUTOMATIC TRACER KIT (UVKIT-7)

NITROGEN BOTTLE CONNECTOR (N2)

Printer

Large LED Display

Automatic Discharge Of Non-Condensable Gases from bottle

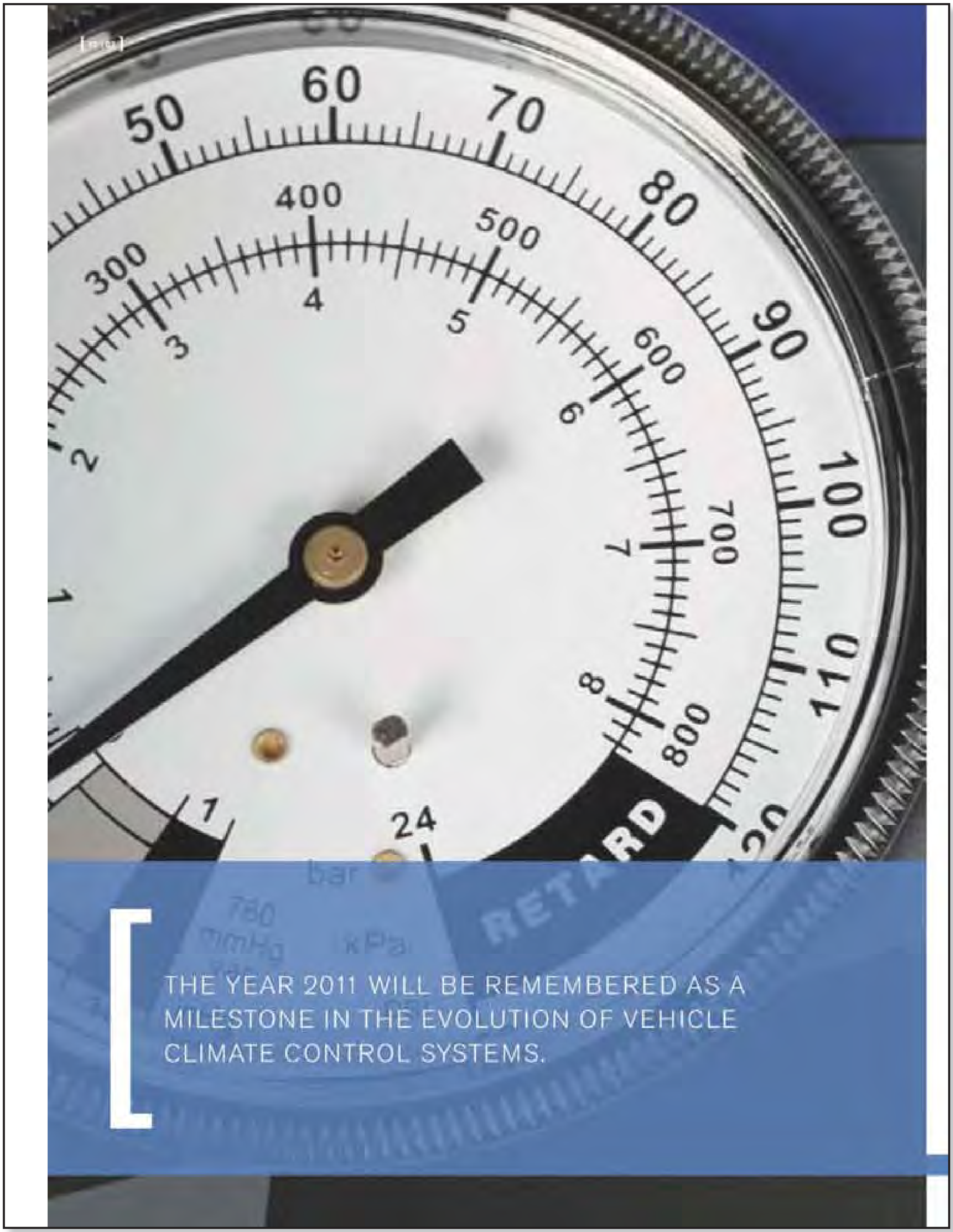
Class 1 pressure Gages

Service hose connector

LAUNCH UK

Pioneering Technical Solutions in the Aftermarket


ROBINAIR.
[COOLING]
A/C
AC1234 PRODUCT LINE AND ACCESSORIES
SERVICE STATION FOR R-1234YF A/C SYSTEMS
100%
SPX.


THE YEAR 2011 WILL BE REMEMBERED AS A MILESTONE IN THE EVOLUTION OF VEHICLE CLIMATE CONTROL SYSTEMS.

ROBINAIR AC1234 – CONTENT

SPX SERVICE SOLUTIONS – KEEPS YOUR WHEELS TURNING

SPX

SPX Service Solutions provides special service tools and equipment, advanced diagnostic solutions and technical information services for the transport and capital equipment sectors. Through its global OTC, Tecnotest and Robinair brands, SPX has been supplying tools and solutions to the automotive industry since 1911. With our extensive variety of quality products, we have the solution to your needs, whatever your system or component.

SPX KEEPS YOU OUT OF TROUBLE

SPX businesses have the lowdown on regulatory requirements across a host of industries. We are familiar with national and regional regulations, and we are aware of the safety and environmental issues.

Our in-house experts are well versed in these industry-specific issues. They can help your business grow by implementing processes that provide traceability, automate compliance tasks and meet specific regulatory requirements.

With our 100-year track record of supplying special tools and equipment to the automotive industry, it's not surprising that we enjoy a close relationship with the world's leading automakers. We've built their high standards and exacting demands into our products.

Last but not least, SPX has an unparalleled network of distributors and service agents. They are happy to advise you on the right products for your specific needs. In addition, they can provide training and after-sales support.

50 YEARS OF INNOVATION BY ROBINAIR

1956

Robinair founded in 1956

1960s

With the increasing popularity of air conditioning, both for homes and cars, in just a few years, the product line was the most complete in the industry.

1970s

Robinair patents rotary mechanical vacuum pump design. (1975)

Robinair introduces deluxe A/C evacuation and charging station. (1976)

Robinair patents first refrigerant recovery and charging station. (1979)

1980s

Robinair patents micro-processor controlled recovery and recharge A/C service station. (1986)

Robinair patents first refrigerant recovery and purification process. (1987)

[COOLING]

ROBINAIR – AN SPX BRAND

GERMAN QUALITY

Robinair is the world's leading manufacturer of air conditioning service units for cars, trucks, buses and aircraft. For more than 50 years, the brand has been renowned for its advanced technology, top quality and reliability.

Robinair was founded in 1956 by the Kent-Moore Corporation of Warren, Michigan, to design and manufacture specialised tools for repairing appliances. The new company was named after two Kent-Moore executives, whose surnames were Robinette and Adair. Soon after, Robinair moved into a growing market: air conditioning, which was becoming increasingly popular, both for homes and cars. In the space of just a few years, Robinair's product line was the most comprehensive in the industry. And it still is today.

Robinair's state-of-the-art production plant is located in Pollenfeld, Germany. Here, the new AC1234 is proudly "Made in Germany", underscoring a commitment to the highest quality.

The AC1234 range is designed to meet specific regulatory requirements. You will find products certified for use in hazardous environments and products designed to meet the most rigorous safety or environmental standards.

Approved and certified: CE, TÜV, SAE, UL.

Robinair introduces the EnviroCharge product. The first A/C service station to recover, recycle and recharge. (1992)

Robinair patents an apparatus for identifying and distinguishing different refrigerants for use in an A/C service station. (1993)

Robinair introduces the Enviro Charge R-134a product. The first A/C service stations to recover, recycle and recharge R-134a refrigerant. (1994)

Robinair patents a method of purging air and system clearing. (1994)

Robinair patents the automatic oil drain function and industry leading background tank fill technology. (1999)

Robinair patents an automatic hose clearing function to minimise oil cross contamination. (2005)

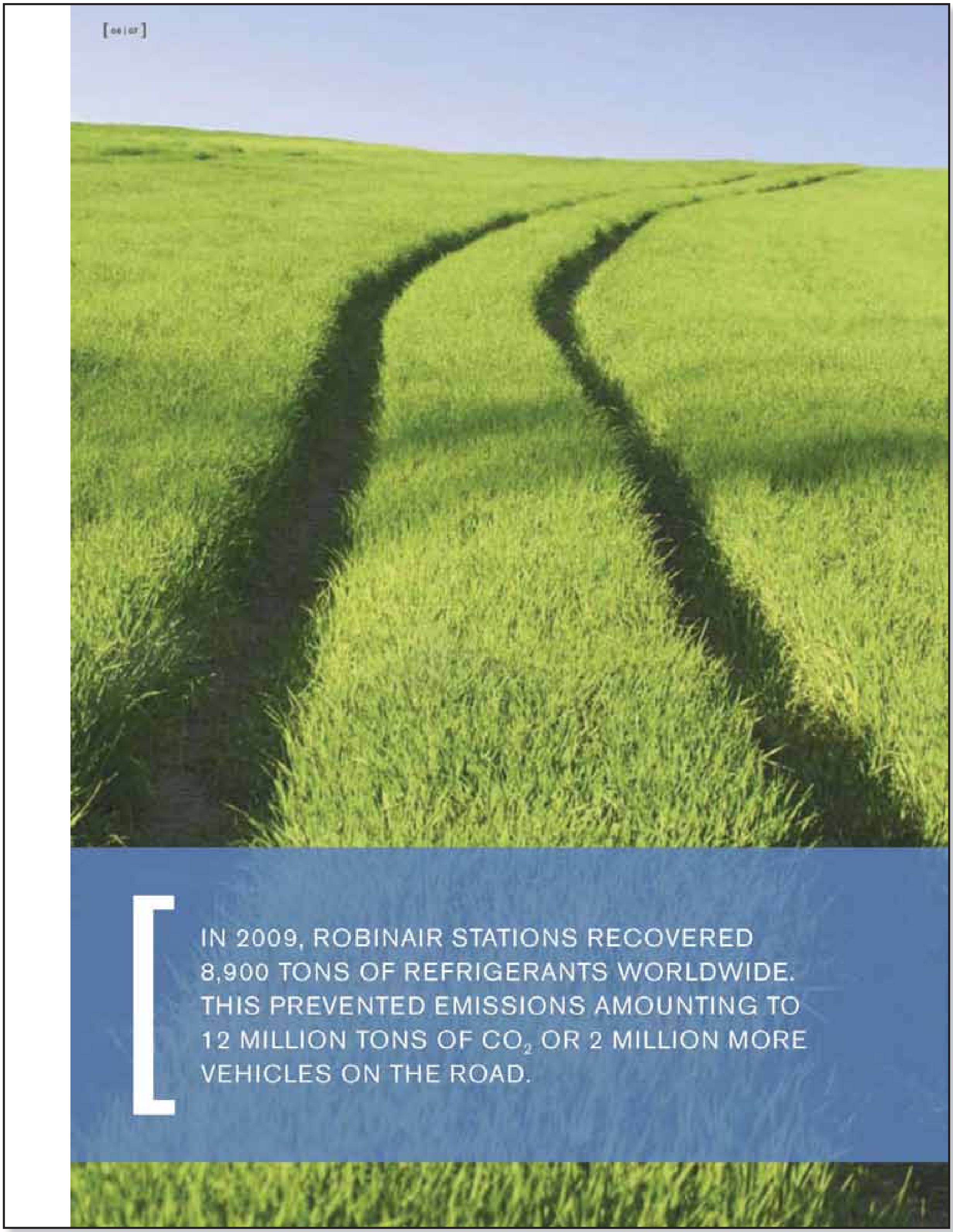
Robinair introduces the 34788 A/C recover, recycle, recharge machine. The first to meet SAE J2788. (2006)

Robinair manufactures the 250,000th A/C service station. (2008)

Robinair introduces the AC788PRO, the first European A/C service station to recover 95% of the refrigerant. (2009)

Robinair introduces the AC1234 for use with new R-1234yf refrigerant. (2010)

1990´s **2000´s** **2010**


IN 2009, ROBINAIR STATIONS RECOVERED 8,900 TONS OF REFRIGERANTS WORLDWIDE. THIS PREVENTED EMISSIONS AMOUNTING TO 12 MILLION TONS OF CO_2 OR 2 MILLION MORE VEHICLES ON THE ROAD.

[COOLING]

INTRODUCING R-1234YF – THE GOOD GAS

Due to its environmental impact, R134a, the refrigerant currently used in vehicles around the world, is being phased out. To comply with new European legislation, a new refrigerant, R-1234yf, is being introduced in its place.

While it is an efficient refrigerant, R134a is also known to have consequences for global warming. Increasing environmental awareness has led the scientific and industrial community to search for a less harmful alternative.

R-1234yf has now emerged as the best possible replacement. This gas has an environmental impact of 4 GWP (units of global warming potential) – well under the EU limit of 150 GWP, and a major improvement on R134a, which has a whopping 1430 GWP. What's more, R-1234yf does not have hefty cost implications for industry.

The only downside of the new refrigerant, compared to R134a, is that it can be flammable in specific circumstances. However, this can be kept under control with well-engineered air conditioning servicing machines – like our Robinair units – and some common sense precautions in the workshop.

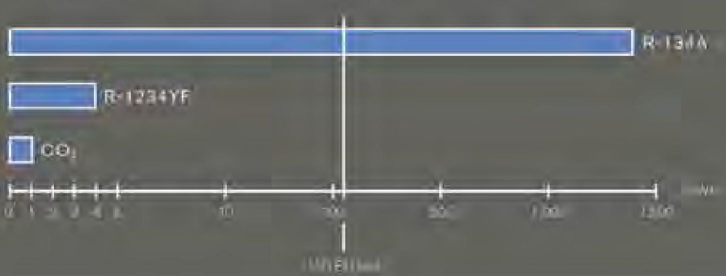
SPX SERVICE SOLUTIONS HELPS COMPANIES GREEN UP

SPX works with customers to develop solutions that require less energy, reduce environmental impact and minimise waste. With AC1234, our focus is on increasing energy efficiency and reducing refrigerant use. The result: a solution that's not just greener, but also more cost-effective.

LESS WASTE, MORE PRODUCTIVITY

SPX companies also create technologies and enhanced processes that help customers operate in more environmentally friendly ways. For example, thanks to Robinair's unsurpassed performance and quality, the AC1234 minimises refrigerant use, recovering 99 per cent of R-1234yf refrigerant.

GLOBAL WARMING POTENTIAL



[04 | 09]

WHAT DOES THIS MEAN FOR YOUR WORKSHOP?

Starting in 2011, a range of vehicles with air conditioning systems running on the new R-1234yf gas will enter the European market. However, the great majority of vehicles on the roads will still be using the older R-134a refrigerant – and these will continue to require servicing for the next 15 years or so. This means that your workshop will need equipment that can handle both the old and new vehicles.

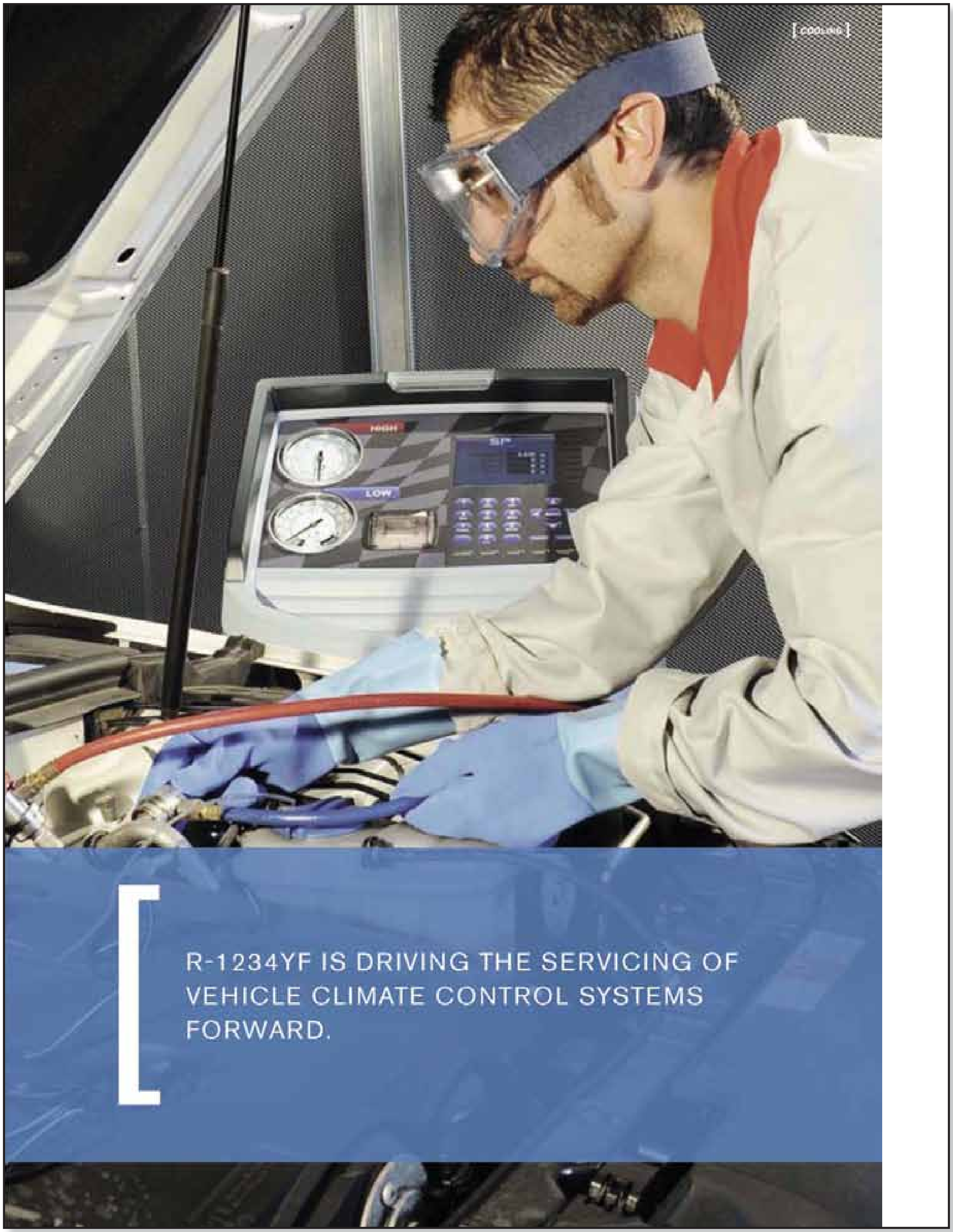
As noted before, R-1234yf is slightly flammable. So it is essential to use equipment that is specifically designed for the new refrigerant and that has been properly certified.

WHAT YOUR WORKSHOP NEEDS:

1. Avoiding contamination between the two refrigerants is imperative. Accordingly, using two distinct circuits for the recovery and recharging process represents the best solution. In reality, this translates into a dedicated machine for each of the two systems. From a purely technical perspective, a "dual use" unit or a retrofit of an older R-134a service machine is possible. But major auto manufacturers have not endorsed either dual use or retrofit solutions for their networks.

2. In addition, major automotive manufacturers are recommending the use of refrigerant identifiers that will allow the workshop to monitor the type, quality and purity of a given refrigerant.

3. Finally, the professional workshop will also require a new leak detector capable of identifying leaks of the new refrigerant in the vehicle's air conditioning system.


HIGH
LOW
R-1234YF IS DRIVING THE SERVICING OF VEHICLE CLIMATE CONTROL SYSTEMS FORWARD.

[10 | 11]

ROBINAIR AC1234 – THE NEW STANDARD IN AIR CONDITIONING SERVICE

AC1234 is the first Robinair air conditioning service station to conduct maintenance and service on mobile air conditioning systems that use the new refrigerant R-1234yf.

Developed in conjunction with car manufacturers, this unit meets the highest standards in performance, safety and efficiency. Working with a global engineering team, Robinair has brought all its experience to bear in this unit. This ensures that R-1234yf-based air conditioning systems are serviced in the most efficient and most reliable way possible, giving you peace of mind.

The unit is designed to be intrinsically safe: it will only operate after having successfully completed a thorough self-check.

[COOLING]

AC1234 – FEATURES AT A GLANCE

Large display; easy to read; 20 languages, video training available

Connectivity: USB ports, LAN network connection, SD card slot for expanding memory

Oil or UV dye injection, separate circuit (for hybrid and electric vehicles' A/C systems)

Unit includes tank storage, making it easy to store flammable refrigerant

Easy to maintain (Vacuum pump oil change, high serviceability)

Vacuum pump with dual stage, for deep recovery and deep vacuum phase

EVERYTHING YOU NEED – AND MORE

What are you looking for in a new recharging station? If maximum safety, ease of use, top quality, efficiency and eco-friendliness are on your list, the AC1234 has your needs covered.

MAXIMUM SAFETY:

- Meets all applicable safety requirements
- Safe management of R-1234yf flammable gas
- Low refrigerant emissions during normal operation
- Compliant with CE and SAE standards – including the tough SAE J2843
- Automatic functionality – prevents error-prone manual processes
- Automatic control of internal ventilation
- Can be connected to an external refrigerant identifier, preventing contamination
- Uses only one gas – eliminates risk of refrigerant contamination

EASE OF USE:

- Automatic unit does the hard work for you
- Electronic scales – ensuring accurate, efficient oil/UV dye recovery and injection
- Handy keypad – functions are performed at the press of a button
- Large colour display, with more than 20 languages available
- A/C database – so it automatically injects exactly the right amount of refrigerant
- Training video and help function – no need to read the manual or get any special training
- Designed for minimum maintenance and maximum serviceability – vacuum pump oil and internal filter are simple to replace, saving you time and hassle
- Oil/dye injection bottles are easily accessible, thanks to magnetic connectors
- Large and readable 100 mm, class 1, EN837 gauges to check A/C system pressure
- Electronic pressure AC system check
- Automatic tank refill (with automatic level check) – just plug in the source tank and the unit does the refilling for you – a feature unique to the AC1234

TOP QUALITY:

- Complies with all international standards (CE, UL, SAE, ANSI)
- Certified by well-regarded independent testing agency TÜV
- Maximum accuracy during recovery – no refrigerant is wasted, minimising refrigerant costs
- Independent oil and UV dye injection systems – no cross contamination of lubricants
- Automatic internal and service hose clearing
- Automatic unit maintenance service counter to ensure unit is operating efficiently
- Designed to comply with rigorous OEM guidelines

[COOLING]

EFFICIENCY:

- Service time can be reduced by 20 minutes compared to a standard unit – thanks to the unique deep recovery function, which cuts out the vacuum phase
- Automatic functionality also minimises time-consuming manual processes
- Recovers 10 per cent more refrigerant than a standard unit (SAE J2843 certification) – so you save refrigerant costs with each service
- Plus, there is 80 per cent less waste of refrigerant during normal operations, saving you even more money
- Can be connected to PCs/shop system
- Extra functionality available with add-on modules
  - Printer – before and after service documentation
  - Micron gauge – measures depth of vacuum, reduced pressure evaporation and moisture before charge
  - Diagnostic tools – link measurements to VIN
  - Temp/Humidity – additional diagnostics, integrated with printer output

ECO-FRIENDLINESS:

- Refrigerant waste is minimised during normal operation – as a result of automatic air purge and oil draining
- At least 95 per cent of refrigerant is recovered from the A/C system – thanks to deep recovery function
- 20 per cent lower energy consumption compared to similar products, thanks to time savings

TECHNICAL DATA, PRIMARY FUNCTIONS

	AC1234-3	AC1234-5	AC1234-7* / AC1324-8**
Refrigerant	R-1234yf	R-1234yf	R-1234yf
Automatic function	Semi - automatic	Automatic	Fully automatic
Single processing mode selection (Recovery, vacuum, charge functions)	Yes	Yes	Yes
Recovery function	Automatic	Automatic	Automatic
Lubricant oil drain function	Automatic – visual (bottle graduations)	Automatic – visual (bottle graduations)	Automatic with electronic scale control
Vacuum function	Automatic	Automatic	Automatic
Leak test	Automatic	Automatic	Automatic
Lubricant oil injection	Manual	Automatic with electronic scale control; 1 tanks	Automatic with electronic scale control; 2 tanks
UV dye injection	Not available	Not available	Automatic with electronic scale control
Refrigerant charge function	Automatic	Automatic	Automatic
Flushing function	Yes	Yes	Yes
Internal storage vessel refill function	Manual	Automatic	Automatic
Air purge function	Manual	Automatic with electronic control	Automatic with electronic control
Hose clearing function	Yes	Yes	Yes
Filter replacement counter	Yes	Yes	Yes
Electronic database	Optional – using smart key	Yes	Yes
Report printout function	Optional	Optional	Yes
Display	Monochrome graphical display (160 x 120)	340 x 220 CD	Color ¼ VGA
Keypad	Function and alpha-numeric keypad	Function and alpha-numeric keypad	Function and alpha-numeric keypad
Gauges, manometers	EN837-1, 63 mm	EN837-1, 100 mm	EN837-1, 100 mm
Manual valves	2 (HP & LP)	No	No

Robinair Service Equipment

[COOLING]

	AC1234-3	AC1234-5	AC1234-7* / AC1324-8**
Service hoses & Couplers	2.50 mt SAE J2888	2.50 mt SAE J2888	2.50 mt SAE J2888
Printer	Optional	Optional	Yes
USB connection	No	Yes, 1	Yes, 2
SD card slot	Yes	Yes	Yes
Internal air flow control	Yes	Yes	Yes
Hermetic compressor	1/3 HP	1/3 HP	1/3 HP
Vacuum pump	3 cfm (71 L/min)	3 cfm (71 L/min)	170 l/min (50 Hz) 198 l/min (60 Hz)
Internal storage vessel	10 Kg (22 LB)	10 Kg (22 LB)	10 Kg (22 LB)
Filter dryer	300 cc	700 cc	700 cc
Vehicle lubricant oil separator	Double chamber	Double chamber	Double chamber
Compressor lubricant separator	Single chamber with solenoid control for oil return	Single chamber with solenoid control for oil return	Single chamber with solenoid control for oil return
CE	Yes	Yes	Yes
TUV	Yes	Yes	Yes
SAE J2099	No	Yes	Yes
SAE J2843	No	Yes	Yes
UL 1963	No	Yes	Yes
ANSI/ASA 12.12.01	No	Yes	Yes
RoHS	Yes	Yes	Yes
WEEE	Yes	Yes	Yes
Batteries and accumulator directive	Yes	Yes	Yes

* AC1234-7 with or without external refrigerant analyser ** AC1234-8 with embedded refrigerant analyser

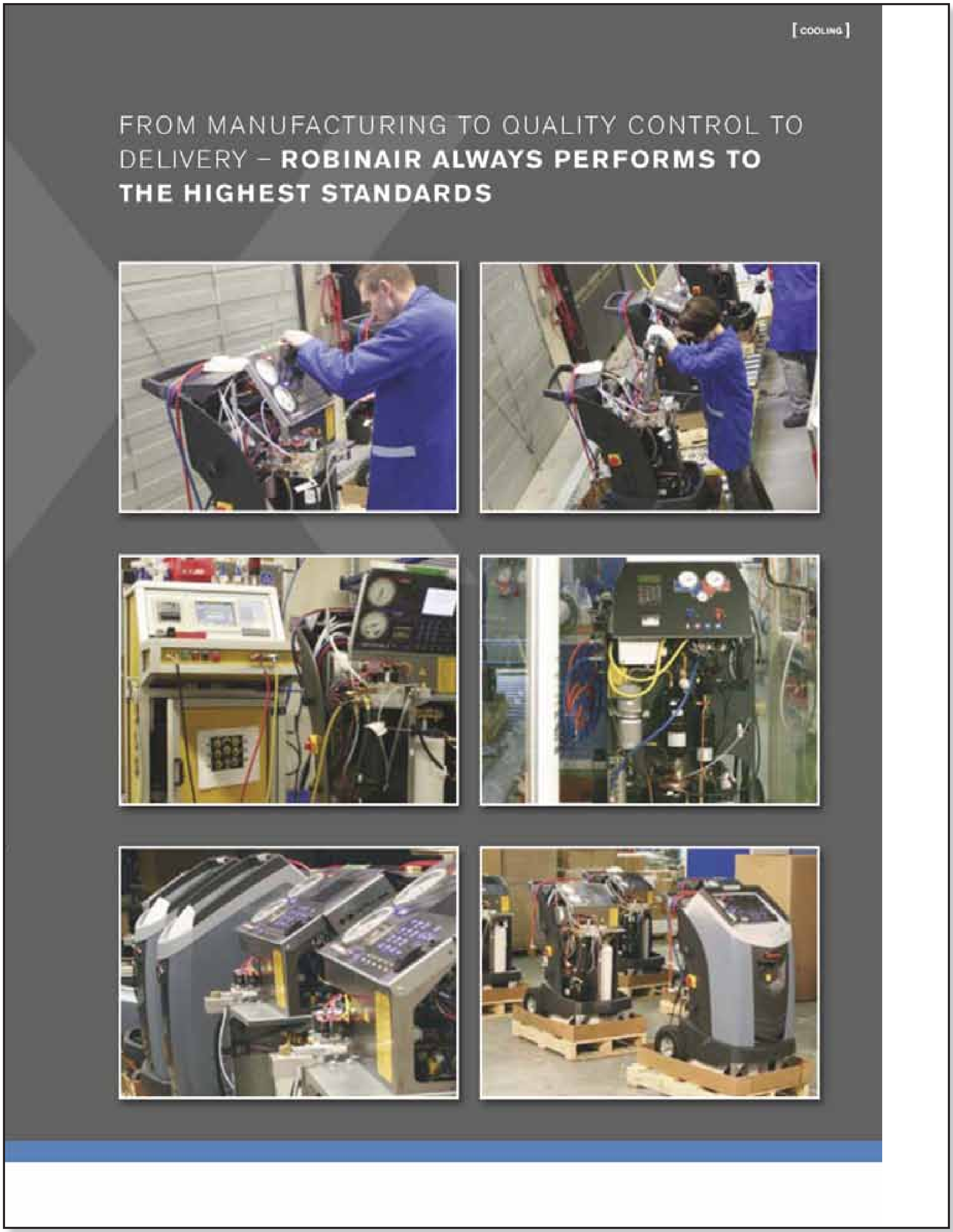
HIGH-TECH PRODUCTION – FOR QUALITY YOU CAN TRUST

Why are Robinair A/C units such exceptional quality? A lot of that has to do with how they're made.

Our **state-of-the-art A/C production line** in Pollenfeld, Germany, reflects the latest Lean Manufacturing, SixSigma and Kanban standards. At ergonomically-designed workstations, highly-skilled workers assemble Robinair products around the clock. In fact, the facility was recently upgraded to produce increased volumes of Robinair A/C machines, following strong demand from the European market.

Multiple quality checks are built into the production process to ensure every unit is 100 per cent safe to operate. These include high-pressure checks in line with the European Pressure Equipment Directive (97/23/EC) (also known as PED) and VDA (German Automotive Industry Association) requirements, which ensure that all components have the necessary strength and stability. Vacuum tests simulate the functionality of the recovery process while leakage tests ensure all connections are completely leak-proof. We also conduct high voltage and insulation tests, and check all electric and electronic functions and interfaces.

Just-in-time processes ensure that our products are available in the right place at the right time – meeting global demand. Because outstanding quality means that our A/C units are durable, reliable and efficient – something that's appreciated worldwide.


[COOLING]
FROM MANUFACTURING TO QUALITY CONTROL TO DELIVERY – ROBINAIR ALWAYS PERFORMS TO THE HIGHEST STANDARDS

Robinair Service Equipment

[COOLING]

AC1234 – ACCESSORIES

THE "AIR CONDITIONING DIAGNOSTICS TRIANGLE":

Air conditioning systems in modern vehicles are increasingly complex, making diagnostic procedures and subsequent repairs difficult. When analysing any air conditioning system, there are three different diagnostic aspects to consider:

› Thermodynamics
› Electronics
› Refrigerant purity

ROBINAIR AIR CONDITIONING DIAGNOSTICS:

The Robinair product range encompasses different tools for each element of the "diagnostics triangle", giving the air conditioning specialist all the equipment required for a complete air conditioning diagnostics system.

On the following pages, you can find out about air conditioning accessories especially designed to be used in conjunction with R-1234yf air conditioning service machines. For all our available accessories, please see the complete Robinair product range brochure.

RA22791 – INFRARED REFRIGERANT LEAK DETECTOR

FEATURES:

- Advanced infrared sensor designed to last a minimum of 10 years
- Three sensitivity levels down to 0.15 oz./year
- Automatically recalibrates in highly contaminated areas to help pinpoint the exact location of the leak
- Won't trigger on oil or moisture
- Detects CFC, HFC and HCFC blend refrigerants
- 8-hour lithium ion battery lasts all day long and beyond
- A visual alert and peak button make it easy to find leaks in noisy environments
- Audible alert with mute button
- Magnetic hanger for simple hanging of unit during leak repair
- Durable carrying case lets you easily transport detector and accessories
- Meets new SAE J2791 leak detection standard

SPECIFICATIONS:

- Gases measured: CFC, HFC, HCFC blends (R-1234yf, R-134a, etc.)
- Sensing element: Infrared
- Response time: Less than 1/2 second
- Sensitivity levels: HIGH 0.15 oz./year and higher
- MEDIUM 0.25 oz./year and higher
- LOW 0.5 oz./year and higher
- Accuracy: Meets current SAE J2791 standards
- Calibration: Automatic
- Warm up time: 30 seconds
- Probe length: 38 cm
- Battery type: 7.4VDC (nominal) rechargeable lithium ion polymer battery
- Battery life: Approximately 8 hours when fully charged
- Patents: 6,791,088 and 7,022,993 Infrared Leak Detector

[COOLING]

REFRIGERANT ANALYSER – FOR SIMPLE, SAFE REFRIGERANT TESTING

Robinair offers two distinct refrigerant analysers designed to meet the German Automotive Industry Association's (VDA) refrigerant analyser specification.

INTERNAL OR EXTERNAL MODEL FOR USE IN AN A/C SERVICE MACHINE

This refrigerant analyser is designed to operate seamlessly with an A/C service machine, and can be mounted internally or externally. At a command from the machine, the analyser receives the sample gas, analyses it and gives a PASS or FAIL signal to be displayed by the A/C service machine. A PASS indication will allow the A/C service machine to begin the recovery part of the A/C service. A FAIL indication will prevent the A/C service machine from recovering the refrigerant.

HAND HELD MODEL FOR USE WITH AN A/C SERVICE MACHINE OR INDEPENDENTLY

This refrigerant analyser is designed to operate independently or in conjunction with an A/C service machine. It is a handheld model that can be used to test vehicles while the A/C service machine is in use elsewhere. It includes an R-1234yf low-side coupler, and receives a sample of the refrigerant gas from a dedicated refrigerant analyser service hose, which connects to the vehicle's vapour (low-side) service port. The unit features easy-to-understand LED status lights and single push-button operation. At the user's command, the analyser receives the sample gas, analyses it and gives a PASS or FAIL signal, indicated with red and green LEDs. The refrigerant analyser stores the test data so that the unit can be connected to the A/C service machine's USB refrigerant analyser port. A PASS indication will allow the A/C service machine to begin the recovery part of the A/C service, after the refrigerant analyser service hose is removed and the A/C service machine hoses are connected. A FAIL indication will prevent the A/C service machine from recovering the refrigerant.

Refrigerant measured	R-1234yf
Accuracy	Better than (+/-) 0.5 %
Pass/Fail setpoint	99.5 %
Ambient operating temp range	10 °C to 50 °C
Elevation range (reference: sea level)	-50m to 2,500m
Vibration sensitivity	Unaffected by standard workshop environment
Power	12 VDC @ 0.5 amps
Approvals	CE, GS
Integral pressure/flow control	Yes
Enclosure	Yes
Integral calibration pump	Yes
Oil contamination trap	Yes, replaceable by user
Filtration	Yes, replaceable by user

[33 | 33]

ACT800 - GAS TRACER KIT –
LEAK DETECTION WITH NITROGEN GAS, N_2H_2

Clearly, air-conditioning service providers may not refill systems with fluorinated greenhouse gases if an abnormal amount of the refrigerant has leaked from the system, until the necessary repair has been completed.

This tracer uses a non-toxic, non-flammable, environmentally-friendly (non-polluting) mixture of 5 per cent hydrogen and 95 per cent nitrogen. As a result, the mixture can be released into the environment after the leak detection procedure is completed. The mixture complies with Article 6, Paragraph 3 of EU directive 2006/40/EC.

The leak detector reacts to the hydrogen component of the tracer - because hydrogen molecules are so small, it is an ideal gas for leak detection. The gas is charged into an empty system at a pressure of approximately 75 psi (5bar). As hydrogen is lighter than air, always probe slightly above the suspected leak area.

Once the source of the leak is located and repaired, the gas can be released and the system can be recharged again with refrigerant.

Leak detector	H_2 Gas Tracer
Sensitivity	< 5 ppm
Sensor life	> 300 hours
Response time	instantaneous
Power supply	4AA alkaline batteries
Battery life	8 hours continuous
Warm up time	< 20 seconds
Probe length	43 cm
Weight	0.68 kg
Warranty	2 years

	Part Number
Professional Kit > Case > Leak Detector > Gas Tank 2l > Low and high side connectors > Hoses > Pressure Regulator > 2 Pressure gauges	ACT800
Base Kit	ACT1000
Leak detector	ACT200
Tank refill	ACTN$_2$H$_2$

[COOLING]

A GLOBAL NETWORK – FOR OUR CUSTOMERS

WE OFFER WORLDWIDE SERVICE, WITH OVER 5,000 SPX SERVICE SOLUTIONS EMPLOYEES AND 300+ SERVICE CENTERS ACROSS THE GLOBE.

AMERICAS

USA
ALLEN PARK, MI
AUBURN HILLS, MI
CANTON, MI
CLEVELAND, OH
FOUNTAIN VALLEY, CA
FRANKLIN, TN
HOUSTON, TX
KALAMAZOO, MI
OWATONNA, MN
PHILADELPHIA, PA
PHOENIX, AZ
ROMEOVILLE, IL
WARREN, MI

BRAZIL
SAO PAULO

MEXICO
MEXICO CITY

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FRANCE
LA FERTE-BERNARD
PARIS

GERMANY
COLOGNE
HAINBURG (2)
MUNICH
MÖNCHENGLADBACH
POLLENFELD

HUNGARY
BUDAPEST

ITALY
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PARMA

NETHERLANDS
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ROBINAIR®

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SPX SERVICE SOLUTIONS GERMANY GMBH
HAINBURG, GERMANY

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SALA BAGANZA, ITALY

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BRIXWORTH, UNITED KINGDOM

SPX SCHWEIZ AG
KRIENS, SWITZERLAND

SPX IBERICA S.A.
GUADALAJARA, SPAIN

RTI Mahle RRR Machine

ArcticPRO® RHS®1280 Series

Digital R1234yf A/C Service Equipment

P/N 460 80370 00

This latest product innovation is designed to competently, efficiently and safely service the new R1234yf refrigerant worldwide.

- Compatible with R1234yf refrigerant
- Meets stringent European OEM specifications
- Features fully automatic servicing
- Recovers over 95% of automobile A/C system refrigerant
- Provides exceptional charge accuracy...+/- 15 g
- Numerous features for safe handling of R1234yf
- Features advanced equipment diagnostics
- Unobstructed equipment accessibility for maintenance
- Includes refrigerant identifier to minimize cross contamina-tion risk
- OE custom software available

ArcticPRO RHS 1280 Specifications

Electrical	120VAC - 60HZ-12.5AMP 230VAC-50HZ-6.3AMP (Optional)
Dimensions	(HxWxL) 50 x 24 x 32 in (126.0 x 60.5 x 80.5 cm)
Weight	265 lbs (120 Kg)
Operating Ranges	50° - 122° F (10° - 50° C)
Scale Accuracy	(+/- 0.5 oz) (+/- 15 g)
Recycle Performance	95% at 70° to 75° F (21° to 24° C) within 30 minutes
Hoses	9 ft (2.74m)
Compressor	3/8HP-pressure protected, balanced start-up, oiled, hermetically sealed - 9KW
Condenser Fan	Industrial-duty 218 CFM
Vacuum Pump	6 CFM, dual stage, 29.9 InHg
Charging Cylinder	30 lb (13.6 kg) DOT
Charge Performance	+/- 0.5 oz at 50° to 122° F (+/- 15g at 10° to 50° C) ambient temperature within 30 minutes
Filter-Drier Capacity	300 Lb (120kg), Spin-on type
Languages	33 total
Certifications	J2099, UL1963, CE, TUV, PED
Warranty	1 Year - parts & labor

RTI - a division of MAHLE Clevite, Inc. | www.rtitech.com | 800.468.2321 Rev. B

Refrigerant Identification

Neutronics Refrigerant Identifier

Neutronics Refrigerant Identifier

Neutronics Refrigerant Identifier

Easy-to-use • Versatile • Accurate

Neutronics Ultima ID™ 1234yf Refrigerant Identifier

*Model No. RI-2012yfp

- Quickly and accurately determines refrigerant purity
- Displays percentage purity of R1234yf, R134a, R22 and Hydrocarbons
- Displays % air in pure R1234yf & R134a
- Easily prints test results*
- Field upgradable via USB port
- Improved oil resistance with the user replaceable oil restrictor

Create customer receipt with optional printer

The Neutronics Ultima ID 1234yf Refrigerant Identifier is also available with an optional factory installed printer module, Model No. RI-2012yfp, which helps you to pass the service cost along to your customers. Ultima ID 1234yf can produce an on-the-spot receipt, which you can attach to your customer's repair order.

New profit opportunity!

Refrigerant identification is a mandatory service that you should get paid for. Look at your ROI: Based on 10 jobs per week at $10 per test, you can bank on earning an extra $1,600 during a typical A/C season with the new Neutronics Ultima ID 1234yf.

SPECIFICATIONS

Ultima ID 1234yf Refrigerant Identifier
Model No.(s) RI-2012yf, RI-2012yfp

Refrigerants Measured:	R1234yf, R134a
Accuracy:	Better than (+/-) 1.0%
Refrigerant % Displayed:	R1234yf, R134a, HC, Air
Ambient Operating Temp Range:	50°F to 122°F
Power:	110/220v 50/60hz
Communication Protocols:	USB 2.0
User Interface:	LCD + 3 Switches
Approvals:	CE, SAE
Integral Pressure/Flow Control:	Yes
Integral Calibration Pump:	Yes
Oil Contamination Pump:	User Replaceable Oil Trap
Filtration:	User Replaceable

Ultima ID 1234yf is part of the full line of Neutronics Refrigerant Analyzers

Ultima ID Pro

Mini ID

Sealant Detector Kit

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