Solstice® yf Refrigerant

User Guide - Europe Region

Honeywell

Honeywell Solstice® yf Refrigerant User Guide - Europe Region

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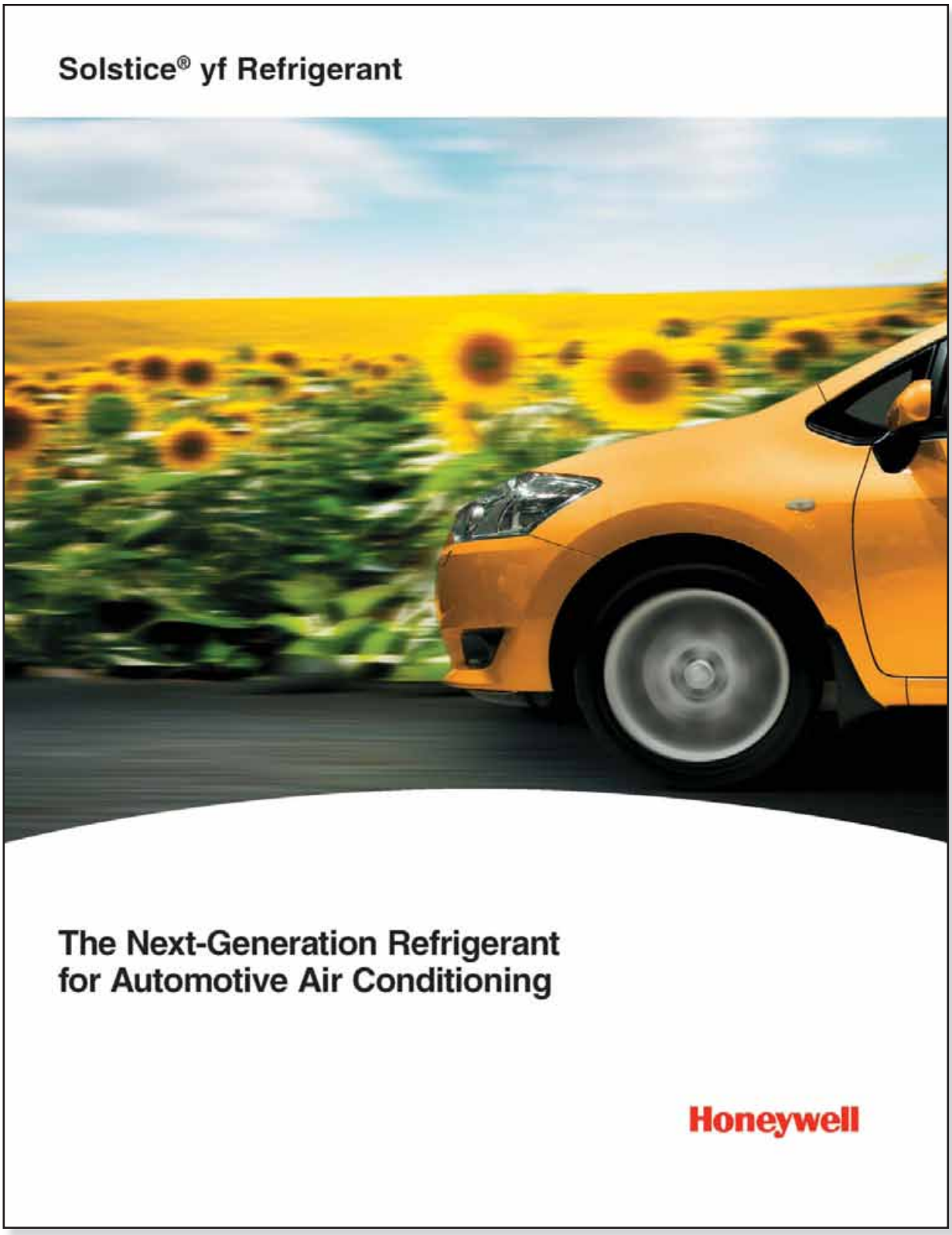
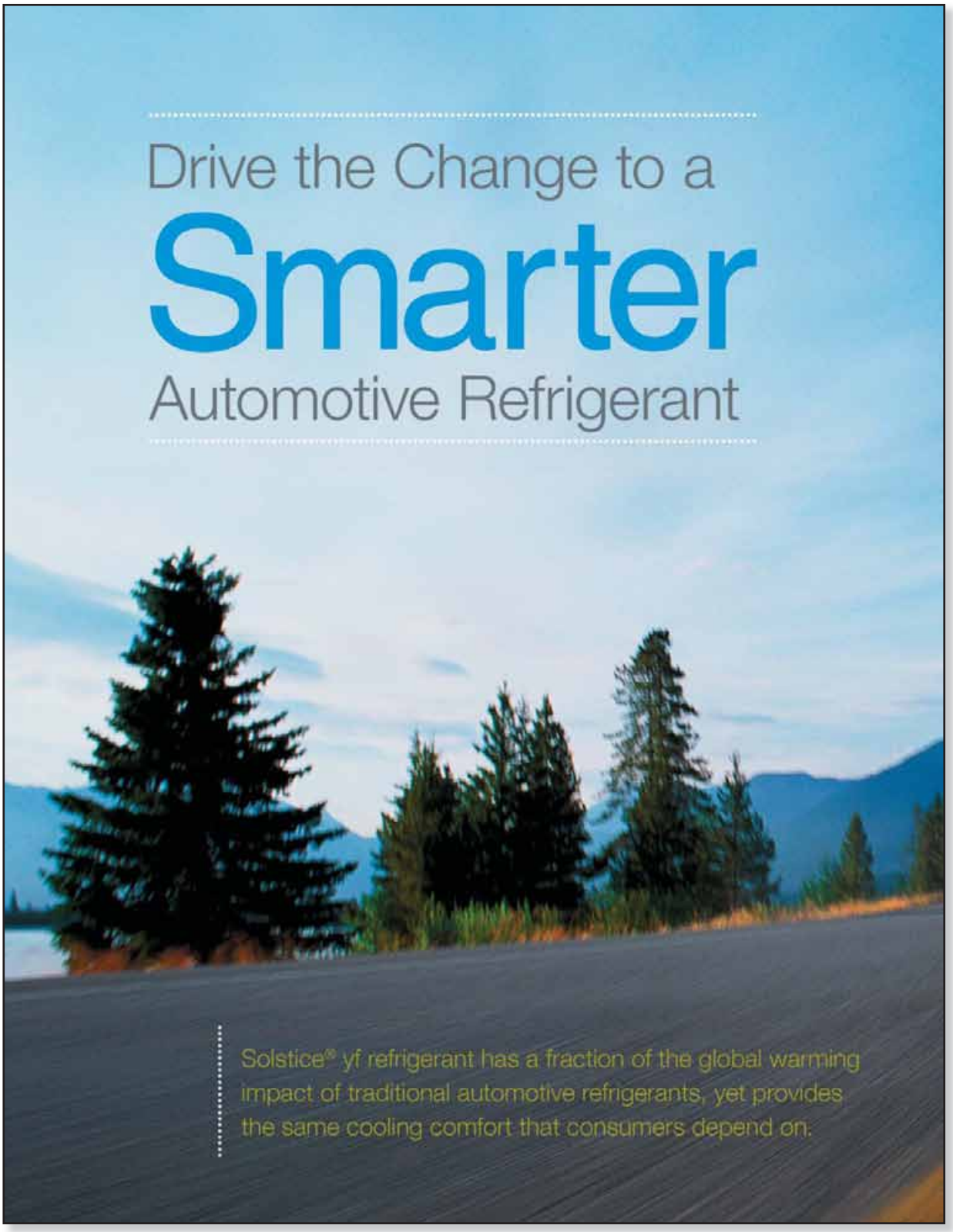
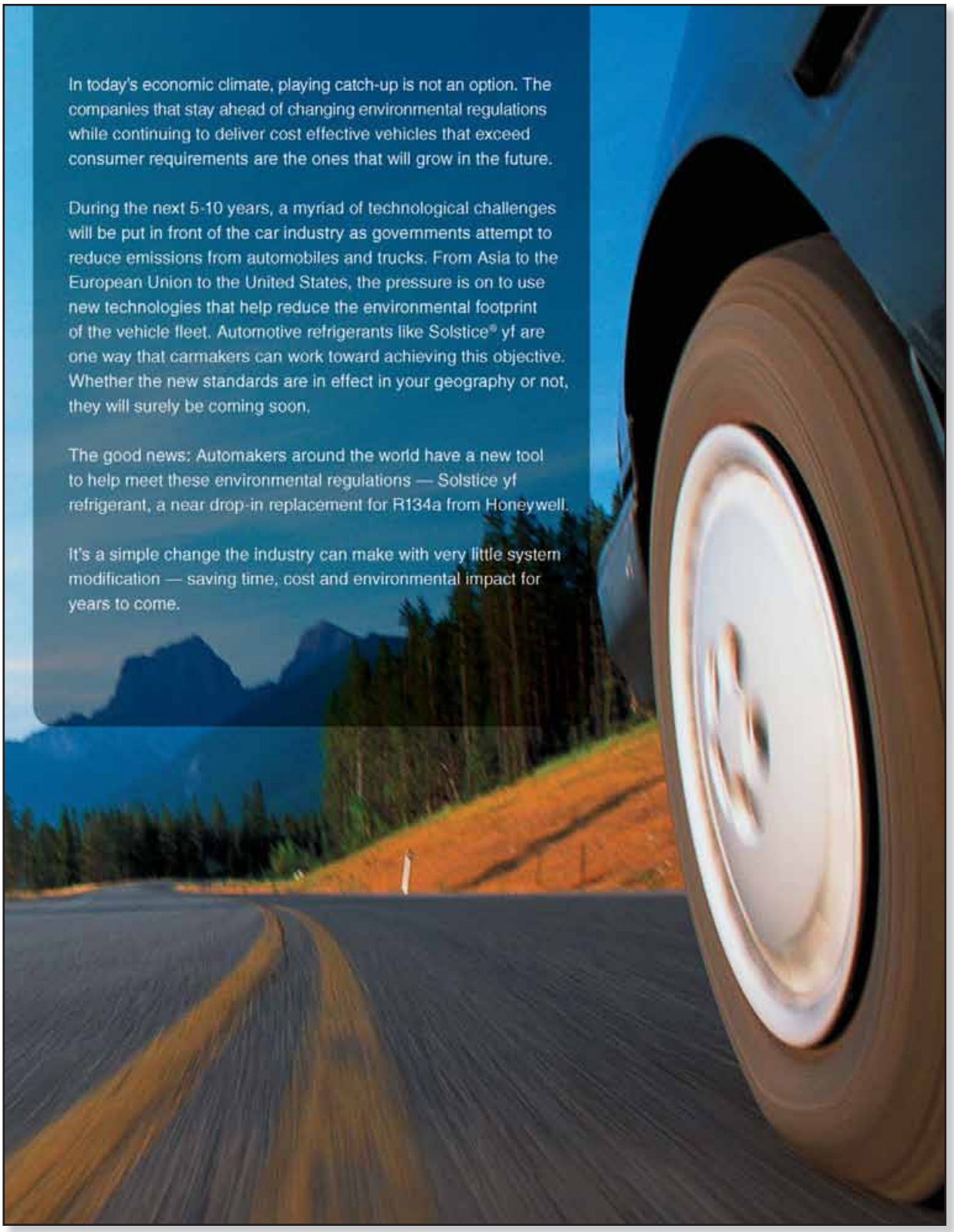




The Next-Generation Refrigerant for Automotive Air Conditioning



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.

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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Responsible Care®

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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.

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 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 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...

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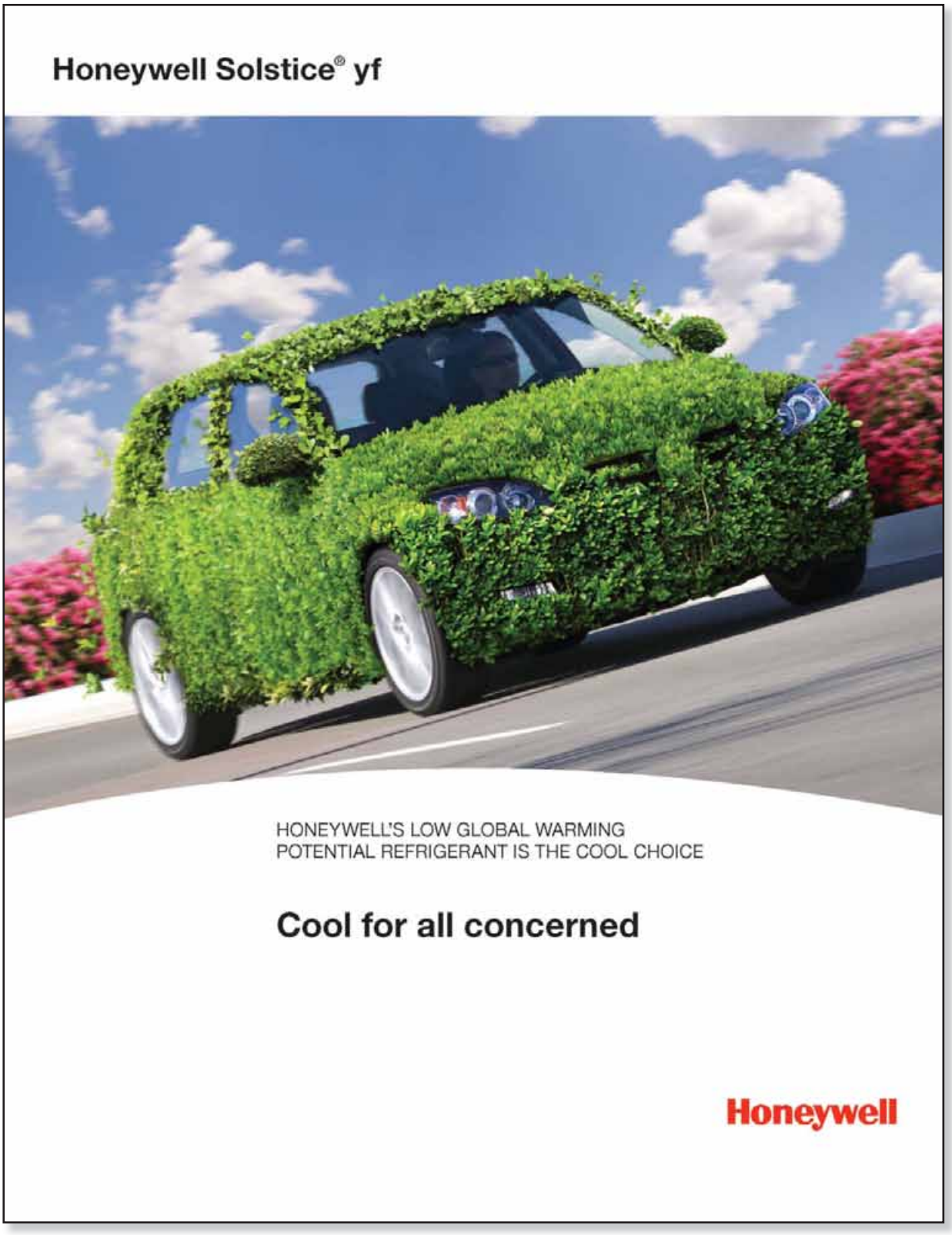
Honeywell Solstice® yf Refrigerant MSDS:

CLICK HERE
For more information

www.1234facts.com/msds



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	$CF_3CF{=}CH_2$
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 (°C)	Pressure (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

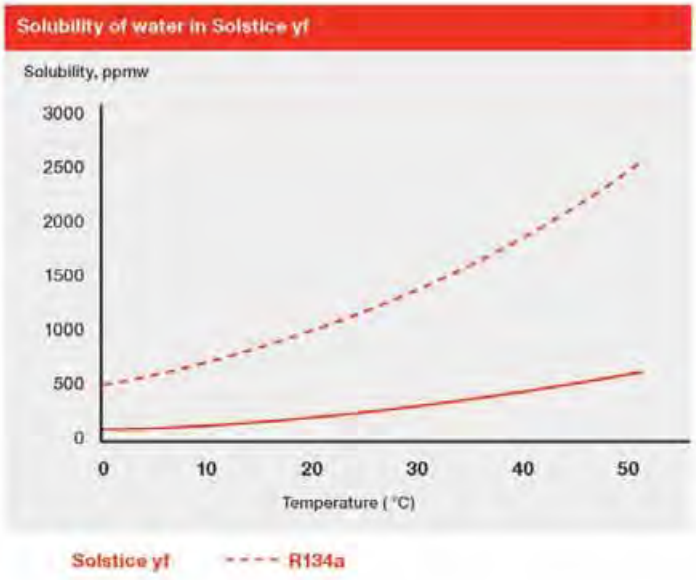
Solstice® yf has been developed for a number of applications beyond automotive air conditioning. These include supermarket cases, walk-in coolers, residential refrigerators and chillers. Generally, there are a few compressor design changes necessary to optimize the performance of Solstice yf in these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

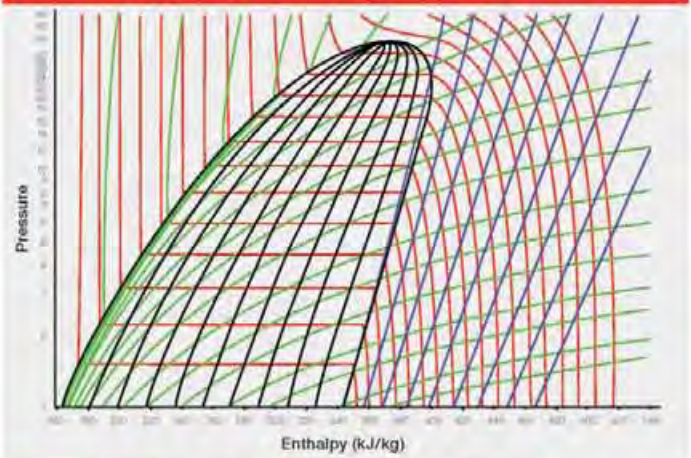
Solstice® yf cylinders must be clearly marked and stored in a cool, dry and properly ventilated area away from heat, flames, corrosive chemicals, fumes and explosives — and be otherwise protected from damage. Under no circumstances should an empty cylinder be refilled with anything other than virgin 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

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Honeywell Performance Materials and Technologies, as a member of the American Chemistry Council, has adopted Responsible Care® as the foundation of health, safety, and environmental (HS&E) excellence in our business. Responsible Care is the chemical industry's global voluntary initiative under which companies, through their national associations, work together to continuously improve their health, safety and environmental performance, and to communicate with stakeholders about their products and processes.

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 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.

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

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·F Liquid	Entropy Btu/lb_m·F Vapor	c_p Btu/lb_m·F Liquid	c_p Btu/lb_m·F Vapor	c_v Btu/lb_m·F Liquid	c_v Btu/lb_m·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
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February 2014

Honeywell

Solstice® yf Refrigerant (R-1234yf)

Honeywell

Packaging Range: Europe, Middle East, Africa and India

5 and 10 kg Cylinder

Valve and Outlet Connection

DIN477 No.1
Single phase discharge valve
Upright for gas
Inverted for liquid

DIN477 No.1
Left-hand thread

Features

- Anti-tamper protection
- Anti-filling function
- Overpressure protection on valve
- Lightweight, open handles for easier access to valve

Specifications

	5 kg Returnable	10 kg Returnable
Full Cylinder SKU	10580565	10616089
Nominal Fill Weight	5 kg	10 kg
Units per Pallet	72	36
Units per Truck	1872	936
Net Gas per Truck Load	9360 kg	9360 kg
Certification	EN	EN
Unit Dimensions (D x H)	229 mm x 343 mm	229 mm x 503 mm

Packaging Range: Europe, Middle East, Africa and India

50 kg Cylinder

900 kg Drum

ISO Container

Valve

Dual phase valve with one outlet

Red: Liquid
Blue: Gas

Valve

Two single phase valves

Liquid and Vapor

Dry Disconnect Fittings

Outlet Connection

CGA-670
Left Hand Thread

Outlet Connection

Features

- Liquid/Vapor phase
- Anti-filling function
- Contamination safeguard

Features

- Zero product loss connections
- Safest delivery possible
- Quick operations

Specifications

	50 kg Returnable Cylinder	900 kg Vertical Ton Tank	ISO Container
Full Cylinder SKU	10617230	10616559	10581428
Nominal Fill Weight	50 kg	900 kg	15000 kg
Units per Pallet	10	N/A	N/A
Units per Truck	260	16	1
Net Gas per Truck Load	13000 kg	14400 kg	15000 kg
Certification	EN	EN	EN
Unit Dimensions	304 mm x 1150 mm (D x H)	1000 mm x 1785 mm x 1160 mm (D x H x W)	6058 mm x 2438 mm x 2591 mm (L x W x H)

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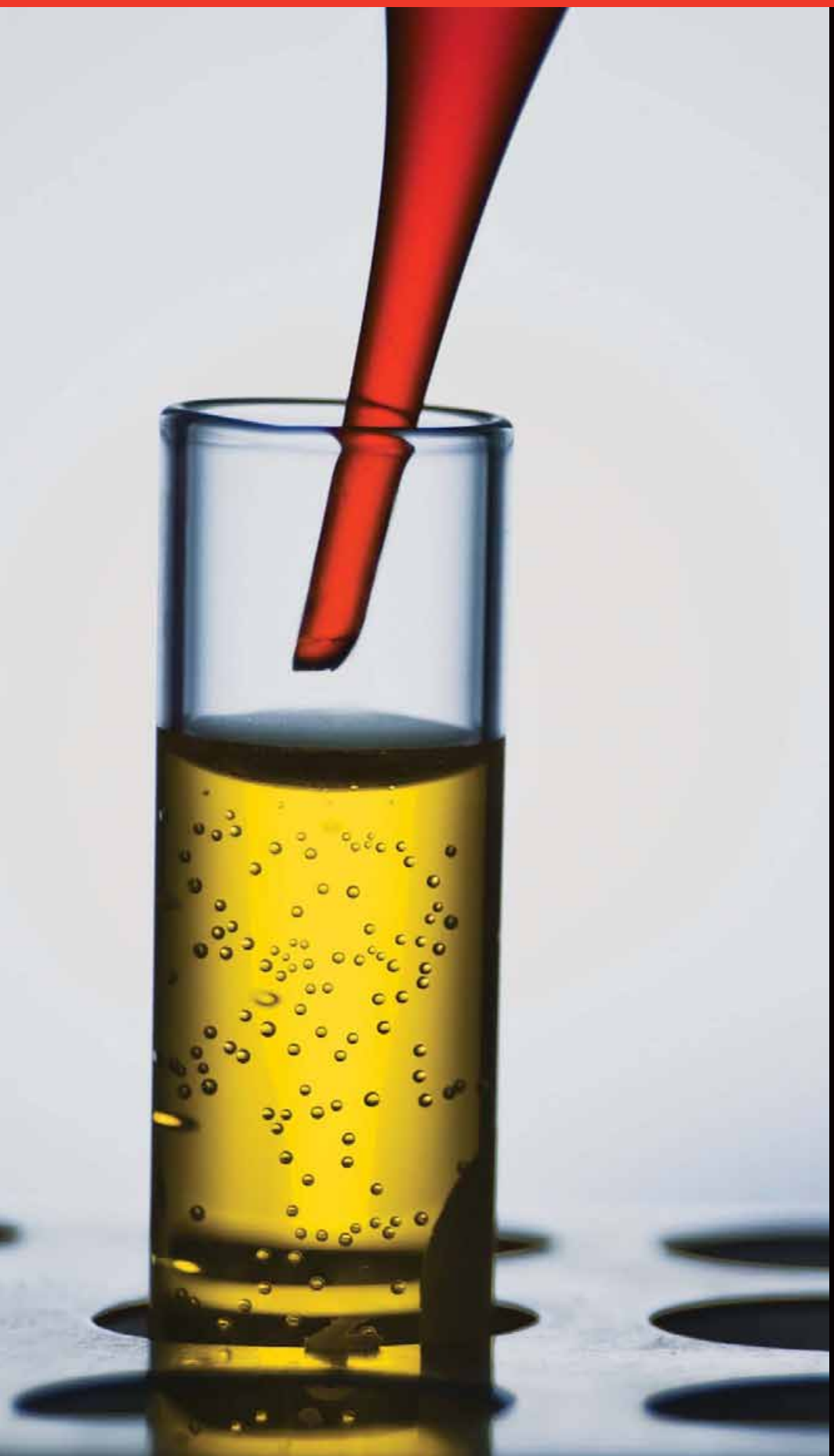
RESPONSIBLE CARE®

March 2014 - v14

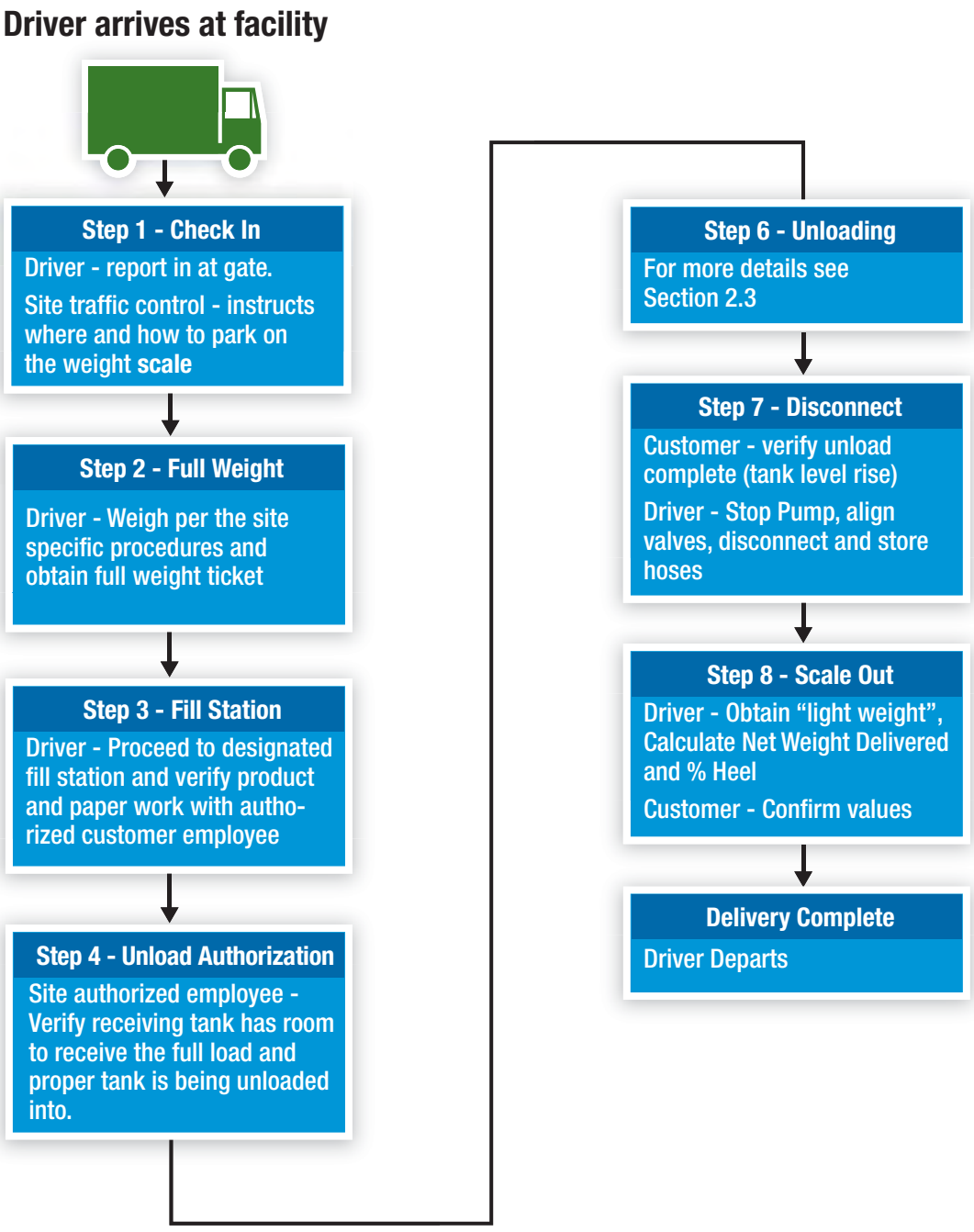
Honeywell

Part 2
Customer Process and Procedures

2



Flow Chart



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. Weigh ISO and receive the “full weight” value from the customer’s facility
- b. Scale to be calibrated according to manufacturer's recommendations

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. Customer 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 Section 2.5 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 site’s 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 Section 2.5 and provide supporting documentation such as digital photos.

3. UNLOADING AND SCALE OUT

3.1 Facility personnel 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 ordered amount of content from the ISO

3.4 Driver safely disconnects and stores the hoses at the facility’s location or on the delivery vessel

3.5 Driver is released and Risk of Loss transfers from Freight Forwarder to the receiving facility

3.6 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 facility’s 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 Offload verification for full ISO delivery
- 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 EU-1234yf-014: Honeywell STOP Procedure and provide supporting documentation such as scale tickets or digital photos.

Most common ISO delivery combination

Generally our truck/trailer combinations can **vary between 12m and max 15m**

PUMP ON BOARD

Hose connections designed to connect to the following tank connectors:

Liquid phase:
Mann Tek Tank unit 2”-2”BSP SS/EPDM *
Type No. T210A4403A

Vapour phase:
Mann Tek Tank unit 1”-1”BSP SS/EPDM *
Type No. T103A4403A

*Or fully compatible

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).

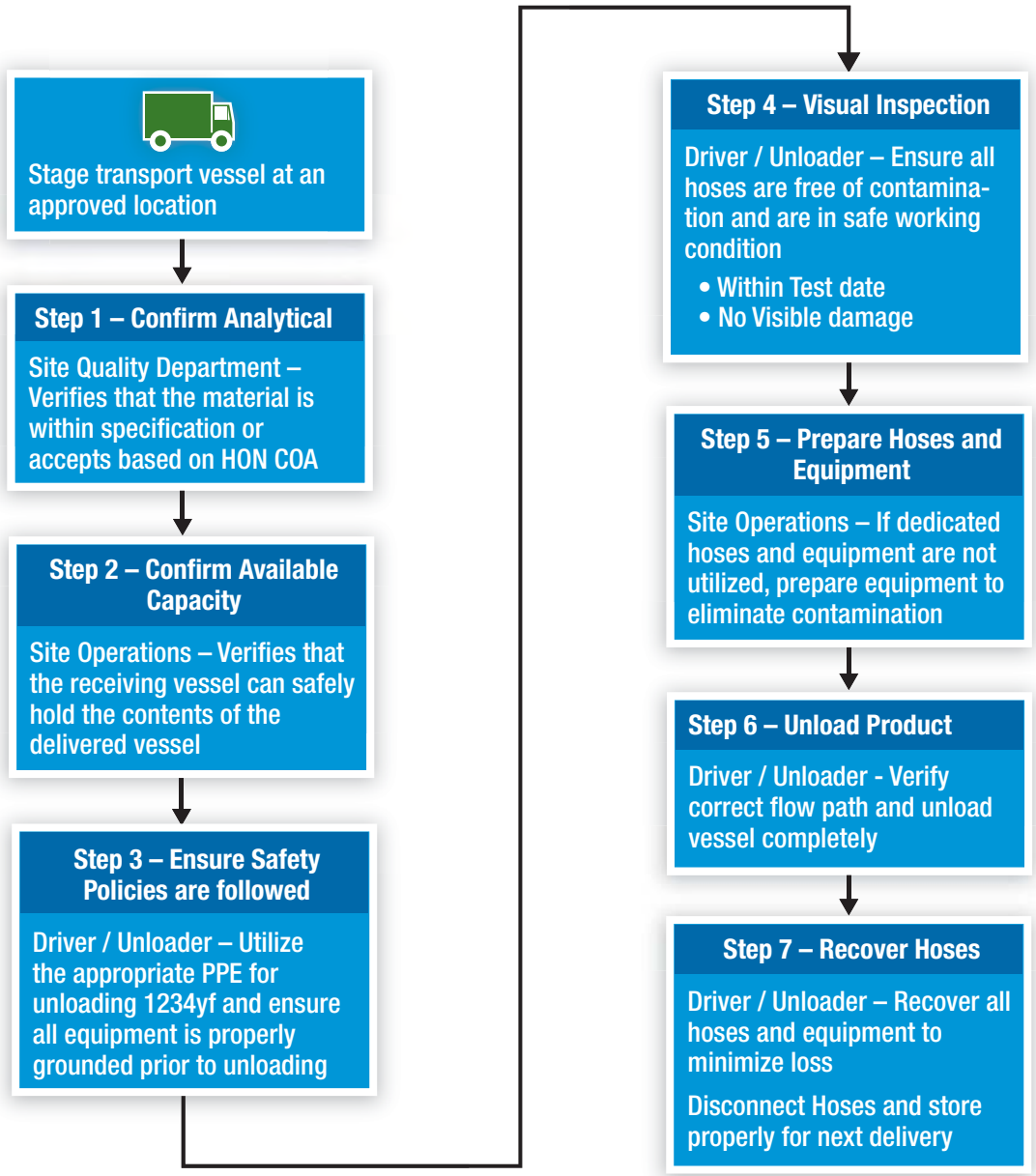
   Note: It is recommended that Step 1 and this step occur two to three times. This will help to "drive" a lot of the moisture out of the low lying points and joints and make the next step easier to accomplish.

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

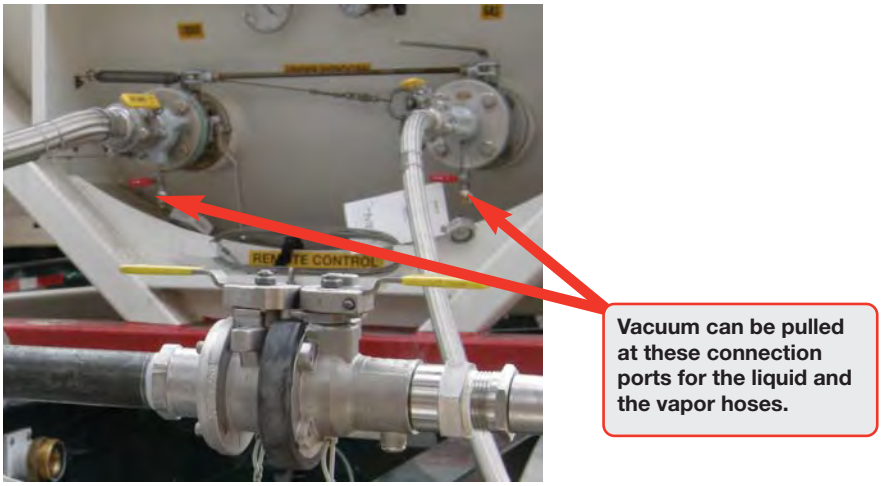
      Caution: If water is present, or during winter, it may be necessary to use a heater with insulating blankets and a tent tarp to elevate the tank temperature and drive off water and/or frost. The fittings and pipes also need to be heated or the water will just move to the coldest portions.

Flow Chart



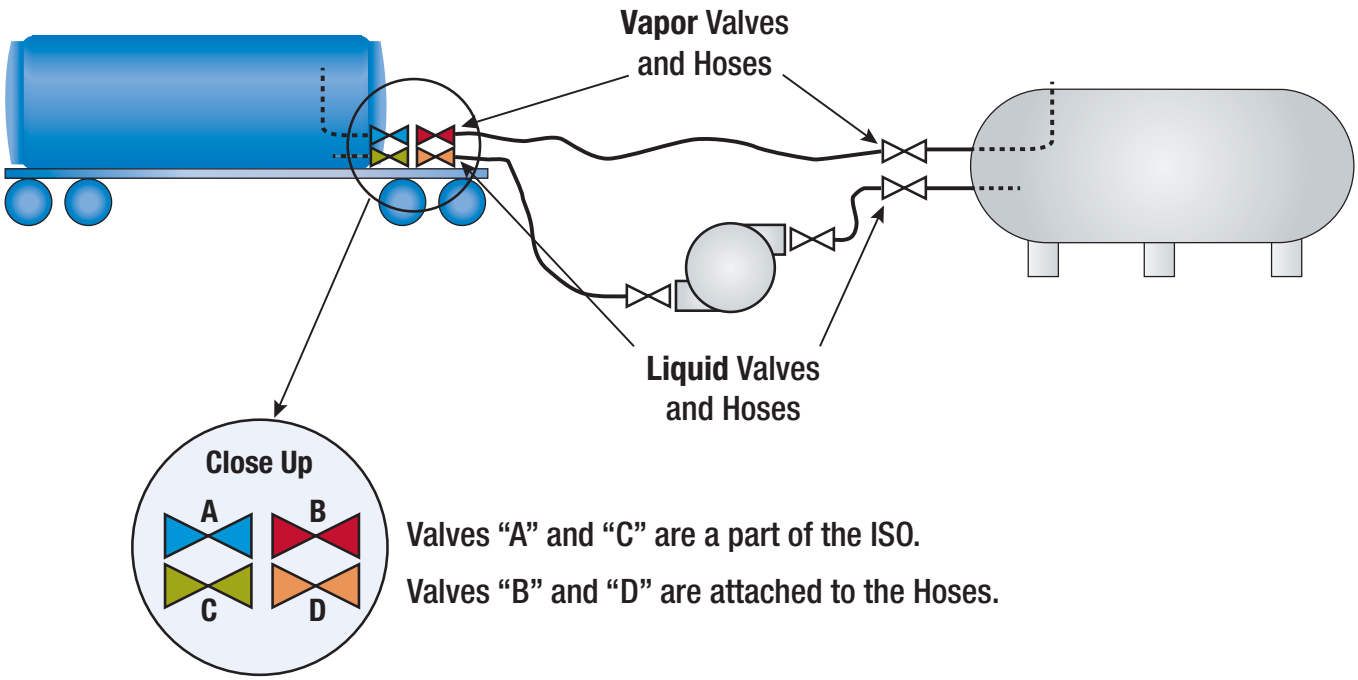
OFFLOADING INTO A FIXED BULK STORAGE ASSET

1. Ensure that the source ISO tank has been sampled per the quality section of this handbook to ensure that material is compliant with the specification
2. Analyze the destination bulk storage asset using the same procedures outlined in the quality section of this handbook to ensure that contained material is compliant with specification
3. 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 95% of their total capacity
4. Ensure site personnel are wearing all required PPE in addition to their standard PPE
5. Inspect the area to ensure sufficient ventilation is present as to prevent the accumulation of vapors in low lying areas
6. 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
7. Check grounding equipment. Use of an ohm meter is recommended
8. Ground the ISO tank, transfer pump and fixed bulk storage asset
9. 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.
10. Visually inspect hoses to ensure they are safe for use, check for:
    a. Fraying
    b. Gouges
    c. Kinks
    d. Any other defects
11. 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
12. Visually inspect each connection to ensure moisture is not present. If present, manually remove with a clean, dry cloth
13. Connect the couplings to the liquid line of the ISO tank
14. Connect the hose from the coupling to the pump
15. Ideally the hoses and pump should be dedicated for specific product usage. If not dedicated, 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



16. Close (ensure that) the bleed valve used to pull the vacuum is closed
17. Open the valve on the ISO tank liquid line
18. Open the valve to fixed bulk storage asset
19. Turn on the pump
20. Using a hand held gas leak detector, frequently monitor the pump, ton tank, all lines and connections for leaks
21. Empty the ISO tank to the gaseous phase
22. Stop the pump
23. Close the bulk storage liquid fill valves (leave the vapor line to the storage open)
24. Close the internal valve and valves “B” and “C” shown
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 in step 15 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 in step 15 as a vacuum connection valve, on the vapor equalization line of the ISO
    c. Open both sample valves
    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

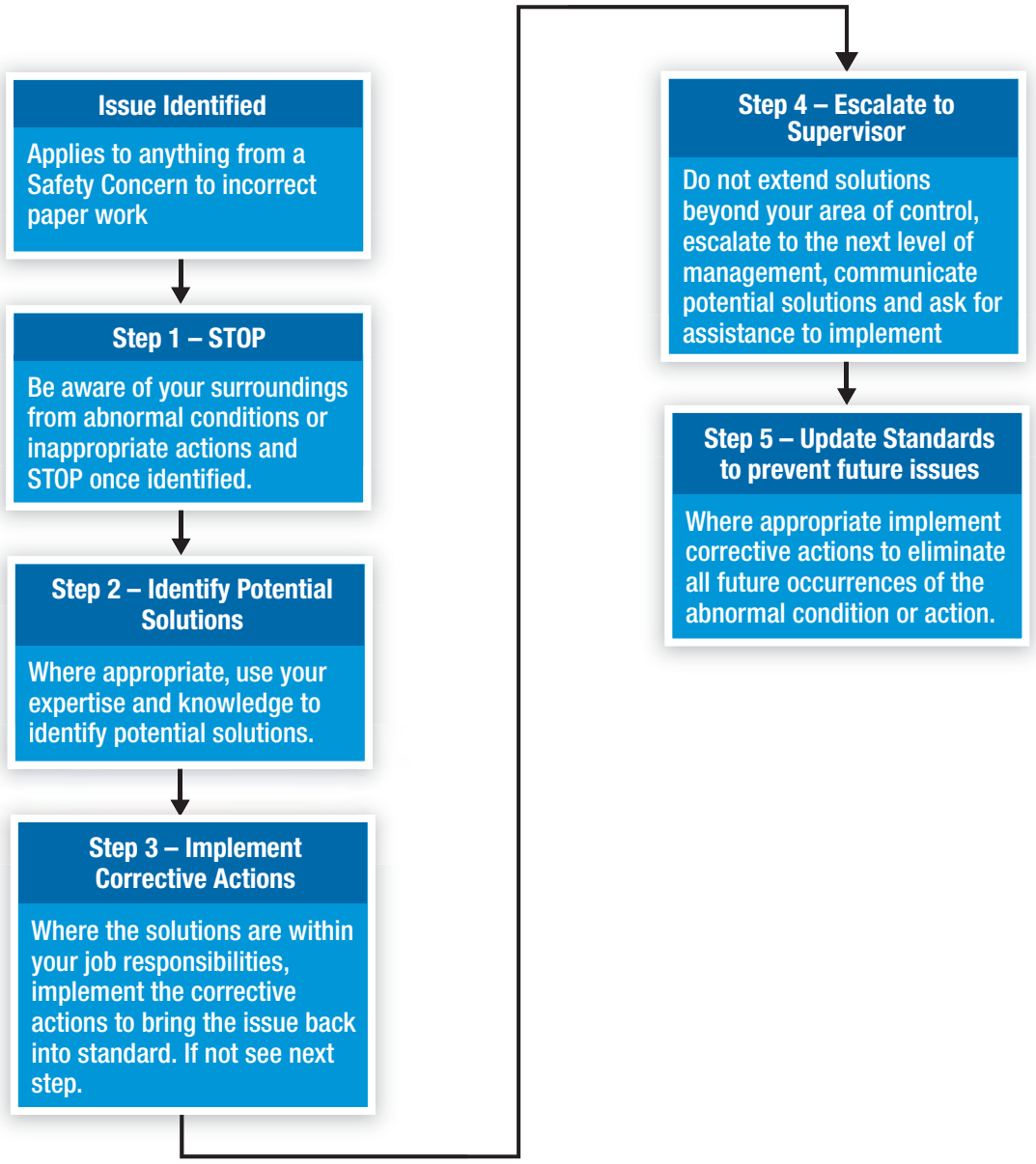
Offloading into a Fixed Bulk Storage Asset



Valves “A” and “C” are a part of the ISO.

Valves “B” and “D” are attached to the Hoses.

Flow Chart



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

1. PURPOSE

This Policy defines the roles and responsibilities of the parties involved in the handling and the return of Honeywell ton tanks and half ton tanks (collectively the "Tank(s)"), DOT returnable cylinders and all other non-disposable cylinders larger than 10kgs (collectively the "Cylinder(s)") Tanks and Cylinders are hereinafter collectively referred to as "Containers".

2. CONTAINERS SPECIFICATION

D= diameter; L = Length, H = Height

Description	Measurement in cm	Tara weight in kg	Max pcs on pallet
Horizontal roll drum	D= 800mm L = 2330	450kg	Not Applicable
Vertical Ton Tank	D=1.2mx1m H =1785cm	620kg	Not Applicable
Cylinders 50 kg	D=304,30 L= 115-137	22,5-29,5	10 pcs on pallet 1x120

3. LIABILITY

a. Containers will at all times remain the property of Honeywell.
b. Buyer will assume full responsibility for the Container and its content after delivery by Honeywell (in accordance to the Incoterms (2010) specified in the confirmed purchase order) until delivery by Buyer of the empty Returnable Container under clause 8 below.
c. Buyer will indemnify and hold Honeywell harmless against any loss of or damage to the Container and any liability to a third party in respect of death, injury or property damages, caused by or arising out of or in connection with the Buyer's (or Buyer's employees, agents and sub-contractors) use or custody of the Container.

4. CONTAINERS RENTAL FEE

Unless stated otherwise in the Agreement, the use of Honeywell's Containers is free of charge for the first 90 days following the shipping date (the "Free Rental Period"). After the Free Rental Period, Honeywell will charge Buyer a daily rental fee of €28 for Tanks and €3 for Cylinders (the "Rental Fee") until the earlier of: (i) the date on which Honeywell has been notified by Buyer that the empty Container is ready for collection or (ii) an additional 90-day period has elapsed after the Free Period (the "Rental Period"). At the end of Rental Period Honeywell will consider the Tank to be lost and will cease accruing the Rental Fee. In either case, Buyer will be invoiced for the total amount of the Rental Fee due. The Rental Fee will not be refunded to Buyer, even if the Container(s) are returned at a later date.

5. INVOICING

The Rental Fee will be invoiced monthly and will be paid by Buyer in accordance to the payment terms stipulated in the confirmed purchase order. Any delay in paying such invoices will immediately and automatically entail a credit block.

6. OPTION TO PURCHASE CONTAINERS.

Buyer may elect to purchase Container(s) in order to avoid paying the Rental Fee, by notifying Honeywell Customer Service at the time of purchase of Product. Honeywell will add the cost of the Container to the invoice on a separate line item.

7. USE OF CONTAINERS

a. Buyer shall use such Containers only for storage of Honeywell's Product as originally delivered therein. It is strictly prohibited to use the Containers for any purpose other than receiving the shipment of Product from Honeywell.
b. Upon shipment's arrival, Buyer will inspect the Container for any visible defects. Buyer will use the Container under normal conditions only.

c. No excessive force will be used when opening and closing the valves. If valves do not operate properly, Buyer must advise Honeywell Customer Service immediately.
d. Buyer will not apply any additional labels or other information onto the Container unless it is identified as defective or damaged in which case it must be marked as such by Buyer and such marking shall not cover product markings or any other markings required by applicable regulations.

8. RETURN OF EMPTY CONTAINERS

a. Buyer will deliver the empty Container to Honeywell FOB (Incoterms 2010) to the destination where the Returnable Container was initially delivered by Honeywell.
b. When Containers are ready for return by road inside the EU, Buyer will notify Honeywell Customer Service via e-mail at the following address: Honeywell@stratwave.com. In this e-mail Buyer will provide (1) the Container number, (2) the Product name, (3) the Date, time and address where the Container can be picked up and (4) the Contact person and/or collection hours (if applicable).
c. When Buyer arranges for ocean freight booking, the following obligations must strictly be complied with :
   - Buyer must book the ocean freight under “freight collect” terms with a Honeywell contracted shipping line, meaning that Honeywell pays the ocean freight piece to the destination port.
   - Buyer must have an “Express B/L” issued, meaning that the Container will automatically be released to the consignee (Honeywell) in the destination port (so no original B/L’s must be mailed to Honeywell). In the event that no Express B/L can be issued, a set of original B/L must be mailed immediately after vessel departure to the notify party (see shipping instructions)
   - Buyer must provide shipping details and a B/L copy (if no express B/L has been issued then originals must be submitted) immediately after vessel departure to the notify party as specified in the B/L instructions. If Buyer fails to do so, Buyer will be liable for any demurrage charges at the port of destination resulting from such failure.

9. RETURN OF PARTIALLY EMPTY CONTAINERS

a. Return by road inside of the EU:
   - Buyer will notify their Honeywell Key Account Manager and will provide: (1) the Container number, (2) the Product name, (3) The approximate weight of remaining product (4) the date, time and address where the Returnable Container can be picked up and (5) the Contact person and/or collection hours (if applicable).
   - Buyer will pay the increased costs of return freight, the exact amount will vary by customer’s location and will be provided to Buyer by their Honeywell Key Account Mananger.
   - Buyer will pay a restocking fee of €300
   - Buyer will pay the laboratory fees required to conduct a full analysis of the Container’s contents:
     - If analytical results demonstrate that the product conforms to Honeywell’s specification, then no further fees are required;
     - If analytical results demonstrate that the produdct is out of specification, then Buyer will be charged for the full costs required to either (i) rework the material back into specification or (ii) dispose of the material in accorance with applicable laws and regulations.
b. Return by ocean freight booking:
   - Buyer must book the ocean freight under “freight collect” terms with a Honeywell contracted shipping line. Honeywell pays the ocean freight piece to the destination port.
   - Buyer must have an “Express B/L” issued, meaning that the Container will automatically be released to the consignee (Honeywell) in the destination port (so no original B/L’s must be mailed to Honeywell). In the event that no Express B/L can be issued, a set of original B/L must be mailed immediately after vessel departure to the notify party (see shipping instructions).
   - Buyer will pay a restocking fee of €300.
   - Buyer will pay the laboratory fees required to conduct a full analysis of the cylinder’s contents:
     - If analytical results demonstrate that the product conforms to Honeywell’s specification, then no further fees are required;

- If analytical results demonstrate that the produdct is out of specification, then Buyer will be charged for the full costs required to either (i) rework the material back into specification Or (ii) dispose of the material in accorance with applicable laws and regulations.

- Buyer must provide shipping details and a B/L copy (if no express B/L has been issued then originals must be submitted) immediately after vessel departure to the notified party as specified in the B/L instructions. If Buyer fails to do so, Buyer will be liable for any demurrage charges at the port of destination resulting from such failure.

10. RETURN OF FULL CONTAINERS

a. For the avoidance of doubt, full Containers returned to Honeywell without the original Honeywell shrink wrap around the valve will be treated as partially empty Containers under clause 9 above.

b. Buyer will pay the increased costs of return freight. The exact amount will vary by customer's location and will be provided to Buyer by their Honeywell Key Account Mananger.

c. Buyer will pay a restocking fee of €300.

11. RETURN CONDITIONS

Buyer will prepare the proper transport documentation (CMR and or BOL) with correct ADR/IMDG identification data:

a. For Road transport:

- Containers which are emptied with the intention to completely emptying them, and thus which have a minimal residue, will be considered as empty uncleaned. In accordance with ADR regulation 5.4.1.1.6.2.1 the information on the transport document shall show "EMPTY PACKAGING, 2".
- Containers which are not completely emptied, and which are known to still contain a residue, shall not be shipped as empty uncleaned packaging. All information required in accordance with ADR regulation 5.4.1.1. shall be shown on the transport document: UN number, proper shipping name (technical name), class, tunnel code.

b. For Ocean Transport:

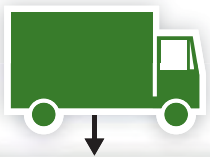
- Containers which are emptied with the intention to completely emptying them, and thus which have a minimal residue, will be considered as empty uncleaned. In accordance with IMDG Code chapter 5.4.1.4.3.2., the information on the transport document shall show EMPTY, UNCLEANED or RESIDUE LAST CONTAINED before or after the dangerous goods description specified in chapter 5.4.1.4.1.1 to 5.4.1.4.1.5. UN number preceded by the letters UN , proper shipping name (technical name), hazard class, EmS-No.
- Containers which are not completely emptied, and which are known to still contain a residue, shall not be shipped as empty uncleaned packaging. All information required in accordance with IMDG Code chapter 5.4.1.4.1.1 to 5.4.1.4.1.5 shall be shown on the transport document: UN number preceded by the letters UN , proper shipping name (technical name), hazard class, EmS-No.

c. Buyer will also specify on the transport documentation:

- Quantity and type of containers
- Container identification numbers
- The following consignee should be indicated on the CMR:
  Honeywell Fluorine Products Europe BV
  Dutch Toller c/o Honeywell
  Van konijnenburgweg 84
  4612 PL Bergen op Zoom
  The Netherlands

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

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)

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 Employees – Utilizing the HON STOP procedure, Section 2.4, 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 performed 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

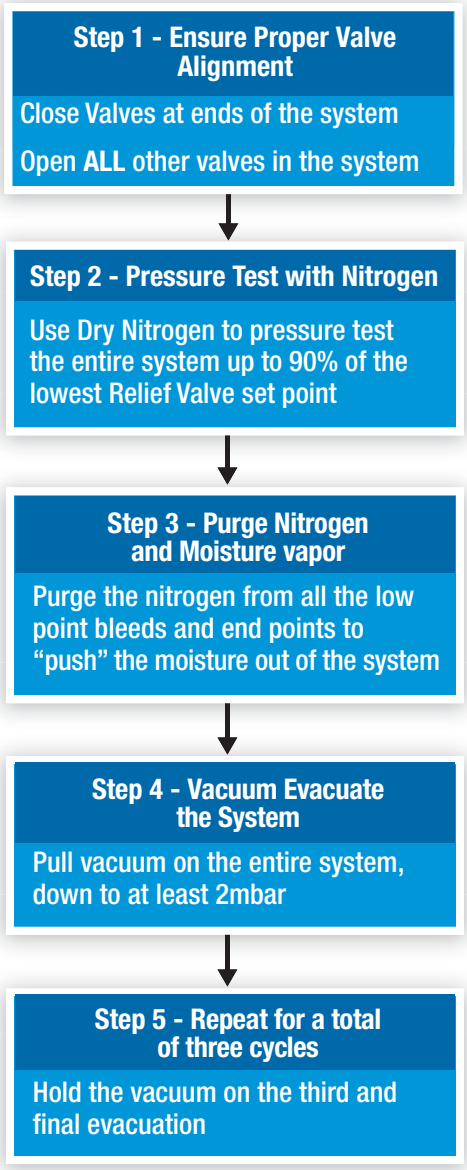
3. Offload truck and store tanks in designated areas. While offloading, watch for obvious signs of leaking or tank damage

   Immediately notify Honeywell of any abnormalities using the STOP procedure as outlined in procedure 2.4: 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 2.4: Honeywell STOP Procedure and provide supporting documentation such as digital photos.

Flow Chart



PRESSURE TEST AND EVACUATION PROCESS

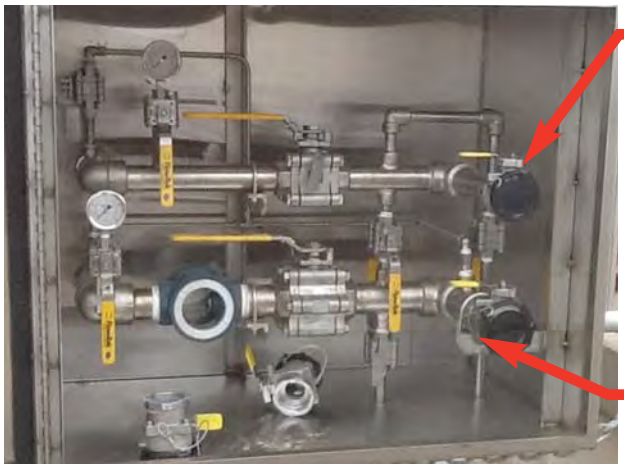
Perform pressure tests and evacuation procedures on **ALL** lines and equipment that will contain R1234yf.

For all steps ensure that all equipment utilized in this procedure, including connections and hoses, are rated for greater than 35 barg and certified to hold a 0,7 mbar vacuum.

1. Pressure test
   a. Ensure that you have enough nitrogen on site to pressure up the entire system
   b. Make certain **ALL** valves are open to the lines and equipment to be tested.

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. If necessary, repair leaking lines and equipment.
e. Repeat steps 2-4 until no leaks are detected.
f. Hold N_2 pressure for one hour water contained in the system will be drawn into the nitrogen as a vapor during this period
g. Once the lines and equipment are deemed to be leak free continue to the next step

2. Purge Nitrogen through the low point bleeds and ends of the system
   a. Open the valves at the ends of the system 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 3,5 to 7 bar, 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 0,3 – 0,7 bar.
3. Evacuate lines and equipment to less than 2mbar
   a. Utilize an adequately sized vacuum pump to evacuate the system. Remember the tank is typically 25m³ capacity and the systems normally have a lot of piping to be evacuated.

We recommend at least one 136 m³/h 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).

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 2mbar vacuum is attained and continue evacuating for two hours. Water remaining in the system will be boiling off during this time.

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 “locking in” the vacuum
f. The system should hold less than 2mbar 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.

4. Repeat all steps above **two** (2) more times to ensure the system is ready to charge.
5. On the third and final evacuation, keep the system under vacuum until the unloading of the R1234yf product takes place. Vapor form the R1234yf ISO will be used to break the vacuum during the initial unloading.

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 Valve (RV) 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 EU-1234yf-2.7)			

- 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

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 < 3 mbar			
Vacuum (measured at the 1234yf holding tank) held < 3 mbar for 2 hours			

Contractor Preforming work Signature: _____

Customer Accepting work Signature: _____

Vacuum (measured at the 1234yf holding tank) held < 3 mbar for 2 hours			

Part 3
Quality and Analytical Information

3

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

Certified by_____
Laboratory Analyst

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

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

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

HFO-Refrigerants-1

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).

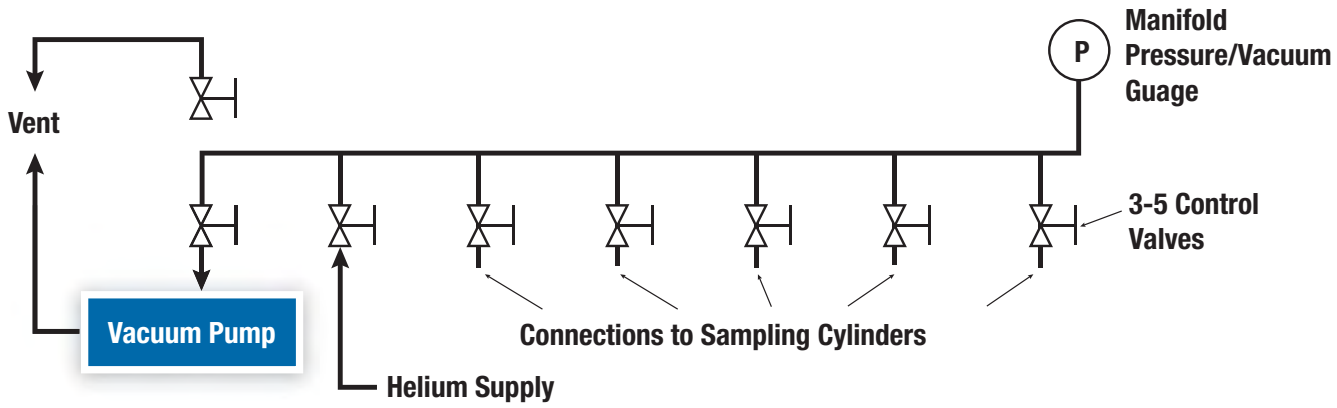
1. Connect the sampling cylinder valve to 1233zd container with clean fittings and tubings.
2. Open the sampling cylinder valve, and then fill the cylinder with about 32 grams of 1233zd solvent (~25 mL of 1233zd).
3. Close sampling cylinder valve, and detach the cylinder from 1233zd container.
4. Carefully 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.

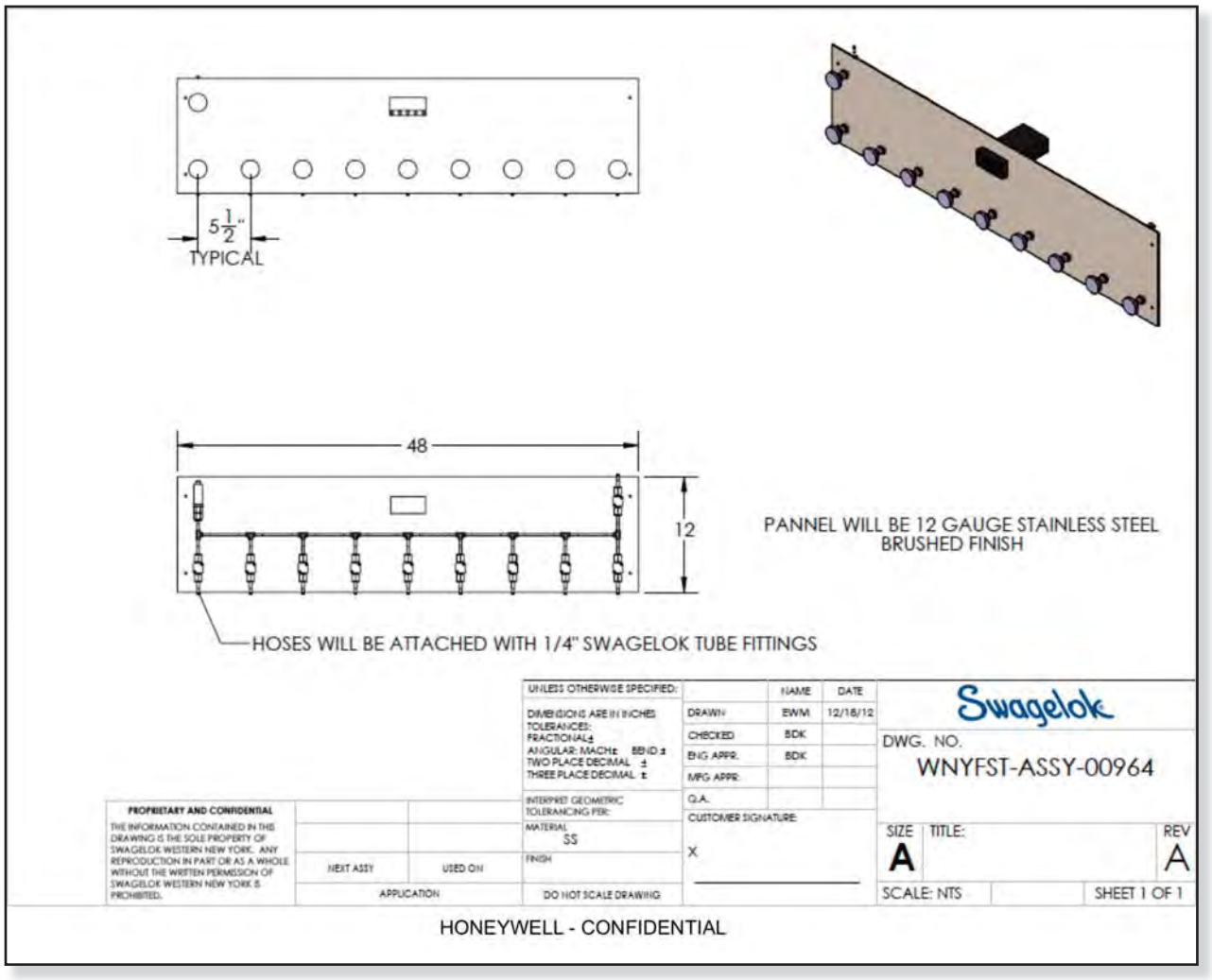
Written by; Jim Tu
Date: April 17, 2012
Date: Sep. 21, 2012, Revised by: Jim Tu, Revision on changing 1234yf to HFO Refrigerants and added cleaning procedures for contaminated cylinders.
Date: Nov. 12, 2012, Revised by: Jim Tu, Revision on adding 1233zd as preferred solvent. Added Acetone and Hexane 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**

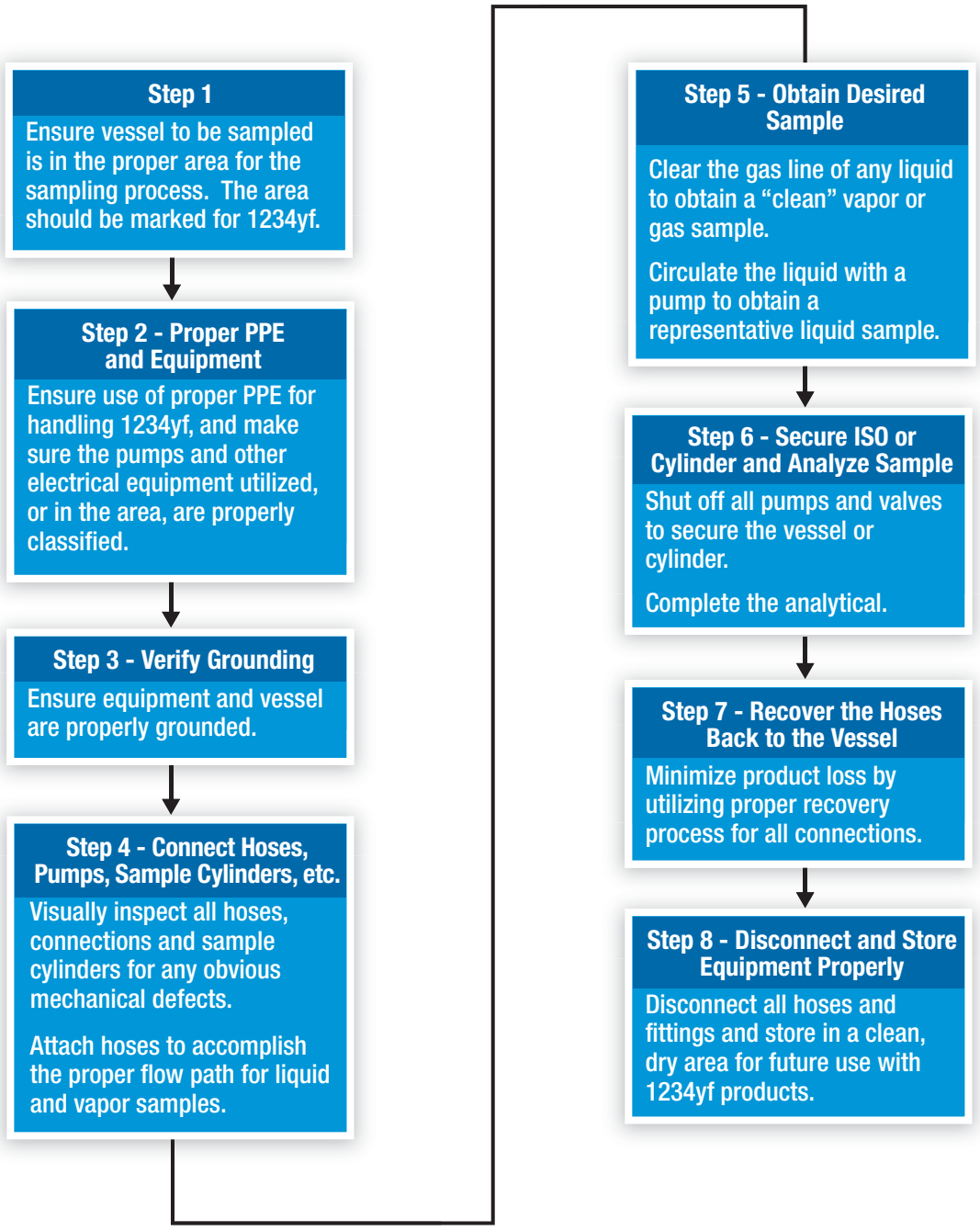
Sampling Manifold Design from Swagelok



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



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.

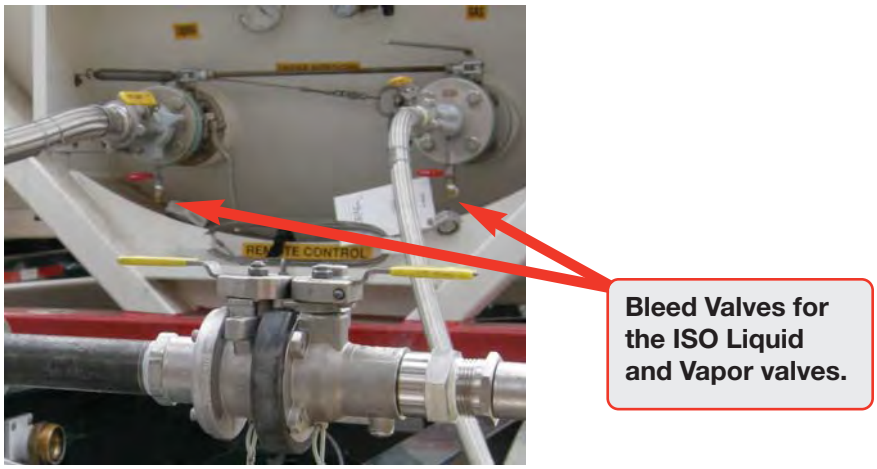
- Circulate using the following guidance:

Pump Capacity
1,700 kg/hr

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

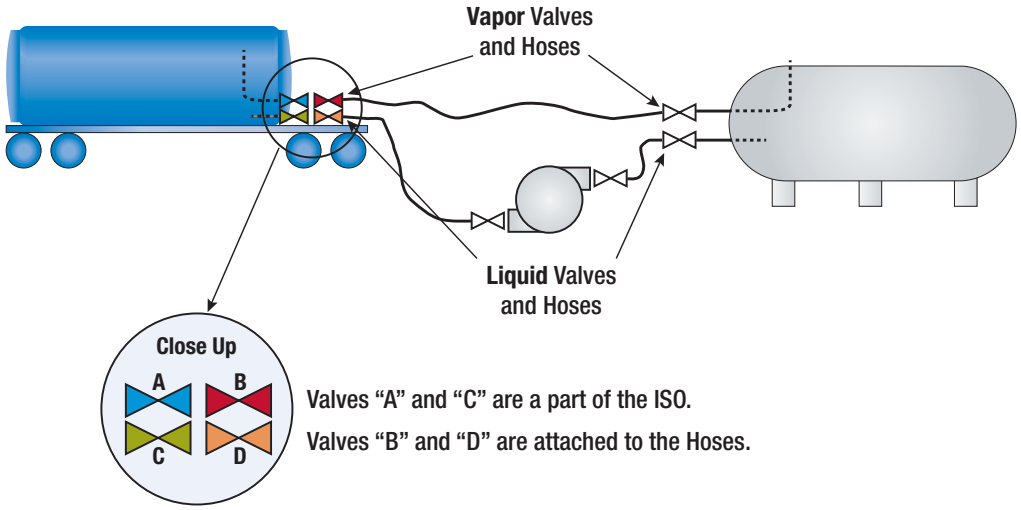
- Note that the above circulation times will have to be adjusted based on the capacity of available pumps.

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.

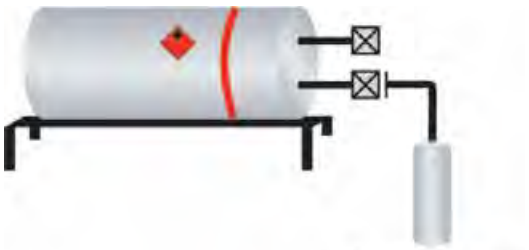
3.3 Tanks returned whose valves exhibit evidence of tamper (i.e. the pilot plate of the CGA670 has been damaged or removed) recover the 1234yf to a bulk tank and pull the cylinder pressure to less than 0.5 bar.

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.

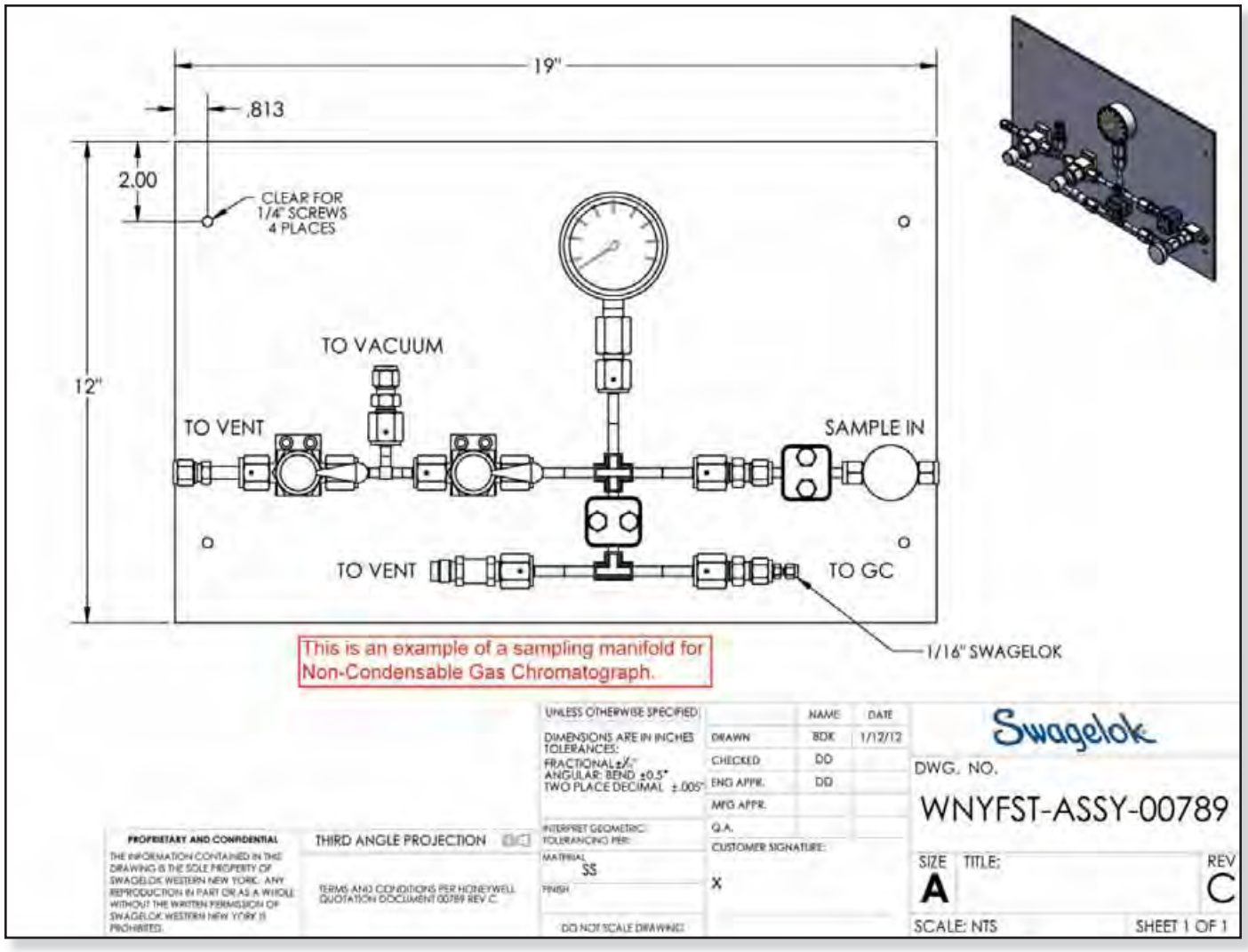
- For Ton Cylinders the valve closest to the 12 o'clock position for vapor sample and closest to the 6 o'clock position for the liquid sample.
- For all other cylinders, use the valve marked "vapor and liquid" for the proper sample.

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.



Sample Bottle

Connection of Sample Cylinder to Gas Chromatograph



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Visual Inspection for Appearance, Particulates and Solids in HFO Refrigerants

HFO-Refrigerants-10

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

HFO-Refrigerants-52

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

HFO-Refrigerants-2

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

HFO-Refrigerants-6

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.

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

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Determination of Chloride in HFO Refrigerants

HFO-Refrigerants-4

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

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Performance Materials and Technologies
Buffalo Research Laboratory
Buffalo, New York 14210
716-827-6245

Determination of HFO Refrigerants Assay

HFO-Refrigerants-7

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

HFO-Refrigerants-8

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

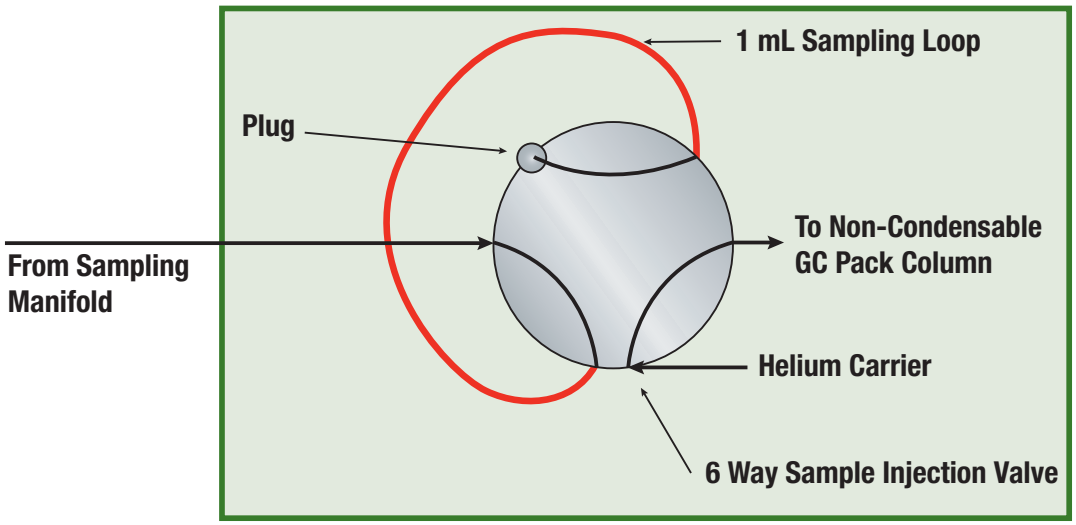
$$\text{Vol.\% Air} = \frac{\text{Vol \% Air Standard x Average Area counts Air in Sample}}{\text{Average Area counts of Air peak of the standard}}$$

Total non-condensable = Vol. % Air

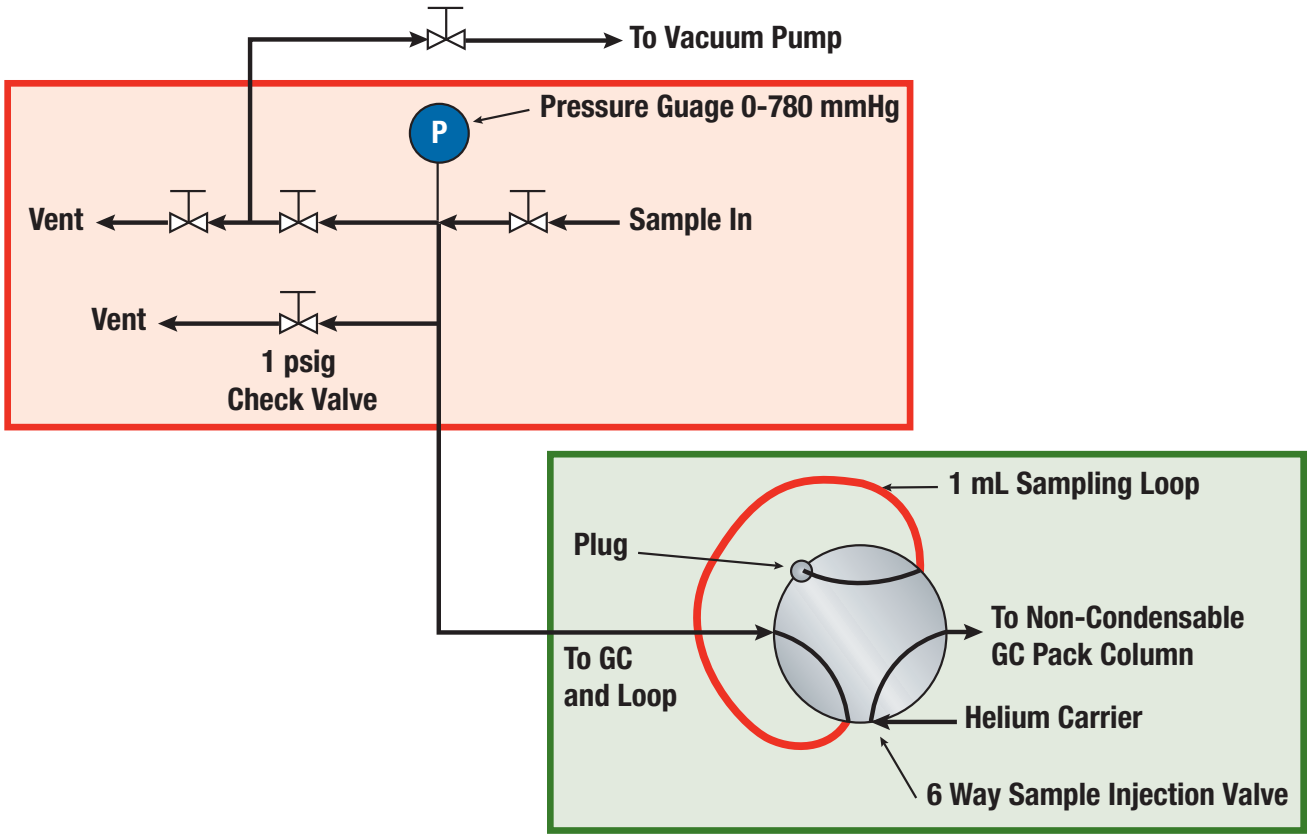
Report results to the nearest 0.1%.
Minimum reportable result is 0.1%

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

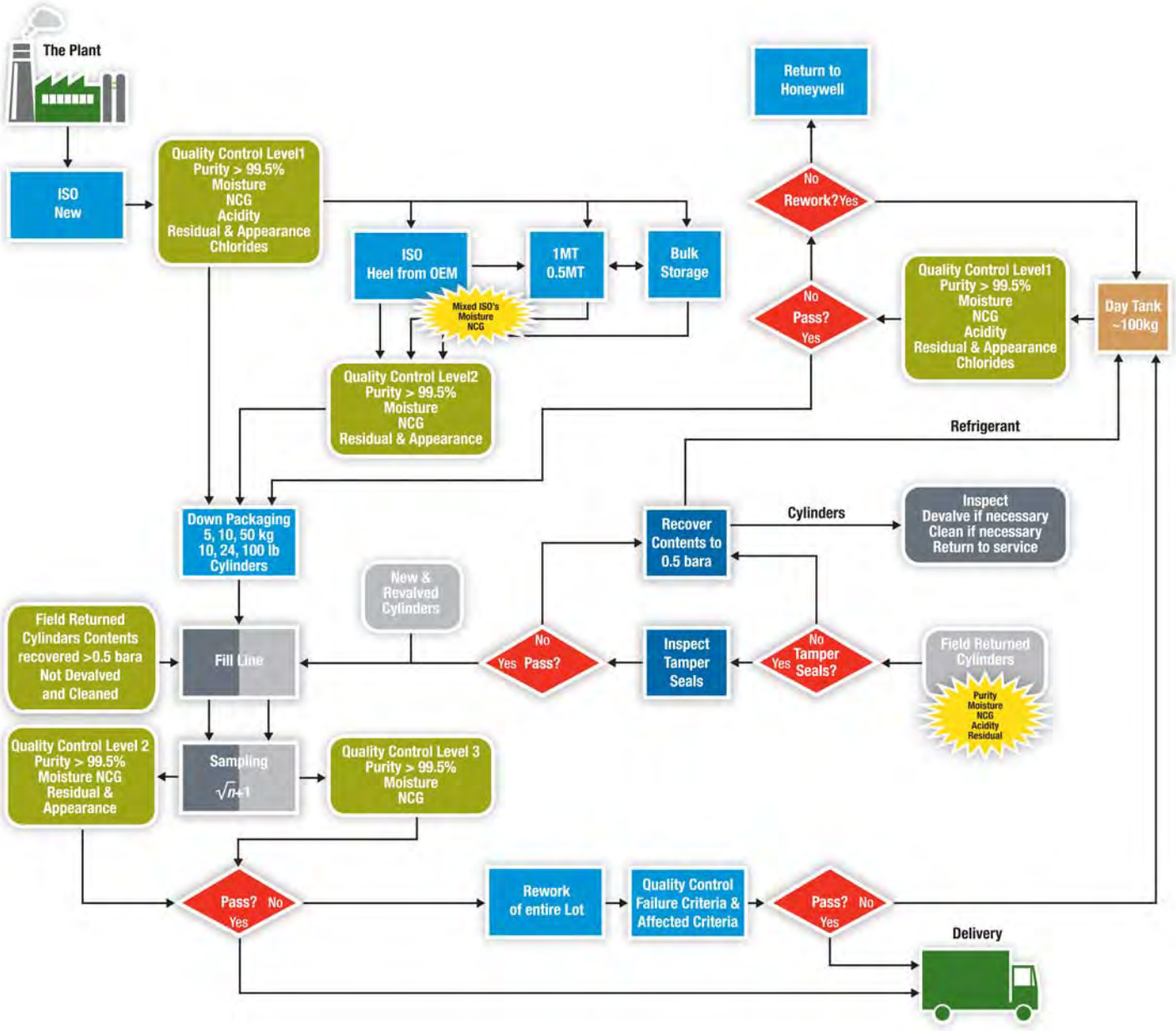
Scheme for Non-Condensable GC Injection Valve



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	√η +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	√η +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	√η +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

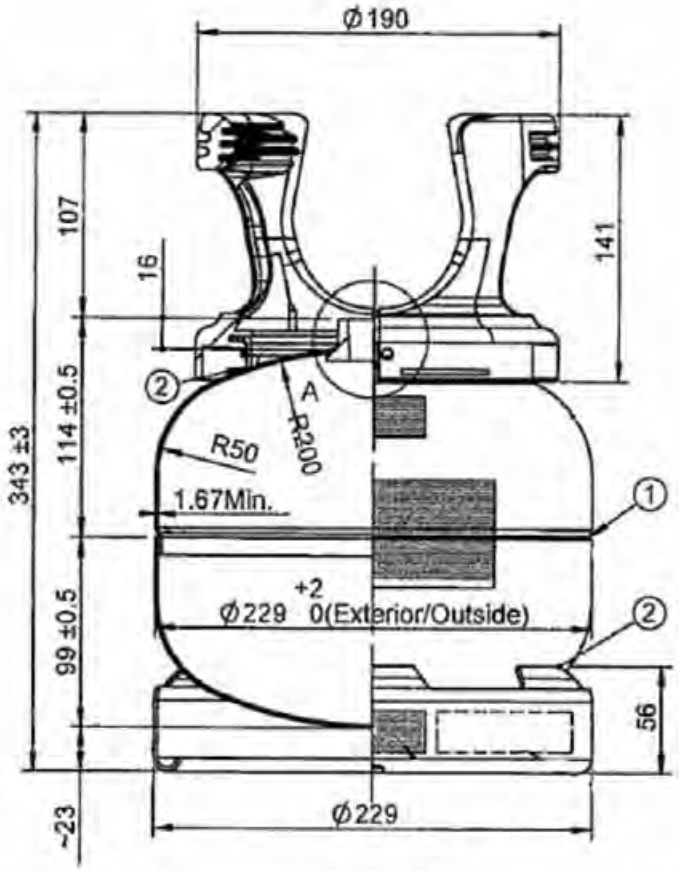
Regions: Europe Only, PI Marked

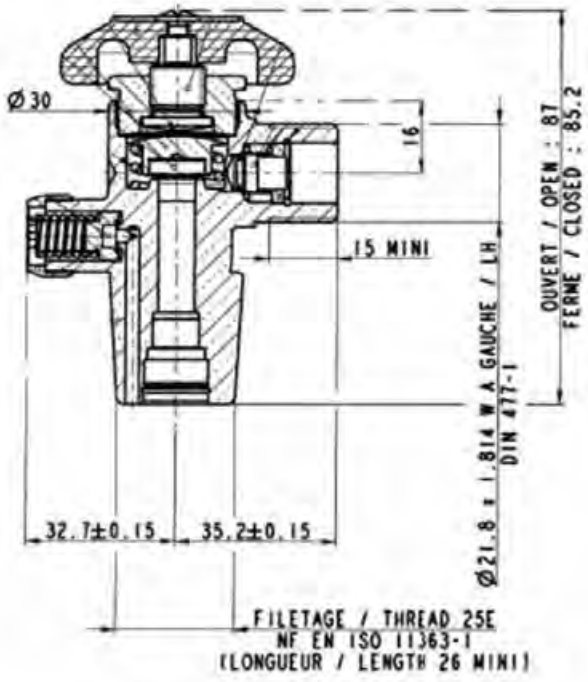
Water Capacity: 6 Liters

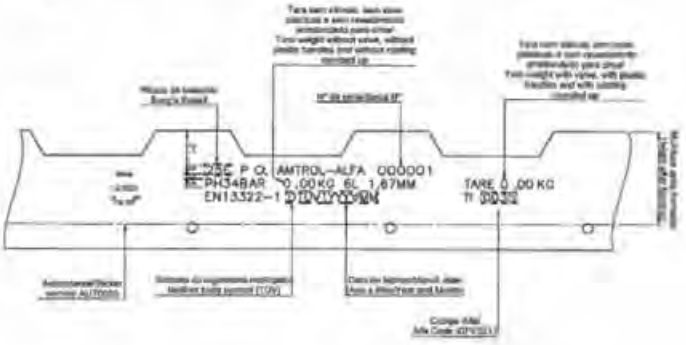
Features: Red Plastic Handle, Tamper Proof Evident Sticker, Anti-Fill Protection

Valve Outlet: Single Phase

Thread Pattern: DIN 477 discharge port with 25E threads into the cylinder body







5 kg Cylinder Specification

Cylinder Manufacturer	Amtrol
Water Capacity	6 Liters
Certifications	EN Only, PI Marked
Test Pressure Rating	25 bar minimum
Height	~350 mm
Diameter	229 mm
Handle Type	Plastic, Red RAL3020

Valve Manufacturer	Ermeto
Certification	PI Marked
Thread Twist	Left Hand
Outlet Thread	DIN 477
Number of Phases	Single Phase
Dip Tube	No
Bung Thread	25E
Valve Pressure Rating	25 bar
Pressure Relief Valve	Yes, Set to ~18 bar
Filter	None
Anti Filling Device	Yes

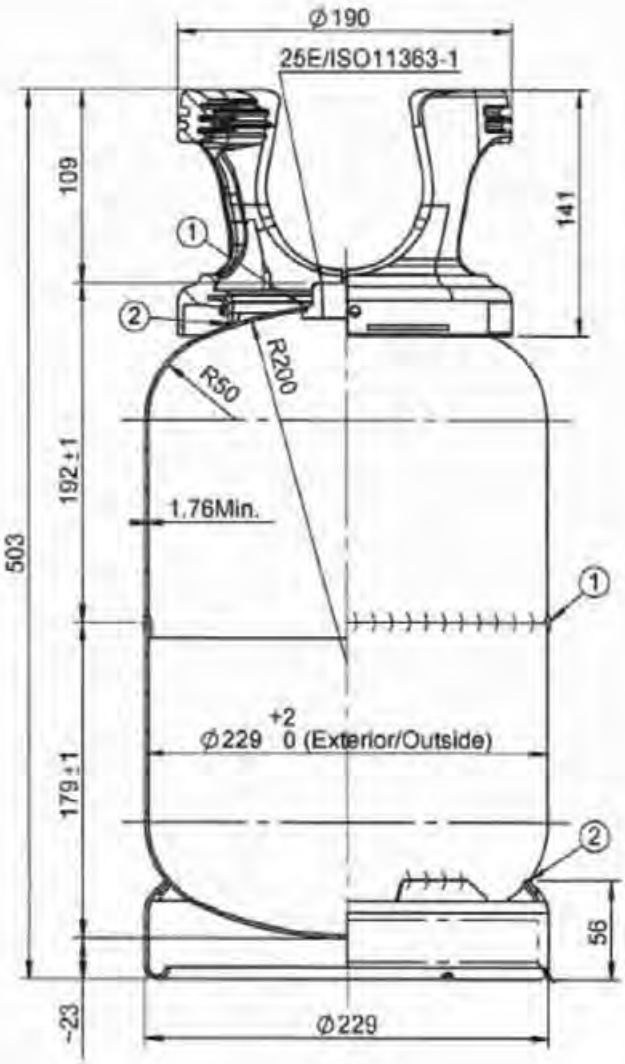
Regions: Europe Only, PI Marked

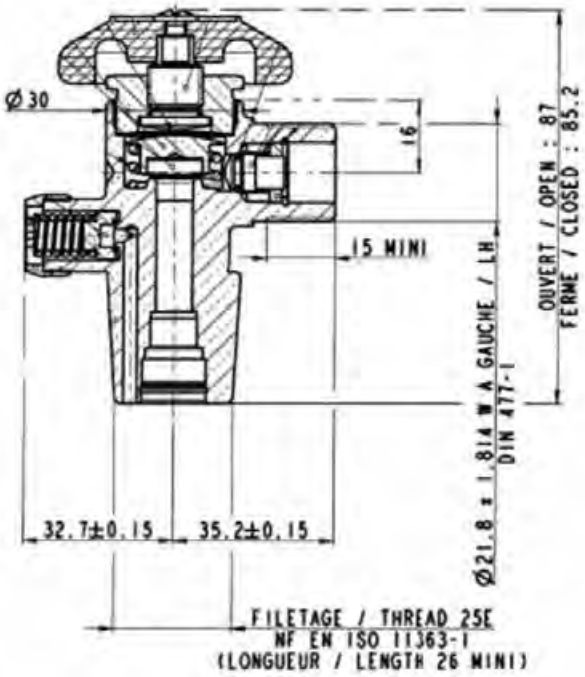
Water Capacity: 12.3 Liters

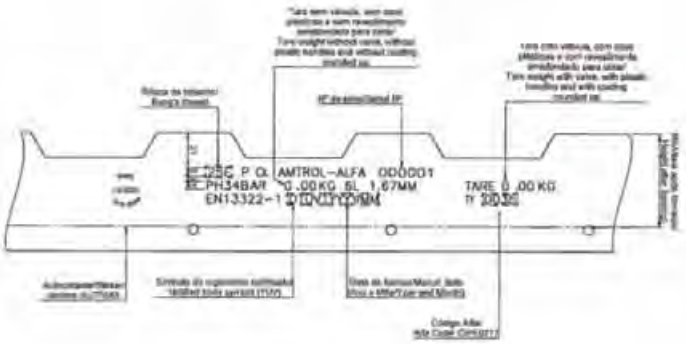
Features: Red Plastic Handle, Tamper Proof Evident Sticker, Anti-Fill Protection

Valve Outlet: Single Phase

Thread Pattern: DIN 477 discharge port with 25E threads into the cylinder body







10 kg Cylinder Specification

Cylinder Manufacturer	Amtrol
Water Capacity	12.3 Liters
Certifications	EN Only, PI Marked
Test Pressure Rating	25 bar minimum
Height	~503 mm
Diameter	229 mm
Handle Type	Plastic, Red RAL 3020

Valve Manufacturer	Ermeto
Certification	PI Marked
Thread Twist	Left Hand
Outlet Thread	DIN 477
Number of Phases	Single Phase
Dip Tube	No
Bung Thread	25E
Valve Pressure Rating	25 bar
Pressure Relief Valve	Yes, Set to ~18 bar
Filter	None
Anti Filling Device	Yes

50 kg Cylinder Specification

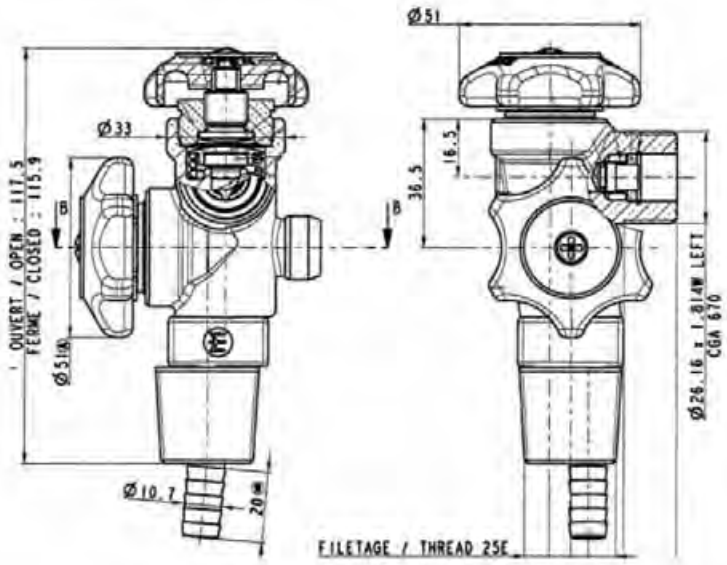
Regions: Europe Only, PI Marked

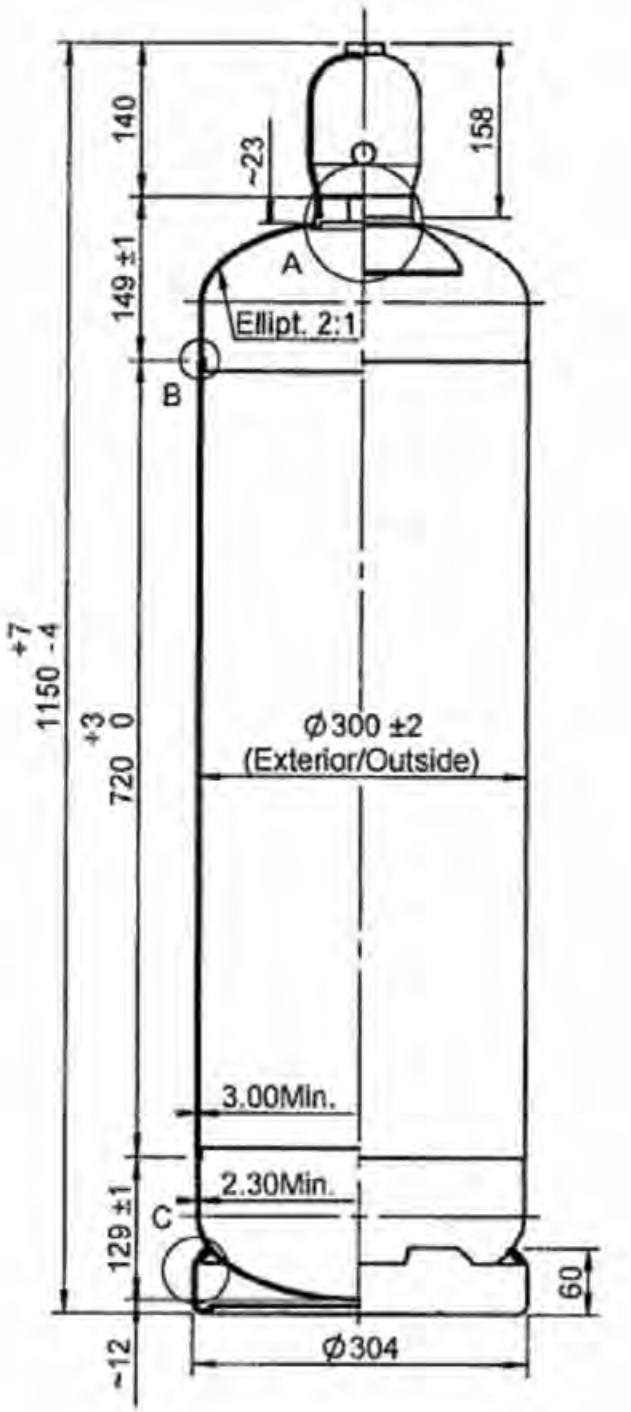
Water Capacity: 61 Liters

Features: Anti-Fill Protection

Valve Outlet: Duel Phase

Thread Pattern: CGA670 discharge port with 25E threads into the cylinder body

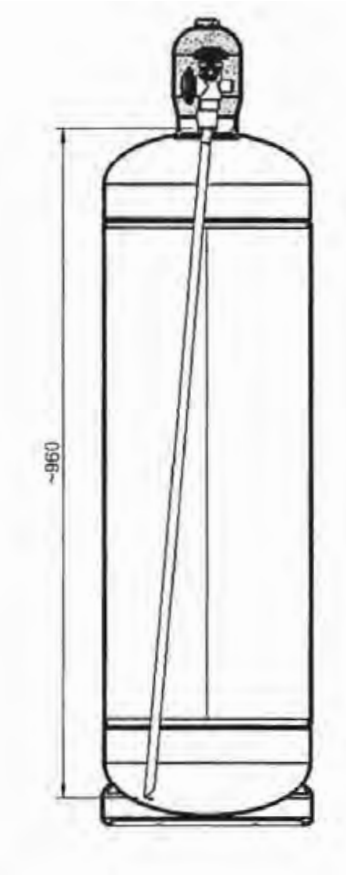


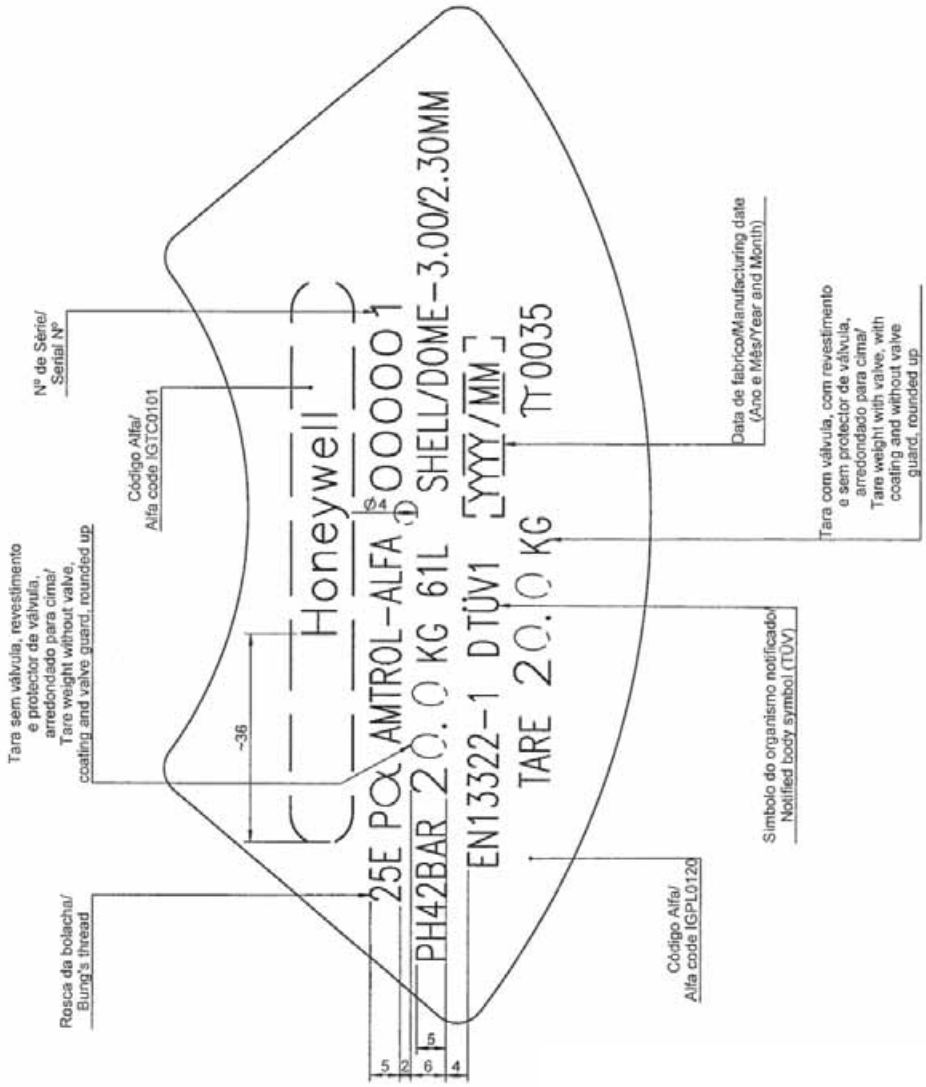


50 kg Cylinder Specification

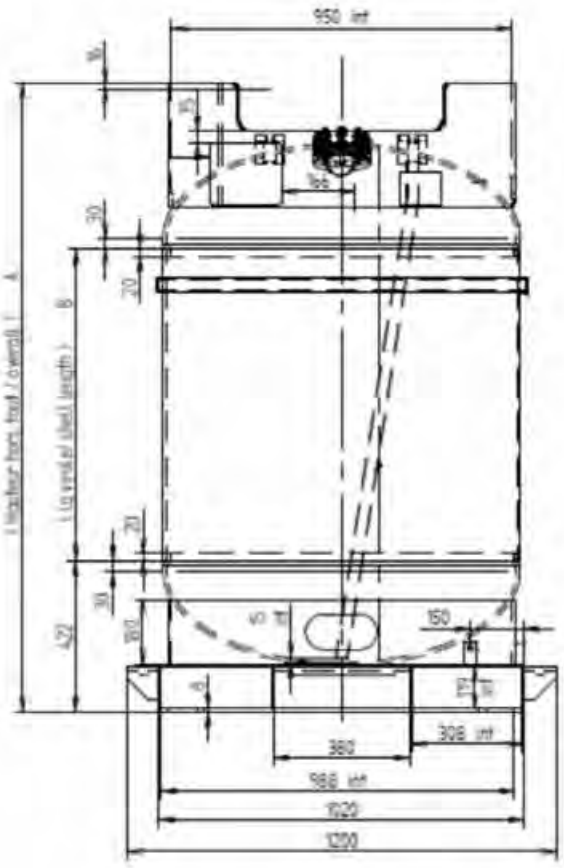
Cylinder Manufacturer	Amtrol
Water Capacity	61 Liters
Certifications	EN Only, PI Marked
Test Pressure Rating	25 bar minimum
Height	~1,150 mm
Diameter	~300 mm

Valve Manufacturer	Ermeto
Certification	PI Marked
Thread Twist	Left Hand
Outlet Thread	CGA 670
Number of Phases	Dual Phase
Dip Tube	Yes
Bung Thread	25E
Valve Pressure Rating	25 bar
Pressure Relief Valve	Yes, Set to ~18 bar
Filter	None
Anti Filling Device	Yes





900 kg Cylinder Specification



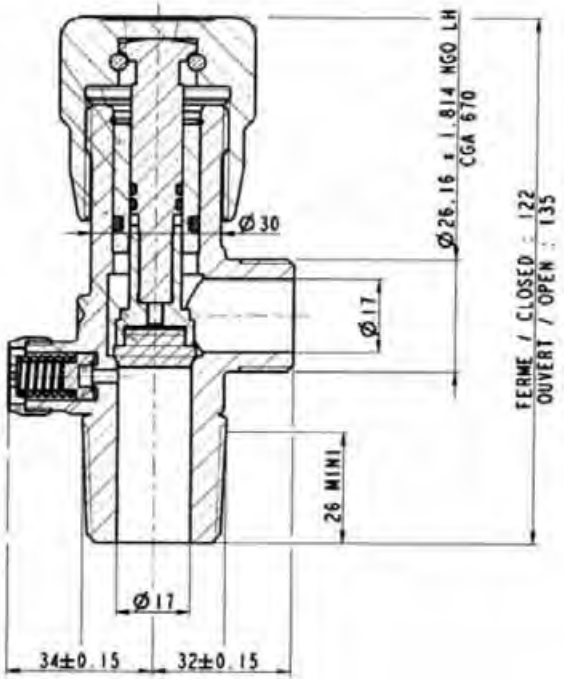
Regions: Europe Only, PI Marked

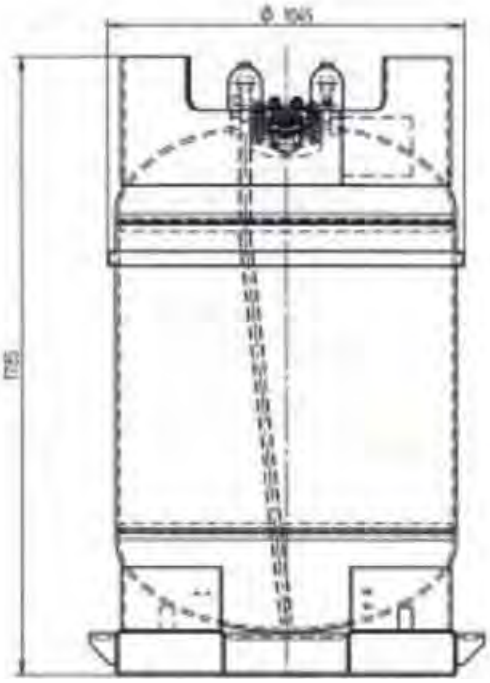
Water Capacity: 960 Liters

Features: Anti-Fill Protection

Valve Outlet: 2x Single Phase Valves, one Liquid and one vapor

Thread Pattern: CGA670 discharge port with 25E threads into the cylinder body

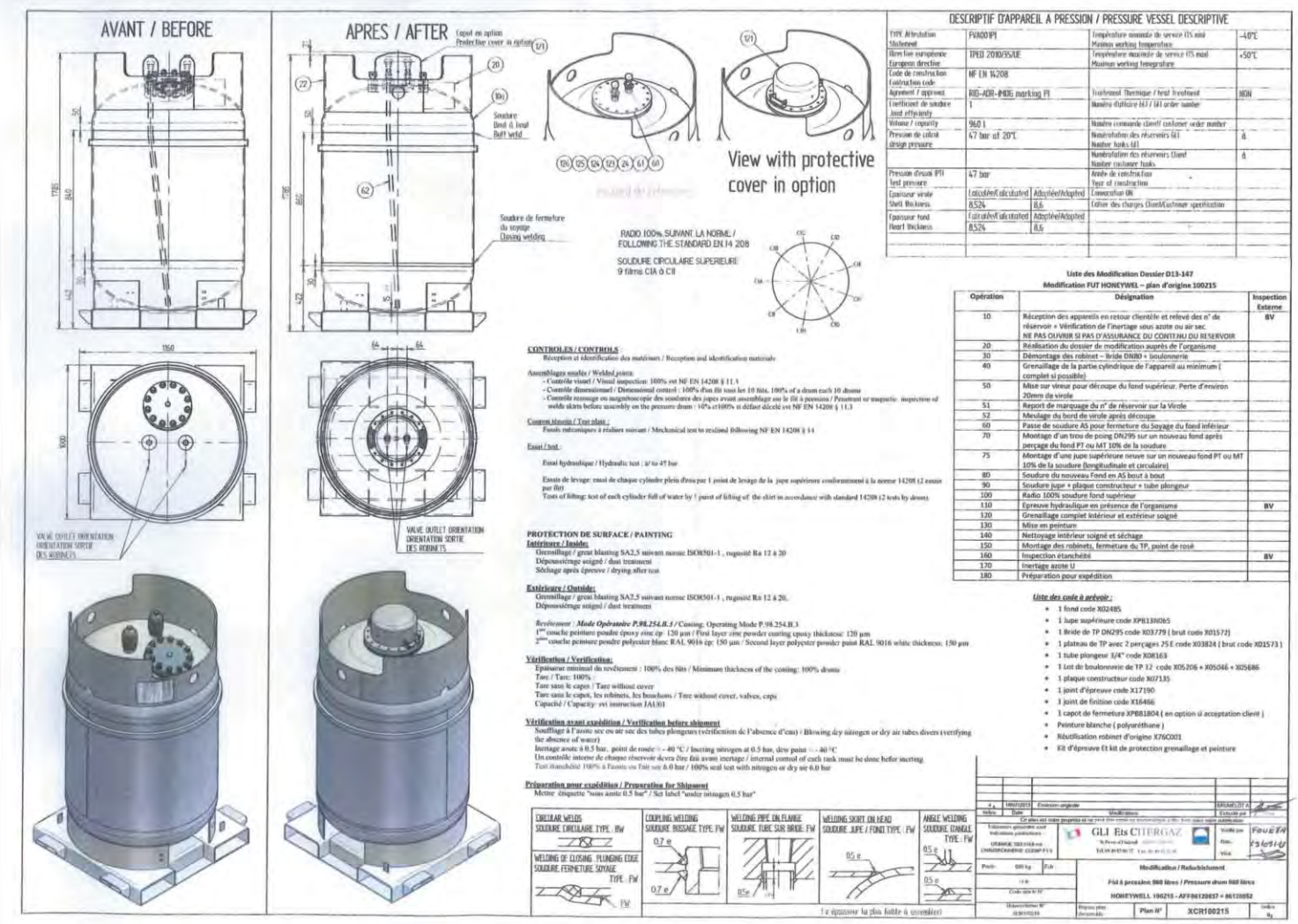




Cylinder Manufacturer	Amtrol
Water Capacity	960 Liters
Certifications	EN Only, PI Marked
Test Pressure Rating	25 bar minimum
Height	~1,800 mm
Diameter	~1,020 mm (external)
Base Width	~1,200 mm

Valve Manufacturer	Ermeto
Certification	PI Marked
Thread Twist	Left Hand
Outlet Thread	CGA 670
Number of Phases	Single Phase
Dip Tube	Yes, on liquid valve outlet
Bung Thread	25E
Valve Pressure Rating	25 bar
Pressure Relief Valve	Yes, Set to ~18 bar
Filter	None
Anti Filling Device	Yes

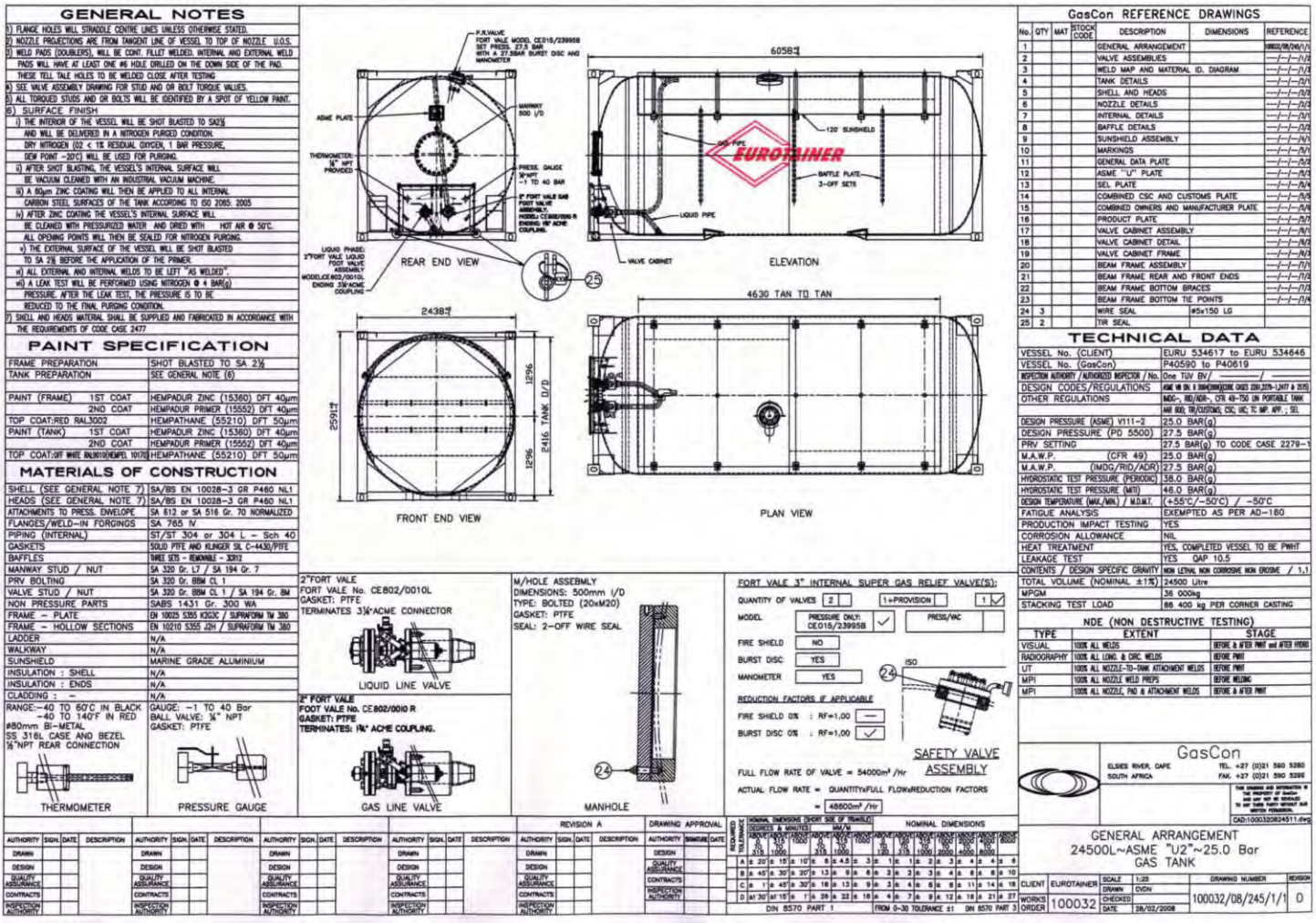
900 kg Cylinder Specification

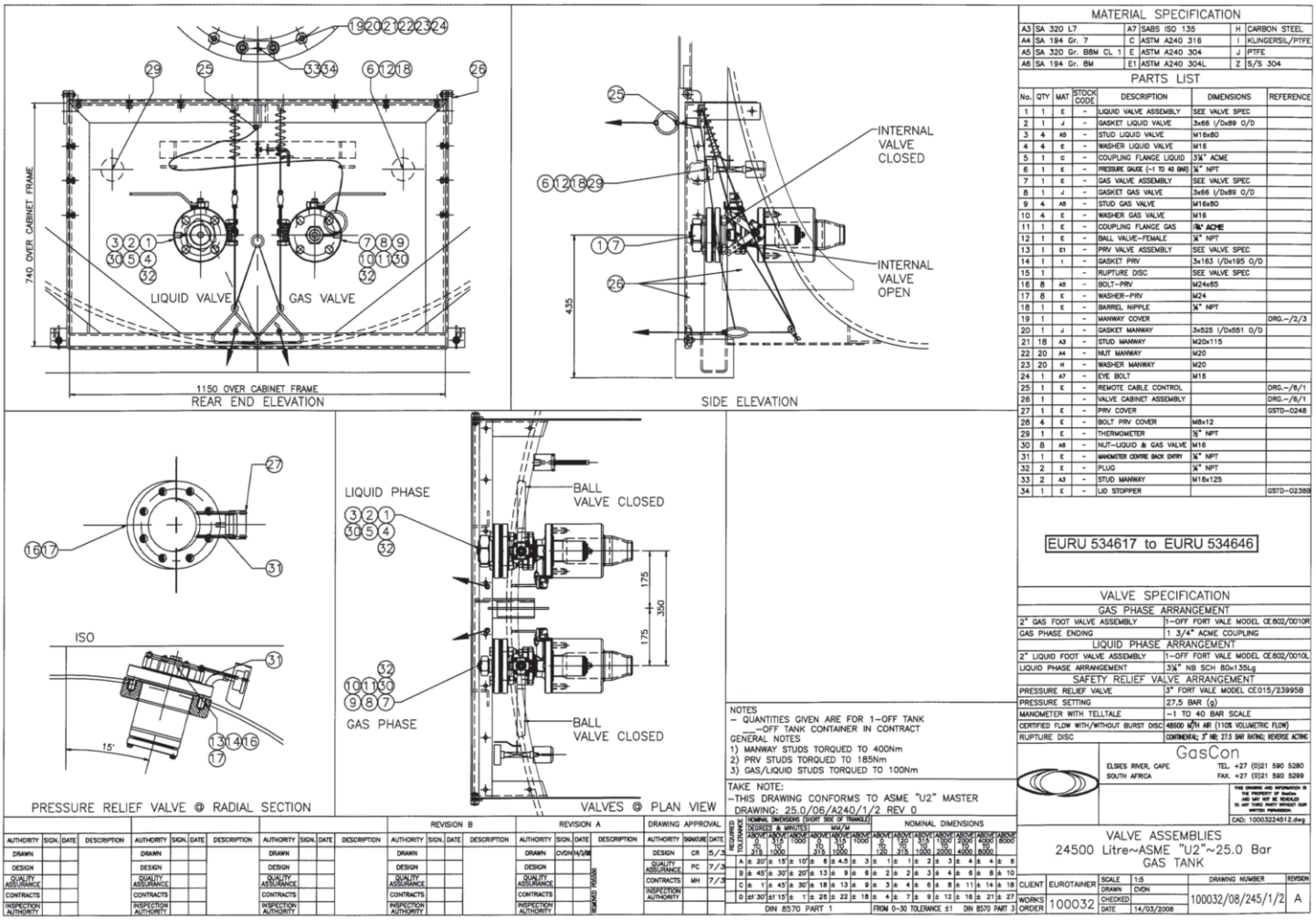


Delivery Quantity: 33,000 lbs / 15,000 kg

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

Features: Bulk Deliveries for OEM facilities





MATERIAL SPECIFICATION

A3	SA 320 L7	A7	SABS ISO 135	H	CARBON STEEL
A4	SA 194 Gr. 7	C	ASTM A240 316	I	KLINGERSIL/PTFE
A5	SA 320 Gr. B8M CL 1	E	ASTM A240 304	J	PTFE
A6	SA 194 Gr. 8M	E1	ASTM A240 304L	Z	S/S 304

PARTS LIST

No.	QTY	MAT	STOCK CODE	DESCRIPTION	DIMENSIONS	REFERENCE
1	1	E	-	LIQUID VALVE ASSEMBLY	SEE VALVE SPEC	
2	1	J	-	GASKET LIQUID VALVE	3x66 I/Dx89 O/D	
3	4	A5	-	STUD LIQUID VALVE	M16x80	
4	4	E	-	WASHER LIQUID VALVE	M16	
5	1	C	-	COUPLING FLANGE LIQUID	¾" ACME	
6	1	E	-	PRESSURE GAUGE (-1 TO 40 BAR)	¼" NPT	
7	1	E	-	GAS VALVE ASSEMBLY	SEE VALVE SPEC	
8	1	J	-	GASKET GAS VALVE	3x66 I/Dx89 O/D	
9	4	A5	-	STUD GAS VALVE	M16x80	
10	4	E	-	WASHER GAS VALVE	M16	
11	1	E	-	COUPLING FLANGE GAS	¾" ACME	
12	1	E	-	BALL VALVE-FEMALE	¼" NPT	
13	1	E1	-	PRV VALVE ASSEMBLY	SEE VALVE SPEC	
14	1	I	-	GASKET PRV	3x163 I/Dx195 O/D	
15	1		-	RUPTURE DISC	SEE VALVE SPEC	
16	8	A5	-	BOLT-PRV	M24x85	
17	8	E	-	WASHER-PRV	M24	
18	1	E	-	BARREL NIPPLE	¼" NPT	
19	1		-	MANWAY COVER		DRG.-/2/3
20	1	J	-	GASKET MANWAY	3x525 I/Dx551 O/D	
21	18	A3	-	STUD MANWAY	M20x115	
22	20	A4	-	NUT MANWAY	M20	
23	20	H	-	WASHER MANWAY	M20	
24	1	A7	-	EYE BOLT	M16	
25	1	E	-	REMOTE CABLE CONTROL		DRG.-/6/1
26	1		-	VALVE CABINET ASSEMBLY		DRG.-/6/1
27	1	E	-	PRV COVER		GSTD-0248
28	4	E	-	BOLT PRV COVER	M8x12	
29	1	E	-	THERMOMETER	½" NPT	
30	8	A8	-	NUT-LIQUID & GAS VALVE	M16	
31	1	E	-	MANOMETER CENTRE BACK ENTRY	¼" NPT	
32	2	E	-	PLUG	¼" NPT	
33	2	A3	-	STUD MANWAY	M16x125	
34	1	E	-	LID STOPPER		GSTD-0238B

EURU 534617 to EURU 534646

VALVE SPECIFICATION

GAS PHASE ARRANGEMENT	
2" GAS FOOT VALVE ASSEMBLY	1-OFF FORT VALE MODEL CE602/0010R
GAS PHASE ENDING	1 3/4" ACME COUPLING
LIQUID PHASE ARRANGEMENT	
2" LIQUID FOOT VALVE ASSEMBLY	1-OFF FORT VALE MODEL CE602/0010L
LIQUID PHASE ARRANGEMENT	¾" NB SCH 80x135Lg
SAFETY RELIEF VALVE ARRANGEMENT	
PRESSURE RELIEF VALVE	3" FORT VALE MODEL CE015/23995B
PRESSURE SETTING	27,5 BAR (g)
MANOMETER WITH TELLTALE	-1 TO 40 BAR SCALE
CERTIFIED FLOW WITH/WITHOUT BURST DISC	48600 NM³/H AIR (110% VOLUMETRIC FLOW)
RUPTURE DISC	CONTINENTAL; 3" NB; 27.5 BAR RATING; REVERSE ACTING

NOTES
- QUANTITIES GIVEN ARE FOR 1-OFF TANK
- 1-OFF TANK CONTAINER IN CONTRACT

GENERAL NOTES
1) MANWAY STUDS TORQUED TO 400Nm
2) PRV STUDS TORQUED TO 185Nm
3) GAS/LIQUID STUDS TORQUED TO 100Nm

TAKE NOTE:
-THIS DRAWING CONFORMS TO ASME "U2" MASTER DRAWING: 25.0/06/A240/1/2 REV 0

GasCon
ELSIES RIVER, CAPE SOUTH AFRICA
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FAX. +27 (0)21 590 5299

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CAD: 10003224512.dwg

VALVE ASSEMBLIES
24500 Litre-ASME "U2"-25.0 Bar
GAS TANK

CLIENT	EUROTAINER	SCALE	1:5	DRAWING NUMBER	REVISION
		DRAWN	CVDN	100032/08/245/1/2	A
WORKS ORDER	100032	CHECKED	
		DATE	14/03/2008	

	REVISION B	REVISION A	DRAWING APPROVAL
AUTHORITY		DRAWN	DESIGN
DRAWN		DESIGN	QUALITY ASSURANCE
DESIGN		QUALITY ASSURANCE	CONTRACTS
QUALITY ASSURANCE		CONTRACTS	INSPECTION AUTHORITY
CONTRACTS		INSPECTION AUTHORITY	
INSPECTION AUTHORITY			

	SIGN.	DATE	DESCRIPTION
DRAWN	CVDN	14/3/08	ISSUED FOR QUOTATION
DESIGN			
QUALITY ASSURANCE			
CONTRACTS			
INSPECTION AUTHORITY			

	SIGNATURE	DATE
DESIGN	CR	5/3
QUALITY ASSURANCE	PC	7/3
CONTRACTS	MH	7/3
INSPECTION AUTHORITY		

NOMINAL DIMENSIONS	ALLOWED TOLERANCE	DEGREES & MINUTES: NOMINAL DIMENSIONS (TIGHT SIDE OF TRIANGLE) ABOVE 0 TO 315	ABOVE 315 TO 1000	MM/M: ABOVE 0 TO 315	ABOVE 315 TO 1000	ABOVE 1000	ABOVE 0 TO 120	ABOVE 120 TO 315	ABOVE 315 TO 1000	ABOVE 1000 TO 2000	ABOVE 2000 TO 4000	ABOVE 4000 TO 8000	ABOVE 8000
A	± 20'	± 15'	± 10'	± 6	± 4.5	± 3	± 1	± 1	± 2	± 3	± 4	± 4	± 6
B	± 45'	± 30'	± 20'	± 13	± 9	± 6	± 2	± 2	± 3	± 4	± 6	± 8	± 10
C	± 1°	± 45'	± 30'	± 18	± 13	± 9	± 3	± 4	± 6	± 8	± 11	± 14	± 18
D	± 1°30'	± 1°	± 15'	± 1	± 28	± 22	± 18	± 4	± 7	± 9	± 12	± 16	± 21	± 27

DIN 8570 PART 1 — FROM 0-30 TOLERANCE ±1 — DIN 8570 PART 3

Honeywell

Cylinder Labels and Tags

Honeywell

Solstice ™ yf Refrigerant (R-1234yf)

2,3,3,3-Tetrafluoroprop-1-ene
CAS No. 754-12-1

Net weight: 5 kg

Product Hazard Warning Instructions

BG GB DA DE EL ES ET FI FR GB HR HU

IT LT LV NL NO PL PT RO SE SK SL

Honeywell Fluorine Products Europe B.V.
Laarderhoogtweg 18, 1101 EA Amsterdam
the Netherlands

Product of the US, China and Japan

THE LABEL LICENSE: Purchase of this product includes the limited right under the Honeywell patents identified at [illegible] to use the purchased product as the total refrigerant in an automotive air conditioning system. Use of the purchased product in a different application or in a blend with another refrigerant or the same refrigerant from a different supplier is expressly prohibited.

(BG) Опасно!
Изключително запалим газ. Съдържа газ под налягане; при нагряване може да експлодира. Да се пази от топлина/искри/открит пламък/нагорещени повърхности. Тютюнопушенето забранено. Не вдишвайте прах/ пушек/ газ/ дим/ изпарения/ аерозоли. Използвайте предписаните лични предпазни средства. При явна или предполагаема експозиция: Потърсете медицински съвет/помощ. Да се пази от пряка слънчева светлина. Да се съхранява на добре проветриво място.

(CZ) Nebezpečí!
Extrémně hořlavý plyn. Obsahuje plyn pod tlakem; zahřívání může způsobit výbuch. Chraňte před teplem/ jiskrami/otevřeným plamenem/ horkými povrchy - Zákaz kouření. Nevdechujte prach/ dým/ plyn/ mlhu/ páry/ aerosoly. Používejte požadované osobní ochranné prostředky. Při expozici nebo podezření na ni: Vyhledejte lékařskou pomoc/ ošetření. Chraňte před slunečním zářením. Skladujte na dobře větraném místě.

(DA) Fare!
Yderst brandfarlig gas.
Indeholder gas under tryk, kan eksplodere ved opvarmning. Holdes væk fra varme/gnister/åben ild/varme overflader - Rygning forbudt. Indånd ikke pulver/ røg/ gas/ tåge/ damp/ spray. Anvend de påkrævede personlige værnemidler. Ved eksponering eller mistanke om eksponering: Søg lægehjælp. Beskyttes mod sollys. Opbevares på et godt ventileret sted.

(DE) Gefahr!
Extrem entzündbares Gas. Enthält Gas unter Druck; kann bei Erhitzen explodieren. Von Hitze/ Funken/ offener Flamme/ heißen Oberflächen fernhalten - nicht rauchen.
Staub/ Rauch/ Gas/ Nebel/ Dampf/ Aerosol nicht einatmen. Vorgeschriebene persönliche Schutzausrüstung verwenden. Bei Exposition oder falls betroffen: Ärztlichen Rat einholen/ ärztliche Hilfe hinzuziehen. Vor Sonnenbestrahlung geschützt an einem gut belüfteten Ort aufbewahren.

(EL) Κίνδυνος!
Εξαιρετικά εύφλεκτο αέριο. Περιέχει αέριο υπό πίεση· εάν θερμανθεί, μπορεί να εκραγεί. Μακριά από θερμότητα/ σπινθήρες/ γυμνές φλόγες/ θερμές επιφάνειες - Μην καπνίζετε. Μην αναπνέετε σκόνη/ αναθυμιάσεις/ αέρια/ σταγονίδια/ ατμούς/ εκνεφώματα. Χρησιμοποιείτε μέσα ατομικής προστασίας όταν απαιτείται. Σε περίπτωση έκθεσης ή πιθανότητας έκθεσης: Συμβουλευθείτε / Επισκεφθείτε γιατρό. Να προστατεύεται από τις ηλιακές ακτίνες. Αποθηκεύεται σε καλά αεριζόμενο χώρο.

(ES) Peligro!
Gas extremadamente inflamable. Contiene gas a presión. Peligro de explosión en caso de calentamiento. Mantener alejado de fuentes de calor, chispas, llama abierta o superficies calientes - No fumar. No respirar el polvo/ el humo/ el gas/ la niebla/ los vapores/ el aerosol. Utilizar el equipo de protección individual obligatorio. En caso de exposición manifiesta o presunta: Consultar a un médico. Proteger de la luz del sol. Almacenar en un lugar bien ventilado.

(ET) Ettevaatust!
Eriti tuleohtlik gaas. Sisaldab rõhu all olevat gaasi; kuumenemisel võib plahvatada. Hoida eemal soojusallikast/ sädemetest/ lahtisest/ kuumadest pindadest - Mitte suitsetada. Mitte hingata sisse tolmu/ suitsu/ gaasi/ auru/ pihustatud ainet. Kasutada vajalikke isikukaitsevahendeid. Kokkupuute või kokkupuutekahtluse korral: pöörduda arsti poole. Hoida päikesevalguse eest. Hoida hästi ventileeritavas kohas.

(FI) Vaara!
Erittäin helposti syttyvä kaasu. Sisältää paineen alaista kaasua; voi räjähtää kuumennettaessa. Suojaa lämmöltä/ kipinöiltä/ avotulelta/ kuumilta pinnoilta - Tupakointi kielletty. Älä hengitä pölyä/ savua/ kaasua/ sumua/ höyryä/ suihketta. Käytä vaadittuja henkilönsuojaimia. Altistumisen tapahduttua tai jos epäillään altistumista: Hakeudu lääkäriin. Suojaa auringonvalolta. Varastoi paikassa, jossa on hyvä ilmanvaihto.

(FR) Danger!
Gaz extrêmement inflammable. Contient un gaz sous pression; peut exploser sous l'effet de la chaleur. Tenir à l'écart de la chaleur/ des étincelles/ des flammes nues/ des surfaces chaudes - Ne pas fumer. Ne pas respirer les poussières/fumées/gaz/brouillards/ vapeurs/ aérosols. Utiliser l'équipement de protection individuel requis. En cas d'exposition prouvée ou suspectée: consulter un médecin. Protéger du rayonnement solaire. Stocker dans un endroit bien ventilé.

(EN) Danger!
Extremely flammable gas. Contains gas under pressure; may explode if heated. Use personal protective equipment as required. Keep away from heat/ sparks/ open flames/ hot surfaces - No smoking. Do not breathe dust/ fume/ gas/ mist/ vapours/ spray. If exposed or concerned: Get medical advice/ attention. Protect from sunlight. Store in a well-ventilated place.

(HR) Opasnost!
Vrlo lako zapaljivi plin. Sadrži stlačeni plin; zagrijavanje može uzrokovati eksploziju. Nositi propisanu osobnu zaštitnu opremu. Držite podalje od topline/ iskrenja/ otvorenog plamena/ toplih površina - Zabranjeno pušenje. Ne udisati prašinu/ dim/ plin/ maglu/ pare/ aerosol. U slučaju izloženosti ili sumnje na izloženost: zatražiti savjet/ pomoć liječnika. Zaštititi od sunčevog svjetla. Skladištiti na dobro prozračenom mjestu.

(HU) Veszély!
Rendkívül tűzveszélyes gáz. Nyomás alatt lévő gázt tartalmaz; hő hatására robbanhat. Hőtől/szikrától/nyílt lángtól/forró felületektől távol tartandó - Tilos a dohányzás. A por/ füst/ gáz/ köd/ gőzök/ permet belélegzése tilos. Az előírt egyéni védőfelszerelés használata kötelező. Expozíció vagy annak gyanúja esetén: orvosi ellátást kell kérni. Napfénytől védendő. Jól szellőző helyen tárolandó.

(IT) Pericolo!
Gas altamente infiammabile. Contiene gas sotto pressione; può esplodere se riscaldato. Tenere lontano da fonti di calore/ scintille/fiamme libere/superfici riscaldate - Non fumare. Non respirare la polvere/ i fumi/ i gas/ la nebbia/ i vapori/ gli aerosol. Utilizzare il dispositivo di protezione individuale richiesto. In caso di esposizione o di possibile esposizione, consultare un medico. Proteggere dai raggi solari. Conservare in luogo ben ventilato.

(LT) Pavojinga!
Ypač liepsniosios dujos. Turi slegiamųjų dujų, kaitinant gali sprogti. Laikyti atokiau nuo šilumos šaltinių/ žiežirbų/ atviros liepsnos/ karštų paviršių - Nerūkyti. Nejkvėpti dulkių/ dūmų/ dujų/ rūko/ garų/ aerozolio. Naudoti reikalaujamas asmenines apsaugos priemones. Esant sąlyčiui arba jeigu numanomas sąlytis: kreiptis į gydytoją. Saugoti nuo saulės šviesos. Laikyti gerai vėdinamoje vietoje.

(LV) Draudi!
Īpaši viegli uzliesmojoša gāze. Satur gāzi zem spiediena; karstumā var eksplodēt. Nelietot vietās, kur ir sastopams karstums/ dzirksteles/ atklāta uguns / karstas virsmas - Nesmēķēt. Neieelpot putekļus/ tvaikus/ gāzi/ dūmus/ izgarojumus/ smidzinājumu. Izmantot personisko aizsargaprīkojumu atbilstoši prasībām. Ja nokļūst saskarē vai saistīts ar to: lūdziet mediķu palīdzību. Aizsargāt no saules gaismas. Glabāt labi vēdināmās telpās.

(NL) Gevaar!
Zeer licht ontvlambaar gas. Bevat gas onder druk; kan ontploffen bij verwarming. Verwijderd houden van warmte/ vonken/ open vuur/ hete oppervlakken - Niet roken. Stof/ rook/ gas/ nevel/ damp/ spuitnevel niet inademen. De nodige persoonlijke beschermingsuitrusting gebruiken. Na (mogelijke) blootstelling: een arts raadplegen. Tegen zonlicht beschermen. Op een goed geventileerde plaats bewaren.

(NO) Fare!
Ekstremt brannfarlig gass. Inneholder gass under trykk; kan eksplodere ved oppvarming. Holdes vekk fra varme/ gnister/ åpen flamme/varme overflter - Røyking forbudt. Ikke innånd støv /røyk/ gass/ tåke/ damp/ aerosoler. Bruk påkrevd personlig verneutstyr. Ved eksponering eller mistanke om eksponering: Søk legehjelp. Beskyttes mot sollys. Oppbevares på et godt ventilert sted.

(PL) Niebezpieczeństwo!
Skrajnie łatwopalny gaz. Zawiera gaz pod ciśnieniem; może wybuchnąć wskutek ogrzania. Przechowywać z dala od źródeł ciepła/ iskrzenia/ otwartego ognia/ gorących powierzchni - Palenie wzbronione. Nie wdychać pyłu/ dymu/ gazu/ mgły/ par/ rozpylonej cieczy. Stosować wymagane środki ochrony indywidualnej. W przypadku narażenia lub styczności: Zasięgnąć porady/zgłosić się pod opiekę lekarza. Chronić przed światłem słonecznym. Przechowywać w dobrze wentylowanym miejscu.

(PT) Perigo!
Gás extremamente inflamável. Contém gás sob pressão; risco de explosão sob a acção do calor. Manter afastado do calor/ faísca/ chama aberta/ superfícies quentes - Não fumar. Não respirar as poeiras/ fumos/ gases/ névoas/ vapores/ aerossóis. Usar o equipamento de protecção individual exigido. Em caso de exposição ou suspeita de exposição: consulte um médico. Manter ao abrigo da luz solar. Armazenar em local bem ventilado.

(RO) Pericol!
Gaz extrem de inflamabil. Conține gaz sub presiune; pericol de explozie în caz de încălzire. A se păstra departe de surse de căldură/ scântei/ flăcări deschise/ suprafețe încinse - Fumatul interzis. Nu inspirați praful/ fumul/ gazul/ ceața/ vaporii/ spray-ul. Utilizați echipamentul de protecție individuală conform cerințelor. În caz de expunere sau de posibilă expunere: consultați medicul. A se proteja de lumina solară. A se depozita într-un spațiu bine ventilat.

(SV) Fara!
Extremt brandfarlig gas. Innehåller gas under tryck. Kan explodera vid uppvärmning. Får inte utsättas för värme/gnistor/ öppen låga/heta ytor - Rökning förbjuden. Inandas inte damm/ rök/ gaser/ dimma/ ångor/ sprej. Använd föreskriven personlig skyddsutrustning. Vid exponering eller misstanke om exponering Sök läkarhjälp. Skyddas från solljus. Förvaras på väl ventilerad plats.

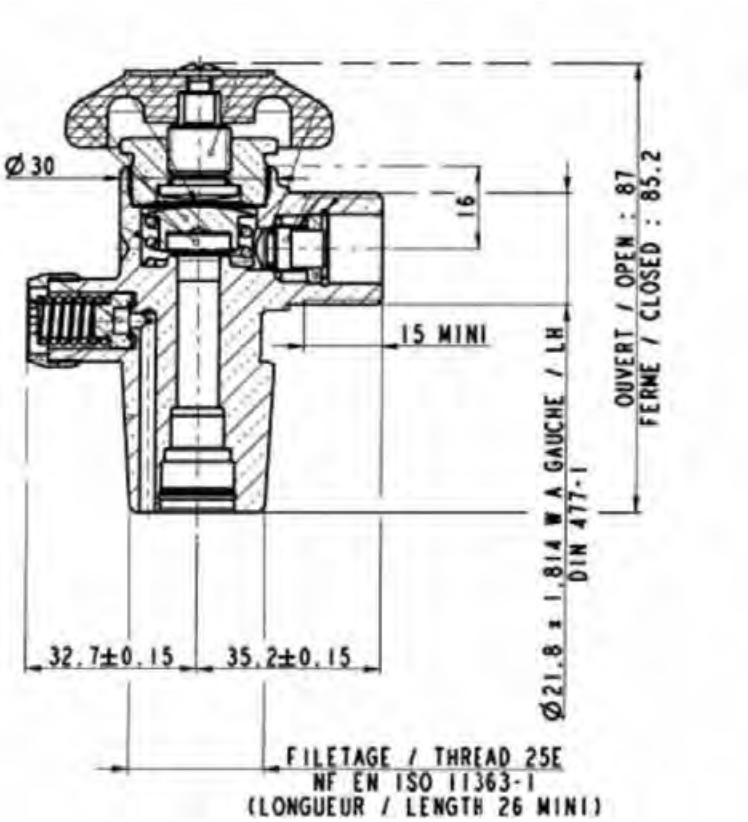
(SK) Nebezpečenstvo!
Mimoriadne horľavý plyn. Obsahuje plyn pod tlakom, pri zahriatí môže vybuchnúť. Uchovávajte mimo dosahu tepla/ iskier/ otvoreného ohňa/ horúcich povrchov - Nefajčite. Nevdychujte prach/ dym/ plyn/hmlu/ pary/ aerosóly. Používajte predpísané osobné ochranné prostriedky. Po expozícii alebo podozrení z nej: Vyhľadajte lekársku pomoc/starostlivosť. Chráňte pred slnečným žiarením. Uchovávajte na dobre vetranom mieste.

(SL) Nevarno!
Zelo lahko vnetljiv plin. Vsebuje plin pod tlakom; segrevanje lahko povzroči eksplozijo. Hraniti ločeno od vročine/isker/odprtega ognja/vročih površin - Kajenje prepovedano. Ne vdihavati prahu/ dima/ plina/ meglice/ hlapov/ razpršila. Uporabiti predpisano osebno zaščitno opremo.
Pri izpostavljenosti ali sumu izpostavljenosti: poiščite zdravniško pomoč/oskrbo. Zaščititi pred sončno svetlobo. Hraniti na dobro prezračevanem mestu.

Part 5
Valve Specifications and Drawings

5

DIN 477 Valve Specification



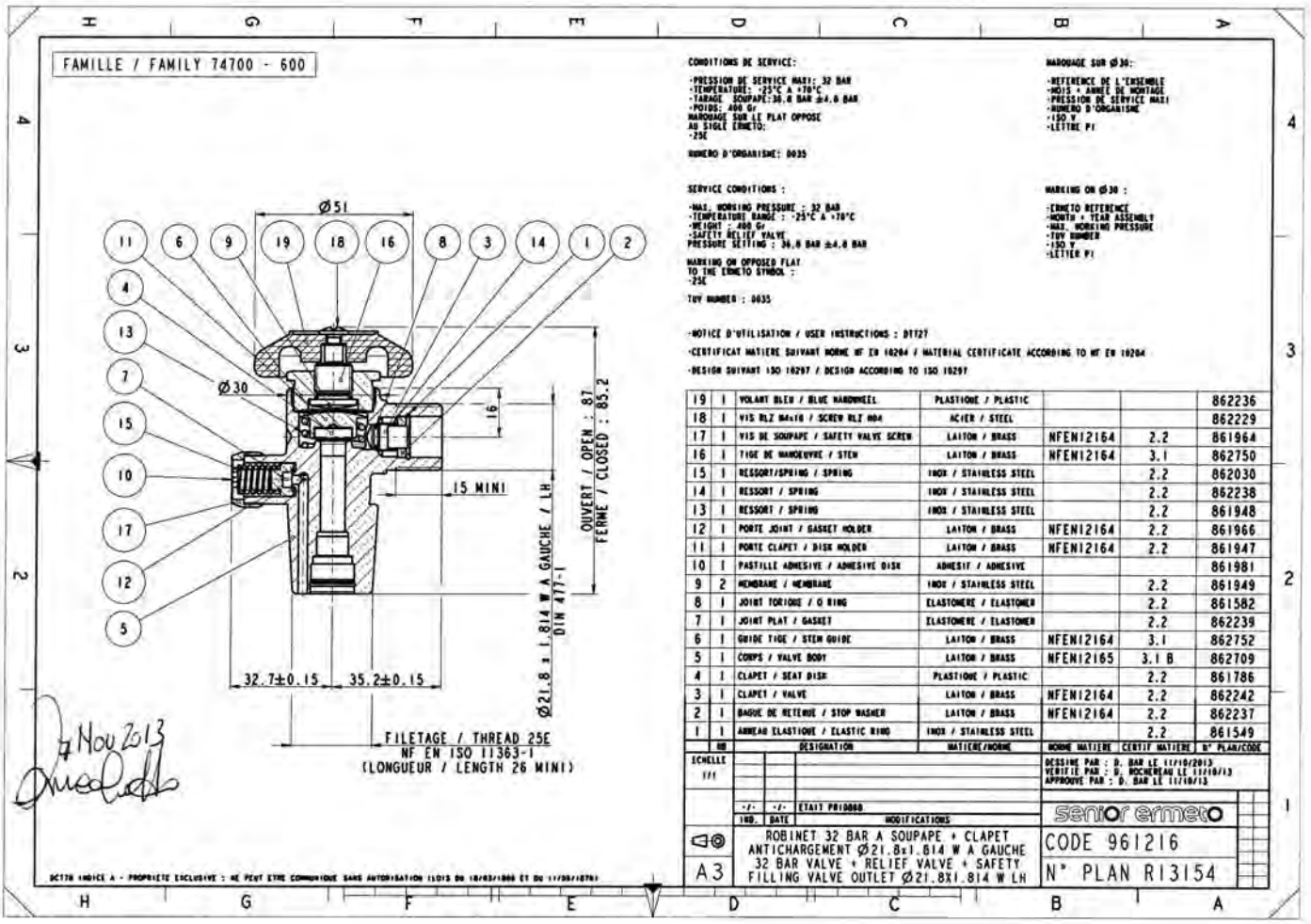
Designed for Cylinder Type: 5 kg and 10 kg Returnable Cylinder

Design Features: Tamper Proof Evident Sticker, Anti-Fill Protection, Single Phase, No Dip Tube attached, Must Invert For Liquid Discharge

Certifications/ Markings: EN, PI Stamped

Pressure Rating: 25 bar

Pressure Relief Setting: 18 bar



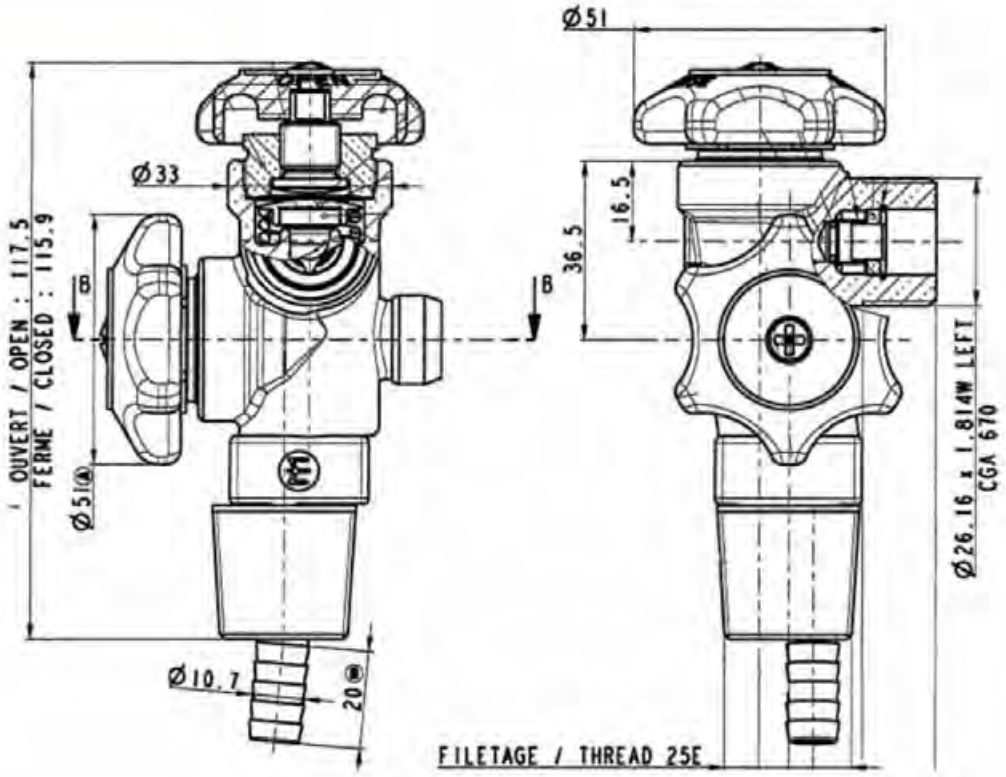
Designed for Cylinder Type: 50 kg Returnable Cylinder

Design Features: Left Handed Outlet Threads, Anti-Fill Protection, Dual Phase, Dip Tube Attached

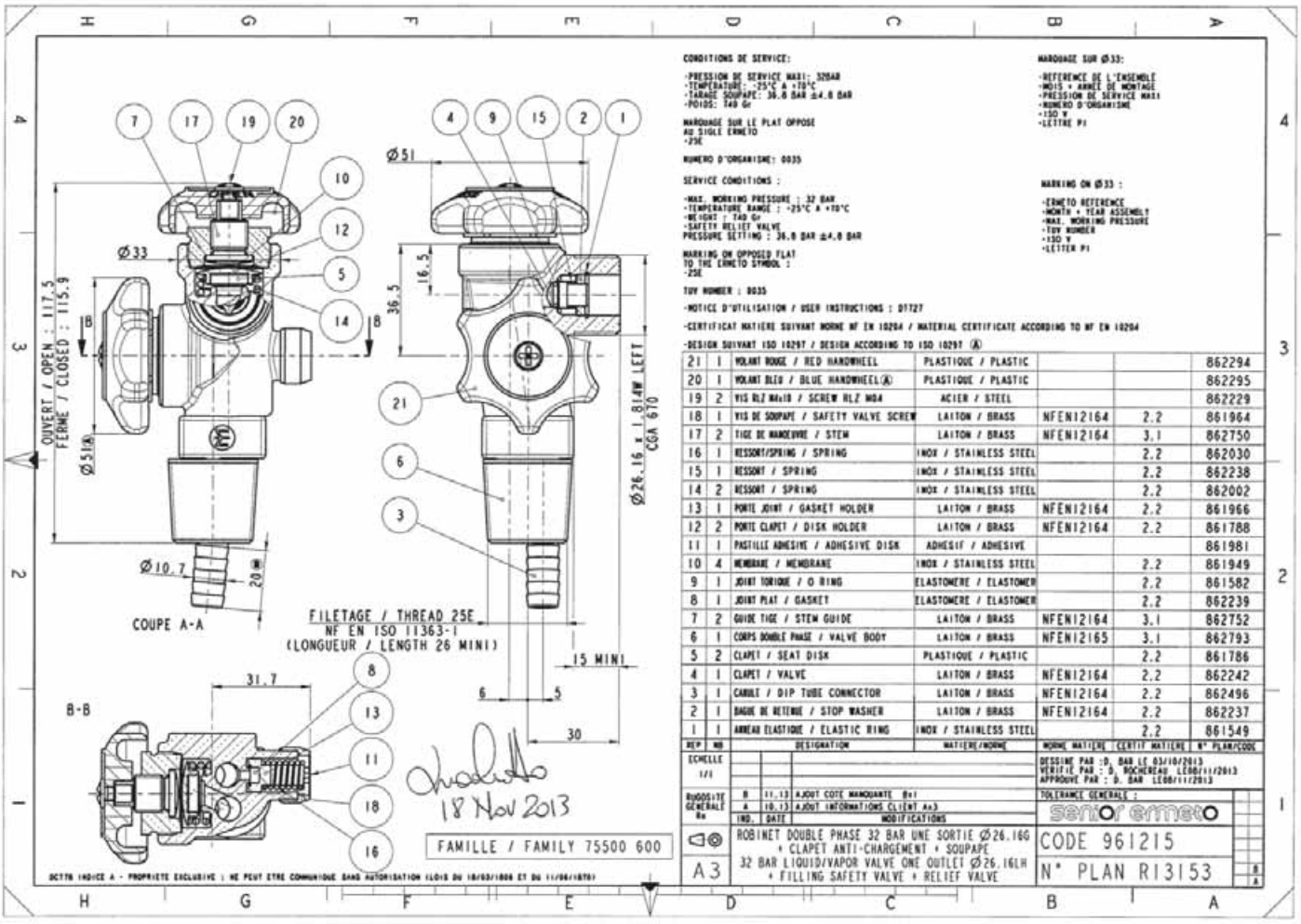
Certifications/ Markings: EN, PI Stamped

Pressure Rating: 25 bar

Pressure Relief Setting: 18 bar



CGA 670 Duel Phase Valve Specification



REP	NB	DESIGNATION	MATIERE/NORME	NORME MATIERE	CERTIF MATIERE	N° PLAN/CODE
21	1	VOLANT ROUGE / RED HANDWHEEL	PLASTIQUE / PLASTIC			862294
20	1	VOLANT BLEU / BLUE HANDWHEEL (A)	PLASTIQUE / PLASTIC			862295
19	2	VIS RLZ M4x18 / SCREW RLZ M04	ACIER / STEEL			862229
18	1	VIS DE SOUPAPE / SAFETY VALVE SCREW	LAITON / BRASS	NFEN12164	2.2	861964
17	2	TIGE DE MANOEUVRE / STEM	LAITON / BRASS	NFEN12164	3.1	862750
16	1	RESSORT/SPRING / SPRING	INOX / STAINLESS STEEL		2.2	862030
15	1	RESSORT / SPRING	INOX / STAINLESS STEEL		2.2	862238
14	2	RESSORT / SPRING	INOX / STAINLESS STEEL		2.2	862002
13	1	PORTE JOINT / GASKET HOLDER	LAITON / BRASS	NFEN12164	2.2	861966
12	2	PORTE CLAPET / DISK HOLDER	LAITON / BRASS	NFEN12164	2.2	861788
11	1	PASTILLE ADHESIVE / ADHESIVE DISK	ADHESIF / ADHESIVE			861981
10	4	MEMBRANE / MEMBRANE	INOX / STAINLESS STEEL		2.2	861949
9	1	JOINT TORIQUE / O RING	ELASTOMERE / ELASTOMER		2.2	861582
8	1	JOINT PLAT / GASKET	ELASTOMERE / ELASTOMER		2.2	862239
7	2	GUIDE TIGE / STEM GUIDE	LAITON / BRASS	NFEN12164	3.1	862752
6	1	CORPS DOUBLE PHASE / VALVE BODY	LAITON / BRASS	NFEN12165	3.1	862793
5	2	CLAPET / SEAT DISK	PLASTIQUE / PLASTIC		2.2	861786
4	1	CLAPET / VALVE	LAITON / BRASS	NFEN12164	2.2	862242
3	1	CANULE / DIP TUBE CONNECTOR	LAITON / BRASS	NFEN12164	2.2	862496
2	1	BAGUE DE RETENUE / STOP WASHER	LAITON / BRASS	NFEN12164	2.2	862237
1	1	ANNEAU ELASTIQUE / ELASTIC RING	INOX / STAINLESS STEEL		2.2	861549

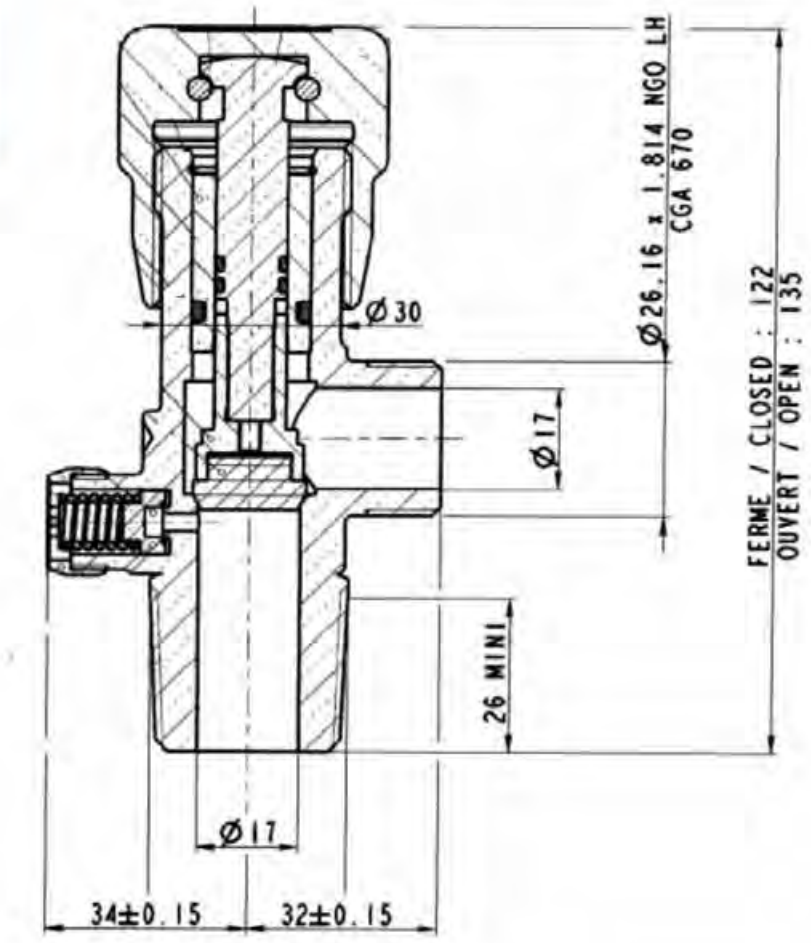
Designed for Cylinder Type: 900 kg Returnable Cylinder

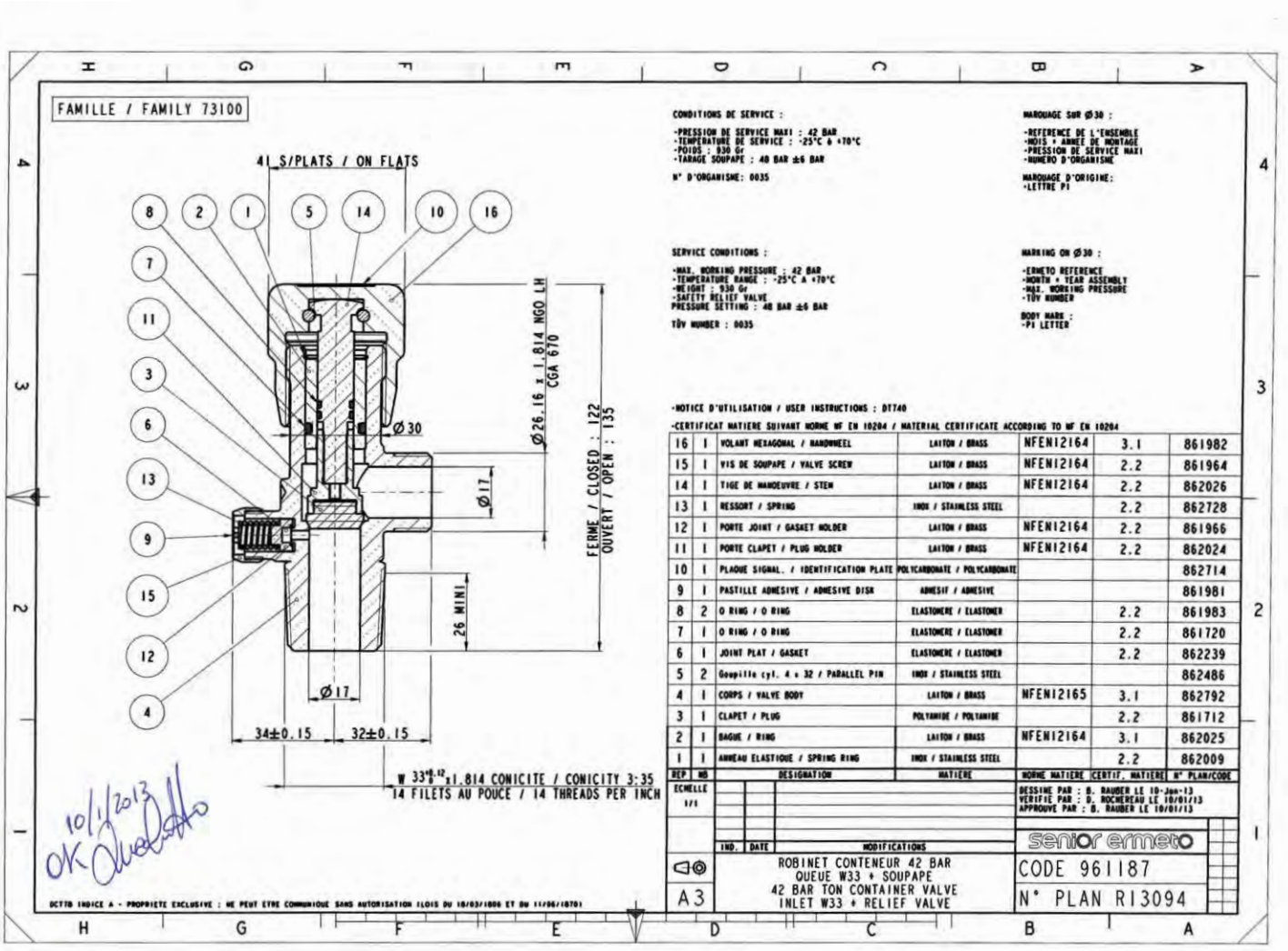
Design Features: Left Handed Outlet Threads, Anti-Fill Protection, Single Phase, Dip Tube Attached To Liquid Phase Valve

Certifications/ Markings: EN, PI Stamped

Pressure Rating: 25 bar

Pressure Relief Setting: 18 bar

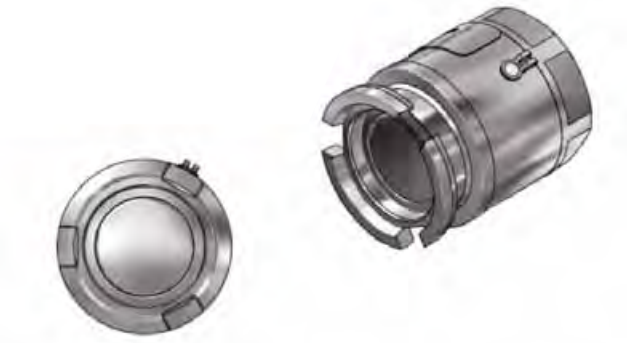


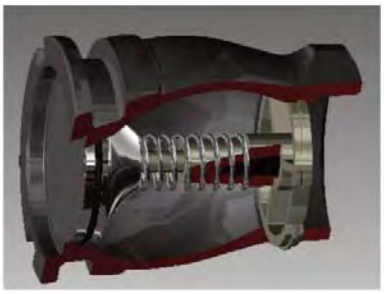


OEM Connections for Solstice™ yf ISO Deliveries

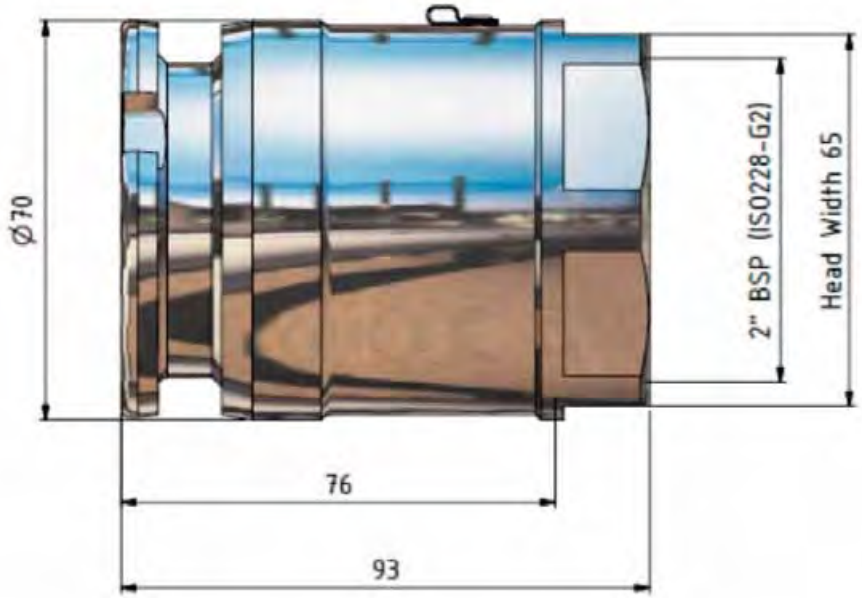
Liquid Phase		
Mann Tek Tank unit 2”-2”BSP SS/EPDM* Type No. T210A4403A	**OR**	TODO-MATIC # 1-5002E-4408
Vapour Phase		
Mann Tek Tank unit 1”-1”BSP SS/EPDM* Type No. T103A4403A	**OR**	TODO-MATIC # 1-4942A-4408

* Or fully compatible

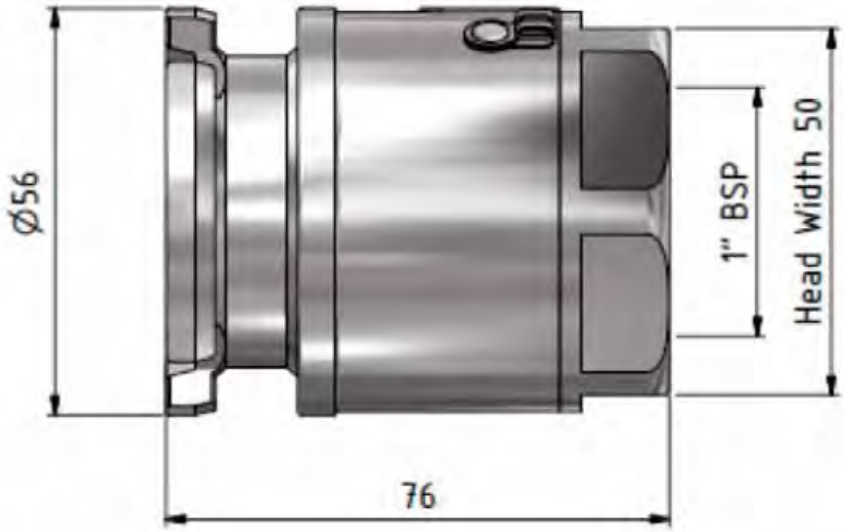


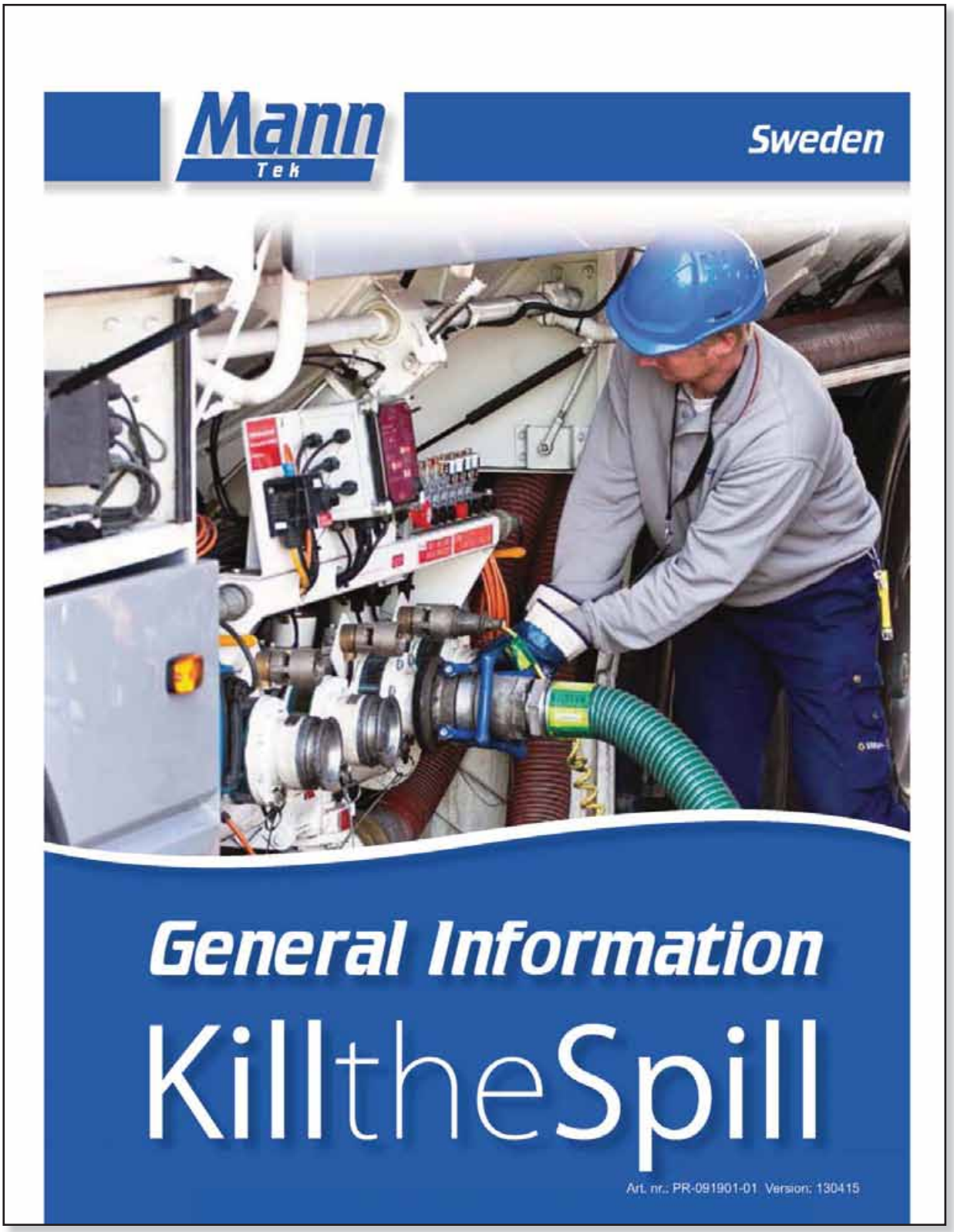


MannTek Liquid connection OEM Tank Side



MannTek Vapor connection OEM Tank Side





Mann Tek

Company Information

Mann Teknik AB is the manufacturer of the DDCouplings®, a full range of Dry Disconnect Couplings for clean, safe and spill free handling of fluids, gases and bulk powders.

Our years of experience in these diverse fields have given us the opportunity to accumulate extensive knowledge about applications in the many types of industries in which our couplings have been and can be used.

We are continuously striving to develope and upgrade the design and perfomance of our products; so that we are always in a position to meet the constant changes in the environments our products can be used in. They are in use in installations all over the world, especially where certification is a prerequisite and are certified by TÜV, Apragaz, Veritas, TDT, plus regionally required approvals.

Mann Teknik AB are certified to ISO9001:2008. The products are CE-labeled. The main products are certified to PED, the European Pressure Equipment Directive and ATEX, the European directive for Equipment intended for use in Potentially Explosive Atmospheres. The products are produced in accordance with several important standards, e.g. the NATO STANAG 3756.

ATEX approved

Ex II 2G

Contact Mann Tek

Phone: +46 501 39 32 00
Email: sales@mann-tek.com

www.mann-tek.com

DDCouplings - The main product

Mann Tek has knowledge from design, production and marketing of DDCouplings® since 1977.

The main product is the DDCouplings® for spill free liquid handling. The products are marketed through independent representatives in more than 30 countries.

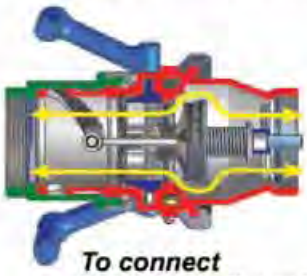
According to NATO STANAG 3756

Advantages

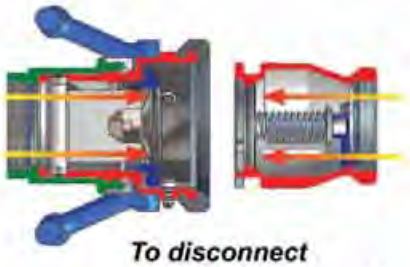
- ***Easy to handle***
  Push and turn - free flow.
  Turn and pull - closed.
- ***Time saving***
  No need to drain hoses or pipe systems.
- ***Economical***
  No loss or spillage of liquids at connection or disconnection.
- ***Safe***
  The valve cannot be opened until the unit is coupled.
- ***Environmentally friendly***
  Accidental spillage eliminated.
- ***Reliability***
  No loss or spillage of liquids at connection or disconnection.

How it works - The coupling function

The principle of operation is similary for all types of Mann Tek Couplings



To connect
Push and turn - it's coupled
- full flow



To disconnect
Turn and pull - it's released
- no spillage

Mann Tek products

Mann Tek products are used for safe and environmentally friendly handling of liquids, chemicals, petroleum and gases. Within the Mann Tek product range you will have proper equipment for handling almost any type of liquid or gas, from nasty chemicals to Jet fuel.

DDCouplings®

Dry Disconnect Couplings

Mann Tek Dry Disconnect Couplings are used for handling and transfer of liquids, gases and bulk powder in an economical, safe and environmental friendly way.

Dry Disconnect Couplings are available in sizes from ¾" up to 6" and in a wide range of materials and seals to be the given choice for almost any application.

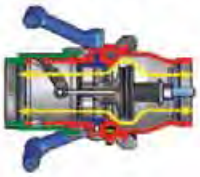
The self sealing design of the couplings guarantees both the highest level of safety and also the quickest way of connecting and disconnecting.

According to NATO STANAG 3756

How it works

The coupling function

The principle of operation is similary for all types of Mann Tek Couplings



To connect
Push and turn
- it's coupled
- *full flow*

To disconnect
Turn and pull
- it's released
- *no spillage*

Size:
The couplings are available with BSP- and NPT-threads in sizes ¾" (DN 20) to 6" (DN 150). Other threads are available on request (S60X6, Acme etc.).

The tank units and Hose units are also available in flanged connections (DIN, ANSI, TW, TTMA, EN 1092-1:2001).

Materials:
Aluminium, Brass/Gunmetal, Stainless Steel, Hastelloy C and PEEK. Other materials on request.

Seals:
FPM (Viton®), EPDM, Chemraz®, Kalrez®, NBR (Nitrile). Other materials on request.

Maximum Working pressure:
MWP PN 10 / 16 / 25
MAWP 150 / 300 psi

Test Pressure:
15 / 24 / 38 bar
225 / 450 psi

Selectivity - Avoid mixing products:
To avoid product contamination caused by connecting a Hose unit to the wrong Tank unit, selective versions of the Hose and Tank units are available. Each unit has a number of selective positions, designated by a coded part number according to the coupling size.

Electrical conductivity
All DDCouplings® have electrical conductivity (<10 ohms).

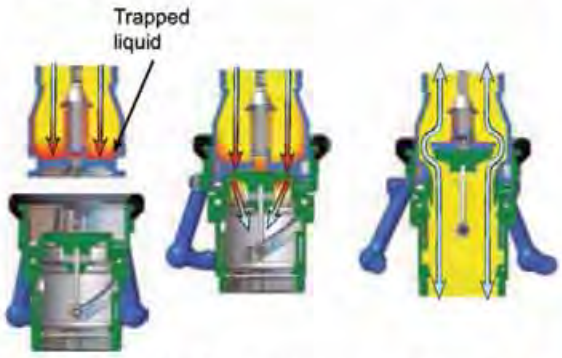
Interchangeability:
Compatibility with other existing brands according to NATO STANAG 3756 and ATOFINA SGM 2049.TUY.C.

Special models:
With integrated break-away, pressure relief valve, etc. on request.

Apragaz · Ex II 2G · PC · Lloyd's Register · TDT · VdTÜV · CE

Pressure relief valve in STANAG 3756 Tank unit

This system dissipates trapped fluid pressure into hose coupler without spillage, to allow easy connection.



Trapped liquid in Tank Unit

Open pressure relief valve
Pressure expands into Hose Unit

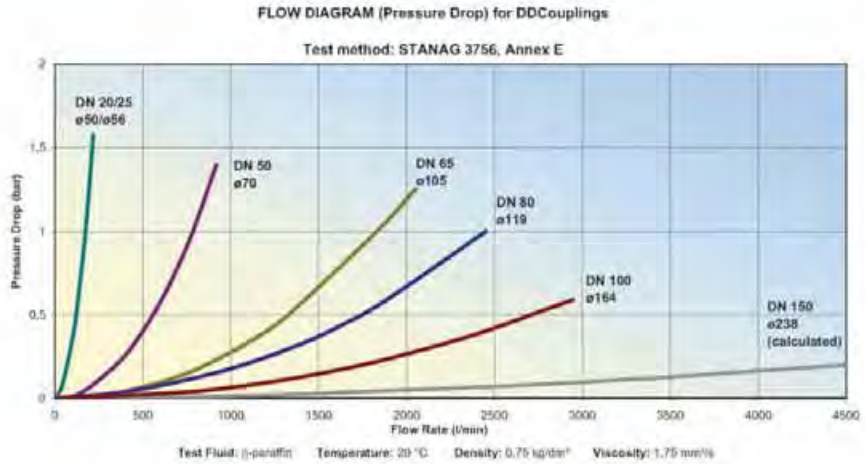
Open without pressure
Full flow

Advantages DDCouplings

- ***Easy to handle***
  Push and turn - free flow.
  Turn and pull - closed.
- ***Time saving***
  No need to drain hoses or pipe systems.
- ***Economical***
  No loss or spillage of liquids at connection or disconnection.
- ***Safe***
  The valve cannot be opened until the unit is coupled.
- ***Environmentally friendly***
  Accidental spillage eliminated.
- ***Reliability***
  No loss or spillage of liquids at connection or disconnection.

FLOW DIAGRAM (Pressure Drop) for DDCouplings

Flow test have been done on all sizes of the DDCoupling sortiment. The results in the flow diagram below.



DDCoupling Hose unit with Break Away integrated

Where there is a risk of excessive force on the hose due to unexpected movement between the loading and unloading station, combining the Dry Disconnect Coupling with a Safety Break Away coupling.

Tank unit / Hose unit, flange EN 1092-2001 Type E (Spigot) / Type F (Recess)

Tank unit
Flange EN 1092-2001 Type E (Spigot)

Hose unit
Flange EN 1092-2001 Type F (Recess)

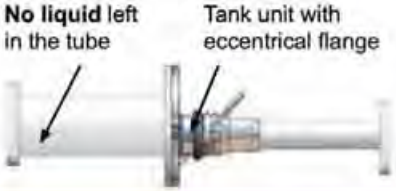
Spigot Type E and Recess Type F has a straight sealing surface which differs from standard flanges. It is a special version that some manufacturers of tankers (tank trucks) and railway-carriages (rail tankers) use as the default for certain applications.

Tank units / Adapters with excentrical flanges

Tank units / Adapters with excentrical flanges are available in sizes 1" to 6".

Traditional flange

Excentrical flange



Pressure Cap for Tank unit / adapter - Working pressure PN 10 bar / PN 25 bar

Can be used as a second or third closing device according to ADR/ RID par 6.8.2.2.2

Working pressure
PN 10 bar / PN 25 bar

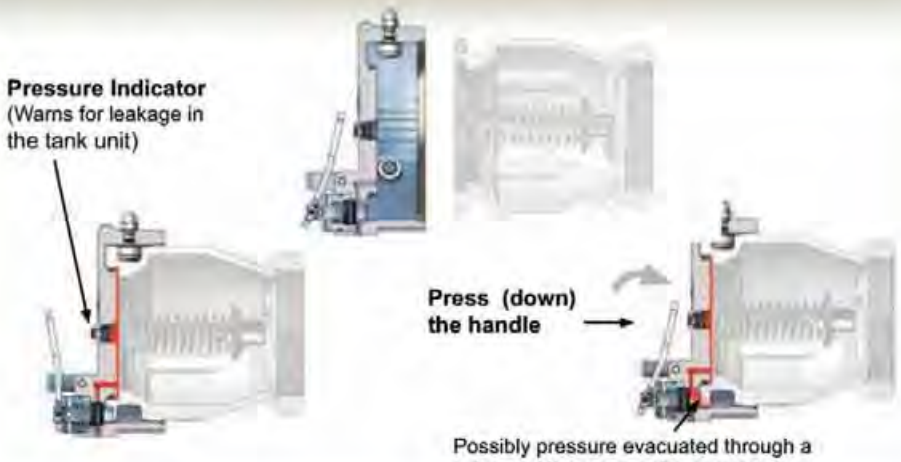
The Mann Tek Pressure Cap for Tank units / Adapters is designed to maximize operator safety and containment safety.

Should the possibility of an upstream closure leakage occur, the Pressure Cap provides identification of a system pressure and will hold this pressure until the problem can be safely resolved. Should the operator still choose to remove the cap it will reduce the static pressure to zero thus preventing the forceful expulsion of the transfer media.

Features

- Pressure indicator
- Depressurization
- Customs / tamper seal feature
- Automatic locking
- Manually lockable (with padlock)

Pressure Cap for Tank unit / adapter - How It Works



Dust Cap

Dust protection in rubber

A Dust Cap gives very good protection against corrosion, and withstands both hot and cold environments.

Dust Cap for increased safety

It´s only possible to remove the cap from the Tank unit /Adapter after pulling the securing stift and at the same time twisting the cap. The Dust Cap is manually lockable with padlock.

Standard Caps in Composite (Polyeten PE-HD 300).

It covers the widest range of chemical and petroleum products.

- ***Elastic v-ring seal in standard NBR that makes disassembly easier and seals of a larger surface than conventional O-rings***
- ***Lockable and sealed***
- ***Patented design***

Caps are also available in Stainless Steel and Aluminium. Other materials on request.

Dust Plug to prevent ingress of dirt and water

Use the Mann Tek Dust Plug to prevent ingress of dirt and water in the couplings.

The material in the Dust Plug is Composite, Aluminium and Stainless Steel.

Swivels

Swivel Joints

Hose swivels

Sizes
¾" (DN20) to 4" (DN100)

Maximum Working pressure:
MWP PN 10 / 16 / 25.
MAWP 150 / 300 psi

Test Pressure:
15 / 24 / 38 bar
225 / 450 psi

Materials
Aluminium, Brass, Stainless steel, Hastelloy, Titanium. Others on request.

Connections
Female and Male BSP / NPT, ACME, Witworth threads and flanged DIN and ANSI. Others on request.

NOTE
Unsuitable for high bending moments. Heavy Duty Swivels should be used in these applications.

The use of swivel hose avoids torsion of hose assemblies, i.e. in filling machines, and improves the handling and coupling of nozzles for refuelling of petroleum based products and chemicals.

Features

- **Simple design, low maintenance.** Each unti consist of two body halves. Stainless Steel balls and a single spring assisted O-ring seal.
- **Compact external dimensions**
- **High flow rate / low pressure drop**
- **Full range of sizes, materials, seals and connections**
- **Minimal maintenance requirements**
- **Safety** Swivel function - allows the hose to relax to it's natural rest position whilst allowing freedom of movement without imparting torque stress at the point of connection - Torque stress is the largest single cause of Composite, PTFE and Stainless Steel convoluted hose failure.
- **Economical** Cost effective solution to prolong lifetime of hoselines.

Heavy Duty Swivels - double ball race

Sizes
1½" (DN40) to 10" (DN250)

Materials
Stainless Steel.
Other material on request.

Maximum Working pressure:
MWP PN 10 / 16 / 25 / 40
MAWP 150 / 300 / 600 psi

Connections
Female and Male BSP / NPT, ACME, Witworth threads and flanged DIN and ANSI.
Others on request.

Swivel Joints are used in the industry wherever a movable pipe-connection system between two equipment parts is needed.

The swivel joints are designed for slow rotary motions under the influence of high internal pressures and/or big external stress such as traction and bending forces.

With an appropriate combination of swivel joints nearly all movements from the simple rotation or swivelling motion up to motional actions in space can be realized.

SBCouplings®

Safety Break-away Couplings

Sizes
1" (DN25) to 10" (DN150)

Maximum Working pressure:
MWP PN 10 / 16 / 25.
MAWP 150 / 300 psi

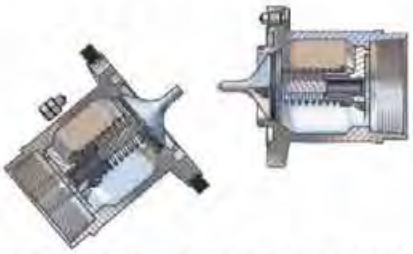
Test Pressure:
15 / 24 / 38 bar
225 / 450 psi

Materials
Aluminium, Brass, Stainless steel, Hastelloy, Titanium. Others on request.

Connections
Female and Male BSP / NPT, flanges DIN and ANSI. Others on request.

Industrial Break-away

Typically installed into loading arm and hose assemblies, where at least one side of the coupling is attached to a rig and fixed point.



Release with a tensile force being applied at an angle to the plane of the coupling housing, up to 90 degrees.

Safety Break-away couplings are used to prevent pull away accidents, the internal valves will close the flow in both lines and prevent unwanted release of product.

The Safety Break-away couplings are available as Industrial and Marine type.

Industrial Break-aways are used at fix points like manifolds, pipelines depots etc.

The Safety Break-away couplings are used in filling systems for airfields, rail tank cars, tank containers etc.

Industrial Break-away coupling is utilized in all industrial product transfer installations.

The industrial SBCouplings are specifically designed to be able to activate with a tensile force being applied at an angle to the plane of the coupling housing, up to 90 degrees.

Features

- Passive security against situations where a hose or loading arm could be subjected to inadvertent excessive loads.
- Design features are a simple mechanism and no loose components which could be lost after release.
- Operates independently of shut off safety system and does not require an external power source.
- Easy to reset on site with one person
- High flowrate / low pressure drop
- Very low loss, positive shut-off of both coupling halves results in minimum product loss.
- Lightweight and robust design.
- Available with ANSI/DIN flanges or threaded (BSP or NPT).

Mann

Product Information

DDCouplings®
Dry Disconnect Coupling.
1" to 8", PN 16 - PN 25. Aluminium, Brass-Gunmetal, Stainless Steel and PEEK. Other materials on request. According to NATO standard STANAG 3756.

DGCouplings®
Dry Gas Coupling.
1" to 8", PN25. Stainless steel.
Other materials on request.

DACouplings,
Dry Aviation Coupling.
2½", PN 10. Main body in Aluminium.
Standards: ISO 45, MS 24484, NATO STANAG 3105, British Aerospace Spec. 2C14.

Sampling, Vent or Drain unit
Stainless Steel SS-EN 10 088-1.4404+AT (AISI 316L). Ball Valve in 1.0619 and 1.4301

***Full Flow* - ballvalves**
2" to 4", PN 10, Aluminium.
Ballvalve and 2-way Ballvalve.
Made for Petroleum Tank Trucks. Variations of flange connections.

Swivel joints
¾" to 10", PN 10 - PN 25.
Aluminium, Brass-Gunmetal, Stainless Steel.
Other materials on request.
Connection: BSP, NPT. Flanged connection (DIN, ANSI/ASA e.t.c)

SBCouplings, bolt series
Industrial and Marine Safety Break-away, breaking bolts,
Aluminium, Brass, Stainless Steel, 1" to 12", female/male threads and with flanges, with breaking bolts.
Safety Break-away, cable release
Stainless Steel, PN10 / PN 25. 2" to 4", female threads. 6" to 12", flanged connection

Business Segment Information

Offshore & Marine | Gas (LPG) | Rail tankers | Chemical industry | Tank trucks | Military | Container | Cryogenic Couplings

Company Information

General Information about Mann Tek, products and Business Segments

Approval Information

Quality, Health, Safety and Environment Policy.
Quality Approvals,
Product Approvals and Declaration of Conformity

Service

Service instructions and operation manuals

Your distributor

Your distributor:

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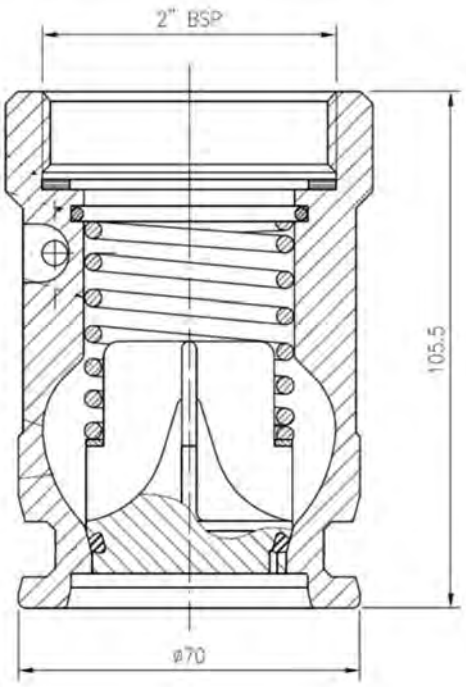
Fax:	+46 501 39 32 09
Email:	sales@mann-tek.com
Web site:	www.mann-tek.com
Address:	Mann Teknik AB Strandvägen 16 SE-542 31 Mariestad Sweden

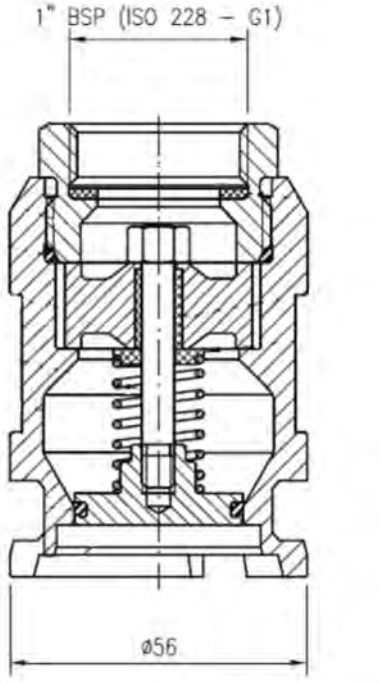
www.mann-tek.com

Mann-Tek is a certified ISO9001-company.

TODO Liquid connection OEM Tank Side

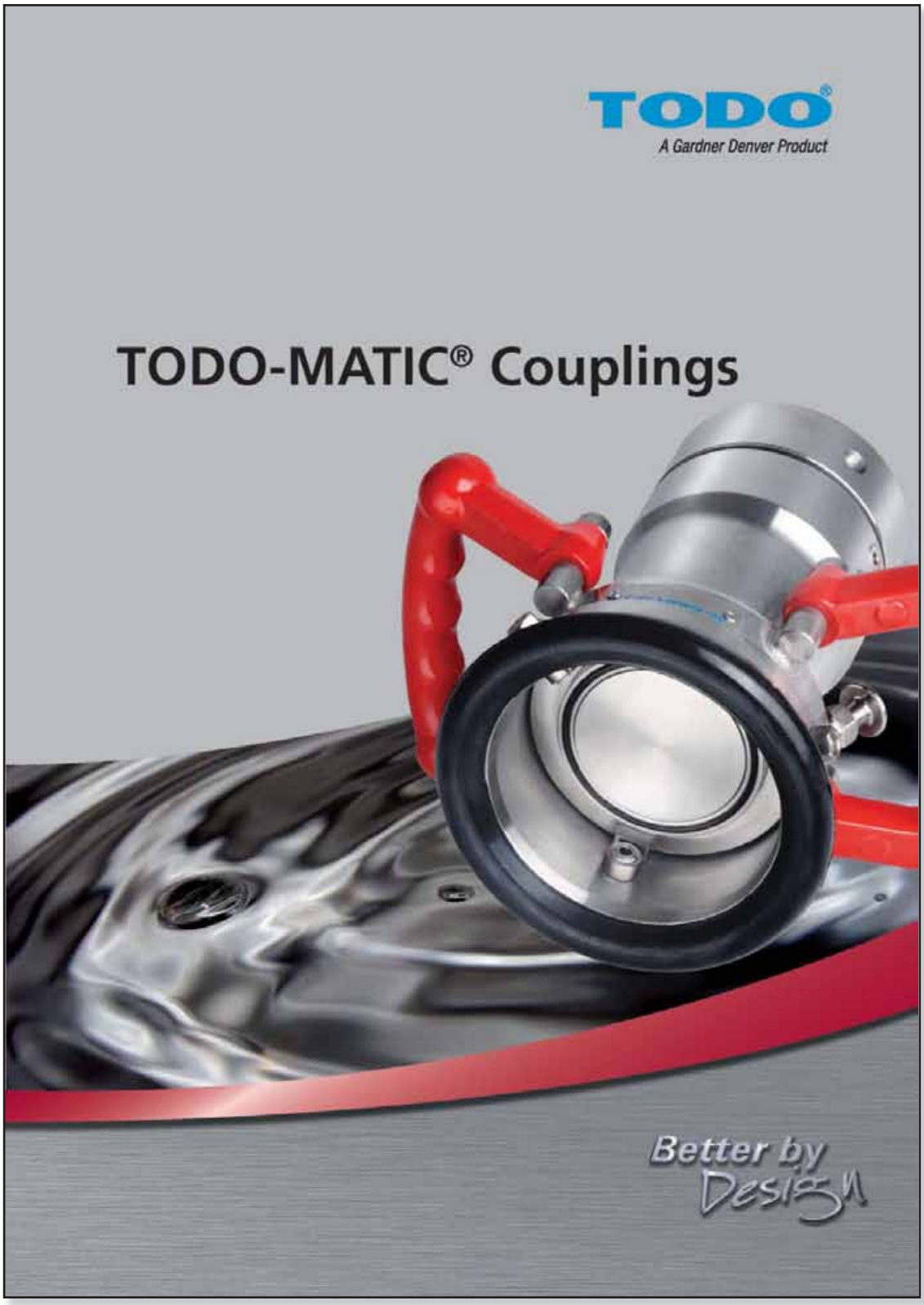


TODO Vapor connection OEM Tank Side



View the Link Below to see TODO's How It Works

www.todo.se



For safe fluid handling

We are proud to present the TODO-MATIC® range of Dry-Break® couplings. More than 30 years of expertise has gone into their design and manufacture.

In sizes from 1" to 6" and a wide range of material options, TODO-MATIC® Dry-Break® couplings offer advanced fluid handling solutions for a diverse range of industries.

Major offshore exploration, chemical, pharmaceutical and petro chemical companies rely on TODO-MATIC® couplings to safely transfer their most aggressive or valuable products.

Designed for safe and easy use with minimum operator intervention, TODO-MATIC® couplings offer an unbeatable combination of technical, safety and performance features.

How it works

Turning the hose unit 15° clockwise locks the units together. The valves are still closed and are not opened until a further rotation of 90° has been performed and then the product flow is guaranteed. To close the valve and to unlock the units, reverse the procedure.

Features

- Valves open and close automatically on connection and disconnection.
- Simple single action operation, no levers or switches to operate.
- Valves are guaranteed closed prior to disconnection.
- Minimal residual loss on disconnection (e.g. maximum 0.35cc for 2" DN50).
- Will connect and disconnect under pressure and flow where necessary.
- Extremely reliable, very few moving parts.
- Robust construction, no external operational components.
- Available with selectivity system to prevent cross contamination.
- Reduces spillages to virtually zero.
- Dramatically improves both operational and fugitive emission performance.
- Reduces the possibility of human error in transfer operations.
- Improves efficiency.

TODO®

A Gardner Denver Product

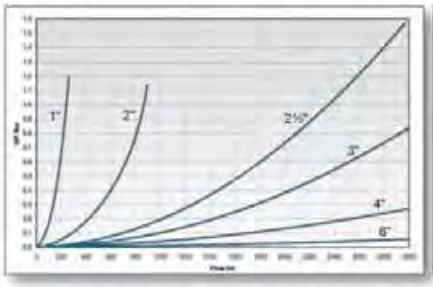
Technical Details

Sizes:	1" (DN19 - DN32) to 6" (DN150).
Materials:	Aluminium, gunmetal and stainless steel 316L, other on request.
Seals:	FKM (Viton®), NBR (Nitrile), EPDM, Chemraz®, Kalrez®. Other materials on request.
Working pressure:	PN 10 - PN 25.
Test pressure:	Working pressure +50%.
Safety factor:	5:1.
End connections:	BSP- and NPT-threads, DIN-, ASA-, TW- and TTMA-flanges (available for both tank and hose units). Other threads and flanges on request.
Compatibility:	NATO STANAG 3756.

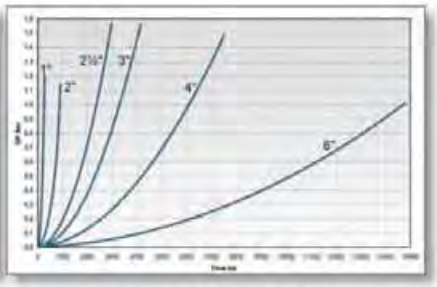
Viton® and Kalrez® is registered trademarks of DuPont Performance Elastomers.
Chemraz® is a registered trademark of Green-Tweed.

Flow capacity

TODO-MATIC® DRY-BREAK® couplings offer high flow capacity.
Media: water. Temperature: 20°C.



Pressure drop for 1" to 6", scale 0-3000 l/min.



Pressure drop for 1" to 6", scale 0-15000 l/min.

Certificates / Approvals

- Vd-TÜV type approval, mark TÜ.AGG.162-93 towards ADR, RID, IMDG and VDI-rules 2440, part 3.3.1.3.
- CE-marked, European directives 97/23/EC (PED) and 94/9/EC (ATEX) compliant.
- TDT approval, mark TDT-UW-30/09 towards ADR/RID in Poland.
- Manufactured under EN ISO 9001:2000.
- Certified towards ISO 14001:2004 and OHSAS 18001:2007.
- Manufactured towards EN 13480 and EN 13445.

Better by Design!

Size range, TODO-MATIC® Dry-Break

1" TODO-MATIC® Dry-Break (DN19 - DN32, Ø56 mm)

TODO-MATIC® Dry-Break® couplings in 1" size are designed for smaller bore applications where compact dimensions are required. One handed operation, high flow rate and minimal release on disconnection make TODO-MATIC® perfect for transferring high value or sensitive medias with confidence. The addition of selectivity to prevent product cross contamination expands the operational possibilities in manifold exchange applications.

2" TODO-MATIC® Dry-Break (DN40 - DN50, Ø70 mm)

Our 2" coupling size probably covers the most diverse selection of applications in the TODO-MATIC® family. Available in a range of material and connection configurations, TODO-MATIC® 2" is designed for rapid and safe transfers. Offshore chemical dosing, Pharmaceutical feedstock and aggressive chemical vapour transfer are just some of the challenging applications TODO-MATIC® couplings see on a daily basis.

2½" TODO-MATIC® Dry-Break (DN65 - DN80, Ø105 mm)

The 2½" TODO-MATIC® coupling is generally used in road tanker and aviation applications transferring a variety of liquids and vapours. Just like all TODO-MATIC® couplings, the 2½" is available in a full range of materials to offer compatibility with most applications. A strong integral swivel, ergonomic design and rugged construction ensure TODO-MATIC® couplings are equipped for the real world.

3" TODO-MATIC® Dry-Break (DN80, Ø119 mm)

A true 3" coupling, similar in size to the 2½" but with greater flow. Typically used for road and rail tank loading / discharge, in plant chemical transfers etc. Tough construction, ease of handling, no spillage and high flow made this coupling form the natural choice for N.A.T.O refuelling standardisation.

TODO®

A Gardner Denver Product

Size range, TODO-MATIC® Dry-Break

4" TODO-MATIC® Dry-Break (DN100, Ø164 mm)

Without exception, the most compact, light weight, high flow 4" self sealing coupling system available. Used extensively for offshore ship to rig transfers of fuels and drinking water, aviation fuel bunkering, rail tank loading / discharge, chemicals etc.

Rapid, positive connection and disconnection make TODO-MATIC® the standard for barge to ferry re-fuelling and multiple rail tank discharge.

6" TODO-MATIC® Dry-Break (DN150, Ø238 mm)

The same features and method of operation as the rest of the range make 6" TODO-MATIC® the ideal ship / barge to shore connection.

Much faster and safer than any flange coupling means not only environmental standards compliance but real turn around time savings. Full marine construction with rotating lifting loop as standard.

As with all TODO-MATIC® couplings, the 6" is equally suitable for flexible hose or loading arm applications.

Hose unit with flange

All sizes of the hose unit are also available with flange.

Better by Design!

Applications

- Road / Rail tanker loading / discharge
- ISO retrofit & new build
- IBC containers
- Offshore rig supply
- Pharmaceutical processing
- Vapour Recovery
- Ship to shore / ship / rig transfer
- Ship manifold exchange
- Bulk loading / discharge
- Paints & inks
- Marine refuelling
- Bitumen transfer
- Brewery
- Food feedstock
- Hazardous waste transfer
- Aviation bunkering
- Exchange manifolds
- Blending pits
- Rail locomotive refuelling
- Tank top / bottom loading
- etc..

TODO®
A Gardner Denver Product






Better by Design

Safety Pressure Tight Cap

Designed to enhance operator safety & containment security in chemical & gas transport.

Pressure indicator, depressurization, customs / tamper seal feature, automatic locking, certified closure.

Manually lockable (with padlock). WP: PN 25. Sizes: 2" - 4"

Dust Plugs and Dust Caps

Available in stainless steel, brass / gunmetal and aluminium. There are also versions availabe in rubber.

Dust plugs / caps should be used to prevent ingress of dirt or water. Sizes: 1" - 6".

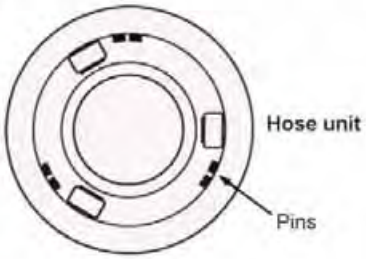
TODO®

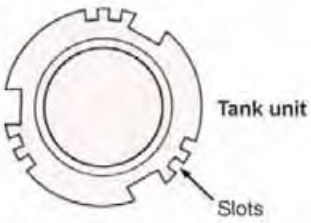
A Gardner Denver Product

Selectivity

To avoid cross contamination by connecting a hose unit to the wrong tank unit.

Each unit has a number of selective positions, designated by a coded part number according to the coupling size.





Specials / Accessories

Pressure relief valve, for tank unit

Dissipates trapped fluid pressure into hose unit without spillage, to allow easy connection.

TODO 4WD

Developed specially for the use of aggressive chemicals and uses a new patented valve mechanism. Easier to connect / disconnect. Less seal wear due to the use of advanced seating and coating technologies. Less total loss of fluid on disconnection. WP: PN 25.

Better by Design!

Specials / Accessories

TODO-MATIC® for extremely corrosive media

Available in Hastelloy, other materials on request.

Tools for draining of hose and tank units

Hose unit with magnetic switch

The switch indicates if the hose unit is fully connected to a standard tank unit. Can be used to start pumps, activation of brakes on road tankers, etc.

Parking device

For safe and convenient storing of hose units.

1" foldable handle

TODO®

A Gardner Denver Product

Specials / Accessories

2" foldable handle mounted on the swivel

2" round handle

2½"-3" straight handle

4" round handle

Better by Design

TODO®
A Gardner Denver Product

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OEM Hose Specifications

MannTek:

Typeno. T210A4403A goes with S210A4403A

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INTERNATIONAL STANDARD

ISO 13341

Second edition
2010-10-01

Gas cylinders — Fitting of valves to gas cylinders

Bouteilles à gaz — Montage des robinets sur les bouteilles à gaz

ISO

Reference number
ISO 13341:2010(E)

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ISO 13341:2010(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13341 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*.

This second edition cancels and replaces the first edition (ISO 13341:1997), which has been technically revised. It also incorporates the Technical Corrigendum ISO 13341:1997/Cor.1:1998.

INTERNATIONAL STANDARD ISO 13341:2010(E)

Gas cylinders — Fitting of valves to gas cylinders

1 Scope

This International Standard specifies the procedures to be followed when connecting cylinder valves to gas cylinders. It specifically applies to all valve and cylinder combinations connected with ISO screw threads as specified in ISO 10920 and ISO 11363-1. It defines routines for inspection and preparation prior to valving for both taper and parallel screw threads.

Torque values are given in Annex A for steel and aluminium gas cylinders including composite cylinders with steel or aluminium boss.

NOTE The procedures and practices specified in this International Standard can be beneficially applied to other valve to cylinder screw thread connection systems. ISO/TR 11364[4] lists the valve to gas cylinder threads in use worldwide. It gives details of the thread identification codes, whether the threads are interchangeable with ISO threads and if the taping procedure and torque values specified in this International Standard can be used. ISO/TR 11364[4] gives clear guidance for the method and torque for all listed inlet threads, which are not interchangeable.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11114-2, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials*

ISO 11119-2, *Gas cylinders of composite construction — Specification and test methods — Part 2: Fully wrapped fibre reinforced composite gas cylinders with load-sharing metal liners*

ISO 11119-3, *Gas cylinders of composite construction — Specification and test methods — Part 3: Fully wrapped fibre reinforced composite gas cylinders with non-load-sharing metallic or non-metallic liners*

ISO 15245-1, *Gas cylinders — Parallel threads for connection of valves to gas cylinders — Part 1: Specification*

3 General requirements and recommendations

Gas cylinders and valves shall be connected so that when in use the combination is gas tight and the valve cannot be removed inadvertently from the cylinder.

The tools used to screw the valve into the gas cylinder shall fit the valve properly and the gas cylinder shall be secured against rotation during the torquing process. The tools shall not cause damage to either the valve or the cylinder. Minor marks to the valve and the cylinder are acceptable. The cylinder and the valving tool axes shall be aligned.

In addition, some composite cylinders need special treatment for the valving process, for example fixing the neck/metal boss during torquing.

Any special instructions given by the cylinder manufacturer shall be followed.

Sealing materials used between the valve stem and cylinder neck threads shall be compatible with the gas to be contained in the cylinder (e.g. oxygen), in accordance with ISO 11114-2.

Except as described in 7.3, the torque applied to the valve shall be within the relevant range given in Annex A. Valve manufacturers shall make available instructions if their specific recommendations regarding their product differ from those included in this International Standard (e.g. if their maximum torque recommendation is less than the maximum allowed in the relevant range included in Annex A).

For all threads, the maximum level of torque should not be exceeded as this will give rise to a high stress in the valve stem and/or cylinder neck.

Care shall be taken with aluminium alloy cylinders, for which valving torques are lower than for steel cylinders. Aluminium alloy cylinders shall not be valved at temperatures above ambient because, on cooling, differential contraction between the cylinder and the valve will give rise to a high stress in the cylinder neck.

High difference of temperature between cylinder neck and valve should be avoided. Some valve designs can be unsuitable to be valved at elevated temperatures (e.g. above 65 °C).

All tools and equipment used for valving cylinders shall be periodically validated for accuracy. Accuracy shall be established by measuring the torque applied to the valve of a valved cylinder as indicated in 5.4.3 for taper threads and in 6.5 for parallel threads.

NOTE Some machine tools rely on the friction between the valve and gas cylinder threads to stop the machine turning once the correct torque has been reached. For fast running machines, the inertia to be absorbed before the machine stops can result in valving torques being in practice far higher than the machine set point.

4 Preparation

4.1 Each valve and cylinder thread shall be examined to ensure that they are to the same dimensional standard, for example ISO 11363-1 or ISO 15245-1.

NOTE 1 Equivalent dimensional standards will make up the subject of the future ISO/TR 11364.

NOTE 2 Some standards require that valve and cylinder threads be identified by marking (e.g. ISO 10297 and ISO 13769).

4.2 The valve and cylinder threads shall be visually inspected for integrity and, where applicable, for damaged O-ring sealing surfaces. In particular, when valving aluminium alloy cylinders, the bottom threads on the stem of valves and the lower threads within the cylinder neck shall be fully formed at the root of the thread and free from ragged edges or burrs. Similar care is required when fitting stainless steel valves to all cylinders. Acceptance criteria for used valves are given in ISO 22434.

4.3 Threads and sealing surface on both valve and cylinder shall be checked for cleanliness. Any remnants of old PTFE sealing tape or other sealants, paints and other contaminants shall be completely removed. Care should be taken to prevent any debris falling into the cylinder. Depending on the gas service and application, before fitting the valve, it shall be ensured that the internal surface of the cylinder is clean and dry.

4.4 The top face of the cylinder, where a parallel thread is used, shall be free of paint, debris or other contamination so that the valve flange can rest directly on it when the cylinder has been valved.

5 Valving procedure for taper threaded valves

5.1 General

Thread sealing can be achieved using sealant tape in accordance with 5.2 or soft metal caps in accordance with 5.3. Alternative sealing methods may be used, for example paste (see Annex B) or PTFE caps (in which case refer to the manufacturer's instructions).

5.2 Wrapping with sealant tape

5.2.1 Wrapping of the valve stem with tape shall commence at the small end of the taper; the sealant tape shall be wound clockwise when looking from the base of the valve.

5.2.2 Wrapping shall be such that it protrudes beyond the small end of the valve stem by a maximum of 3 mm and a minimum of 1 mm. At the small end, there shall be a minimum of three layers of tape (see 5.2.5). Tape shall then be overlapped during wrapping to give an even double thickness all the way up to include the top thread of the valve stem. The number of layers may be adjusted depending on thickness of tape. Excessive tape thickness may increase the stress or push the tape out.

5.2.3 The tape shall not be excessively stretched during wrapping and shall be carefully torn or cut.

5.2.4 Tape shall be carefully worked into the valve thread profile.

Adherence between the tape and the valve stem thread form should be established.

5.2.5 Roll back the tape which protrudes beyond the bottom of the valve stem to leave the bottom face of the valve stem clear of tape; this will result in a doubling of the layers of tape covering the first valve stem thread at the small end. The valve shall then be fitted to the cylinder by hand prior to torquing.

5.3 Application of soft metal caps

5.3.1 Soft metal caps containing lead shall not be used with aluminium alloy cylinders.

5.3.2 The soft metal cap used shall be of the correct size.

5.3.3 After the cap is pulled over the valve stem, it shall be carefully worked into the valve thread profile with a suitable tool or a leather glove, to prevent the bottom end of the soft metal cap being cut off when the valve is fitted.

5.3.4 Valves shall be fitted to the cylinder by hand prior to torquing.

5.4 Valve torquing

5.4.1 After the valve has been screwed in by hand as far as possible and after making sure that sufficient threads are engaged, a properly fitting tool shall be used to tighten the valve into the cylinder (see Clause 3).

5.4.2 For threads according to ISO 11363-1, the torque applied shall be as specified in Annex A.

5.4.3 To validate the torque that was applied for fitting, the value shall be measured by further tightening the valve. The minimum value obtained to move the valve shall be within the limits of Annex A. A properly calibrated torque wrench shall be used.

5.4.4 If curing type of sealant fluid is used, the method described above is not applicable. A specific method should be validated and applied because anaerobic pastes solidify very quickly when the valve is fitted at the specified torque.

6 Valving procedure for parallel threaded valves

6.1 An O-ring seal dimensionally in conformance with ISO 15245-1 and compatible with the gas in service (see ISO 11114-2) shall be placed onto the valve stem. It shall be correctly positioned in the sealing area and shall not be damaged during placement.

6.2 No lubricant, sealant or tape shall be applied to the threads.

6.3 With the cylinder secured against rotation, the valve shall be fitted by hand paying particular attention to prevention of damage to the O-ring as it is engaged into the cylinder sealing area.

6.4 Once the valve has been screwed in by hand as far as possible, a properly fitting tool shall be used to apply the torque specified in Annex A.

6.5 To validate the torque that was applied for fitting, the value shall be measured by unscrewing the valve. The minimum value obtained to move the valve shall be within the limits specified in Annex A. The checked valve/cylinder assembly shall be retorqued properly after this procedure.

A calibrated torque wrench shall be used.

7 Procedure for achieving valve alignment for cylinders with fixed (e.g. welded) shroud and taper threads

7.1 The valve shall be inserted as specified in Clause 5.

7.2 Torque the valve to the minimum value, as indicated in the appropriate table, given in Annex A.

7.3 If necessary, screw the valve in further to achieve alignment of the valve outlet with the shroud opening. Do not in any case partially unscrew the valve.

NOTE Once the minimum torque in the range given in Annex A has been achieved, further rotation to align the valve should ideally continue at a lower speed without stopping; this is particularly important if a curing paste or fluid is used.

Annex A
(normative)

Valving torques for threads in accordance with ISO 11363-1 and ISO 15245-1

A.1 General

This annex applies to valves made from conventional material, e.g. stainless and carbon steels and brass.

The torque values given in this annex are based on the recommendations of gas cylinder and valve manufacturers. Many years of experience have proven that they are safe, give gas tight connections and are reliable for the full retest period.

However, for special valves (e.g. some valves with integrated pressure regulators) or special cylinders (e.g. composite cylinders with plastic liner or without liner), the manufacturers may specify reduced torque values (even below the minimum values given in this annex) that shall be applied (see Clause 3). In such a case the torque range values shall be identified by marking the cylinder in accordance with ISO 11119-2 and ISO 11119-3 and by issuing of installation instructions by the valve manufacturers. In case of doubt the manufacturer shall be consulted.

A.2 Valving torques for seamless steel cylinders and composite cylinders with steel boss

Table A.1 — Taper threads according to ISO 11363-1

Taper valve stem size	Torque Nm	
	Minimum[a]	Maximum[a]
17E	120	150
25E	200	300
NOTE Users should be aware that use of high torque levels gives the possibility of valve stem thread deformation.		
[a] All values shall be reduced to 2/3 of the values in this table for stainless steel valves.		

Table A.2 — Parallel threads according to ISO 15245-1

Parallel valve stem size	Torque Nm	
	Minimum	Maximum
M18	100	130
M25	100	130
M30	100	130

A.3 Valving torques for aluminium alloy cylinders and composite cylinders with aluminium alloy boss

Table A.3 — Taper threads according to ISO 11363-1

Taper valve stem size	Torque Nm		
	Minimum	Maximum	
		Without cylinder neck reinforcement	With cylinder neck reinforcement
17E	75	95	140
25E	95	110	180
NOTE A method to reduce tensile stress in the cylinder neck is by a shrunk-on-neck-ring reinforcement (this puts the neck into compression). Material for the neck ring should be chosen with care to ensure compatibility with the cylinder material, e.g. to avoid galvanic corrosion. This method of reducing local tensile stresses should be done by the manufacturer or with the manufacturer's guidance. It might be difficult to distinguish between a simple neck ring and a neck ring providing neck reinforcement; in case of doubt consult the cylinder manufacturer or use the lower maximum value.			

Table A.4 — Parallel threads according to ISO 15245-1

Parallel valve stem size	Torque Nm	
	Minimum	Maximum
M18	85	100
M25	95	130
M30	95	130

A.4 Valving torques for welded steel cylinders

Table A.5 — Taper threads according to ISO 11363-1

Taper valve stem size	Torque Nm	
	Minimum	Maximum
17E	90	150 (120[a], 130[b])
25E	110	300 (200[a], 250[b])
NOTE Users should be aware that use of high torque levels gives the possibility of stem thread deformation.		
[a] Reduced values for stainless steel.		
[b] Reduced values for dedicated LPG valves in accordance with ISO 14245 and ISO 15995.		

Annex B
(informative)

Application of paste as sealant

B.1 General

For some applications, for example refrigerant gases, an anaerobic paste is generally used. During tightening, the paste sticks very quickly. If the protection of the valve on the cylinder is a shield, it is necessary to angle the valve after tightening in order to put the connection just in front of the opening of the shield.

B.2 Proposed procedure

Apply the paste on the first thread of the valve, then fit the valve to the cylinder one turn by hand; the operator continues to apply paste at the base of the thread with each rotation of the valve by hand, and the valve is then fitted at a specific torque on the valving machine. This method makes it possible to avoid introducing paste inside the cylinder.

Anaerobic pastes stick very quickly when the valve is fitted at the specified torque. Apply specific procedures as recommended by the manufacturers of the cylinder, the valve and the paste.

After fitting the valve at the specified torque, it can be necessary to angle the valve after tightening. At that time the torque can be substantially greater than the applied torque. In such cases the specified torque must be regulated with a lower value. Apply specific procedures as recommended by the manufacturers of the cylinder, the valve and the paste.

Bibliography

[1] ISO 10297, *Transportable gas cylinders — Cylinder valves — Specification and type testing*

[2] ISO 10920, *Gas cylinders — 25E taper thread for connection of valves to gas cylinders — Specification*

[3] ISO 11363-1, *Gas cylinders — 17E and 25E taper threads for connection of valves to gas cylinders — Part 1: Specifications*

[4] ISO/TR 11364[1)], *Gas Cylinders — Compilation of national and international valve stem/gas cylinder neck threads and their identification and marking system*

[5] ISO 13769, *Gas cylinders — Stamp marking*

[6] ISO 14245, *Gas cylinders — Specifications and testing of LPG cylinder valves — Self-closing*

[7] ISO 15995, *Gas cylinders — Specifications and testing of LPG cylinder valves — Manually operated*

[8] ISO 22434, *Transportable gas cylinders — Inspection and maintenance of cylinder valves*

1) Under preparation.

ISO 13341:2010(E)

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Part 6
Regulatory Information

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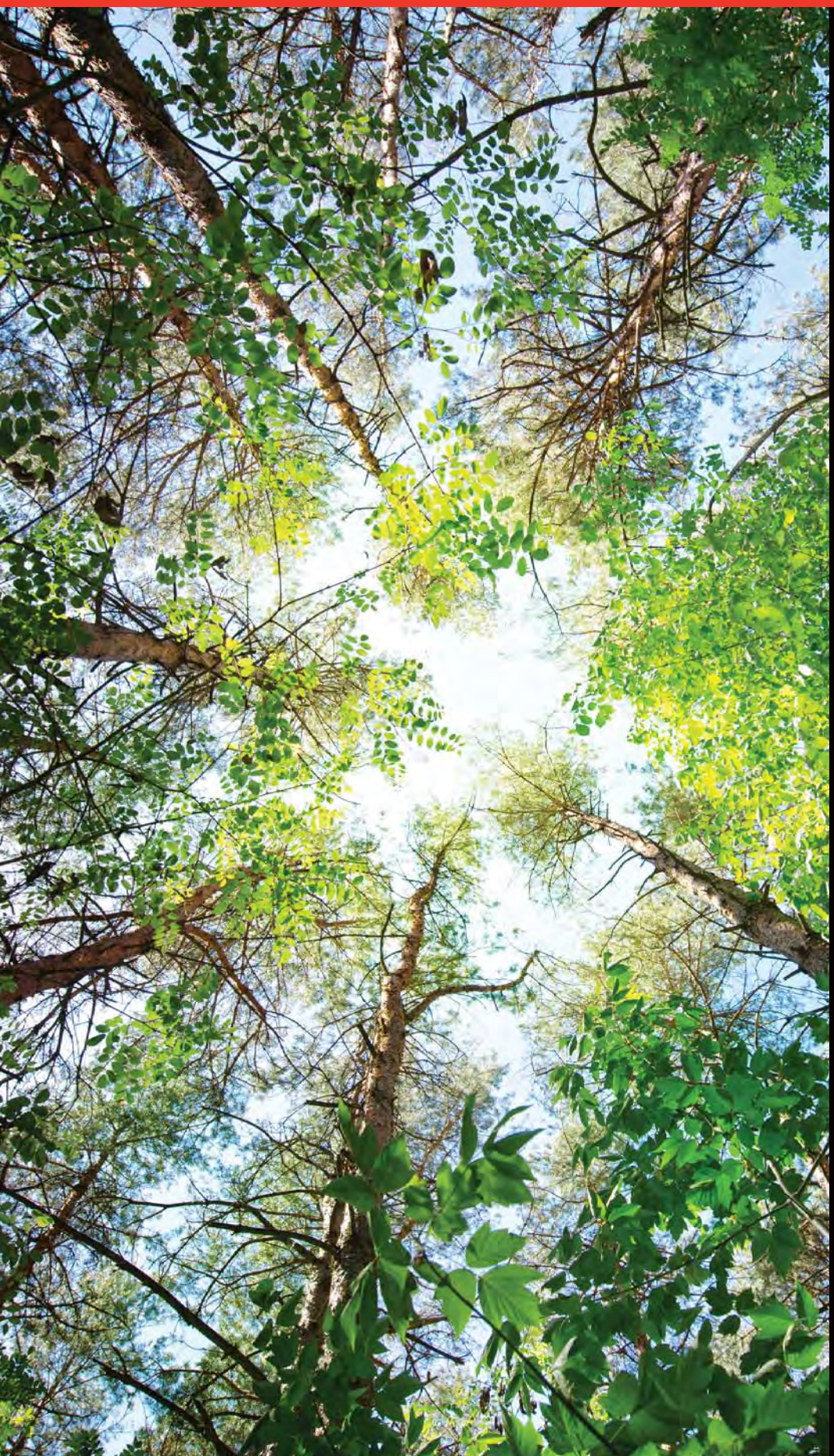

www.unece.org/trans/danger/publi/adr/adr_e.html

European Agreement concerning the International Carriage of Dangerous Goods by Road

ADR applicable as from 1 January 2013

The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) was done at Geneva on 30 September 1957 under the auspices of the United Nations Economic Commission for Europe, and it entered into force on 29 January 1968. The Agreement itself was amended by the Protocol amending article 14 (3) done at New York on 21 August 1975, which entered into force on 19 April 1985.
The Agreement itself is short and simple. The key article is the second, which say that apart from some excessively dangerous goods, other dangerous goods may be carried internationally in road vehicles subject to compliance with:

-the conditions laid down in Annex A for the goods in question, in particular as regards their packaging and labelling; and
-the conditions laid down in Annex B, in particular as regards the construction, equipment and operation of the vehicle carrying the goods in question.

Annexes A and B have been regularly amended and updated since the entry into force of ADR. Consequently to the amendments for entry into force on 1 January 2013, a revised consolidated version has been published as document ECE/TRANS/225, Vol. I and II ("ADR 2013").
The structure is consistent with that of the United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations, the International Maritime Dangerous Goods Code (of the International Maritime Organization), the Technical Instructions for the Safe Transport of Dangerous Goods by Air (of the International Civil Aviation Organization) and the Regulations concerning the International Carriage of Dangerous Goods by Rail (of the Intergovernmental Organisation for International Carriage by Rail). The lay-out is as follows:

Annex A: General provisions and provisions concerning dangerous articles and substances

Part 1	General provisions
Part 2	Classification
Part 3	Dangerous goods list, special provisions and exemptions related to limited and excepted quantities
Part 4	Packing and tank provisions
Part 5	Consignment procedures
Part 6	Requirements for the construction and testing of packagings, intermediate bulk containers (IBCs), large packagings and tanks
Part 7	Provisions concerning the conditions of carriage, loading, unloading and handling

Annex B: Provisions concerning transport equipment and transport operations

Part 8	Requirements for vehicle crews, equipment, operation and documentation
Part 9	Requirements concerning the construction and approval of vehicles

Applicability of ADR

Notwithstanding the transitional measures provided for in ADR 2013, which allow compliance with certain requirements contained in previous editions, the editions of ADR published by the United Nations which may be used for compliance are as follows:
Until 30 June 2013: 2011 edition (ECE/TRANS/215, Vol. I and II), and corrigenda 1 and 2

As from 1 January 2013: 2013 edition (ECE/TRANS/225, Vol. I and II), and corrigendum 1.

European Commission
Enterprise and Industry

- What's new
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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

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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.

TABLE OF CONTENTS

1 INTRODUCTION

The objective of these Guidelines is to clarify certain matters and procedures referred to in **Directive 94/9/EC**[1] 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)"[2].

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[3].

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[1] 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.

[2] http://ec.europa.eu/enterprise/policies/single-market-goods/documents/blue-guide

[3] 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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[1] 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.

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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).

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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.

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

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[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 are 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.

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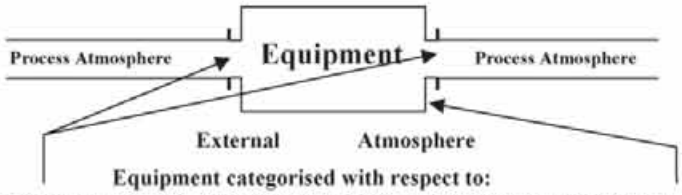
[22] Equipment here is taken to mean all products within scope of Directive 94/9/EC

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.

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[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,

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[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.

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[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 atmosphere[34].

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[39]. 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)[40], 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.

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[39] 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.

[40] 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):

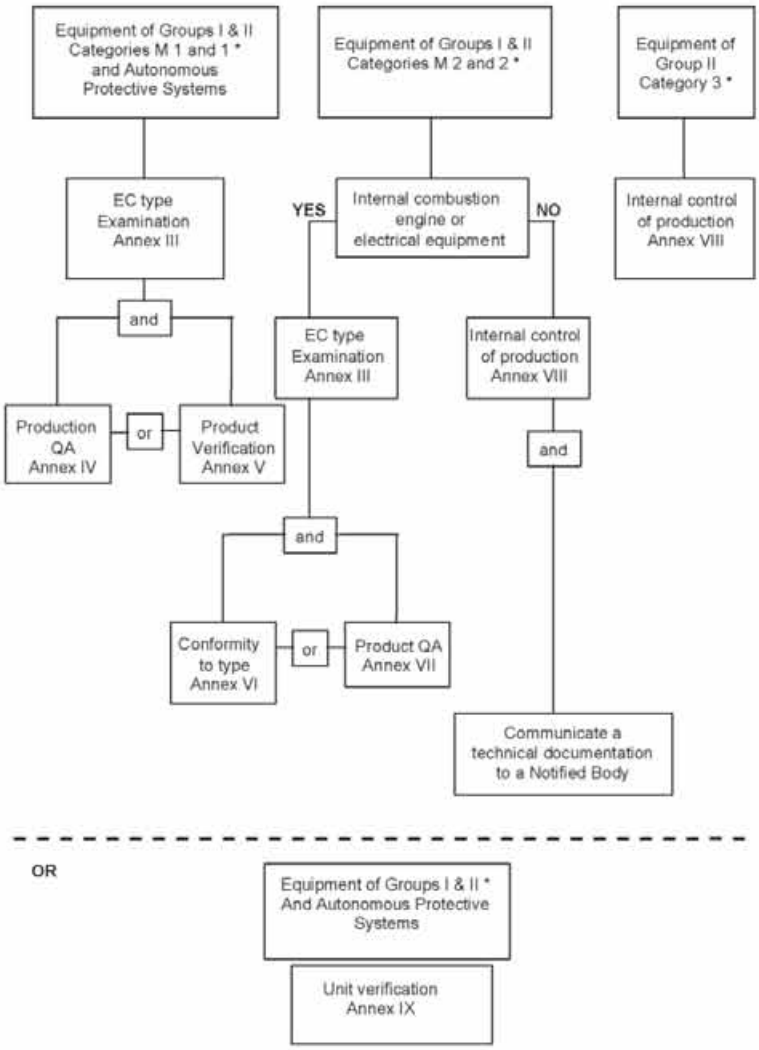
Notified Body examines individual equipment or protective system and carry out tests as defined in the harmonised standards, if they exist, or otherwise in European, international or national standards or conduct equivalent tests to ensure conformity with the relevant requirements of Directive 94/9/EC 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.

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.

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* 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 not foreseen by the Directive**. 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 final 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  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.

[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.

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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

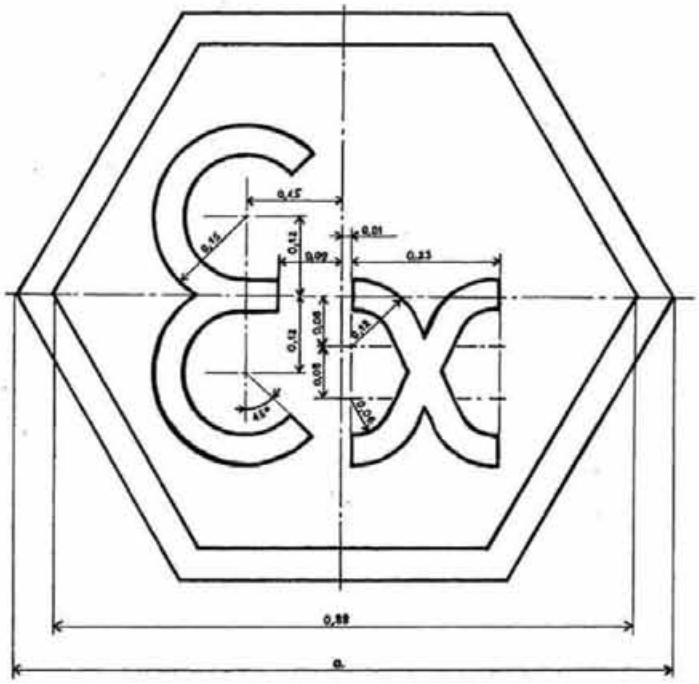
ATEX Directive interest group on CIRCA:
http://circa.europa.eu/Members/irc/enterprise/atex/home

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



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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			
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)

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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.

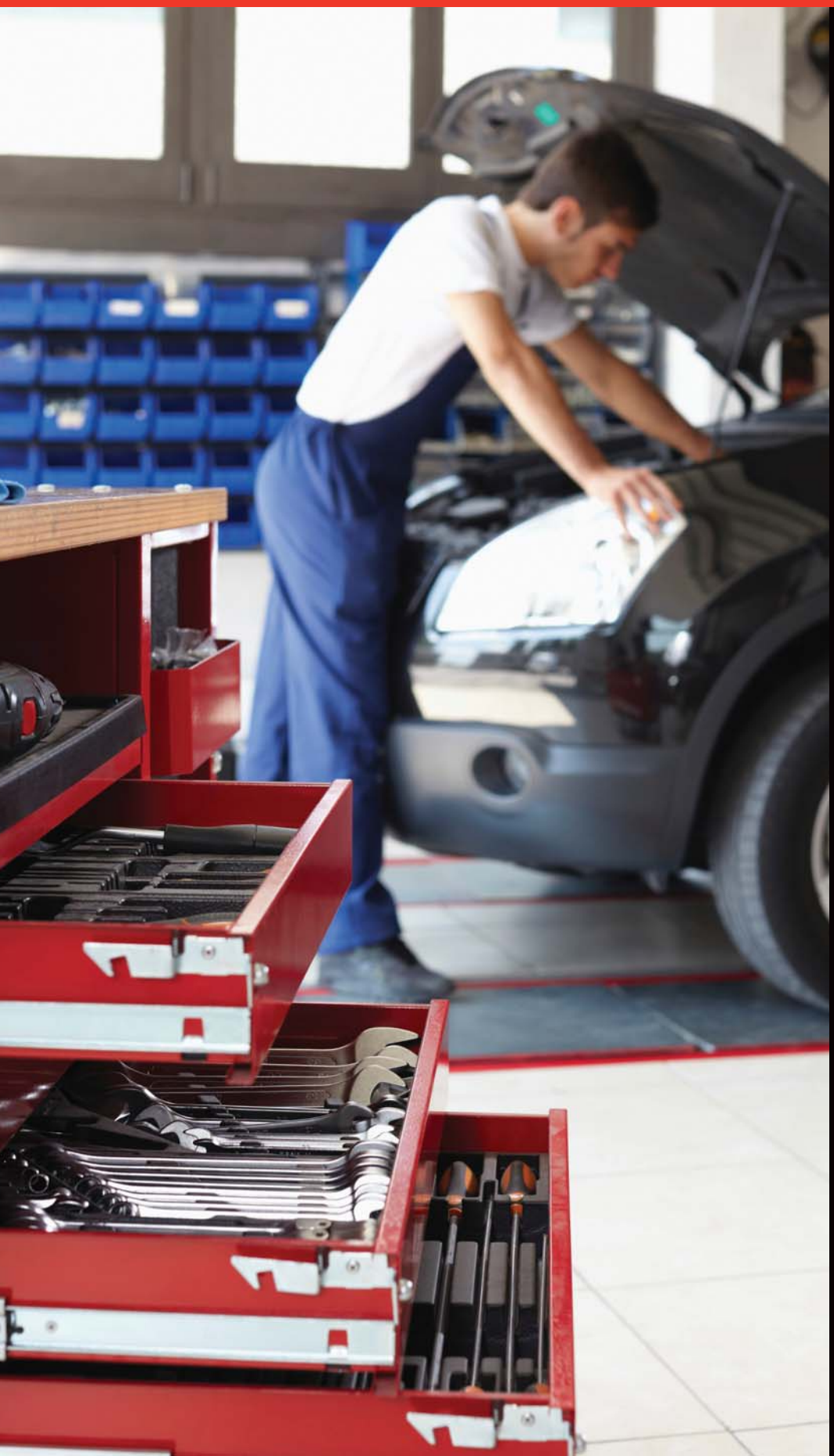
Note 1: Additional information can be obtained in the ATEX Guidelines and Standing Committee Considerations to directive 94/9/EC but also in the Non-binding guide to directive 1999/92/EC.

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. aluminium and magnesium) and their alloys may initiate an aluminothermic (thermite) reaction, which can give rise to particularly incentive sparking.

2 (2)

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

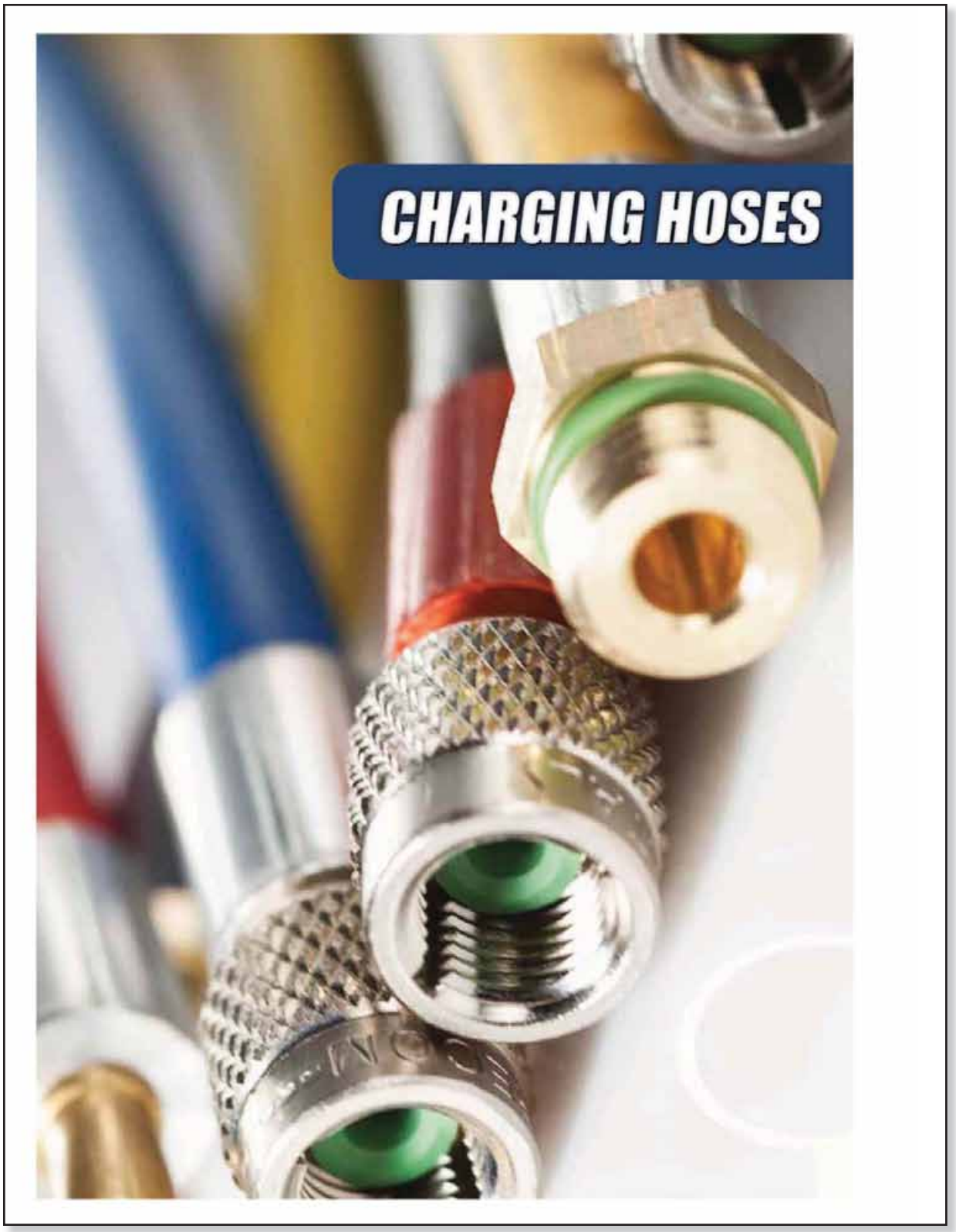
Hoses and Connections

CPS Gauges and Fittings

Errecom Hose

Mastercool Gauge Manifold

Yellow Jacket (CGA 166 LH Adapter)



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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 coverlay	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

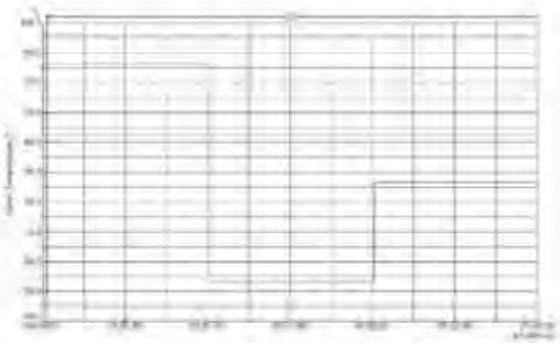
To run this test, reference is made to a methodology developed internally, which consists in subjecting 4 samples of hose to a thermal cycle of stress. This cycle takes 6 hrs. and is repeated 28 times (in total: 168 hrs., 7 days).

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

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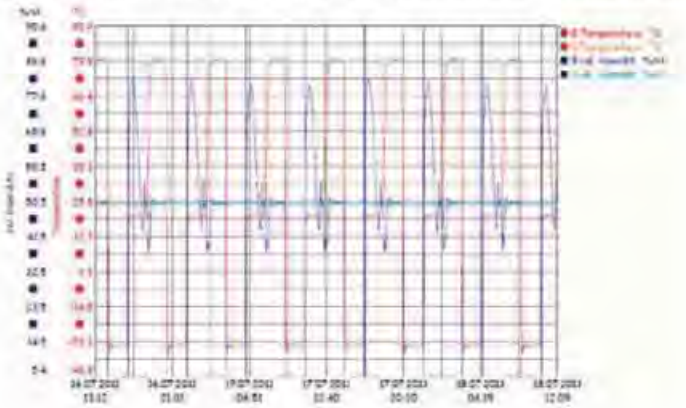


Trend of relative Humidity and Temperature during the test

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

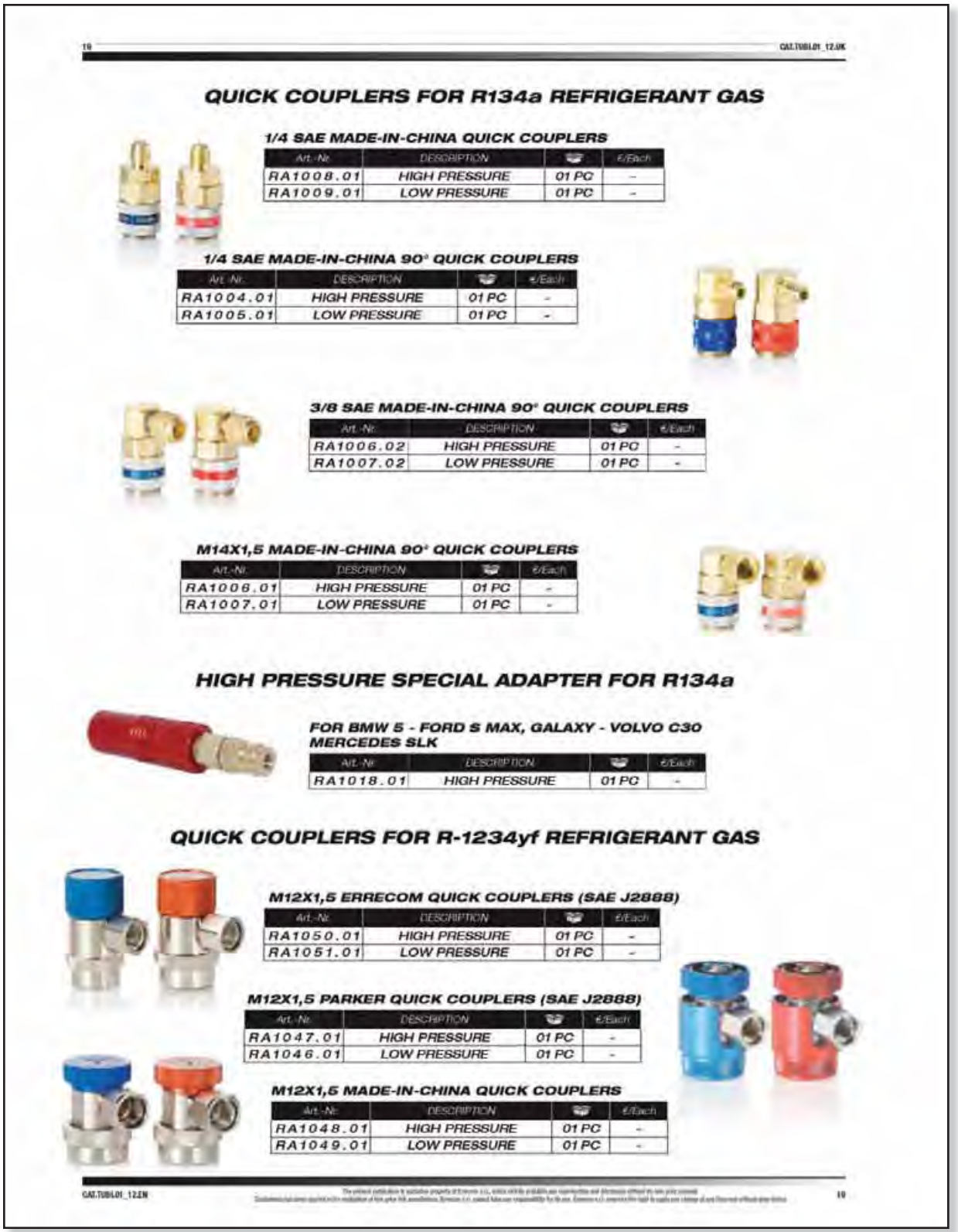
ERRECOM Refrigerant Charging Hose ### SAE J2888 R-1234yf ### WP 60 Bar - MBP 240 Bar ### SAE J2196 R134a R410a R407 R404 R422 R424 ### *Made in ITALY*

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.



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	-

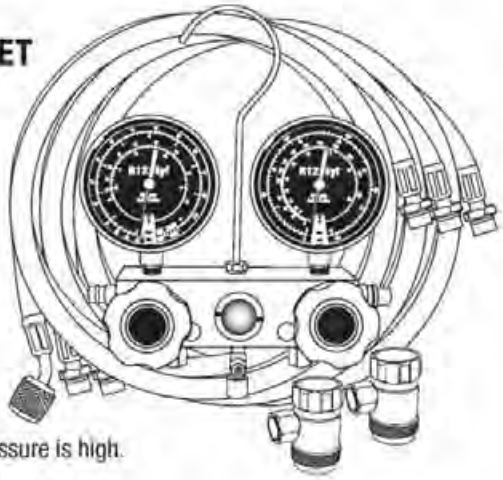
Mastercool Inc.
"World Class Quality"
1 ASPEN DRIVE, RANDOLPH, NJ 07869
PHONE: 973-252-9119 / FAX: 973-252-2455
WEB: WWW.MASTERCOOL.COM

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

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.*)

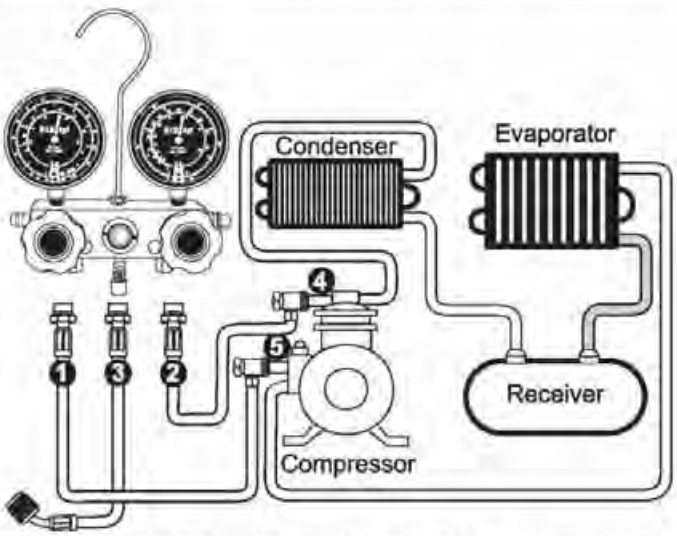
e. Open manifold low side (blue) valve slowly until pressure reaches 42 psi. Do not exceed 42 psi during the recharging process. Exceeding 42 psi could damage the compressor.

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)

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.

B3272 INST

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

Leak Detection

CPS Leak Detector

Robinair Leak Detector

RTI Leak Detector

Techno Tools Leak Detector

Yellow Jacket Leak Detector

cps®

Innovations in Design

Patent Pending

Ergonomic design for comfort and ease of use

Rugged carrying case included

500+ Hour Sensor Life

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

WORLD HEADQUARTERS
1010 East 31st Street, Hialeah, Florida 33013, USA
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e-mail: cpssales@cpsproducts.com www.cpsproducts.com

LTLDA1000

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: 32°F (0°C) to 122°F (50°C) at <75% RH

Storage environment: <80% RH for detector and battery

For 80% battery recovery:

-4°F (-20°C) to 140°F (60°C) less than 1 month
-4°F (-20°C) to 113°F (45°C) less than 3 months
-4°F (-20°C) to 68°F (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

Specifications

Model #:	LD-2
Name:	Refrigerant Leak Detector
Sensitivity:	.05 oz/yr R134, .0123 oz/yr R12134yf
UV Mode:	3 UV LED's
UV Wavelength:	395-415 nanometers
Electronic Sensor Life:	>10 years
Response time:	Instantaneous
Power Supply:	4 AA Alkaline batteries (included)

Battery Life:	6 hours continuous
Warm-up Time:	<20 seconds
Probe Length:	17 inches
Weight, lbs:	1.6 lbs
Warranty:	2 years (2 on sensor)
Numerical Display:	7 segment digital display (1 to 9)
Alarm near sensor:	Visual probe LED

RTI Technologies

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Web: www.rtitech.com

Equipment Part Number: 076-808635-00
Document Part Number: 035-811982-00

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Techno Tools Corporation
Model D440A
Refrigerant Gas Leak Detector

SAE J2791 and J2913 CERTIFIED

EURO STANDARD EN14624

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.

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.

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

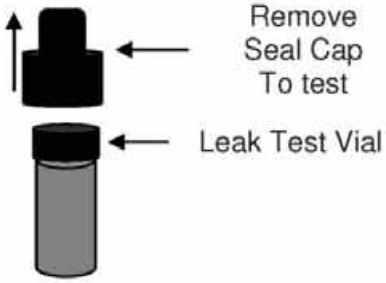
The Leak Detector will default to the NORM sensitivity level automatically once the unit comes out of the warm up cycle and the green LED will turn on.

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:

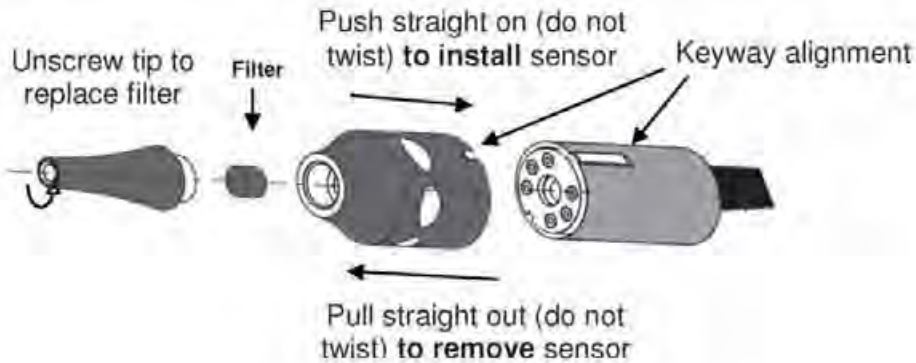
Install Batteries: Remove screw located at rear end of unit and pull down hinged battery door to open as shown. Always insert all four batteries into the battery compartment in the same direction. Note polarity mark on the inside of the battery door for proper battery orientation.

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.



5

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.

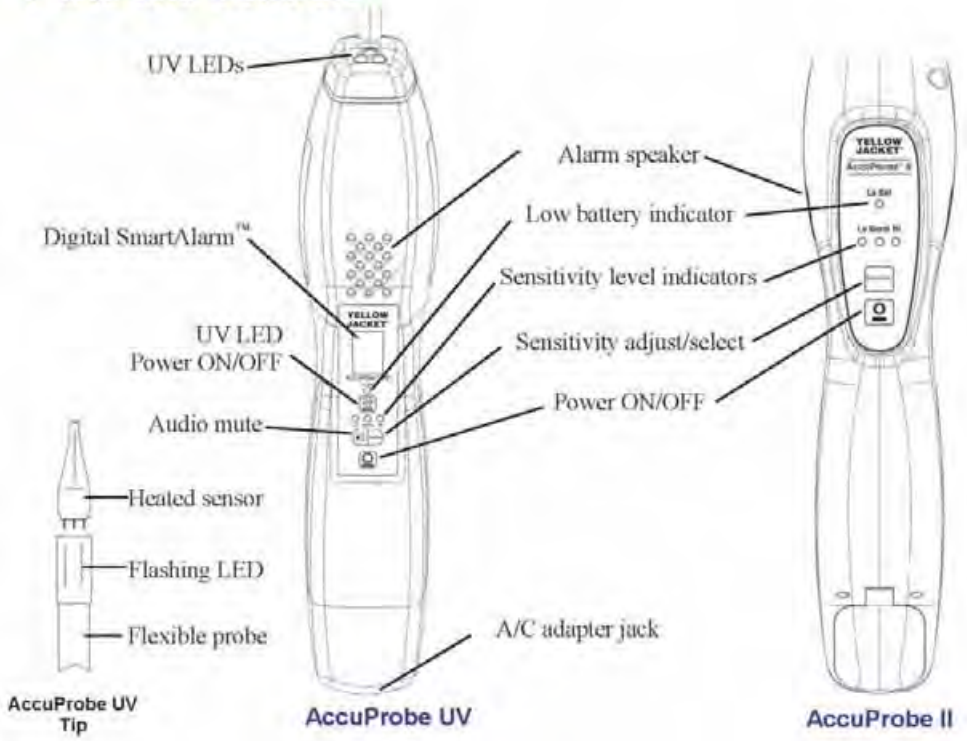
When finding leaks, it is important to note that the AccuProbe responds to changes in concentration of refrigerant. For this reason, the detector will stop alarming even though it is held at or near the source of the leak and will not alarm again until the detector senses a change in concentration. To 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

2

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.

3

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.

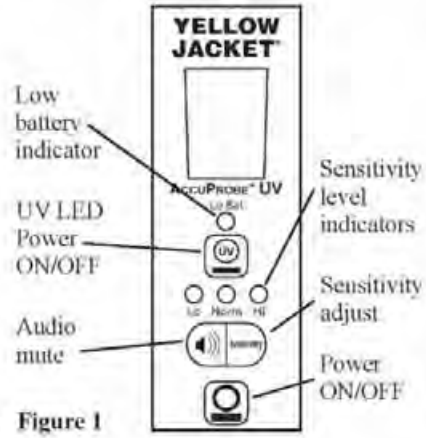


Figure 1

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.

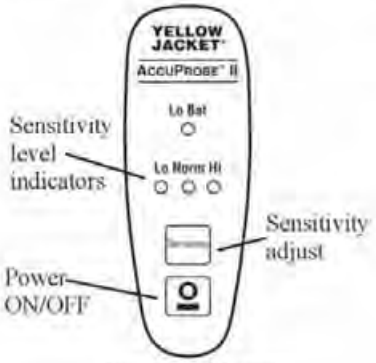
1. Turn on UV light by pressing the UV light ON/OFF button (see diagram on left).
2. Holding the leak detector approximately 10" to 14" away, shine the UV light beam slowly over the components, hoses, and metal lines that make up the A/C system.
3. When the UV light shines on the fluorescent dye that 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

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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.

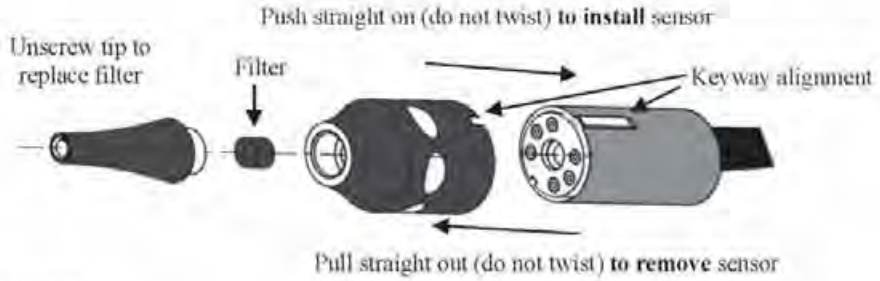


Figure 2

6

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 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.

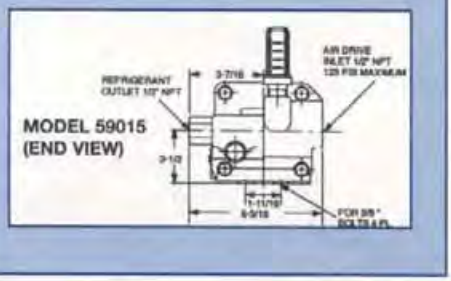
Safety – Pneumatically driven. Operates from an air hose like an air tool. No electrical hazard.

Portability – Each model is an integral pump with linear air motor assembly weighing from 13 to 24 lbs.

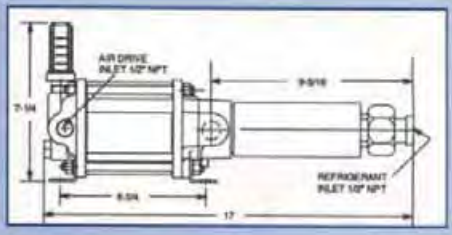
Clean – No lubrication required. Nothing is added to the refrigerant, liquid or vapor.

*For R-11 or R-113 specify model number –2 (e.g. 59015-2) Provides change to buna o'rings in wetted section.

DIMENSIONS AND PORTS

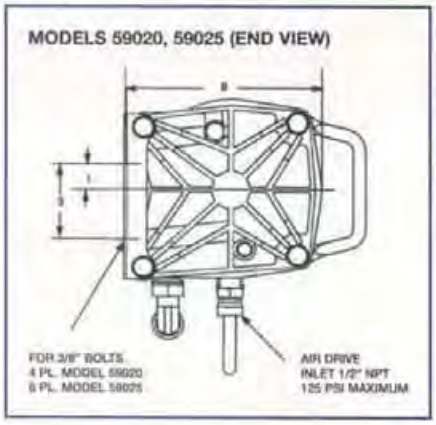


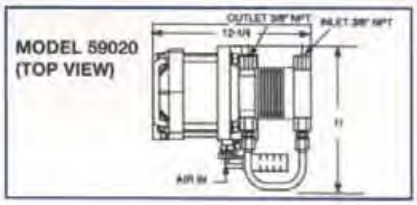
MODEL 59015 (SIDE VIEW)

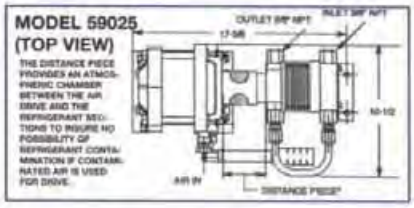


PUMPS FOR REFRIGERANT RECOVERY OR RECHARGE

PUMPS FOR REFRIGERANT RECOVERY OR RECHARGE





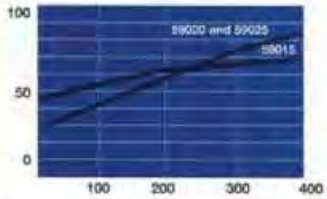


BASIC SPECIFICATIONS

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	0 psi•27"HG	250 psi and inlet falling from 50 psi•0 psi	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:** 2. **Suction or Plumbing:** 3. **Safety and Relief Valves**

Haskel International, Inc.
North America • South America
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Burbank, California 91502 • USA
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Tel: 65-6455-7559 • Fax: 65-6455-2841

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For further information on Haskel products, visit our website at: **www.haskel.com**

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Table of Contents

Recovery, Recycle, Recharge (RRR) Machines

CPS RRR Machine

Ecotechnics ECK Twin

Launch UK RRR System

Robinair Service Equipment

RTI Mahle RRR Machine

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

Autoclimate Ltd
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Document Ref: PGECKTWIN v1.0 April 2013

autoclimate

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 82cm 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

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Document Ref: 336ECKTWIN v1.0 April 2013

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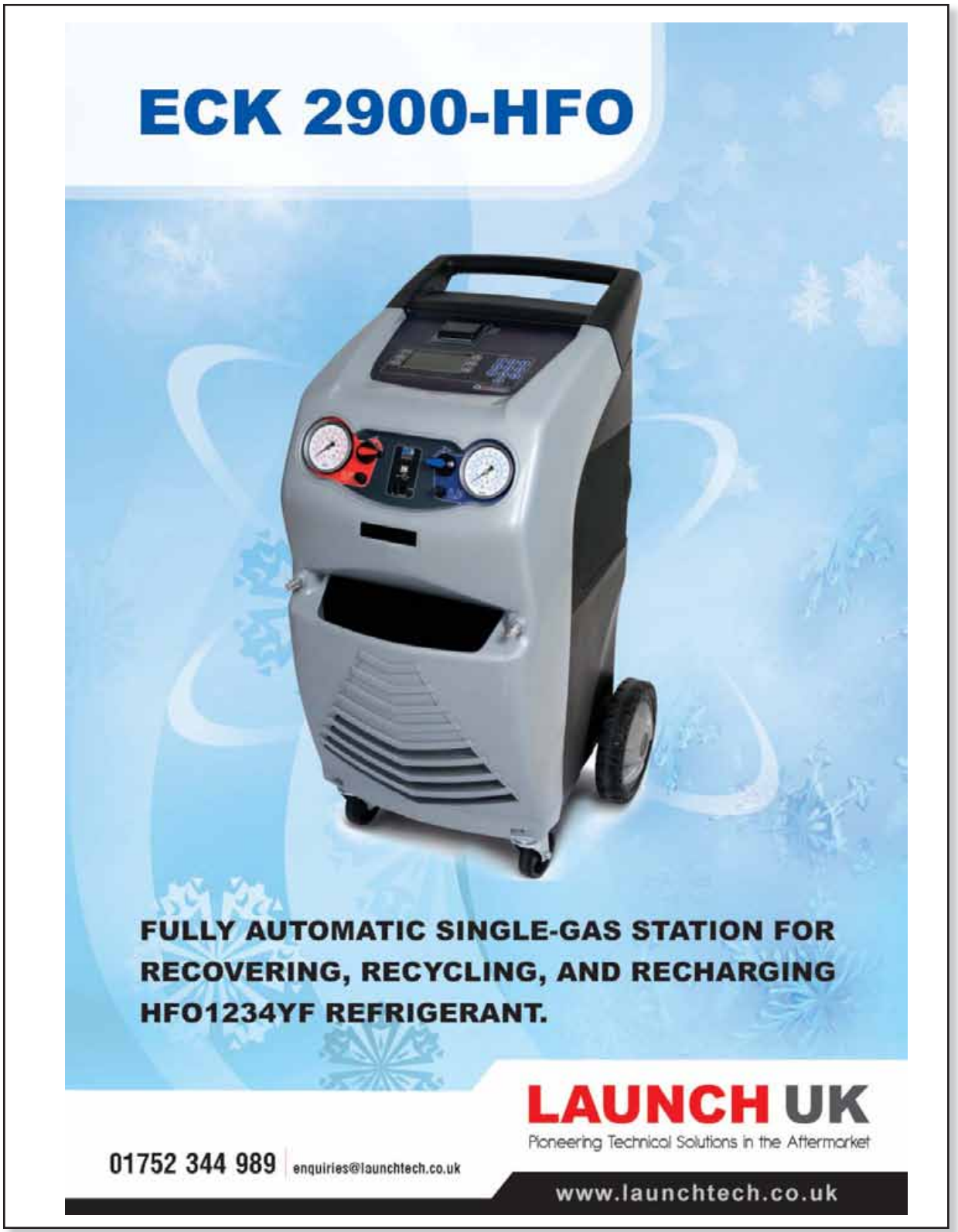


ECK 2900-HFO

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 (UV/GT-7)

NITROGEN BOTTLE CONNECTOR (N2)

ISO

INDEPENDENT

LAUNCH UK
Pioneering Technical Solutions in the Aftermarket

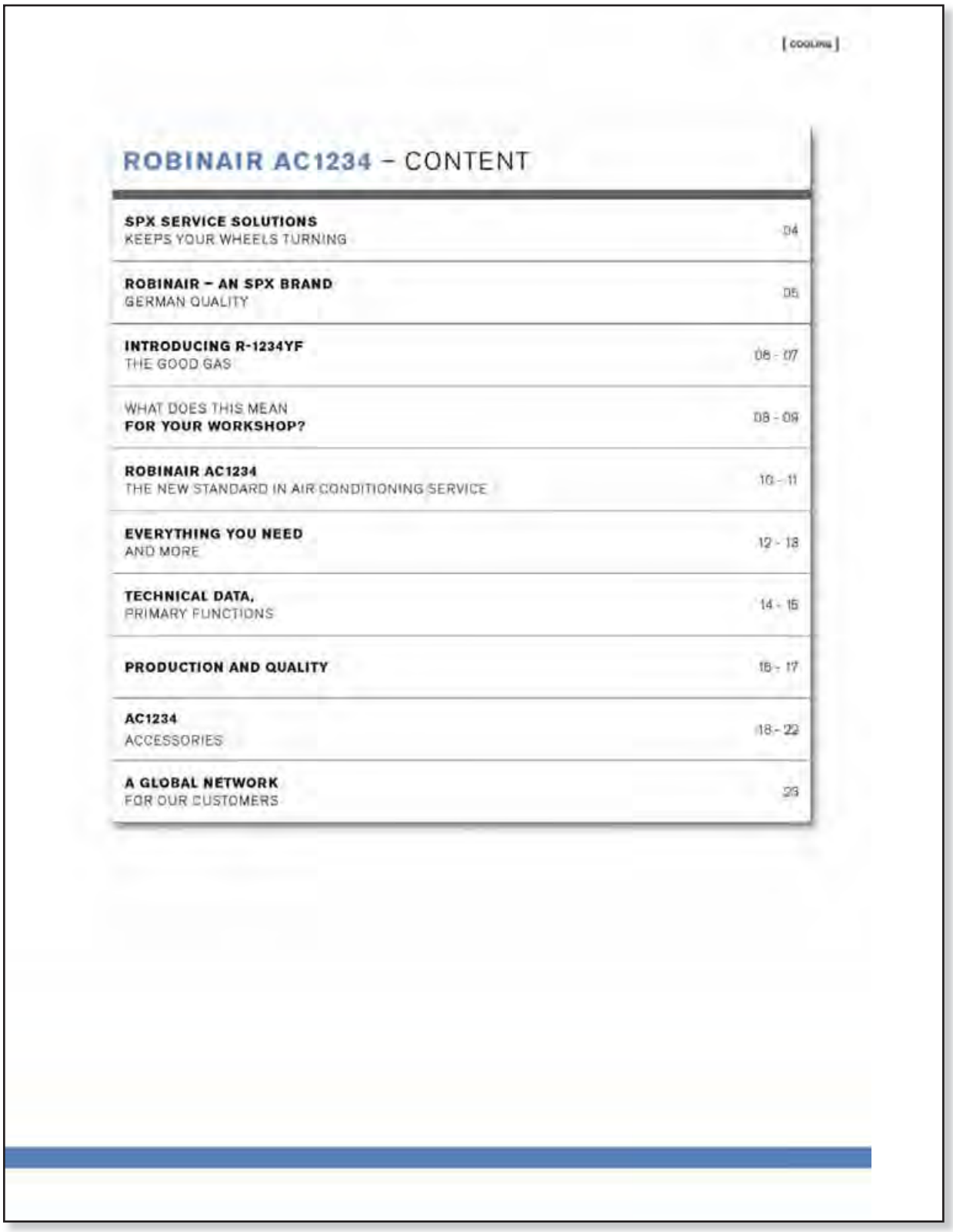
ROBINAIR.

[COOLING]

AC1234 PRODUCT LINE AND ACCESSORIES

SERVICE STATION FOR R-1234YF A/C SYSTEMS

SPX.



[COOLING]

ROBINAIR AC1234 – CONTENT

[04 | 05]

SPX SERVICE SOLUTIONS – KEEPS YOUR WHEELS TURNING

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

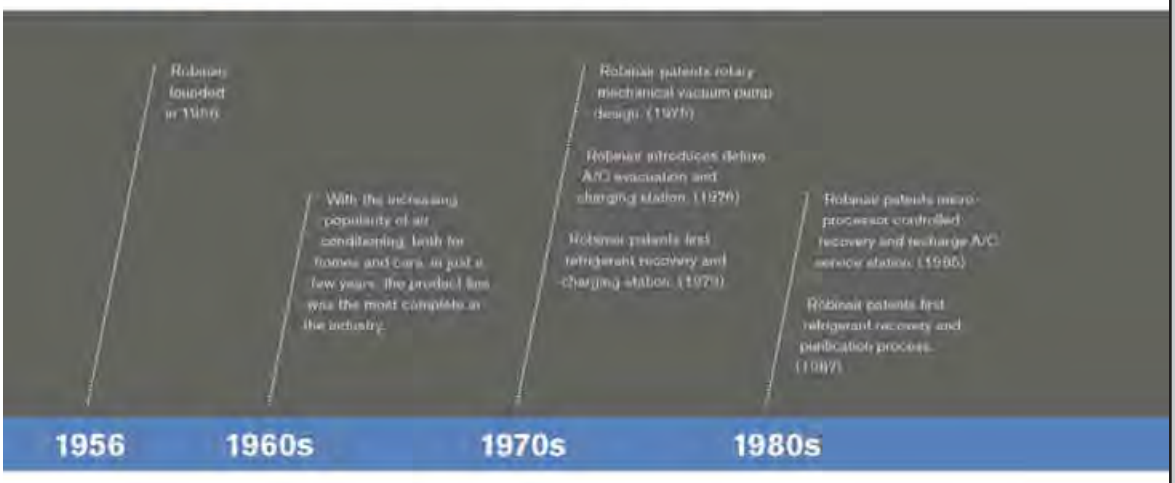
SPX businesses have the lowdown on regulatory requirements across a host of industries. We are familiar with national and regional regulations, and we are aware of the safety and environmental issues.

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



[COOLING]

ROBINAIR – AN SPX BRAND

ROBINAIR.

GERMAN QUALITY

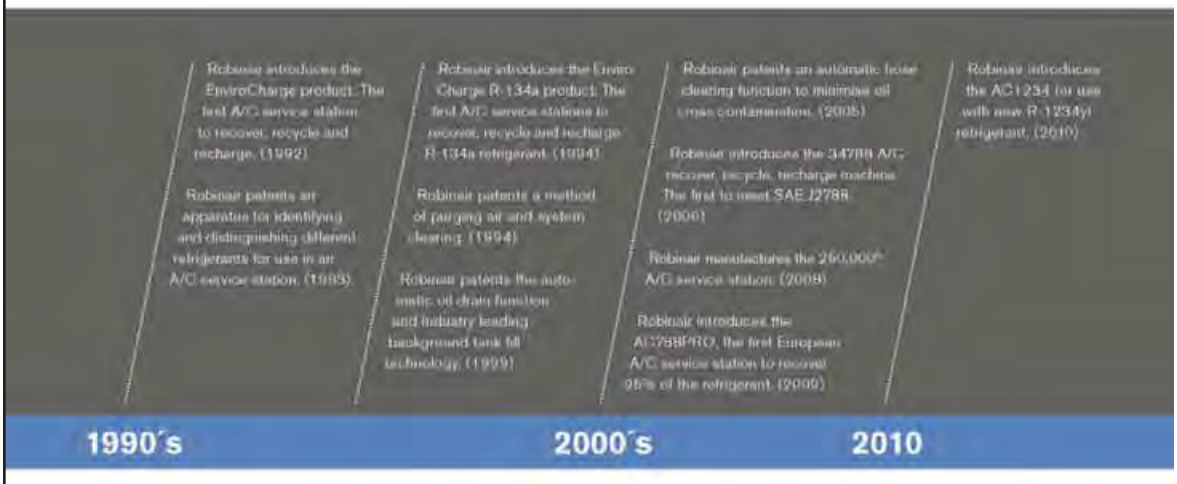
Robinair is the world's leading manufacturer of air conditioning service units for cars, trucks, buses and aircraft. For more than 50 years, the brand has been renowned for its advanced technology, top quality and reliability.

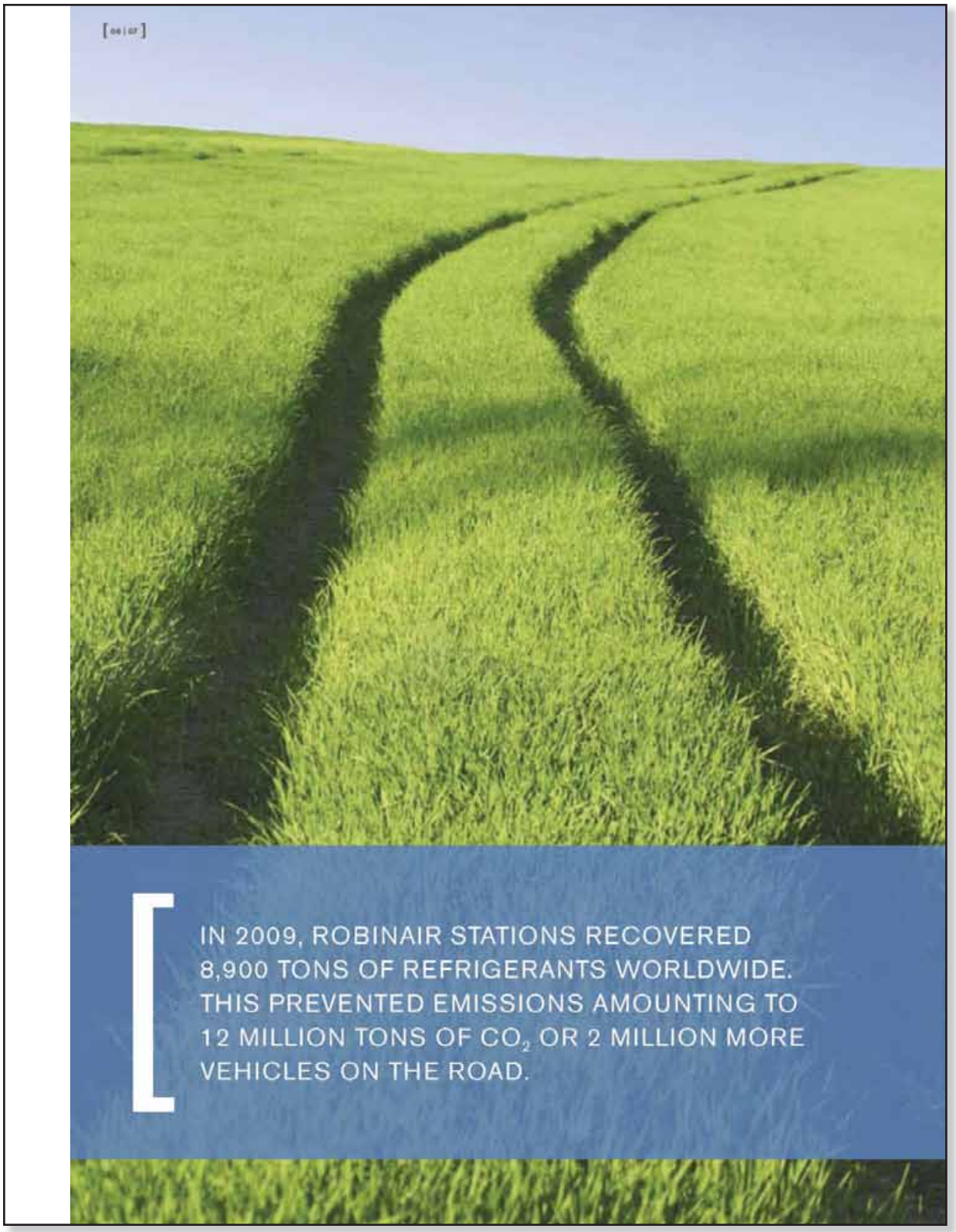
Robinair was founded in 1956 by the Kent-Moore Corporation of Warren, Michigan, to design and manufacture specialised tools for repairing appliances. The new company was named after two Kent-Moore executives, whose surnames were Robinette and Adair. Soon after, Robinair moved into a growing market: air 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





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.

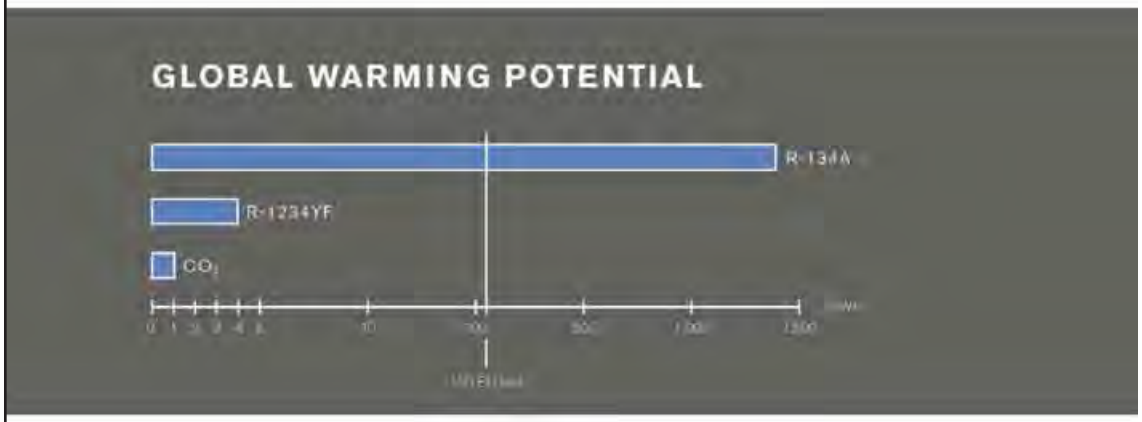
The only downside of the new refrigerant, compared to R134a, is that it can be flammable in specific circumstances. However, this can be kept under control with well-engineered air conditioning servicing machines – like our Robinair units – and some common sense precautions in the workshop.

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.



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.

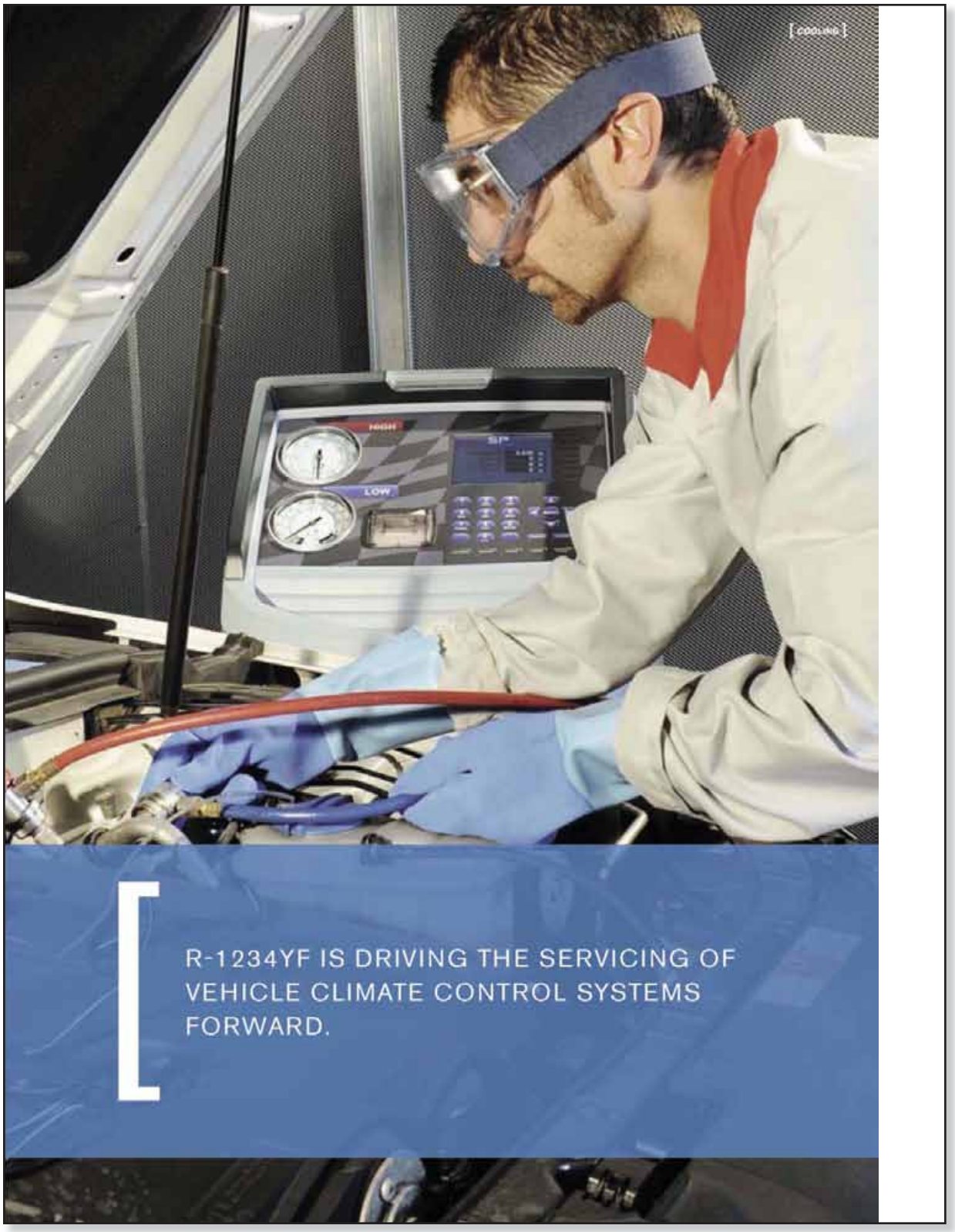
As noted before, R-1234yf is slightly flammable. So it is essential to use equipment that is specifically designed for the new refrigerant and that has been properly certified.

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.



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.

[12 | 13]

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:

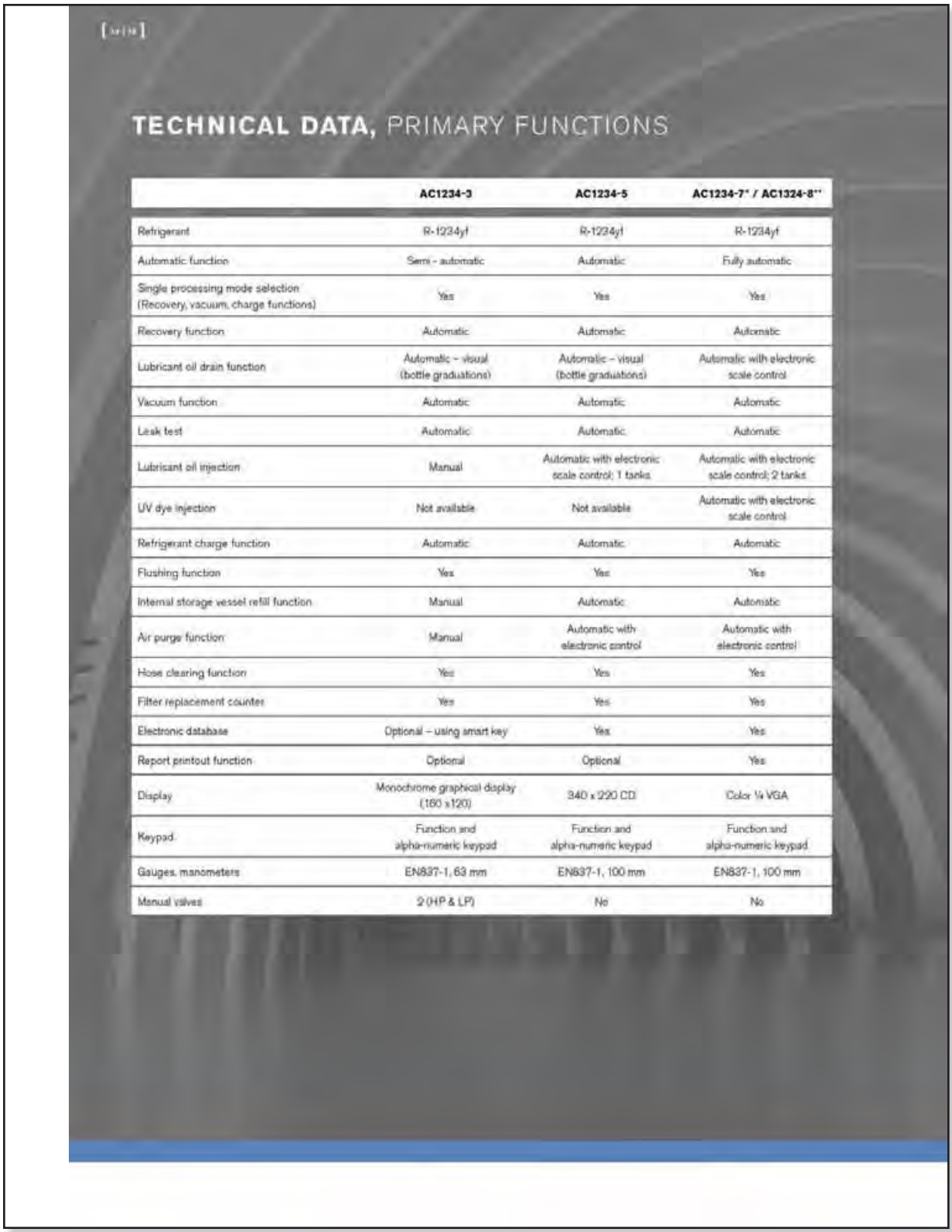
- Complies with all international standards (CE, UL, SAE, ANSI)
- Certified by well-regarded independent testing agency TÜV
- Maximum accuracy during recovery – no refrigerant is wasted, minimising refrigerant costs
- Independent oil and UV dye injection systems – no cross contamination of lubricants
- Automatic internal and service hose clearing
- Automatic unit maintenance service counter to ensure unit is operating efficiently
- Designed to comply with rigorous OEM guidelines

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

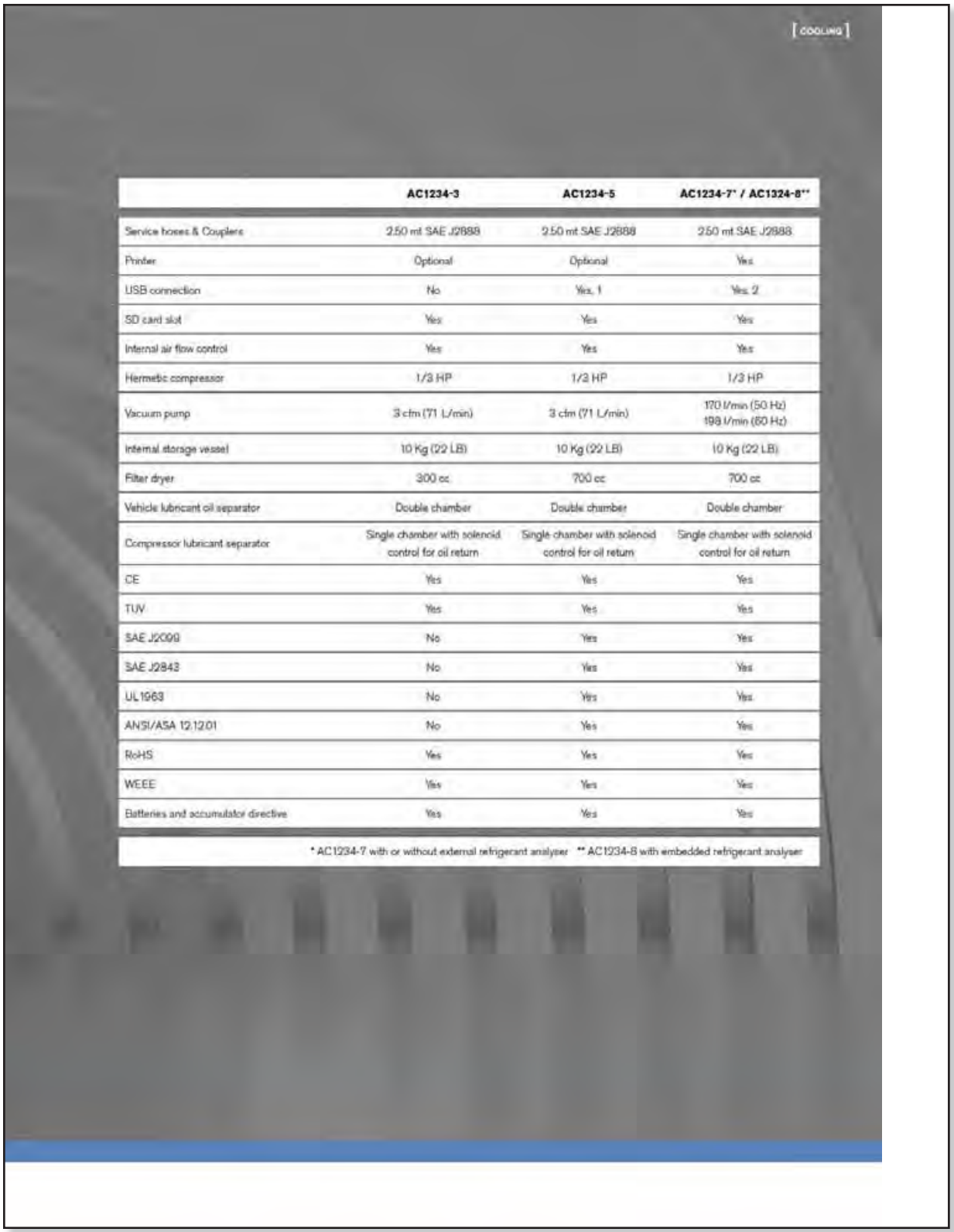
ECO-FRIENDLINESS:

› 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 x120)	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



	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
UL1963	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

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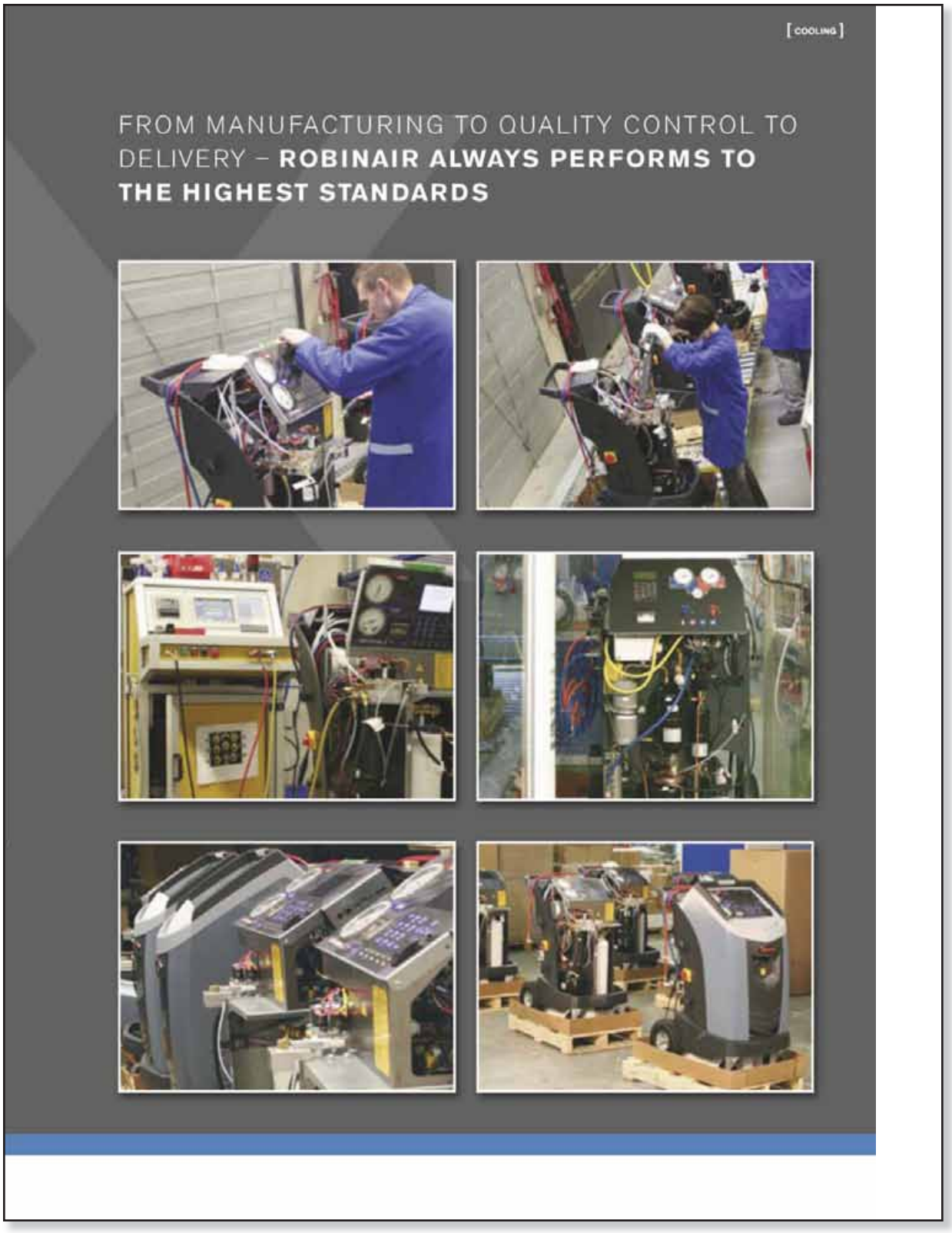
HIGH-TECH PRODUCTION – FOR QUALITY YOU CAN TRUST

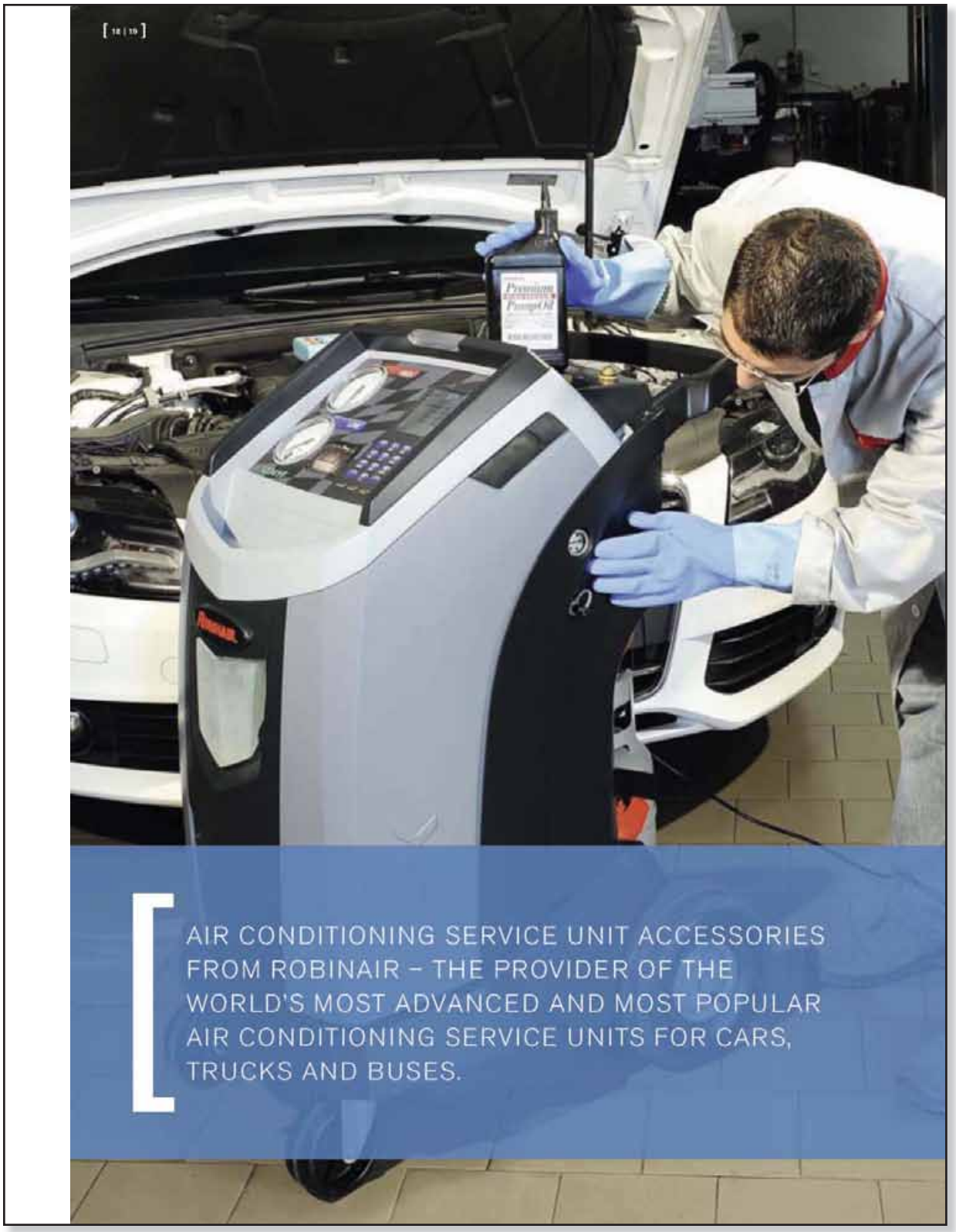
Why are Robinair A/C units such exceptional quality? A lot of that has to do with how they're made.

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.





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.

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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

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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.

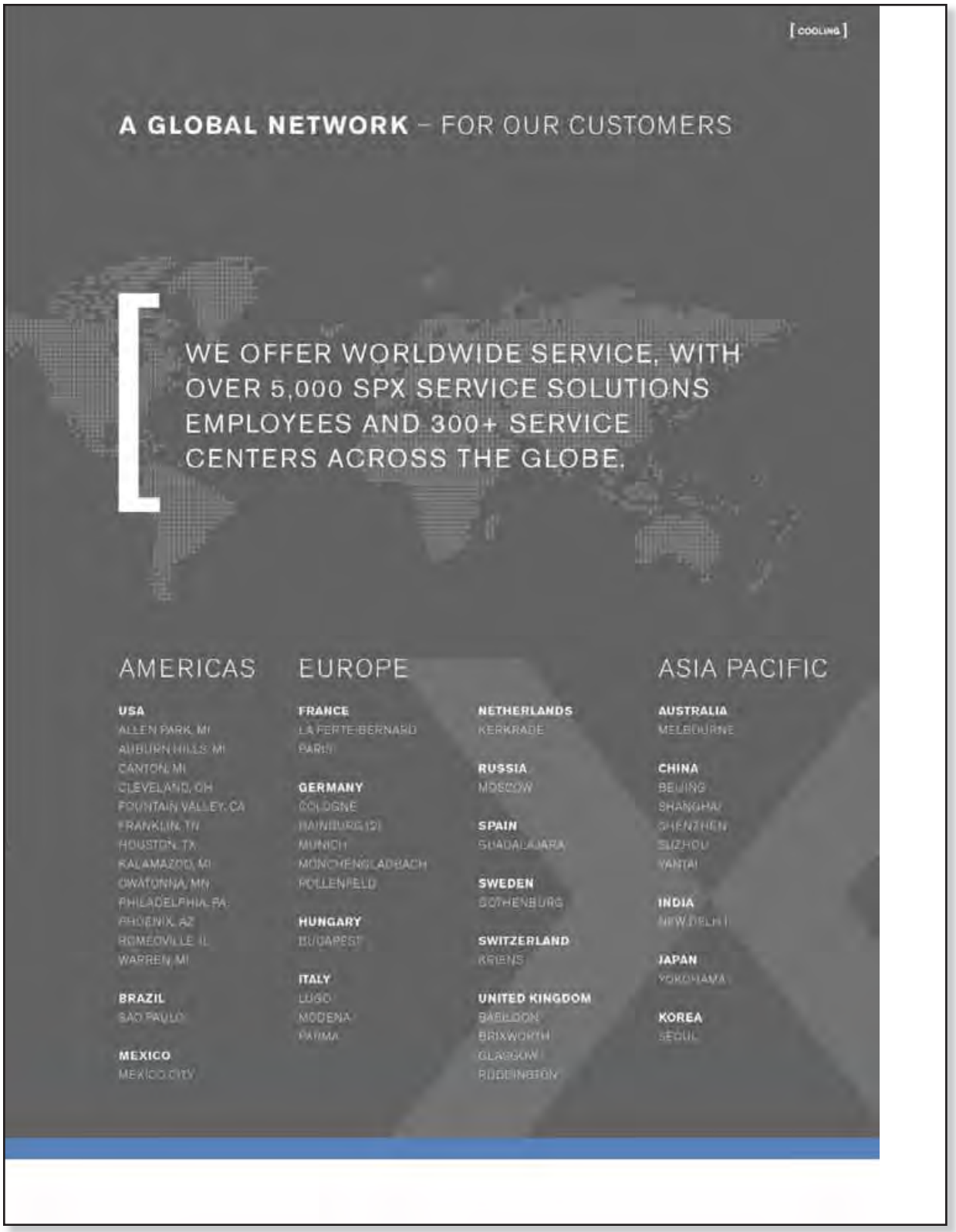
This tracer uses a non-toxic, non-flammable, environmentally-friendly (non-polluting) mixture of 5 per cent hydrogen and 95 per cent nitrogen. As a result, the mixture can be released into the environment after the leak detection procedure is completed. The mixture complies with Article 6, Paragraph 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 2 l • Low and high side connectors • Hoses • Pressure Regulator • 2 Pressure gauges	ACT800
Base kit	ACT800
Leak detector	ACT200
Tank refill	ACTN2H2



ArcticPRO® RHS®1280 Series

MAHLE RTI

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 contamination risk
- OE custom software available

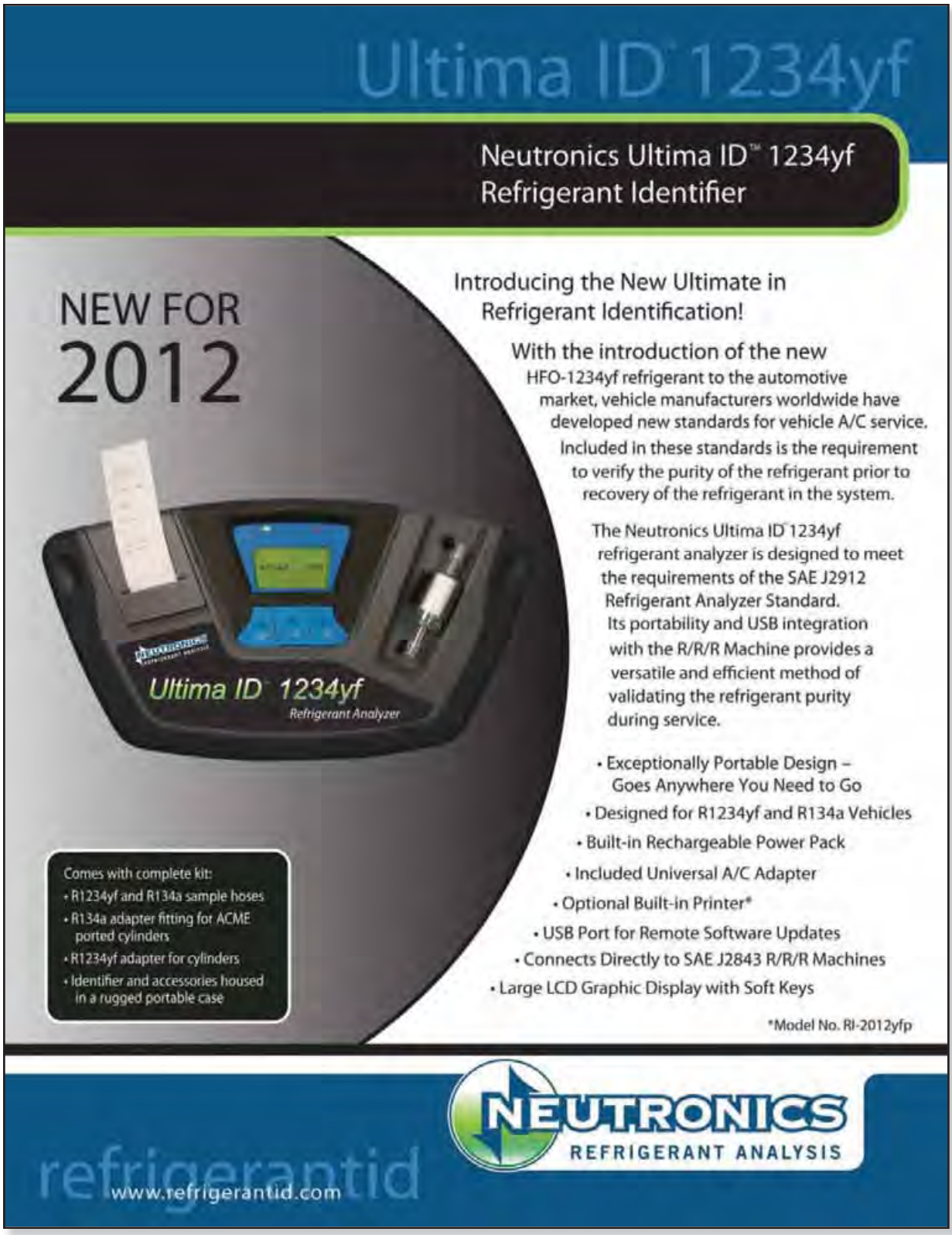
ArcticPRO RHS 1280 Specifications

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



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