

Refrigerant Handling Guide

Marine Products



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Safe handling when working with refrigerants

The below provides general information for CFC, HCFC and HFC refrigerants. For more details, please refer to the applicable Safety Data Sheet.

These can be downloaded from wilhelmsen.com or wssproducts.wilhelmsen.com under the Documentation tab of each refrigerant.

Environmental concerns

- All refrigerants have a global warming potential and therefore contribute to the greenhouse effect when released into the atmosphere.
- CFC and HCFC refrigerants also contribute to the depletion of the ozone layer when released into the atmosphere (see regulations implemented on page 12).

Hazards identification

- Odour: Sweet ether-like odour.
- Appearance: Liquefied gas.
- Contact with eye: May cause irritation.
- Contact with skin: Possible frost-bite of affected areas.
- Inhalation: May cause dizziness, confusion, headache or stupor. In case of severe exposure, unconsciousness may develop.

Handling and storage

Storage

Do not expose cylinders to temperatures above 45°C, 113°F. Store as a compressed gas. Keep in a well-ventilated place. Keep away from open flames, hot surfaces and other sources of ignition.

The gas is normally transported under pressure in gas cylinders. In case of a leak, prevent sparks and open flames.

Safety measures to protect persons

- Always wear eye protection and insulated gloves.
- Protective clothing should be worn if there is a possibility of direct contact or splashes.
- Wear safety boots when handling refrigerant cylinders.
- Never lift a cylinder by the top valve.
- When moving cylinders, keep their caps on.
- Always assume that the cylinder contains gas.
- Wear self-contained breathing apparatus in high gas concentrations.
- Provide good ventilation.

Safety measures to protect the environment

Do not release refrigerants into the atmosphere and always use recovery equipment. Obsolete cylinders should be returned to an approved reception facility and empty ones to the supplier at a maximum 10% of the initial product weight to meet import restrictions.

Proper methods for damage limitation and cleanup

Stop leaks immediately, if possible without jeopardising personal safety. Move leaking cylinder(s) to the open air, where the leak will not jeopardise personal safety.

Exposure control

Refrigerant gases are heavier than air and will accumulate on the ground. They may cause suffocation by reducing oxygen available for breathing. Wear self-contained breathing apparatus in confined spaces.

Accidental human exposure to gas or liquid

General

Provide fresh air and keep the patient warm and at rest. If in doubt, seek immediate medical advice.

Inhalation

High concentrations or prolonged exposure may cause headache and dizziness, as well as unconsciousness and other central nervous system disorders. Provide fresh air, keep the patient warm and at rest. Perform mouth-to-mouth resuscitation and cardiac massage if necessary.

Skin contact

First aid treatment of frostbite after skin contact with liquid refrigerant: flush with large amounts of lukewarm water (about 40°C, 104°F). Do not remove clothing if frostbitten. Frostbite must be treated by a doctor.

Eye contact

Contact with gas or vapour has no effect. In case of splashes or symptoms due to high vapour concentrations, flush the eyes immediately with a soft jet of preferably lukewarm water for at least 15 minutes. Get immediate medical attention. Continue to rinse.

Medical information

Do not give adrenalin or equivalent medicines.

Ingestion

Ingestion is not considered a serious risk. DO NOT INDUCE VOMITING! Give the patient 1-2 glasses of water, or preferably milk, to drink if the affected person is fully conscious. Get immediate medical advice.

Fire fighting measures

Under pressure fluorinated refrigerants can be combustible when mixed with air and oil.

Main fire fighting measure

Cool the cylinder with large amounts of water from a safe distance.

Fire and explosion hazards

Cylinders may explode when heated. Fire or high temperatures will cause formation of toxic gases, vapors and fumes.

Personal protection when fire fighting

If refrigerants are involved in fire, use self-contained breathing apparatus.

Other information

Remove gas cylinders from the fire area. Do not move any cylinder which has been involved in fire until it has cooled down.



Charging and recovery of refrigerants

Practical advice for charging and recovery operations

1. Read the Safety Data Sheets (SDS) on all compounds including refrigerants and compressor oils that you are likely to come in contact with. Refrigerant SDS's can be downloaded from wilhelmsen.com/marine-products under the Documentation and Literature section.
2. Never overfill recovery cylinders. Overfilling may cause the recovery cylinder to burst. Safety codes state that recovery cylinders are filled to a maximum of 80% of their volume with liquid (the remaining 20% is used for thermal expansion). Use a weighing scale for filling control (see table of refrigerant quantities on page 6).
3. Use only approved recovery cylinders and ensure the cylinders have the correct pressure rating.
4. Do not mix refrigerants in a recovery cylinder.
5. Keep the lengths of recovery hoses as short as possible. When increased through put is required use larger diameter hoses.
6. The key to quick recovery is to recover the liquid refrigerant first.
7. Some refrigerant blends are mixtures of gases with different volatility that appreciably change in composition or temperature as it evaporates or condenses at a given pressure, causing a temperature glide. A refrigerant blend assigned a R-400 series ASHRAE number designation, is a zeotrope. (See glossary.)

Note: All zeotropic blends must be charged to the refrigeration system in the liquid phase.

Refrigerant recovery packages and cylinders

Stringent emission regulations prohibit venting of refrigerants into the atmosphere. Hence, in order to be compliant, recovery cylinders are required to store recovered refrigerants from onboard refrigeration machinery.

Features and benefits

- ✓ Unitor recovery cylinders are fitted with dual port valves.
- ✓ They are made to DOT 4BA 400 standards.
- ✓ They are designed especially for recovery purposes.
- ✓ Comes with a complete documentation kit including transport label following European and American requirements.

Recovery Cylinder

Wilhelmsen Ships Service also offers a flexible range of refrigerant recovery cylinders.

Kindly note that recovery cylinders are not available for rentals due to legal implications connected to the content when returned.

Product	Product Number
Small 21.6L Recovery Tank (For Sale)	596544
Large 56L Recovery Cylinder (For Sale)	632588



Refrigerant Recovery Package

The refrigerant recovery package consists of carefully selected quality equipment designed to handle recovery from a vessel's refrigeration systems.

This cost saving solution is suitable for all CFC, HCFC, HFC refrigerant and it helps the ship operator to re-use the refrigerants during system maintenance and service.

Product	Product Number
Refrigerant Recovery Package (1ph.230V 50 / 60Hz)	652522
Refrigerant Recovery Package (1ph.115V 50 / 60Hz)	652511



Wilhelmsen Ships Service (WSS) range of recovery cylinders can hold the following refrigerant quantities:

Refrigerant	Small 22 Ltr. Tank	Large 56 Ltr. Cylinder
R-22	17kg / 37 lbs	45kg / 99 lbs
R-134a	17kg / 37 lbs	45kg / 99 lbs
R-401A	17kg / 37 lbs	45kg / 99 lbs
R-404A	13kg / 29 lbs	36kg / 79 lbs
R-407C	15kg / 33 lbs	41kg / 90 lbs
R-407F	15kg / 33 lbs	41kg / 90 lbs
R-410A	13kg / 29 lbs	36kg / 79 lbs
R-417A	17kg / 37 lbs	43kg / 94 lbs
R-502	16kg / 35 lbs	44kg / 97 lbs
R-507	13kg / 29 lbs	36kg / 79 lbs
R-422D	15kg / 33 lbs	41kg / 90 lbs
R-427A	16kg / 35 lbs	44kg / 97 lbs

Global warming potential

Prepare for a low GWP future

Our climate is changing and many countries have committed to fight this by reducing the amount of man-made greenhouse gases in order to ultimately reduce the greenhouse effect, also referred to as Global Warming Potential (GWP).

All refrigerants have global warming potential and especially Hydro Fluoro Carbons (HFC) are potent greenhouse gases contributing significantly to climate change.

In October 2016, an historic Kigali amendment to the Montreal Protocol was signed by almost 200 countries agreeing to a complex phase down of HFC refrigerants, administrated through the same process used for the successful phase-out of HCFCs. Three phase down groups were created;

1. Developed countries will cap and phase down HFCs starting in 2019
2. Developing countries, including China – by far the largest HFC consumer and producer – will freeze HFC consumption in 2024 and start making cuts in 2029
3. India, Kuwait, Pakistan, and Saudi Arabia will cap consumption in 2028 and begin cuts in usage in 2032 (see illustration in table).

In EU the F-gas regulation (EC regulation 517 / 2014) came into force on January 1st, 2015 with the aim to reduce EU's HFC consumption by 79% in 2030. This means phasing down HFCs in EU countries and EU flagged ships (including EEA) based on the GWP of each refrigerant recalculated to CO₂ equivalents. HFCs with GWP above 2,500 (4AR) will become illegal to recharge from January 1st, 2020.

The Environmental Protection Agency (EPA) in the US will ban a host of high GWP refrigerants including R404A, R134a, R407C and R410A in certain new products from as early as January 1st, 2021. In addition, EPA is introducing a tightening of leak rate rules to reduce HFC emissions.

Several countries have introduced CO₂ tax (Carbon Tax, environmental deposit, and environmental fee) in order to minimize emissions of HFCs to the atmosphere. These taxes / fees are calculated based on the GWP for the refrigerant and is already introduced in 39 countries. GWP is calculated according to a formula introduced by IPCC (see glossary, page 17).

The GWP issue will get more focus from legislative bodies in the future, and further restrictions are expected. Prepare for a low GWP future.

Refrigerant	Non-A5 (developed countries)	A5 – Group 1 (developing countries)	A5 – Group 2 (developing countries)
Baseline – HFC component	2011-2013 Average HFC consumption	2020-2022 Average HFC consumption	2024-2026 Average HFC consumption
Baseline – HCFC component	15% of baseline	65% of baseline	65% of baseline
Freeze	–	2024	2028
1st step	2019 – 10%	2029 – 10%	2032 – 10%
2nd step	2024 – 45%	2035 – 30%	2037 – 20%
3rd step	2029 – 70%	2040 – 50%	2042 – 30%
4th step	2034 – 80%	–	–
Plateau	2036 – 85%	2045 – 85%	2047 – 85%
Notes	Belarus, Russian Federation, Kazakhstan, Tajikistan, Uzbekistan, 25% HCFC component and 1st two steps are later: 5% in 2020, 35% in 2025	Article 5 countries not part of Group 2	GCC, India, Iran, Iraq, Pakistan

Refrigerant leak detection

Refrigerant leak detectors (fixed and portable)

Refrigerants have an impact on global warming because of leaks in refrigeration system (direct emission) where the refrigerant escapes into the atmosphere. Furthermore, a leaking system run less efficiently and consume more energy compared to optimally charged system (indirect emission).

Refrigerant leaks also lead to extra costs and downtime to the owner. It is because refrigerant must be topped up more frequently and higher energy bills due to less

efficient system. Also, an under-charge system will severely stress the compressor, leading to unexpected breakdowns.

The easiest way to stop refrigerant leaks before they escalate into major problems is to have early detection. So, the national and international regulatory bodies have requirements for owners / operators e.g. installing a permanent leak monitoring system, conducting regulate leak inspection and complying with the maximum leak where they must keep their annual refrigerant charge within the allowable threshold.

To keep your system free of leaks and working at its optimum we provide a complete range of tools, spares and maintenance equipment.

Hand Held Leak Detector

The hand held refrigerant leak detector enabling you to perform refrigerant leak inspection and find leaks in your system. It is battery powered and able to detect all types of refrigerants (CFC, HCFC and HFC). The sensing tip need to be changed after 30 hours of usage to ensure detection accuracy.



Product	Product Number
Hand Held Leak Detector	716142
Maintenance Kit (Contains 3 tips)	548700

UV Tracer Kit

The refrigerant leak detection kit able to locate refrigerant leaks in inaccessible areas by circulating the tracer fluid and using UV light.

Product	Product Number
UV Tracer Kit 1.5V	597199
UV Tracer Kit 12V	711523
Universal Tracer fluid for all oil types	606268



Refrigerant quality and its impact on refrigeration machinery

In order to allow trouble-free and safe operation of refrigeration systems, refrigerants must comply with certain quality standards - just as compressors, the control systems, the piping and other essential components have to meet specific quality standards. A major quality concern with regard to refrigerants is their purity. The moisture content in the refrigerant is of great importance: Even a drop of water, which can enter a refrigeration system through sub-quality refrigerants during top-up, can cause serious operational problems.

Moisture in refrigeration systems

Excessive moisture in refrigeration systems may cause the following four major conditions:

Freeze ups

Freeze ups occur when moisture picked up by the refrigerant starts to freeze, building ice crystals that block the refrigerant passage in narrow passageways, for example in the expansion valve. This effect is called intermittent cooling, as the compressor stops after a while due to the blockage in the expansion valve and starts again when the ice crystals have melted and allow the refrigerant to pass through again. This is a periodical process of constant freezing and melting of the moisture inside the system, causing a periodical stop / start operation of the compressor.

Corrosion

Moisture alone in the form of water can cause corrosion. However, moisture plus a refrigerant containing Chlorine (like for example the HCFC R-22 and mixtures) creates much more serious corrosion, as the Chlorine will slowly hydrolyse with the water and form Hydrochloric Acid (HCl) which is aggressive to most metals. Heat adds significantly to the problem by accelerating the acid-forming process. When it comes to the HFC refrigerants, it is the oil (especially polyolester oils that are very hygroscopic) that may decompose at high temperatures forming aggressive Hydrofluoric acid with the moisture contained in the refrigerant.

Oil sludging

As refrigeration oil is highly hygroscopic, it rapidly absorbs moisture. Moisture changed into acid from the hydrolyses with a refrigerant (see above) can be especially dangerous, as it emulsifies with the refrigeration oil to form aggressive oil sludge that greatly reduces its lubrication properties, which can result in serious compressor damage.

Sludge formation

Due to high acid content inside a system, a solid product can be formed. It exists as fine powders or sticky solids and it is commonly known as sludge. This sludge can cause a variety of problems such as blockages of fine strainers, expansion valves and capillary tubes. And because sludge usually contains acid, it can also be strongly corrosive. Acid will, over time, attack the windings in hermetic compressors.

Quality

To rectify problems caused by too much moisture inside refrigeration systems can be a costly exercise. If the moisture enters the system with the refrigerant it will lead to continuous costly repairs that rectify the consequences but do not eliminate the cause.

It is therefore important that refrigerants comply with appropriate quality standards with regards to their purity.

In order to ensure trouble-free and safe operation of your onboard refrigeration machinery, all refrigerants supplied by Wilhelmsen Ships Service throughout the world comply with the stringent ARI 700-2006 standard that defines and benchmarks the purity of these substances. ARI 700-2006 demands the moisture content to be less than 10 ppm.

Compressor oil

Guidelines on refrigeration oils

Correct lubricant selection for a refrigeration system is important not only for the compressor itself, but also to ensure that the oil does not separate from the refrigerant gas in any part of the plant. If the oil type or supply manufacturer is mixed, incompatibility and hence poor miscibility within the plant can cause problems.

With the wide range of mineral and synthetic products on the market, coupled with different additive technology, it is vitally important to check oil miscibility prior to top-up with a different grade oil. The alternative is to drain the oil completely from a refrigeration system, which can be very difficult or even impossible without strenuous procedures. During warranty, compressor and / or system designers often prohibit the use of non-approved refrigeration oils.

Oil testing

A field test of oil can be done by visually inspecting the oil and using an oil acid test kit to determine if the system has been exposed to moisture.

Oil samples can also be sent to a laboratory for analysis; this routine requires clean sample bottles and is used for systems containing large quantities of oil.

Oil changing procedures

Refer to manufacturers recommendations on oil change intervals. These may be annually or could be more frequent if the oil becomes dark or cloudy.

A good rule is to renew the oil if a major service or repair has been done to the compressor or the system.

For changing the oil in a standard condensing unit, it

is normal to replace the oil charge in the compressor crankcase. It is also recommended to clean or change the oil filter (if applicable) and the refrigerant drier filter cores at the same time.

Normal oil change procedure:

1. Run pump down and shut down the unit.
2. Close the service valves on the compressor.
3. Ensure that any crankcase oil heaters are switched off.
4. Drain oil carefully from the compressor crankcase.
5. If the oil has been drained with the compressor pressurised, new oil can be charged with an oil-filling pump capable of working against pressure.
6. Fit the oil pump to the oil container according to manufacturer's instructions, attach pump to compressor with a charging hose and leave the hose connection to compressor loose. Pump oil into the charging hose until it is filled. This is necessary to prevent air from entering the system and to ensure proper pump function when working against a pressurised system.

If the compressor has been opened for inspection or repair:

7. Ensure that the compressor crankcase is clean.
8. Run deep vacuum on the compressor using a vacuum pump, preferably down to 500 micron.
9. Charge oil using the vacuum to suck up the oil from the container into the crankcase.
10. Remember to switch on the crankcase oil heater if applicable and allow time for the oil to be heated before the unit is put back in operation.

Note

Used refrigeration oil must be returned to an approved waste reception facility.



Overview of refrigerants

The table below provides a summary of environmental and technical data for the commonly used refrigerants.

Refrigerant Ashrae Number	ODP	GWP IPCC (SAR)	GWP IPCC (4AR)	Replacement For	Chemical / Composition	Group Name	Oil Type*	Boiling Point °C	Remarks
R-11	1	3800	4750	–	Trichlorofluoromethane	CFC	Min, AB	+23.7	Consumption and trade ended**
R-12	0.82	8100	10900	–	Dichlorodifluoromethane	CFC	Min, AB	-29.8	Consumption and trade ended**
R-502	0.224	5590	4657	–	Blend R-22 / R-115 (48.8 / 51.2) %	CFC	Min, AB	-45.3	Consumption and trade ended**
R-22	0.049	1500	1810	–	Chlorodifluoromethane	HCFC	Min, AB, PAO	-40.8	Consumption and trade limited Phase out 2030**
R-401A	0.031	970	1182	R-12	Blend R-22 / R-152a / R-124 (53 / 13 / 34) %	HCFC	Min, AB, PAO	-34.4	Interim replacement. Zeotrope, Glide 4,9 K
R-134a	0	1300	1430	R-12	Tetrafluorethane	HFC	POE	-26.1	–
R-404A	0	3260	3922	R-502	Blend R-125 / R-143a / R-134a (44 / 52 / 4) %	HFC	POE	-46.6	Glide 0,7 K
R-407C	0	1530	1774	R-22	Blend R-32 / R-125 / R-134a (23 / 25 / 52) %	HFC	POE	-43.8	Zeotrope, Glide 7,4 K
R-407F	0	1555	1824	R-22 / R-404A / R-507	Blend R-32 / R-125 / R-134a (30 / 30 / 40) %	HFC	POE	-45.0	Zeotrope, Glide 6,6 K
R-410A	0	1730	2090	–	Blend R-32 / R-125 (50 / 50) %	HFC	POE	-51.6	Glide 0,2 K. Pressure 60% higher than R-22
R-507	0	3300	3985	R-502	Blend R-125 / R-143a (50 / 50) %	HFC	POE	-47.1	Azeotrope, No Glide
R-417A	0	1900	2346	R-22	Blend R-125 / R-134a / R-600a (46.5 / 50 / 3.5) %	HFC	Min, AB, PAO, POE	-42.0	Zeotrope, Glide 6,0 K
R-422D	0	2230	2729	R-22	Blend R-125 / R-134a / R-600a (65,1 / 30,5 / 3,4) %	HFC	Min, AB, POE	-43.2	Zeotrope, Glide 4,9 K
R-427A	0	1830	2138	R-22	Blend R-32 / R-125 / R-143a / R-134a (15 / 25 / 10 / 50) %	HFC	POE	-42,7	Zeotrope, Glide 7 K
R-717	0	–	–	–	Ammonia	–	Min, PAO	-33.3	Flammable / Toxic
R-744	0	1	1	–	Carbon dioxide	–	Min, AB, PAO, POE	-78.4	Low critical temperature high operating pressure
R-290	0	3	3	–	Propane	HC	Min, AB, PAO, OE	-42.1	Extremely flammable

* Min = Mineral oil, AB = Alkyl benzene oil, PAO = Polyalphaolefin oil, POE = Polyolester oil

** Applicable for Article-2 countries to the 1987 Montreal Protocol only

Refrigerant rules & regulations

National and international regulatory bodies will continue to regulate the environmental situation through the gradual phase-out of CFC and HCFC refrigerants. Most regulatory work builds upon The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. From October 14th 2016 HFC refrigerants will be controlled under the Montreal Protocol and it will be phased down from 2019 in order to fight climate change. The following table summarises the current major regulations.

International Regulation	HCFC	HFC	HFC Consumption Phase Down		Note
Montreal Protocol Valid For: Non-article-5 countries	Total phase out by 2030 (Up to 2.5% of base level consumption can be used until 2030 for servicing existing equipment.	Phase down from 2029	Non A5-1 2019 - 90% 2024 - 50% 2029 - 30% 2034 - 20% 2036 - 15%	Non A5-2 2020 - 90% 2025 - 80% 2029 - 30% 2034 - 15% 2036 - 15%	Non A5-1: All non A5 except non A5-2 and the EU Non A5-2: Belarus, Russia, Kazakhstan, Tajikistan, Uzbekistan
Montreal Protocol Valid For: Article-5 countries	Total phase out by 2020 (Up to 0.5% of base level consumption can be used until 2030 for servicing existing equipment.	Phase down from 2019	Non A5-1 2029 - 90% 2035 - 70% 2040 - 50% 2045 - 20%	Non A5-2 2032 - 90% 2037 - 80% 2042 - 30% 2047 - 15%	A5-1: All A5 expect A5-2 A5-2: India, Pakistan, Iran, Iraq, Bahrain, Kuwait, Oman, Qatar, Saudi, Arabia, UAE
Reg. (EC) 1005 / 2009 Valid For: EU countries	Illegal to use new, reclaimed and recycled HCFCs for servicing from 2015.	NA	NA	NA	Annual leak test is required if existing HCFC system charge >3kg.
Reg. (EC) 517 / 2014 (F-Gas regulation) Valid For: EU countries	NA	Phase down from 2015 by means of a quota system. Illegal to use new HFCs with GWP >2500 such as R-404A, R-507 and R-422D from 1st Jan 2020. Recycled or reclaimed HFCs can be used until 2030.	2016 - 93% 2018 - 63% 2021 - 45% 2024 - 31% 2027 - 24% 2030 - 21%	NA	The quota (in CO2 equivalent / GWP) limits the amount of HFCs which can be placed on the market. It is capped and allocated annually to eligible HFC producers and importers.

Regulatory Body	HCFC	HFC	Note
ABS Valid For: ES / ENVIRO+ Notation	Permitted until year 2020 GWP <=2000	GWP <=2000	<ul style="list-style-type: none"> • Illegal to vent to atmosphere • Recovery system & cylinders • Consumption logbook • Fixed leak detection system • Used refrigerant to be landed to appropriate reception facilities for banking or destruction • Max leak = 10% of total charge annually
LRS Valid For: ECO Class Notation	Not permitted	GWP <1950	<ul style="list-style-type: none"> • Illegal to vent to atmosphere • Recovery system & cylinders • Consumption logbook • Fixed leak detection system • Max leak = 10% (Month check for system charge of 3-30kg), 5% (Monthly check for system charge of 30-300kg), <3% (Monthly check for system charge of >300kg).
DNV GL Valid For: Class Notation Clean	Not permitted	GWP <=2000 (Clean Design)	<ul style="list-style-type: none"> • Illegal to vent to atmosphere • Recovery system & cylinders • Refrigerant monitoring with one of more of the following: Fixed leak detection, weekly check with handheld device & weekly logging of consumption • Max leak = 10% of total charge annually.
BV Valid For: Cleanship Notation	Not permitted	GWP <=2000	<ul style="list-style-type: none"> • Illegal to vent to atmosphere • Recovery system & cylinders • Consumption logbook • Fixed leak detection system
US Clean Air Act Section 608 Valid For: Cleanship Notation	Permitted until year 2020	Prohibition on the use of certain high GWP HFCs.	<ul style="list-style-type: none"> • Illegal to vent to atmosphere • Recovery system & cylinders • Consumption logbook • Refrigerant monitoring: Quarterly or annual leak inspection for system charge >50lbs • Max leak = 10% of total charge annually.
IMO Marpol 73 / 78 Valid For: Parties to Annex VI	Permitted until year 2020	NA	<ul style="list-style-type: none"> • Illegal to vent to atmosphere • Recovery system & cylinders • Consumption logbook • Refrigerant monitoring: Quarterly or annual leak inspection for system charge >50lbs. • Max leak = 10% of total charge annually.

The table is intended to be a guideline only. Wilhelmsen Ships Service takes no legal responsibility in case of errors or new regulations in the above table, as applicable rules and regulations are constantly changing.

Refrigeration equipment

Refrigeration Handy Tools Case

The kit contains both specialized refrigeration tools and general tools that are necessary for day to day ship-board operation and maintenance of refrigeration systems.



Product	Product Number
Refrigeration Handy Tools Case	752154

Collection of Fittings

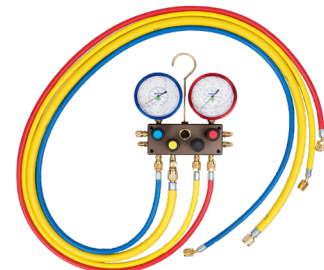
An assorted collection of the most common types of brass fittings that are used in various refrigeration piping and connection applications. Items are not sold individually.



Product	Product Number
Size 1/4 - 3/8"	636431
Size 3/8 - 5/8"	636449

Manifold Set

Service manifold set is equipped with high and low pressure gauges and an optical sight glass. It also includes 3 hoses 1/4" (yellow, red, blue) and 1 vacuum hose 3/8" (yellow) hose.



Product	Product Number
Manifold Set 2-Way (Temp. scale for R-410A)	711499
Deluxe Manifold Set 4-Way (Temp. scale for R-407F, R-404A, R-407C, R-134a)	711473

Unitor Drinking Water Cooler

The water coolers are designed to operate in the most demanding climate conditions on board. The unit is silent in operation and runs on R-134a.



Product	Product Number
220V 50 / 60Hz	708552
110V 50 / 60Hz	711333

Duct Air Treatment

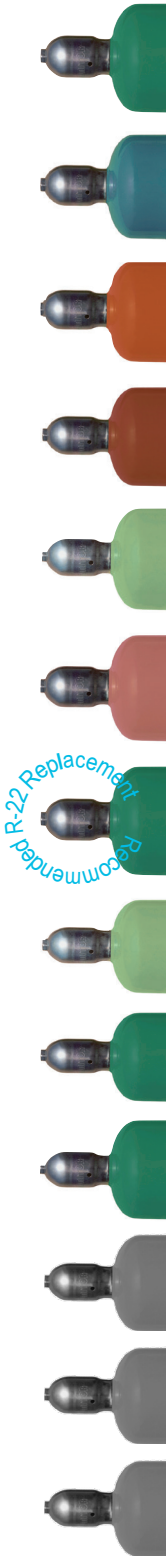
The natural, biodegradable, non-toxic gel block helps prevent the buildup of bacteria, mould and fungi which are commonly found in marine HVAC systems. It is suitable for use in all HVAC systems, including ducted systems, AC unit, room air conditioners.



Product	Product Number
2kg Block	743466
4kg Block	764417

Unicool marine refrigerants

Refrigerant	4AR GWP IPCC 4th	Cylinder volume	Filling weight	Product number	Cylinder colour
Unicool R-22 Single fluid. Widely used for low, medium and high temperature applications. Phase-out regulated by the Montreal Protocol.	1810	12.3 litre 56 litre	12.5kg 57kg	905621 905059	green green
Unicool R-134a Single fluid. Long-term replacement for R-12. Best performance in medium and high temperature applications. Suitable for new systems and system changeover.	1430	12.3 litre 56 litre	12.5kg 57kg	905620 905557	blue blue
Unicool R-404A Near-azeotropic blend. Replacement for R-502 and R-22. Best performance in low and medium temperature applications.	3922	12.3 litre 56 litre	9.5kg 45kg	905623 905606	orange orange
Unicool R-407C Zeotropic blend. Long-term replacement for R-22. Best performance in medium and high temperature applications.	1774	12.3 litre 56 litre	11kg 52kg	905624 905607	orange-brown orange-brown
Unicool R-407F Zeotropic blend. WSS recommended replacement for R-404A in both new and existing systems. Suitable for low, medium and high temperature applications.	1824	12.3 litre 56 litre	11kg 51kg	905712 905715	light green light green
Unicool R-410A Near-azeotropic blend. Long-term replacement for R-22. Suitable for low, medium and high temperature applications. Our recommendation for new system installations.	2090	12.3 litre 56 litre	9.5kg 45kg	905627 905608	rose rose
Unicool R-417A Zeotropic blend. Long-term replacement for R-22. Suitable for low, medium and high temperature applications. Wilhelmsen Ships Service preferred R-22 changeover solution.	2346	12.3 litre 56 litre	11kg 51kg	905705 905637	green green
Unicool R-422D Zeotropic blend to replace R-22 in existing direct expansions chilling systems.	2729	56 litre	52kg	905710	light green
Unicool R-427A Zeotropic blend, replaces R-22 installations with electronic expansions valves.	2138	56 litre	53kg	905708	green
Unicool R-507 Azeotropic blend. Replacement for R-502 and R-22. Best performance in low and medium temperature applications.	3985	12.3 litre 56 litre	9.5kg 45kg	905628 905610	teal teal
Unicool R-452A Zeotropic blend. Replacement for R-404A. Most suitable for low temperature applications.	2140	12.3 litre 56 litre	10kg 45kg	905728 905732	gray
Unicool R-448A Zeotropic blend. Replacement for R-404A. Most suitable for new systems.	1387	12.3 litre 56 litre	10kg 45kg	905736 905740	gray
Unicool R-449A Zeotropic blend. Replacement for R-404A. Most suitable for new systems.	1397	12.3 litre 56 litre	10kg 45kg	905744 905748	gray



Secondary Refrigerant & Other Spares	Product Number		Product Number
Hycool Marine 45 25L Can	708511	Top Valve Adaptor Set Connect charging hose with refrigerant cylinder	544932
Hycool Blue Additive 25L Can	708495	Pressure Switch – KP1 -0.2 to 7.5Bar	547406
Hycool Degradation Analysis	750150	Pressure Switch – KP5 8 to 28Bar	547448
Liquid Line Drier Core 48 Dn	548255	Dual Pressure Switch – KP15	547463
Hand Oil Pump 5L & 25L Drums (for refrigerant oil change)	597534	Diff. Pressure Control Oil Pressure Switch	547588
Cylinder Stand Fits all Unicool 56L refrigerant cylinders	513564	Solenoid Valve Coil 220V 50 / 60Hz	602581
Charging Hose Set UCH-72 3 x 1.8m	597757	Sight Glass	547869

Quality guaranteed

Some refrigerants are cheaper upfront, but they’ll cost you in other ways: refrigerants susceptible to moisture contamination can cause corrosion in compressors in short time – you’ll pay more via lesser operating efficiency and frequent mechanical breakdowns.

With Unicool refrigerants, moisture content is guaranteed at an optimum level – filled and sealed only by approved suppliers.

Cylinder safety and maintenance

Strict rules govern cylinder inspections before filling and those that fall below our standards are scrapped, because the integrity of our cylinders is our hallmark.

Global track and trace

Know the whats, wheres, and whens of all your cylinders with global track and trace: our accurate, secure, and cost-effective stock management system. With this, you can have your Unitor cylinders delivered, exchanged, serviced, and re-supplied on a worldwide stage – we’ll go to wherever your vessels are.

Complete compliance

The ISPS Code enforces strict rules on the close monitoring of high-pressure cylinder movements. Thankfully, global track and trace does just that; allowing us, and thereby, you, to stay fully compliant.

Our gas products and services also comply with all international regulations for global warming reduction and the prevention of ozone depletion.



Glossary

4AR

Fourth assessment report: IPCC formula for calculating GWP. Published in 2007. Used for calculating CO2 taxes and import quotas for refrigerants.

AB

Alkyl benzene refrigeration oil.

ARI

U.S. Air Conditioning and Refrigeration Institute.

ASHRAE

American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Azeotrope

Blend of refrigerants of different volatilities which do not appreciably change in composition or temperature as it evaporates or condenses under constant pressure. Behaves like a single refrigerant and has no glide. Refrigerant blends assigned R-500 series number designations by ANSI / ASHRAE 34 are azeotropes.

Blend

Mixture of two or more refrigerants with different volatilities.

CFC

Fully Halogenated Chlorofluorocarbon, e.g. R-12, R-500, R-502 and others. Environmental burden: High ODP, high GWP.

Disposal

Destruction of used refrigerants in an environmentally sound and Montreal Protocol approved manner.

EPA

U.S. Environmental Protection Agency.

FC, PFC

Fluorocarbons, Perfluorocarbon; fully halogenated Fluorocarbons.

F-Gas Regulation

A EU regulation that is aimed at preventing emissions of Fluorinated gases which are contributing to Global Warming.

Glide

Temperature Glide. This means that the boiling point temperature increases while vapour is boiled off at constant pressure. (The most volatile component boil off first) Usually used to describe the evaporation or condensation of a zeotropic blend.

Greenhouse gases

Gases that contributes to Global Warming, i.e. has a certain GWP. Regulated by the Kyoto Protocol.

GWP

Global Warming Potential. Reference value is CO2 which has GWP=1 (time horizon 100 years).

Halon

Fully halogenated hydrocarbons, containing Bromine, mainly used as fire fighting agent. Regulated and banned by the Montreal Protocol. Environmental burden: High ODP, high GWP.

HC

Hydrocarbons, e.g. Propane, Butane. Environmental burden: No ODP, low GWP.

HCFC

Hydrochlorofluorocarbon. Partly halogenated Hydrocarbon e.g. R-22, R-401A and others. Environmental burden: Low ODP, moderate - high GWP.

HFC

Hydrofluorocarbon. Partly halogenated Hydrocarbon, e.g. R-134a, R-125, R-404A and others. Environmental burden: No ODP, moderate - high GWP.

IMO

International Maritime Organization, main task has been to develop and maintain a comprehensive regulatory framework for shipping.

IPCC

Intergovernmental Panel on Climate Change is a scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP).

Kyoto Protocol

Promotes policies and measures that limit or reduce the emission of Greenhouse Gases not controlled by the Montreal Protocol, e.g. HFCs, Methane, CO2 and other substances.

Min

Mineral refrigeration oil.

Montreal Protocol

Regulates the production and consumption of substances that contribute to the depletion of the ozone layer (i.e. have a certain ODP) e.g. R12, R22 and others.

ODP

Ozone Depletion Potential. Reference value is R-11, which has ODP=1. The substances implicated generally contain chlorine or bromine.

ODS

Ozone Depleting Substance.

PAO

Polyalphaolefin refrigeration oil.

POE

Polyolester refrigeration oil.

Recovery

Extraction of refrigerants from a system into a separate container, e.g. a recovery cylinder or tank.

Recycling

Reuse of a recovered refrigerant following a basic cleaning process such as filtering and drying for removal of oil, moisture and acid from the refrigerant.

Reclamation

Treatment of recovered refrigerant in order to restore the substance to a specified purity standard (e.g. ARI 700 - 2006).

SAR

Second Assessment Report; IPCC formula for calculating Global Warming Potential (GWP). Published in 1996, used by some governmental bodies and classification societies.

Single Fluid

Refrigerant comprising of one component only e.g. R-22, R-134a and others.

STEK

Stichting Erkenningregeling voor de uitoefening van het Koeltechnisch Installatiebedrijf. (Dutch non-profit organization to set standards for and monitor refrigeration companies).

SWEDAC

Swedish Accreditation.

TAR

Third Assessment Report; IPCC formula for calculating Global Warming Potential (GWP). Published in 2001. Used by few selected countries, predominantly to calculate GWP to a higher value, as a basis for CO₂ tax calculations.

TEWI

Total Equivalent Warming Impact. Takes into account the direct GWP and the energy consumption required to run the refrigeration system. The TEWI is not refrigerant specific information, but rather relates to a particular refrigeration system.

Zeotrope

Blend of refrigerants of different volatilities that appreciably change in composition or temperature as it evaporates or condenses at a given pressure. Causing a temperature glide. Zeotropes are assigned R-400 series number designation.

VESSEL NAME:			FLAG:				OWNER:			
Date	System type	Refrigerant type	Initial system charge (kg)	Refrigerant added (kg)	Refrigerant recovered (kg)	Location of recovered refrigerant (for instance recovery cylinder or tank, disposed etc.)	Remarks / follow up	Original oil type and filling (ltr)	System oil changed added or changed (ltr)	Sign



Ships Service

SYSTEM NAMEPLATE

System Name/No: _____

Refrigerant Type: _____

Total Charge: _____ kg

Second Refrigerant Type: _____

Amount of second refrigerant type is stated in logsheet

UNITOR[™]
by Wilhelmsen



Ships Service

SYSTEM NAMEPLATE

System Name/No: _____

Refrigerant Type: _____

Total Charge: _____ kg

Second Refrigerant Type: _____

Amount of second refrigerant type is stated in logsheet

UNITOR[™]
by Wilhelmsen



Ships Service

SYSTEM NAMEPLATE

System Name/No: _____

Refrigerant Type: _____

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Second Refrigerant Type: _____

Amount of second refrigerant type is stated in logsheet

UNITOR[™]
by Wilhelmsen



Ships Service

SYSTEM NAMEPLATE

System Name/No: _____

Refrigerant Type: _____

Total Charge: _____ kg

Second Refrigerant Type: _____

Amount of second refrigerant type is stated in logsheet

UNITOR[™]
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Unicool Marine Refrigerants • Reliable delivery • World wide compliance • Assured quality • Committed to protecting the environment



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