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REFRIGERATION BOOKLET

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Contents

Phase-out of Global Warming Potential Gases

Under 2014 EU F-Gas Regulation (517/2014) High Global Warming Potential HFC's will begin phase-out from 2020.

An important new feature of the 2014 F-Gas Regulation is the Service Ban:

· From 1st January 2020 the use of F-Gases with a GWP above 2,500 to maintain refrigeration systems with a charge size of 40 tonnes CO2 equivalent or more shall be prohibited.

In the Refrigeration sector this will mostly affect systems that use HFC 404A. The size threshold of 40 tonnes CO2 is equivalent to 10 kg of HFC 404A.

It will be legal to continue operating systems affected by the Service Ban, but you will not be allowed to top up any leaks with virgin refrigerant.

Recycled/reclaimed refrigerant can be used for plant maintenance until 1st January 2030.

New systems

If you are about to purchase new refrigeration plant using R404A, you need to think again. After 2020 you will not be allowed to use R404A to maintain existing plant. So it makes no sense to buy new R404A equipment now. There are a number of alternatives that you could consider that could give you better energy efficiency and will definitely avoid problems in 2020. These fall into two groups:

· Ideally you should try and avoid HFCs altogether, using very low GWP alternatives such as ammonia, CO2, hydrocarbons (HCs) or the new HFOs. Ammonia is suitable for large industrial systems. CO2 is growing in popularity, especially in the supermarket sector. For the marine/offshore sector I advice to use HFC with a low GWP.

· For some refrigeration applications it may be difficult to find a cost-effective low GWP option. In particular this applies to small and medium-sized systems that are too large for HCs (because of high flammability) and too small for ammonia. However, that is no excuse to revert to R404A. You can consider HFC refrigerants such as R134A, R407A, R407C, R417A and R407F. These "medium GWP" alternatives all fall well below the GWP threshold of 2,500 in the proposed servicing ban, so you should be able to use them for much longer than R404A.

Design for low leakage

For all new plants make, sure that your equipment is designed to very low leakage standards. Historically HFC equipment has achieved a poor leakage record – annual leakage of 10-20% was common for supermarket systems and industrial plant. There is no need for such high leakage. If you choose to use a medium GWP HFC, don't forget that the HFC phase-down will put pressure on the available quantities of HFCs and hence on prices. There is plenty of evidence that new systems can be designed for leakage levels of well below 5% per year. If you are choosing a very low GWP refrigerant such as ammonia or CO2, low leakage is essential for safety and practical reasons.

Existing systems

If you already own R404A systems you will need to have taken some action before 2020 to respond to the servicing ban. If the plant is already near the end of its projected life in 2020 then you should consider replacing it with new equipment before that date. The choice of alternative refrigerant need not be decided yet – no doubt there will be lots of new refrigerants on the market by 2020.

If the plant is younger and is projected to have plenty of life left in 2020 then you should consider a retro-fill to a lower GWP refrigerant. The two main options are R407A or R407F. Both of these are well below the service ban GWP threshold and there is already good experience in the supermarket sector for successful conversion of R404A systems to these refrigerants.

If you are operating medium temperature equipment (evaporating temperature above -10 deg C) then do the retro-fill sooner rather than later – you should get a good payback in terms of reduced energy consumption. For low temperature systems (e.g. evaporating temperature -30 deg C) the energy efficiency benefits are less clear, although there is some evidence of improvements.

It is essential to keep focus on reducing leakage from existing systems – the new F-Gas Regulation will retain all the current requirements for leak checking and leak repairs. It will also require the on-going use of trained and F-gas certificated technicians from Marine Invest.

Mandatory automatic leak detection

For all Refrigeration, Air-Conditioning and Heat Pump systems containing over 500 tonnes CO2 equivalent there is a mandatory requirement for an automatic leak detection system to be fitted. An automatic leak detection system is defined as a "calibrated mechanical, electrical or electronic device for detecting leakage of F-Gases which, on detection, alerts the operator or a service company of any leakage".

Mandatory automatic leak detection is a continuation of a similar requirement in the 2006 Regulation, although the size threshold is changed from 300 kg to 500 tonnes CO2 equivalent. This will have a significant impact on plants using high GWP refrigerants. For HFC R404A systems the new threshold for automatic leak detection systems is reduced from 300 kg to 127 kg.

This rule applies from 1st January 2015. The lower size threshold for HFC 404A will affect many large refrigeration systems as they often contain more than 127 kg. The table below shows the size threshold for automatic leak detection for a number of refrigerants used in Refrigeration, Air-Conditioning and Heat Pump systems.

For most refrigerants, the new size threshold is lower than the 300 kg threshold in the 2006 Regulation.

Automatic leak detection systems must be tested every 12 months to ensure their proper functioning.

HFC	GWP	40 tons of CO_2 Equivalent in Kg's (If system running on RED refrigerant has >than KG's = Virgin ban from 1st Jan 2020	Mandatory Leak check* every 12 Months if system contains >than KG's (5 ton CO_2 Equivalent) can be reduced to once per 2 years if fixed leak detection is fitted.	Mandatory Leak check* every 6 Months if system contains >than KG's (50 ton CO_2 Equivalent) can be reduced to once per year if fixed leak detection is fitted.	Mandatory leak check* every 3 months plus MUST have fixed leak detection system If system contains >than KG's (500 tons or more CO_2 equivalent)
R404A	3922	10.20	1.27	12.75	127.49
R417A	2346	17.05	2.13	21.31	213.13
R422D	2729	14.66	1.83	18.32	183.22
R507	3985	10.04	1.25	12.55	125.47
R407C	1774	22.55	2.82	28.18	281.85
R407F	1825	21.92	2.74	27.40	273.97
R410A	2088	19.16	2.39	23.95	239.46
R434A (RS-45)	3245	12.33	1.54	15.41	154.08
R22	1810	22.10	2.76	27.62	276.24

*Mandatory Leak Check to be carried out by a qualified person.

Record keeping

Operators must ensure records are kept for each piece of equipment that is subject to a mandatory leak check (i.e. above the 5 tonnes CO2 equivalent threshold).

The records are similar to those required under the 2006 Regulation:

a) Quantity and type of F-Gas installed.

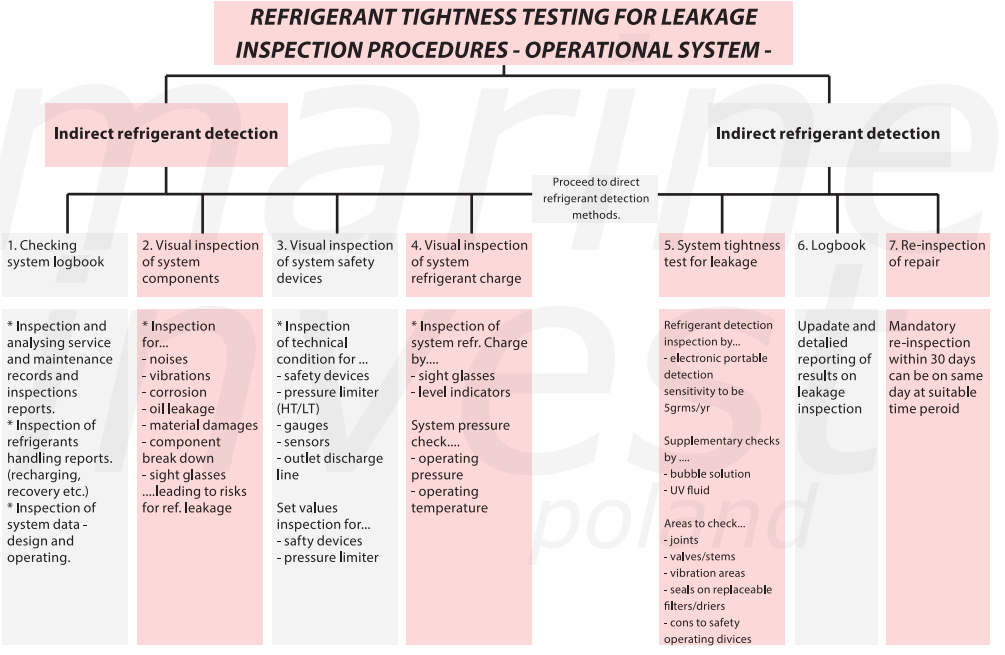
b) Quantities of F-Gas added during installation, maintenance or when repairing a leak.

c) NEW: whether the F-Gases used have been recycled or reclaimed (including the name and address of the recycling or reclamation facility and, where applicable, the certificate number).

d) Quantity of any F-Gases recovered the identity of the undertaking that installed, serviced or decommissioned the equipment, including, where applicable, their certific ate number, dates and results of all mandatory leak checks.

e) NEW: if the equipment was decommissioned, the measures taken to recover and dispose of the F-Gases.

NEW: Records must be kept by the plant operator for at least 5 years.



Most relevant refrigerants

Type	Name	R-Number	Formula	ODP = 0 ?	GWP 100 yr value	Toxic or Flammable
CFC	Trichlorofluoromethane	R-11	CCL_3F	no	4750	A1
CFC	Dichlorodifluoromethane	R-12	CCL_2F_2	no	10900	A1
CFC	Chlorotrifluoromethane	R-13	$CCLF_3$	no	14400	A1
HCFC	Chlorodifluoromethane	R-22	$CHCLF_2$	no	1810	A1
HCFC	Dichlorofluoroethane	R-141b		no	725	A1
HFC	Difluormethane	R-32	CH_2F_2	yes	675	A2L
HFC	Pentafluoroethane	R-125	C_2HF_5	yes	3500	A1
HFC	Tetrafluoroethane	R-134a	$C_2H_2F_4$	yes	1430	A1
HFC	Fluoroethane	R-161	C_2H_5F	yes	12	A3
HFC		R-404A	44%C_2HF_5· 52%$C_2H_3F_3$· 4%$C_2H_2F_4$	yes	3922	A1
HFC		R-407A	20%CH_2F_2· 40%C_2HF_5· 40%$C_2H_2F_4$	yes	2107	A1
HFC		R-407C	23% CH_2F_2· 25%C_2HF_5· 52% $C_2H_2F_4$	yes	1774	A1
HFC		R-407F	30%CH_2F_2 ·30% C_2HF_5 ·40% $C_2H_2F_4$	yes	1825	A1
HFC		R-410A	50% CH2F2 · 50% C2H5F	yes	2088	A1
HFC	Isceon 59	R-417A	46% C_2HF_5 · 50% $C_2H_2F_4$ · 4% C_4H_{10}	yes	2346	A1
HFC	Isceon 79	R-422A	85% C_2HF_5 · 11% $C_2H_2F_4$ · 4% C_4H_{10}	yes	3143	A1
HFC	Isceon 29	R-422D	65% C_2HF_5 · 31% $C_2H_2F_4$ · 4% C_4H_{10}	yes	2729	A1
HFC		R-507(A)	50% C_2HF_5 · 50% $C_2H_3F_3$	yes	3985	A1
HFO		R-1234yf	$C_3H_2F_4$	yes	4	A2L
HFO		R-1234ze	$C_3H_2F_4$	yes	6	A2L
HC	Methane	R-50	CH_4	yes	25	A3
HC	Propane	R-290	C_3H_8 or $CH_3CH_2CH_3$	yes	≤ 3	A3
HC	HCR-188C	R-441A	3% C_2H_6 · 55% C_3H_8 · 42% C_4H_{10}	yes	≤ 3	A3
HC	n-butane	R-600	C_4H_{10} or $CH_3CH_2CH_2CH_3$	yes	≤ 3	A3
HC	iso-butane	R-600a	C_4H_{10} or $CH(CH_3)_2CH_3$	yes	≤ 3	A3
HC / HO	Propylene	R-1270	C_3H_6	yes	≤ 3	A3
REMAINING	Ammonia	R-717	NH_3	yes	0	B2L
REMAINING	Water	R-718	H_2O	yes	0,2	A1
REMAINING	Air	R-729	Air	yes	0	A1
REMAINING	Carbon Dioxide	R-744	CO_2	yes	1	A1

A1	non flammable, toxicity OEL > 400 ppm
B2L	low flammability and toxicity OEL < 400 ppm
A2L	lower flammability < 10 cm/s
A3	flammable, non toxic

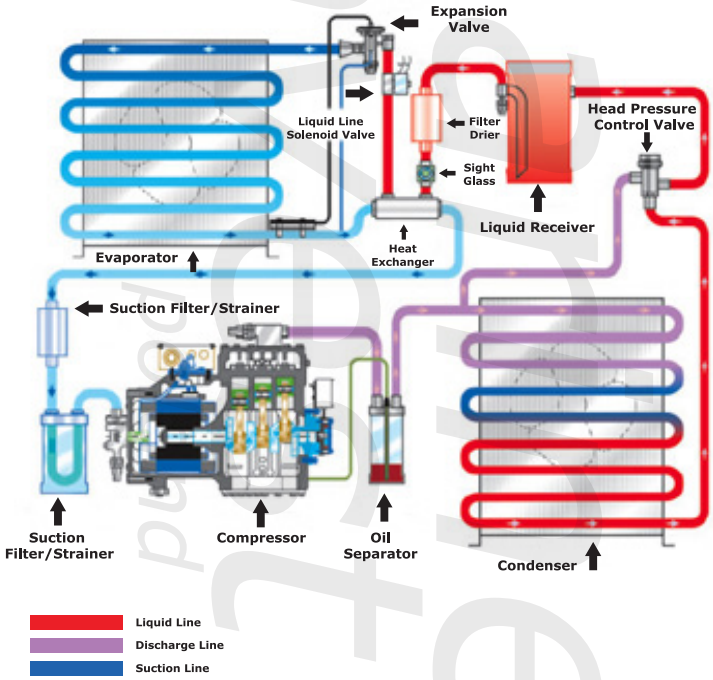
CFC	= CFK's	synthetic chlorinated compound
HCFC	= HCFK's	same, but partly hydrogen, partly chloride
HFC	= HFK's	same, or hydrogen and fluoride, without chloride
HFO	= also a HFC with (less stable) double bond	
HC	= natural hydrocarbom	
HC / HO	= natural hydrocarbon with double bond	

TROUBLE/SYMPTOM	PROBABLE CAUSE	REMEDY
Compressor will not start	Power off.	Check main switch, fuse and wiring.
	Thermostat set too high.	Reset thermostat.
	Thermal overload switch open.	Reset switch.
	Oil safety switch open.	Reset switch.
	Dirty contacts.	Clean all, control contacts.
	Loose electrical connections or faulty wiring.	Tighten connections, check wiring and rewire.
	Compressor motor burned out.	Check and replace if defective.
	Liquid line solenoid valve closed.	Check for burned-out holding coil. Replace defective.
	Evaporator fan off.	Check fuses, overload. Restart.
Compressor cycles intermittently	LP-Switch irregular in operation	Check for blocked tubing to switch. Check switch setting.
	Low refrigerant charge	Check cause, repair. Charge refrigerant.
	Capacity control setting incorrect.	Adjust, reset.
	Thermostat differential too narrow.	Adjust, reset.
	Suction valve closed or throttled.	Open up valve.
Compressor cycles on HP-Switch	Tubing to HP-Switch restricted.	Check, clean or replace tubing.
	Faulty HP-Switch.	Repair or replace.
	Refrigerant overcharge.	Remove excess refrigerant.
	Insufficient condenser, water flow or blocked condenser.	Adjust water regulating valve to condenser. Clean condenser.
	Discharge service valve not fully open.	Open valve.
	Air in system.	Purge air, call Refrigeration engineer.
High discharge pressure	Condenser inlet water temperature too high.	Increase water quantity by adjusting water regulating valve. Use colder water.
	Insufficient water flow through condenser.	Re-adjust water regulating valve. Increase size of water supply main to condenser.
	Plugged or scaled condenser tubes.	Clean tubes.
	Discharge valve partially closed.	Open valve.
	Refrigerant overcharge.	Remove excess refrigerant.
	Air in system.	Purge air, call refrigeration engineer.

Low discharge pressure	Excessive water flow through condenser	Adjust water regulating valve.
	Worn piston rings	Replace
	Suction service valve partially closed.	Open valve.
	Leaky compressor suction valves.	Inspect valve discs and valve seats. Replace if worn
Flooding	Defective or improperly set of expansion valve.	Adjust to 5-10K superheat. Valve operation most be stable (no hunting).
Low suction pressure	Low refrigerant charge.	Check cause, repair. Charge refrigerant.
	Excessive superheat.	Adjust expansion valve.
	Loose or misaligned coupling.	Check alignment and tightness.
	Insufficient clearance between piston and valve plates.	Replace defective parts.
	Motor or compressor bearing worn.	Replace bearings.
	Loose or misaligned belts.	Check alignment and tension. (Belt slack should be on top).
	Loose hold-down bolts.	Tighten bolts.
	Unit foundation improperly isolated.	Isolate foundation.
	Improper support or isolation of piping.	Use proper piping connections and support piping with suitable hangers.
	Slugging from refrigerant feedback.	Check the expansion valve setting. Check thermal bulb looseness and correct location.
	Hydraulic knock from excessive oil in circulation.	Remove excess oil. Check expansion valve for flood-back.
	Defective valve lifter mechanism (noise level varies with unloading).	Replace sticking filter pins. Check un-loader fork for alignment. Check power element for sticking piston. Check for oil leakage at tube connections to power element. Check the amount of valve pin lift above valve seat.
	Piping vibration.	Support pipes are required. Check pipe connections.
	No muffler in discharge line or improperly located.	Install muffler. Move muffler closer to compressor.
System noise	Hissing (insufficient flow through expansion valve, or blocked liquid line strainer).	Find cause, charge refrigerant or clean strainer.

Compressor will not unload	Capacity control valve not operating.	Repair.
	Un-loader element sticking.	Repair.
	Hydraulic relay sticking.	Replace control cover assembly.
	Plugged pressure line to power element.	Clean line.
	External adjusting stem broken.	Replace.
Compressor will not load	Low oil pressure.	Check oil charge, switch settings.
	Capacity control valve stuck open.	Repair or replace.
	Un-loader element sticking.	Repair.
	Plugged or broken pressure line to power element.	Clean or repair.
	External adjusting stem broken.	Replace.
	Control oil strainer blocked.	Clean or replace.
	Control valve bellows leaking.	Remove thread protector and leak test. Replace valve body if bellows leak.
	Pipe plug in pneumatic connection.	Remove pipe plug.
	Foaming in crankcase from refrigerant flooding.	Check expansion valve adjustments and piping.
	Hydraulic relay sticking.	Replace control cover assembly.
Rapid un-loader cycling	Excessive fluctuation in suction pressure from oversized expansion valve.	Resize expansion valve.
	Partially plugged control oil strainer.	Clean or replace strainer.
	Low oil pressure.	See trouble/symptom – low oil pressure.
Low oil pressure	Low oil charge.	Charge oil.
	Faulty oil gauge.	Check and replace.
	Defective oil pressure regulator.	Repair or replace.
	Blocked oil suction strainer or filter.	Clean strainer or filter.
	Broken oil pump tang.	Replace pump assembly.
	Blocked oil line.	Remove obstruction.
	Worn oil pump.	Replace pump assembly.
	Worn compressor bearings.	Replace.
Cold compressor	Liquid carryover from evaporator.	Check refrigerant charge and expansion valves.
Low crankcase oil level	Oil return, check valve, stuck, blocked or closed.	Repair, replace or clean.
Cylinders and crankcase sweating	Refrigerant flood-back.	Check refrigerant charge and expansion valves.

High crankcase temperature (should be +71C max. At seal housing	Liquid line strainer blocked.	Clean strainer.
	Excessive superheat.	Adjust expansion valves.
	Compression ratio too high.	Recheck design.
	Discharge temperatures over +135C.	Check unit application.
	Leaking suction or discharge valves.	Replace valves.



Piston/Screw Compressor Small Maintenance:

Every 10000Hrs it is required to service the compressor.

- Necessary to change the complete valve-plate, for high wear, constriction of the ports due coking or damage to the valve seats.

- When the inspection is made new gasket (valve plate, cylinder head) should be kept ready, as the existing gasket may be damaged during dismantling.

- Oil change, clean oil filter(s) or magnetic plug.

- In order to increase the operation reliability it is however to check the shaft seal in conjunction with an oil change or after faults in the lubrication circuit. Special attention should be given to: Hardening and cracking of the O-rings and to wear, scoring, material deposits, oil coke, copper plating and condition of crank-case heater.

Piston/Screw Compressor Large Maintenance:

Every 25000Hrs it is required to service the compressor.

- Visual inspection of the compressor crank-case (cracks and faults).
- Overhauling the accessories of the compressor (gaskets, o-rings, valve-plates, bearings, etc).
- Measuring the axial crankshaft play and if necessary adjusting.
- Oil change, replace oil filters.
- Replace the safety relief valve.
- Leak tightness inspection after the overhaul and adjusting the safety pressure switches if necessary.

This maintenance can be provided for every major compressor manufacturers.

Filter/Driers Flare connection:

Make	Type	Size	Part No.
Danfoss	DML163	3/8"	023Z5043
Danfoss	DML 164	½"	023Z5044
Danfoss	DML 305	5/8"	023Z0051
Danfoss	DML 306	¾"	023Z0193
Castel	4316/3	3/8"	6656009
Castel	4316/4	½"	6656010
Castel	4332/5	5/8"	6656013

Drier Cores:

Make	Type	Part No.
Danfoss	48 DU/DM	023U1391
Castel	4490/A	6656060

Solenoid Valve (flare) without coil:

Make	Type	Size	Kv-Value (m3/h)	Part No.	
Danfoss	EVR-3	¼"	0.27	032F8107	
Danfoss	EVR-6	3/8"	0.80	032F8072	
Danfoss	EVR-10	½"	1.90	032F8095	
Danfoss	EVR-15	5/8"	2.60	032F8101	
Danfoss	EVR-20	7/8"-22mm	5.00	032F1240	
Danfoss	EVR-20	7/8"-22mm	5.00	032F1254	Manual valve
Danfoss	EVR-25	1.1/8"	10.00	032F2200	Manual valve
Danfoss	EVR-25	1.1/8"	10.00	032F2201	

(We supply also Castel, Alco, Parker, Saginomiya solenoid valves).

Coil for Solenoid Valve:

Make	Type	Volt(s)	Frequency (Hz)	Part No.
Danfoss	Coil 10W	110	50/60	018F6730
Danfoss	Coil 10W	220/230	50/60	018F6732
Danfoss	Coil 12W	110	50	018F6811
Danfoss	Coil 12W	220/230	50	018F6801
Danfoss	Coil 12W	110	60	018F6813
Danfoss	Coil 12W	220	60	018F6814

(We supply also Castel, Alco, Parker, Saginomiya coils for solenoid valves).

Pressure Safety Switches (LP/HP):

Make	Type	Lock LP	Lock HP	LP. Range (Bar)	Diff. (Bar)	HP. Range (Bar)	Diff. (Bar)	Part No.
Danfoss	KP-1			-0.2 / 7.5	0.7 / 4.0			060-110166
Danfoss	KP-1	Yes		-0.9 / 7.0	lock 0.7			060-110366
Danfoss	KP-2			-0.2 / 5.0	0.4 / 1.5			060-112066
Danfoss	KP-5					8 / 32	1.8 / 6.0	060-117166
Danfoss	KP-5		Yes			8 / 32	lock 3	060-117366
Danfoss	KP-15	Yes	Yes	-0.9 / 7.0	lock 0.7	8 / 32	lock 4	060-124566
Danfoss	KP-15	Adj.	Adj.	-0.9 / 7.0	lock 0.7	8 / 32	lock 4	060-122066

(We supply also Johnson Controls, PENN, Saginomiya).

Thermostatic Expansion Valves (flare):

Make	Type	Connection(s)	Length cap.	Ref.	Temp (.C)	Part No.
Danfoss	TX-2	3/8" – ½"	1.5 m	R-22	-40 / +10	068Z3206
Danfoss	TEX-2	3/8" – ½"	1.5 m	R-22	-40 / +10	068Z3209
Danfoss	TS-2	3/8" – ½"	1.5 m	R-404a	-40 / +10	068Z3400
Danfoss	TES-2	3/8" – ½"	1.5 m	R-404a	-40 / +10	068Z3403
Danfoss	TZ-2	3/8" – ½"	1.5 m	R-407c	-40 / +10	068Z3496
Danfoss	TEZ-2	3/8" – ½"	1.5 m	R-407c	-40 / +10	068Z3501

Thermal Element:

Make	Type	Length cap.	Ref.	Temp (.C)	Part No.
Danfoss	TEX-5	3.0 m	R-22	-40 / +10	067B3250
Danfoss	TEX-12	3.0 m	R-22	-40 / +10	067B3210
Danfoss	TEX-20	3.0 m	R-22	-40 / +10	067B3274
Danfoss	TEX-55	3.0 m	R-22	-40 / +10	067G3205
Danfoss	TES-5	3.0 m	R-404a	-40 / +10	067B3342
Danfoss	TES-12	3.0 m	R-404a	-40 / +10	067B3347
Danfoss	TES-20	3.0 m	R-404a	-40 / +10	067B3352
Danfoss	TES-55	3.0 m	R-404a	-40 / +10	067G3301
Danfoss	TEZ-5	3.0 m	R-407c	-40 / +10	067B3278
Danfoss	TEZ-12	3.0 m	R-407c	-40 / +10	067B3366
Danfoss	TEZ-20	3.0 m	R-407c	-40 / +10	067B3371
Danfoss	TEZ-55	5.0 m	R-407c	-40 / +10	067G3240

(We supply also Alco, Saginomiya, Sporlan Expansion Valves).

Safety relief valve:

Make	Type	Connection	Pressure	Part No.
Henry	526-CE	3/8" NPT – 3/8" flare	20.7 Bar	4901668
Henry	526-CE	3/8" NPT – 3/8" flare	24.1 Bar	4901670
Henry	526-CE	3/8" NPT – 3/8" flare	27.6 Bar	4901672
Henry	526-CE	3/8" NPT – 3/8" flare	31.0 Bar	4901674
Henry	5232A-CE	½" NPT – ¾" flare	20.7 Bar	4901656
Henry	5232A-CE	½" NPT – ¾" flare	24.1 Bar	4901658
Henry	5232A-CE	½" NPT – ¾" flare	25.0 Bar	4901660
Henry	5232A-CE	½" NPT – ¾" flare	27.6 Bar	4901662
Henry	5232A-CE	½" NPT – ¾" flare	31.0 Bar	4901664

Orifice for Expansion valves:

Make	Type	Orifice No.
Danfoss	T/TE-2	00 – 06
Danfoss	TE-5	01 – 04
Danfoss	TE-12	05 – 06
Danfoss	TE-20	08 – 09
Danfoss	TE-55	10 – 13

(We supply also Alco, Saginomiya, Sporlan Orifices).

It is required for every vessel to have Basic Refrigeration Tool Kit which contain:

- Recovery cylinder
- Recovery unit
- Vacuum pump
- Scale
- Refrigeration manifold set
- Leak detector

Technical System Status

Refrigerant:	Type-				Charge					KGs
Compressor Manufacturer & type:										
Oil Manufacturer and type:										
Oil Separator (Y/N) Make/Model:	Y	N								
Serviceable (Y/N):	Y	N								
Suction Accumulator (Y/N) Make/Model:	Y	N								
Discharge Line ODSize/Material:										
Suction Line OD Size/Material:										
Liquid Line OD Size/Material:										
Motor Volts/Phase/Cycles/ Power/Current/RPM:	V-	PH-	HZ-	KW-	A-	RPM-				
Mounting –Foot, Flange or Foot & Flange:										
Condenser Manufacturer, model & Test Pressure:					Bar-					
Relief Valve Manufacturer, Connections & Set Pressure:					Bar-					
Drier Manufacture, Type and Flare/Solder/Weld:										
Expansion Valve Manufacturer & Model:										
AHU Manufacturer & Model:										
Evaporator Manufacturer & Model:										
System Parameters:	Evaporating T^0C					Condensing T^0C				
System Cooling Capacity (KW, Kcal/h or BTU/h):										
Condenser Cooling (Air/Fresh water/Sea water):										
Pipe run Details:	Height-			Metres		Length-				Metres

System Performance Test

Discharge Pressure (Bar/PSI)	Discharge pipe Temperature at Compressor outlet (^{0}C/^{0}F)	Suction Pressure (Bar/PSI)	Suction pipe Temperature At Compressor inlet (^{0}C/^{0}F)	Compressor Oil Pressure (Bar/PSI)

Crankcase Oil Level	Crankcase Temperature Inspection Door (0C/0F)	Condition of Oil	Percentage Load(%)	Full Load Amps	Running Amps	Running Hours

Sea Water Temperature (^{0}C/^{0}F)	Cooling Water/Air Inlet Temp (^{0}C/^{0}F)	Cooling Water/Air Outlet Temp (^{0}C/^{0}F)	Liquid Line Temperature at Condenser Outle (^{0}C/^{0}F)	Condenser/Receiver Sightglass Level (%)

Liquid Line Temperature Expansion Valve Inlet (^{0}C/^{0}F)	Suction Line Temperature at Expansion Valve Location (^{0}C/^{0}F)	Suction Pressure At Evaporator Outlet (Bar/PSI)	Liquid Line Moisture Indicat	Sightglass Condition

Air On Evaporator (^{0}C/^{0}F)	Air Off Evaporator (^{0}C/^{0}F)	Ambient Temp. (^{0}C/^{0}F)	Percentage Recirculated Air (%)	Air Temp. at Cabin Outlet (^{0}C/^{0}F)	Average Cabin Temp. (^{0}C/^{0}F)	Thermostat Set Point (^{0}C/^{0}F)

Are all fans operating at correct speed and current	Evaporator(s) Frost free	Cooling/Heating coil(s) clean and fins in good condition (not corroded)	Inlet filters installed and clean

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