Technical information
14th March 2002

Refrigerant charge retrofit guidelines for hermetic Maneurop® reciprocating and Performer® scroll compressors

During most systems' retrofits, the refrigerant and lubricant have to be replaced and the refrigeration circuit cleaned.

This bulletin provides a step-by-step mode of operation when carrying out a refrigerant and/or lubricant replacement.

The same procedure may also be used when cleaning a refrigeration circuit after a major motor burnout.

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Info

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CONDENSING UNITS

System retrofit basic guidelines

The table below provides basic information regarding the type of lubricant to be used when converting an existing system to new refrigerants. It also gives recommendations as to the type of cleaning procedure to carry out and the number of lubricant changes required.

Existing System			Converting system to new refrigerant					
Original system	Application	Compressor model	Refrigerant	Compressor	Oil	Compressor oil drain	System cleaning	Comments
Mineral oil + CFC	Low temp refrigeration R502	LT	Transitional	Same (LT)	160ABM	Once	Light	
			HFC R404A R507	Same (LT)	160Z	Multiple	Thorough	
				LTZ	160Z	Not applicable *	Thorough	
	Medium temp refrigeration R502	MT	Transitional	Same (MT)	160ABM	Once	Light	
			HFC R404A R507	Same (MT)	160PZ	Multiple	Thorough	Life time reduction shall be expected
				MTZ	160PZ	Not applicable *	Thorough	
Mineral oil + HCFC	Air conditioning R22	SM	HFC R407C	Same (SM)	160SZ	Multiple	Thorough	
	Air conditioning R22	MT	HFC R407C	Same (MT)	160Z	Multiple	Thorough	Not recommended **
				MTZ	160PZ	Not applicable *	Thorough	
	Medium temp refrigeration R22	MT	HFC R404A R507	Same (MT)	160PZ	Multiple	Thorough	Life time reduction shall be expected
				MTZ	160PZ	Not applicable *	Thorough	

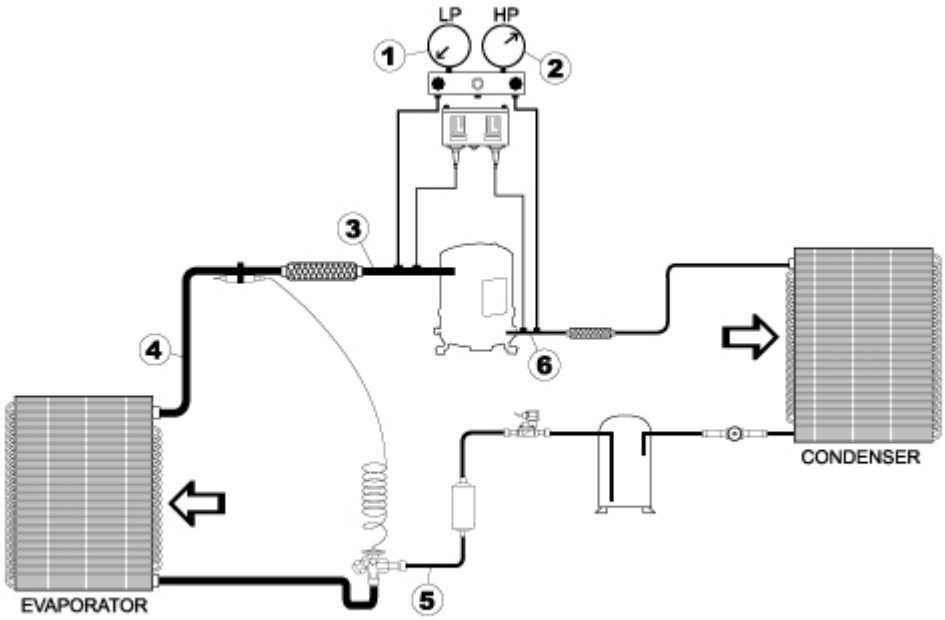
All systems: direct expansion types.
* Oil change is not required provided the system is thoroughly flush cleaned before start-up.
** Risk of rapid compressor wear and failure.

LUBRICANT CHARGE

Series	Model	Quantity (litre)
MT / MTZ	18-22-28-32-36-40	1.0
LT / LTZ	22-28	
MT / MTZ	44-50-56-64-72-80	1.8
LT / LTZ	40-44-50	
MT / MTZ	100-125-144-160	3.9
LT / LTZ	88-100	
SM / SZ	084-090-100-110-120-161	3.3
SM / SZ	115-125-160	3.8
SM / SZ	175-185	6.6
SZ / SY	240-300	8.0

System retrofit procedure

Step 1 - Controlling the operating parameters



Measure: **1**. Suction pressure at the compressor
2. Discharge pressure at the compressor

Measure: **3**. Suction temperature at the compressor (i.e.: total superheat)
4. Suction temperature at the evaporator outlet (i.e.: evaporator superheat)
5. Liquid temperature at the expansion valve inlet (i.e.: liquid sub cooling)
6. Discharge temperature at the compressor

Measure: Power supply voltage and current
Control the refrigerant flow to the evaporator on each distributor tube (carefully check for tubes blocked by dirt and sludge).

Step 2 - Removing the refrigerant charge

A refrigerant recovery equipment has to be used.

- Close the liquid receiver's shut off valve or any component of the liquid line susceptible to be used for a pump-down.
- Let the system run until the low-pressure compressor switch brings it to a stop.
- Switch the main circuit breaker off.
- Insulate (if possible) the compressor HP side from the system by closing the rotolock discharge valve.
- Remove the refrigerant from the HP side of the system through any connection or valve located on the liquid line.
- Once the HP side refrigerant has been transferred, open the insulating device on the LP side.
- Make a note of the weight of refrigerant mass reclaimed.

Step 3 – Flush cleaning procedure

The following describes the method whereby the circuit is flushed several times with a solvent in order to remove the old oil residues and other circuit impurities. The recommended solvent is HCFC R141b, available from refrigerant suppliers.

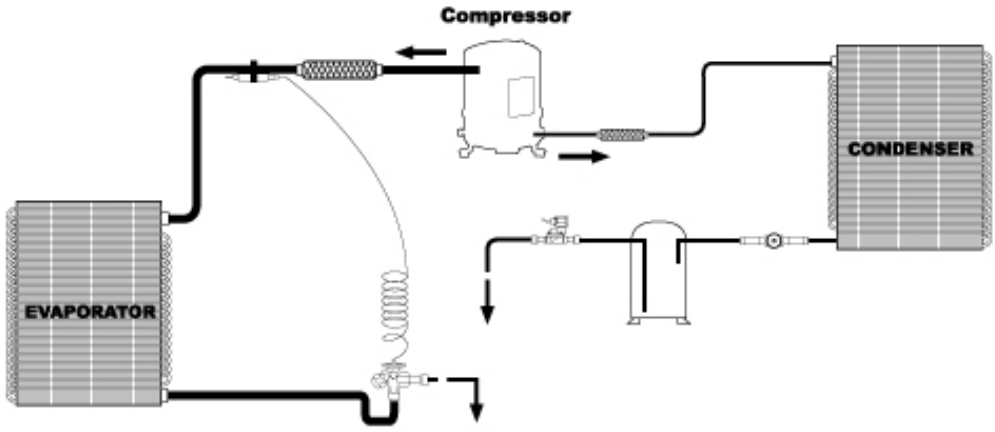
Precautions:

- In case of circuit cleaning after motor burn out, the aim is to keep the failed compressor in its condition for factory analysis. Therefore it needs to be isolated from the circuit.

  Install obturators between the compressor and the suction and discharge valves. The flat plain washers delivered with all new rotolock compressors can be used to block suction and discharge compressor inlets.

  For brazed type compressor models, the compressor needs to be removed from the installation first.

- In case of retrofit of an operational system, the aim is to totally insulate the compressor from the system with the suction and discharge rotolock valves fully opened to enable flushing of the pipe work.



Low pressure side cleaning up

- Remove the expansion valve orifice (restrictor). The filter drier has to be removed and the circuit cut open at the location, as shown above. The medium used for cleaning is recovered from the liquid line at the filter drier location.
- Fill solvent in the system from the suction valve of the compressor (counter flow). Fill solvent until it flows out with a clear colour. To enhance impurities removal, flush solvent with nitrogen.
- Remove residual solvent by venting the circuit with pressurized nitrogen, repeat cleaning/purging procedure until the system is cleared from impurities and old oil sludge.

Note: If during the check out control, a problem has been identified on the distributor tubes of the evaporator, flush pressure shocks (liquid hammering) can be generated using nitrogen gas pressure.

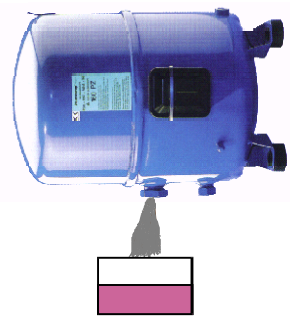
High pressure side cleaning up

- The circuit is cut open at the filter drier inlet.
- The cleaning solvent is recovered from the liquid line at the filter drier location.
- Fill solvent in the system from the discharge valve of the compressor (normal flow direction). Fill the solvent until it flows out with a clear colour.
- Remove residual solvent by venting the circuit with pressurized nitrogen, repeat cleaning/purging procedure until the system is cleared from impurities and old oil sludge.

Step 4 - Compressor oil drain

Take the compressor off the system.

Maneurop reciprocating compressors



Performer large scroll compressors

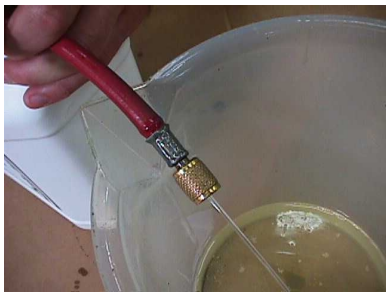
- Open the suction port, or the sight glass port (when fitted).
- Move the compressor slowly to a horizontal position and recover the oil through the compressor suction connection port, or from the oil sight glass opening.
- Note: the large scroll compressor is equipped with an oil drain connection and can therefore be drained of its lubricant in a vertical position. In this case, pressurize the LP side of the compressor (using dry nitrogen).
- Pick an oil sample for analysis if needed (i.e. operational installation).
- Before re-installing the compressor, or replacing the sight glass, replace the gaskets by new ones (suction & discharge ports, sight glass gasket). Check the old lubricant for acid content using an acid test kit.
- Install a new filter drier. An anti-acid type cartridge has to be used if the acid test is positive. The anti-acid filter drier has to be replaced by a standard cartridge after a few days when the system is acid free.

Step 5 – Lubricant: filling in instructions

The following procedure describes how to add lubricant to compressors installed on a system. It does not apply to compressors removed from the system for a complete oil drain and recharge.

1. Initial steps and equipment required

- Pump the low-pressure side of the compressor down to atmospheric pressure. Exercise care not to go into vacuum to prevent air and moisture ingress into the compressor during the filling in procedure.
- Use a new sealed lubricant can and a manual oil pump. The pump hose shall be sized for ¼" flare fittings and include a valve depressor at its end, which will open the valve on the compressor shrader service port.
- The approved lubricant type is stamped on the compressor nameplate. Check that the oil can reference matches the type of lubricant on the compressor nameplate.



2. Pump and hose purging

- The hand pump (similar to the one shown) is inserted in the oil container – ensure the pump is clean – at the very last moment to keep container open to the atmosphere a minimum amount of time (use plug adaptor kit when available to further reduce lubricant exposure to the atmosphere).
- With a few strokes of the pump bleed all the air from the pump and hose. Purging the pump is necessary to flush clean the hose of the moisture-saturated lubricant left inside from previous usage.
- Connect hose to the compressor shrader immediately after purging to avoid moisture contamination.

3. Pumping the lubricant in the compressor

- Pump in the estimated amount of lubricant or until the sight glass shows the level to be correct.

Note: when an excessive amount of lubricant has been lost from a compressor not fitted with a sight glass, the oil level cannot be measured or seen. The only way to ensure the correct charge is poured in, is to drain the compressor and recharge it with new lubricant. In such a case, the compressor shall be removed from the installation.

Additional recommendations

- After adding oil, allow the compressor to run fully loaded for 20 minutes and re-check the level in the oil sight glass. This level should be between ¼ and ¾.
- Be careful not to add more oil than necessary. The following adverse conditions can occur if excessive oil is present:
  Failure of valves and pistons or scroll involutes due to oil slugging
  Excessive carry over of oil
  Loss of evaporator performance due to oil level built-up in the low side of the system.

Step 6 - Vacuum pump down and dehydration procedure

When carrying out a retrofit, after changing the plant components (e.g. filter drier, expansion valve, etc…) and re-installing the compressor, the refrigerating circuit must be thoroughly evacuated.

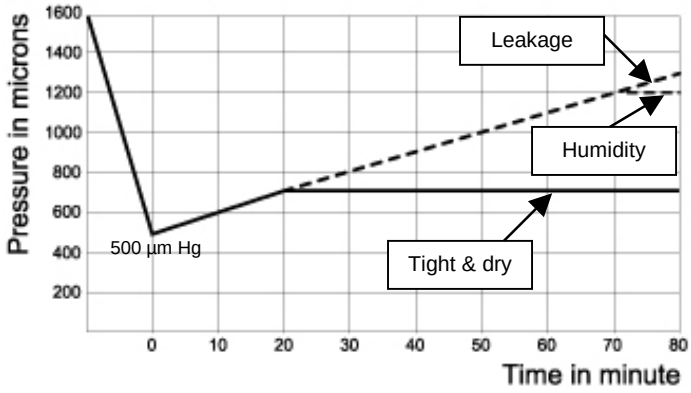
This section gives the best rules of practice when carrying out the vacuum dehydration of a system. The moisture content of a refrigeration circuit is quite difficult to measure. Therefore, following this procedure is the best way to reach a safe and acceptable moisture level before commissioning an installation.

Moisture obstructs the proper functioning of the compressor and the refrigeration system. Air and moisture reduce service life and increase condensing pressure. They also cause excessively high discharge pressure and temperature, which can destroy the lubricating properties of the oil. Air and moisture also increase the risk of acid formation, giving rise to copper plating and motor insulation damage. All these phenomena can cause mechanical and electrical compressor failure. To eliminate these factors, a vacuum pump down according to the procedure below is recommended.

Procedure

Whenever possible (if shut-off valves are present), the compressor must be isolated from the system. It is essential to connect the vacuum pump to both the LP & HP side in order to avoid dead-ending parts of the system.

1. After the leak detection,
2. Pull down the refrigeration circuit under a vacuum of 500 µm Hg (0.67 mbar).
3. When a vacuum level of 500 µm Hg is reached, the circuit must be isolated from the pump.
4. Wait for 30 mn.
5. If the pressure rapidly increases, then the circuit is not leak tight. Locate and repair leaks. Restart from step 1.
6. If the pressure slowly increases, then the circuit contains moisture. Break the vacuum with nitrogen gas and repeat steps 2 - 3 - 4.



Compressor fitted with shut off valves

7. Connect the compressor to the system by opening the valves.
8. Repeat 2 - 3 - 4 (and 5 or 6, if required)
9. Break the vacuum with nitrogen gas
10. Repeat 2 - 3 - 4 on the entire circuit

Compressor without shut off valves

7. Break the vacuum with nitrogen gas
8. Repeat 2 - 3 - 4 (and 5 or 6, if required)

A vacuum of 500 µm Hg (0.67 mbar) should be reached and maintained for 4 hours. It will guarantee that the circuit is both tight and fully dehydrated. This pressure shall be measured at the refrigeration system, not at the vacuum pump gauge.

Vacuum pump

A two-stage vacuum pump with gas ballast (0.04 mbar standing vacuum) shall be used with a capacity consistent with the system volume. It is recommended to use connection lines with a large diameter and to connect these to the shut off valves, not to the compressor Schrader connection. This is to avoid excessive pressure losses.

Moisture level

At the time of commissioning, system moisture content may be up to 100 ppm. During operation, the filter drier must reduce this to a level between 20 and 50 ppm.

Points to remember

- During the initial system/circuit evacuation, lowering the pressure below 500 µm Hg introduces the risk of freezing the moisture present in the system (liquid moisture trapped in small pockets will turn into ice and not evaporate). The low vacuum achieved can be misinterpreted as a moisture free system whereas, in fact, ice is still present. Such a risk becomes major when utilizing a relatively large vacuum pump on a small volume circuit. A single vacuum pump down evacuation at 0.33 mbar (250 µm Hg) will not guarantee a sufficiently low moisture level.
- A low ambient temperature around the equipment impedes moisture removal – below 10°C ambient. Take counter measures and energize the compressor's crankcase heater.
- Adopting the above procedure is even more important with HFC and polyolester oil than it has traditionally been with HCFC (R22) or CFC and mineral oil.

Warning

Do not use a meghometer or apply power to the compressor while it is under vacuum. This may cause motor winding damage. Never run the compressor under vacuum as it may cause compressor motor burnout.

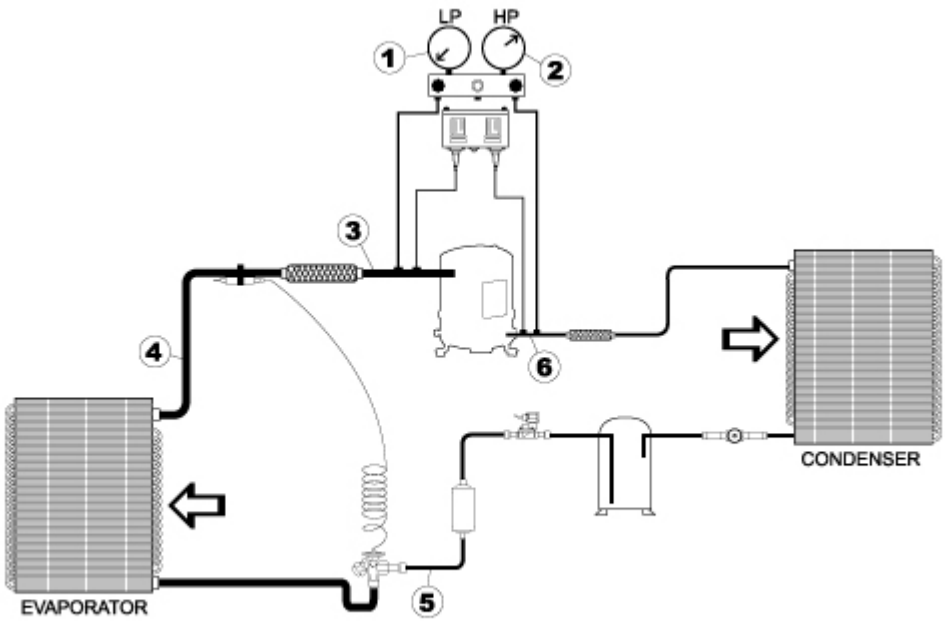
Step 7 - Refrigerant charging

Zeotropic and "near-azeotropic" refrigerant mixtures such as R407C and R404A must always be charged in liquid phase. For the initial charge, the compressor must be stopped and service valves must be closed. Charge refrigerant as close to the nominal system charge as possible before starting the compressor. Then, slowly add refrigerant in liquid phase on the low-pressure side, as far away as possible from the running compressor.

Warning

- When a liquid line solenoid valve is used, the vacuum on the low-pressure side must be broken before applying power to the system.
- The refrigerant charge must be suitable for both winter and summer operation. Refer to the section "Liquid refrigerant control and charge limits" of the compressor application guidelines brochures for information about refrigerant charge limits.

Step 8 - Controlling after start-up



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