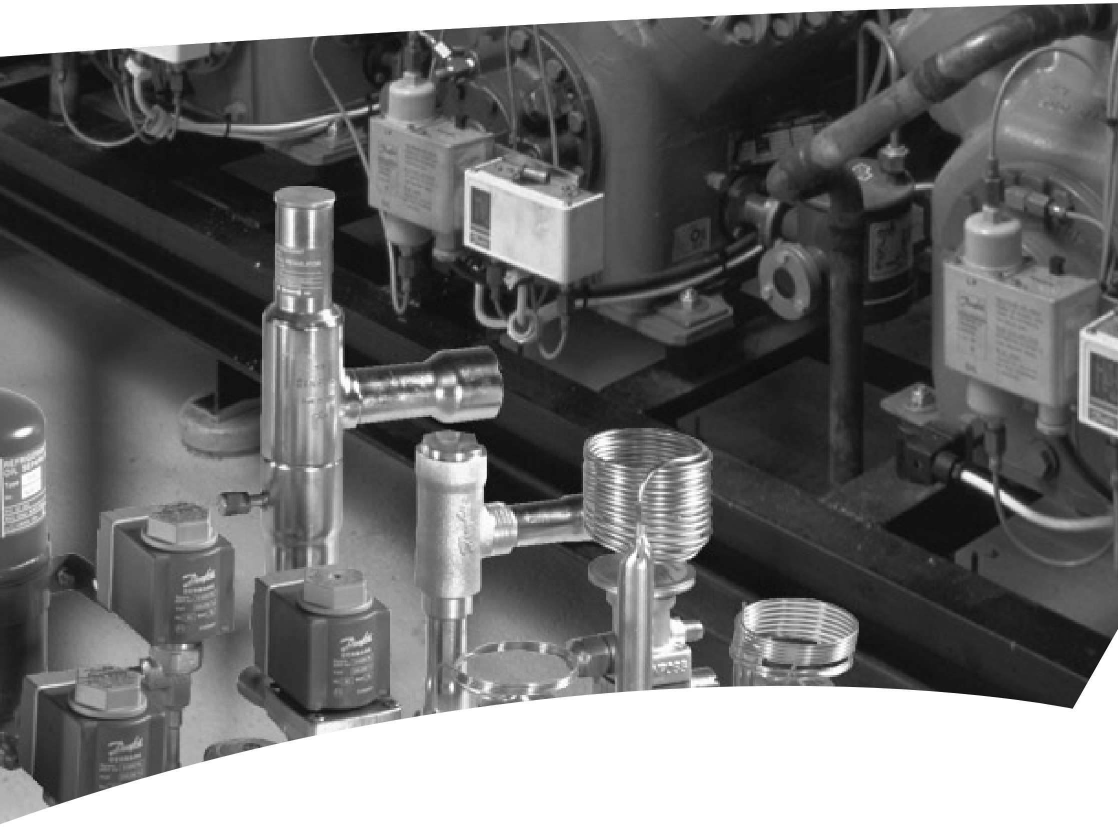


Practical Tips
The installation process

REFRIGERATION AND
AIR CONDITIONING

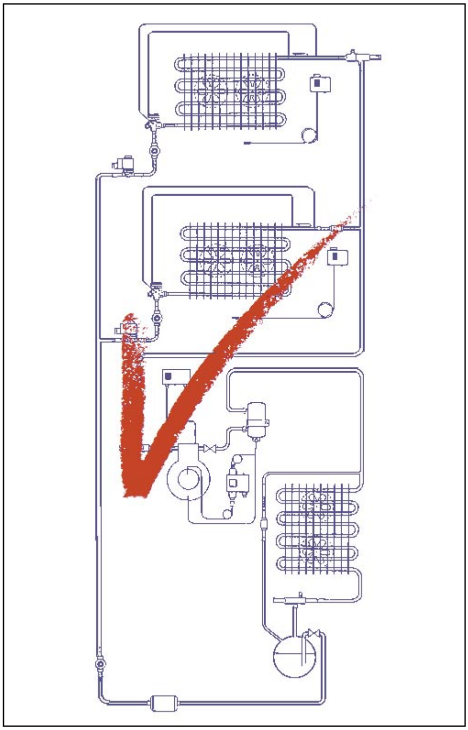
Fitters notes

Contents

Installation process

Process:

- Planning of component location and tubing layout
- Setting up of main components
- Piping and component installation
- Evacuation
- Flushing
- Pressure testing
- Leak testing
- Charging
- Setting safety equipment
- Testing safety equipment
- Setting controls
- Testing the complete system and readjusting controls, etc.

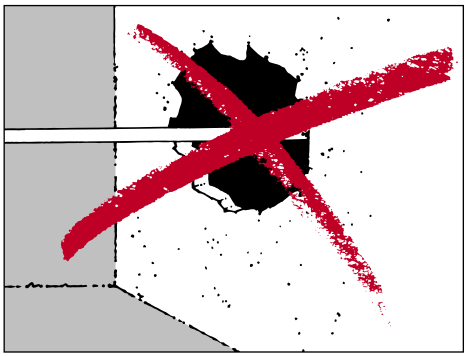


Ac0_0061

Planning

Installation must be planned so that

- Damage to building sections, including cold room insulation, is minimal.
- Components are located functionally correctly (e.g. adequate air flow to compressor, condenser, evaporator).
- Pipe runs are as short as feasibly possible.

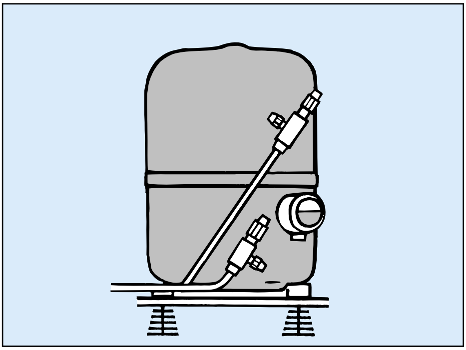


Ac0_0008

Location of main components

Main components (compressor, condenser, evaporator, etc.) must be mounted securely in position, using the accompanying brackets and in accordance with the manufacturer's instructions.

The compressor must always be secured to a horizontal base. If vibration dampers are supplied, they must also be fitted.

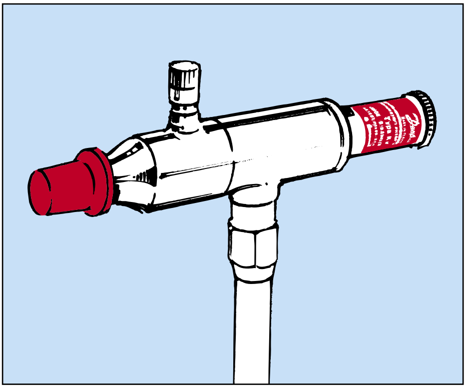

Ac0_0009

Installation of refrigeration system

Installation must be as rapid as possible so that significant quantities of moisture, air or other impurities have little chance of collecting in the system.

Compressors and filter driers should therefore be installed last, immediately before evacuating and charging the system.

All openings into the refrigerant system - with absolutely no exception - must be completely sealed against air and water vapour for the duration of any pauses that might occur in installation work.


Ac0_0004

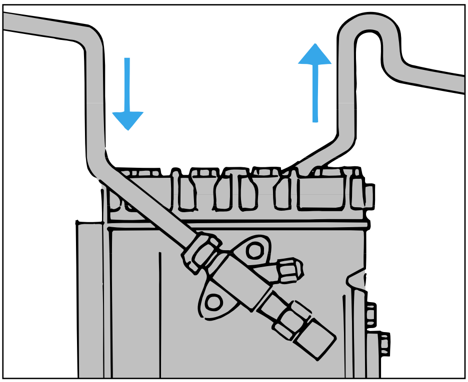
Piping installation

As far as possible, piping must be horizontal or vertical. The exceptions are:

- Suction lines, which can be given a slight fall towards the compressor.
- Discharge lines, which can have a slight fall away from the compressor.

Pipe fixing brackets, clips, etc. must be pitched to suit the pipe diameter and load from components mounted in the lines.

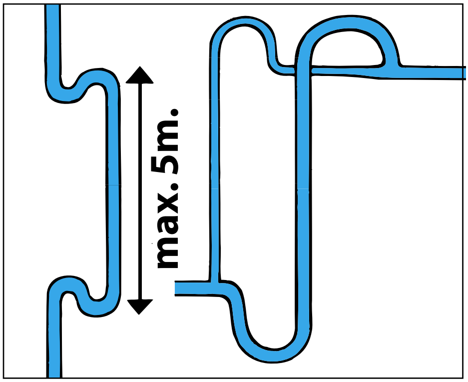
If vibration dampers are fitted to the compressor, then suitable vibration eliminators should be fitted to suction and discharge piping.


Ac0_0002

Oil locks must be mounted in vertical suction lines at a pitch of 4 to 5 m. In systems with large load variations it can be necessary to introduce double risers.

Suction lines must also be installed to take account of oil return to the compressor.

In systems with varying loads, the demands are particularly critical at low loads.

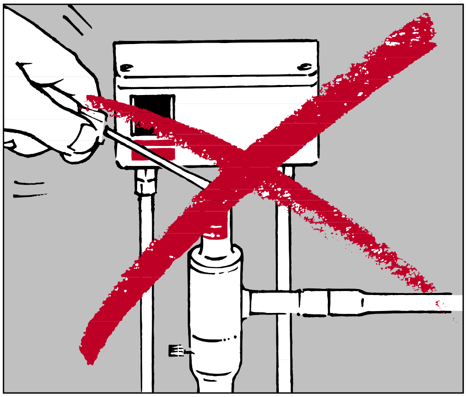


Ac0_0011

Location of other components

All components should be installed so that they are easily accessible for service and possible repair.

Controls and safety equipment must be located so that testing and adjustment can easily be performed using ordinary tools.


Ac0_0012

Parallel-coupled compressors

Parallel-coupled compressors must be installed with oil equalization between compressor crankcases, otherwise whichever compressor(s) run most will „steal" oil from the other compressor(s). Oil equalization can be introduced by installing an equalizing tube between oil sumps. In systems with one equalizing tube, the tube must be installed between compressor oil sumps and must be of such a diameter that both oil and refrigerant vapour are able to flow through it unhindered.

With two equalizing tubes (fig. 1)
One tube must be installed between compressor oil sumps, the other between compressor vapour chambers (crank-cases). When installing oil equalization in either of the forms described, the compressors must be set up in exactly the same horizontal plane.

Oil level controls (fig. 2)
Oil equalization is also possible using oil level regulators.
If these are used, the compressors can be installed at different levels. However, level controls are much more expensive than equalizing pipes.
The following components are necessary with oil level regulation:

- Oil separator (1)
- Pressure equalizing valve (2)
- Oil reservoir (3)
- Oil filter (4)
- Oil level regulator (5)

Remember that each compressor must be protected with a high-pressure control, e.g. KP5.

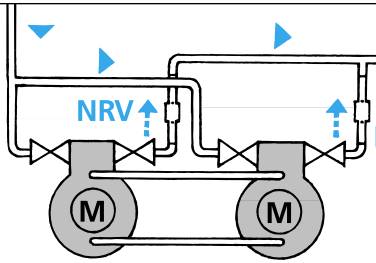


Fig.1

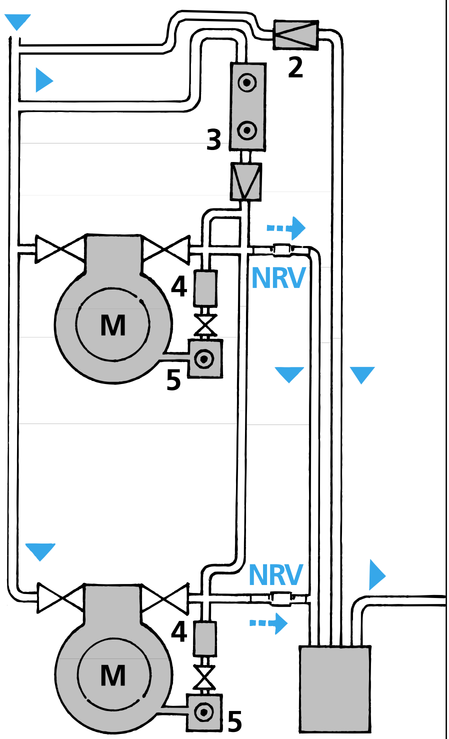


Fig. 2

Ac0_0036

Important installation processes

The processes that might give rise to contamination of refrigerant systems are:

- Component storage,
- Pipe cutting,
- Cleaning pipe ends
- Soldering
- Flare connections..

Component storage

All components must have a temperature not lower than that of their surroundings - before they are opened. This prevents condensation in the components.

For example, components must not be installed immediately after they have been brought from a cold service van into a warm room.

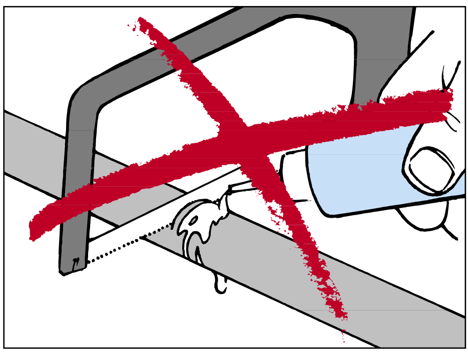
Ac0_0013

Pipe cutting

Tubing must be cut with a pipe cutter or be sawn. Never use any kind of lubricant/refrigerant.

Remove internal and external burrs with a special deburring tool.

Avoid copper swarf entering the pipe.
Use calibration tools to ensure the correct diameter and roundness.



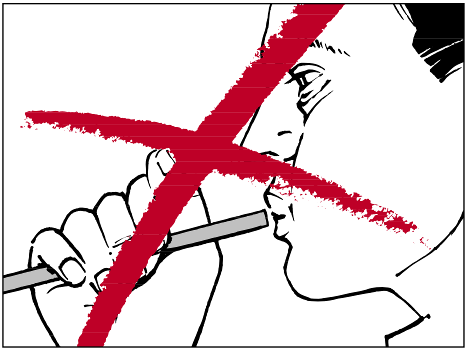
Ac0_0014

Pipe cleaning

Blow through the pipe using a blast of dry compressed air or dry nitrogen.

Never use ordinary compressed air; it contains too much moisture. Never blow through piping by mouth.

Piping which has been prepared for later use must be laid ready, with sealed ends, together with the other components.



Ac0_0015

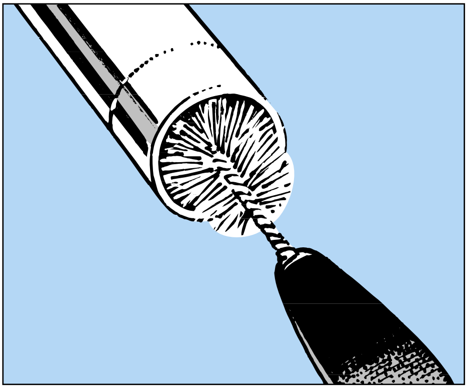
Silver soldering (brazing)

Silver solder consists of 30% silver, copper, zinc and tin. The melting range is just over 655°C to about 755°C.

Silver solder will bind only with clean, non-oxidized metal surfaces.

Clean the pipe ends with a special brush and apply flux at once, immediately before soldering.

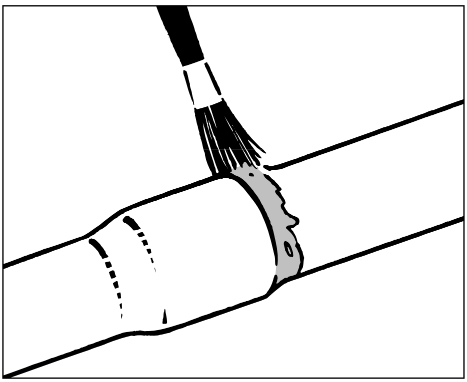
Silver soldering flux must be suspended in spirit, never water.



Ac0_0016

Smear a thin layer of flux around the soldering point after the parts have been joined.

Silver solder can then be used to permanently join different materials, e.g. brass/copper and iron/copper.



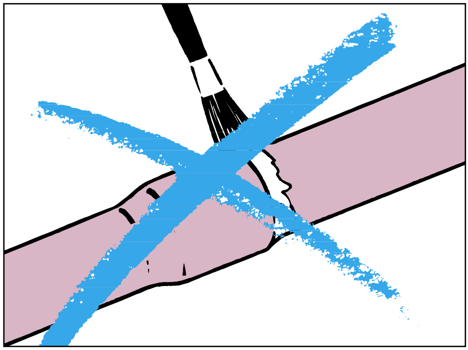
Ac0_0017

Phosphor solder

Phosphor solder consists of 2-15% silver with copper and phosphor. The melting range is about 640°C to 740°C.

Flux must not be used when making phosphor solder connections.

Phosphor solder can only be used to join copper to copper.



Ac0_0018

Use of inert gas when soldering

At the high temperatures used in soldering, oxidation products (scale) form immediately if the pipe comes into contact with atmospheric air while soldering is taking place.

An inert gas must therefore be blown through the system during soldering. Send a slight flow of dry nitrogen or another kind of inert gas through the tubing.

Do not begin soldering until there is no more air in the component(s) concerned.

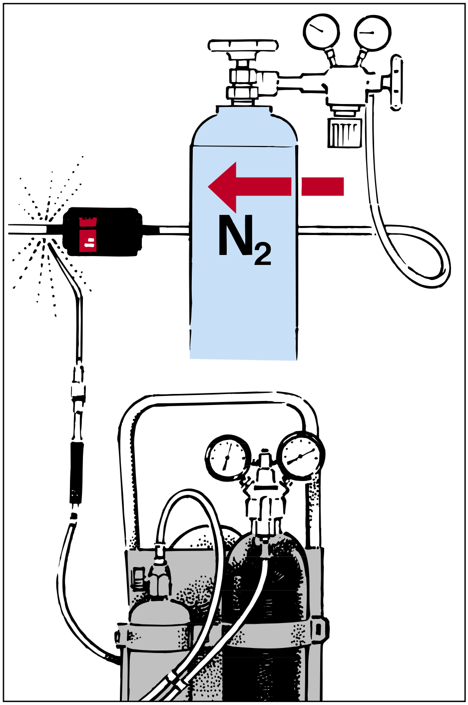
Start the operation with a strong flow of inert gas.

Reduce the flow to a minimum when soldering is started.

Maintain this slight flow of shielding gas during the whole soldering process.

Soldering must be performed with oxygen and gas, with a slight oxygen deficit and a relatively large burner jet.

The solder must not be applied until the melting temperature is reached on the parts being connected.

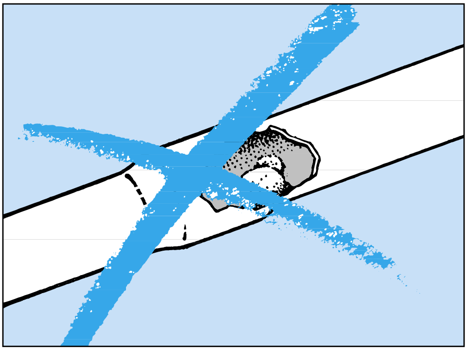


Ac0_0019

Economic soldering

Never use more solder than necessary, otherwise there is a risk of blocking the pipe partially or completely.

Solder quickly so that the oxygen absorption property of the flux is not impaired, i.e. for no longer than about 15 seconds.



Ac0_0020

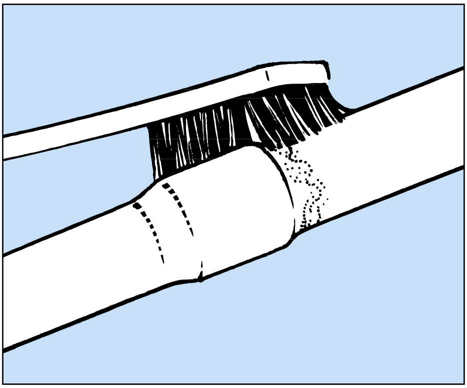
Be careful with the temperature

The temperature must not be higher than necessary.

Therefore draw the flame back slowly when the melting temperature is reached.

External flux residue must be removed by brushing with hot water.

Alloys based on tin or lead are not recommended as solders for refrigerant systems.



Ac0_0021

Flare connections (copper piping)

Use only approved refrigeration copper piping.

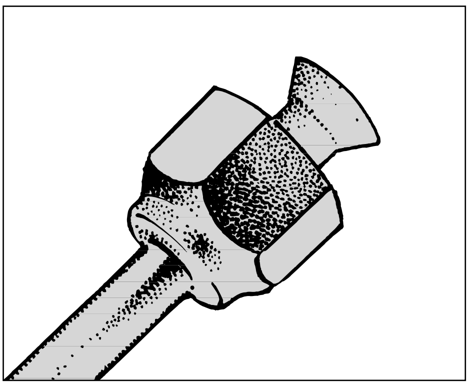
Cut ends at right angles to the piping.

Remove all internal and external burrs.

Make the flare the right size, neither too small nor too large.

Do not compress the flare so severely that it becomes hard.

Leave final tightening up until actual installation



Ac0_0022

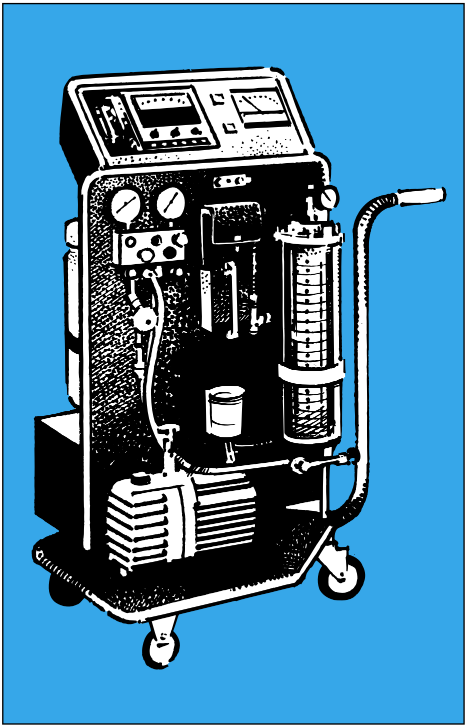
Evacuation, flushing and charging

Steps to follow:
On completing installation work, the next steps are:
- Evacuation and refrigerant charging
- Leak testing
- Starting up and adjustment.

Faults, which occur after the system has been started, can necessitate:
- Repair of the system.

Necessary equipment:
- Vacuum pump
- Vacuum gauge
- Charging bottle (or service cylinder containing refrigerant)
  (Vacuum pump, vacuum gauge and charging bottle can be obtained assembled as an evacuation and charging board.)
- Charging hoses
- Leak detector

Remove moisture, atmospheric air and inert gas from the system when evacuating.



Ac0_0023

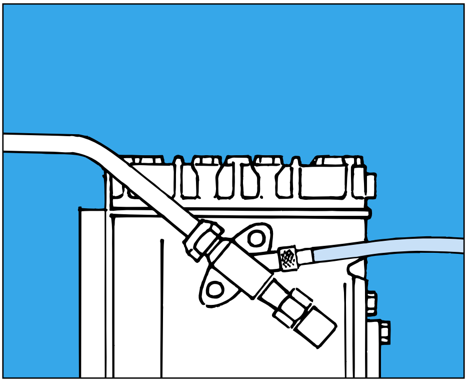
Vacuum pump

The vacuum pump should be capable of quickly bringing the system pressure down to about 0.05 mbar.

Pump capacity, e.g. 20 l/minute. Effective evacuation requires large pipe diameters.

Therefore evacuation through "Schrader" valves is not advisable. Use a "Quick Connector" for compressors with process tube or use the process connectors on the compressor suction and perhaps the discharge stop valve.

The valve spindle must be in its mid position.


Ac0_0024

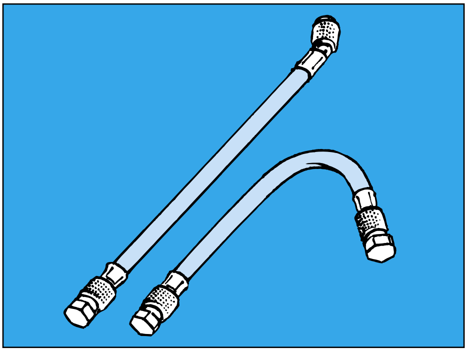
Vacuum hoses

Vacuum hoses and tubes must be as short as possible and the diameter sufficiently large.

Normally, an ordinary 1/4" charging hose not more than 1 m in length can be used.

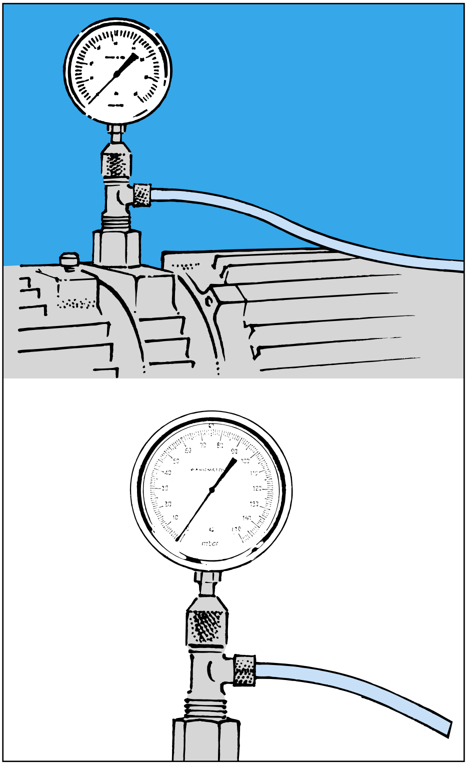
Evacuate in two stages with refrigerant flushing between.

The process of evacuation, flushing and charging is described below.


Ac0_0025

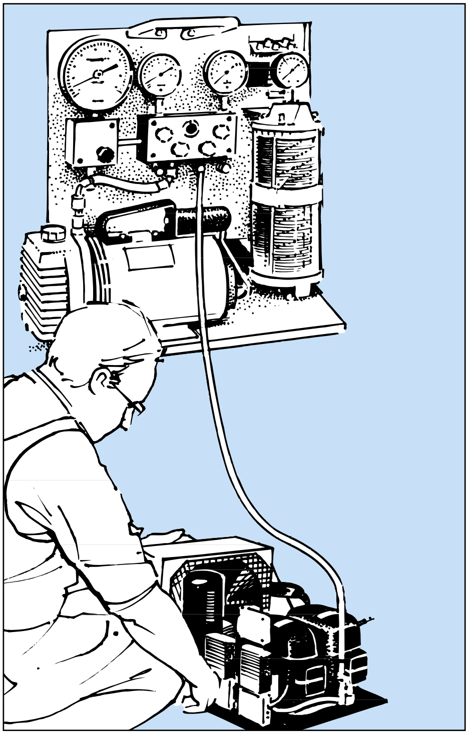
Checking the vacuum pump and hoses

a) Mount the charging hoses between charging board and compressor. Shut off the connections between charging hoses and compressor.
b) Start the pump and allow it to suck the pressure down as far as possible.
c) Shut off the pump from the rest of the system.
d) Stop the pump.
e) Read off and register the pressure on the vacuum gauge. The pressure must not be more than 0.05 mbar.
f) Check to ensure that the vacuum can be maintained. If not, replace charging hoses and/or leaking valves and/or vacuum oil in the vacuum pump.



Ac0_0026

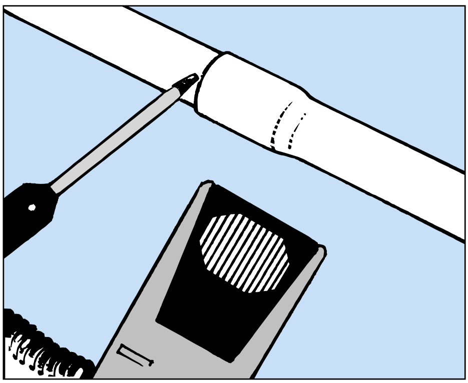
First evacuation
Evacuation from suction side of compressor and possibly also the discharge side.
- Charging hose(s) mounted between charging board and compressor.
- All valves, incl. solenoid valves, open.
- Automatic regulating valves at maximum opening.
- Evacuate system, if possible down to the pressure previously indicated by the vacuum gauge.


Ac0_0028

System vacuum test
To be performed as described under „Checking the vacuum pump and hoses".
If any leakage is detected:
- Approximately localize the leakage by shutting off sections of the system. Retighten flare and/or flange connections. Repeat evacuation.
- Repeat the test until vacuum is maintained or continue with the next point.

Flushing and provisional leak testing
- Apply refrigerant pressure to the system (approx. 2 bar overpressure).
- Leak-test all connections.

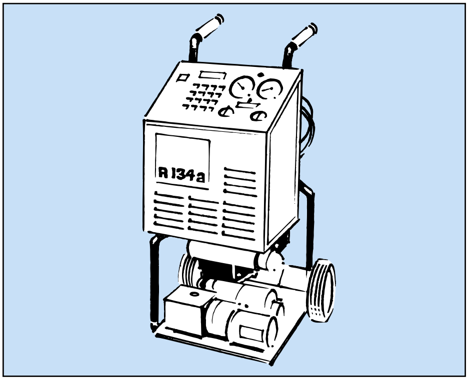
If leakage is detected:
- Use a recycling unit and vacuum pump to remove refrigerant from the system.
- Repair the leakage.
- Repeat the process until no system leakage remains.


Ac0_0030

Second evacuation

- If overpressure remains on the system, use the recycling unit to empty it of refrigerant.
- Then evacuate again as described under "First evacuation".

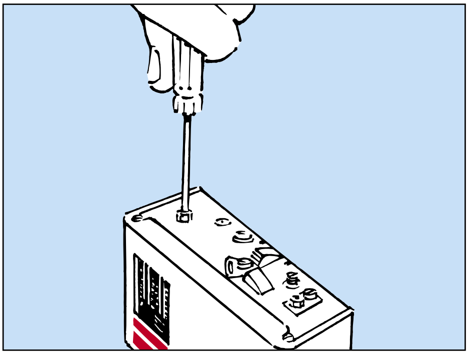
This will further remove any air and moisture remaining in the refrigerant system.



Ac0_0029

Provisional setting of safety equipment

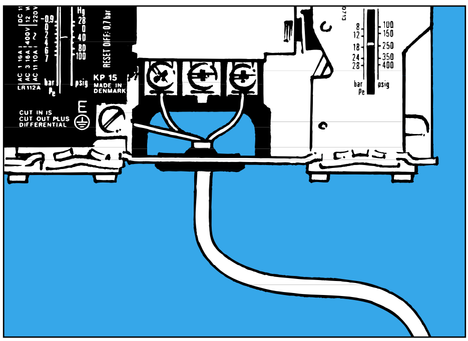
- Check and set high-pressure control and any other safety equipment, incl. motor protector (setting in accordance with scale values).



Ac0_0031

Checking the electrics

- Check all wiring.
- Test the control system with compressor motor disconnected.
- Check the direction of rotation of the motor. Swap two phases if necessary.



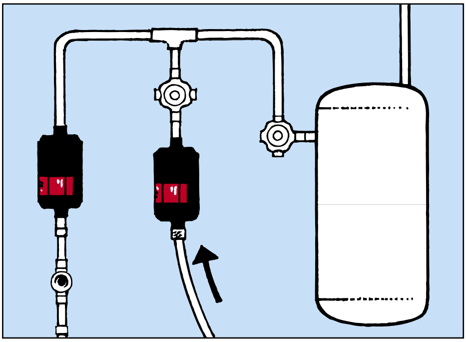
Ac0_0032

Refrigerant charging

After final evacuation, the system can be charged with refrigerant.

A charging board can be used for the purpose and will, with sufficient accuracy, dose the correct quantity of refrigerant for the system. High accuracy is needed in systems without receiver.

If the system has a charging valve, refrigerant can be supplied in the form of liquid to the liquid line. Otherwise the refrigerant can be supplied as vapour to the compressor suction stop valve with the compressor running.

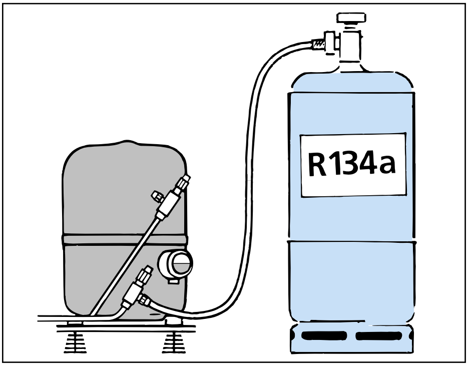


Ac0_0033

Charging must be continued until no vapour formation appears in the sight glass - unless vapour formation is due to other faults, see "Tips for installers, Fault location".

If the necessary quantity of refrigerant is not known, use the method last described.

Here however, it is necessary the whole time to check that the condensing pressure and suction pressure remain normal and that the Thermostatic expansion valve superheat is not too low.



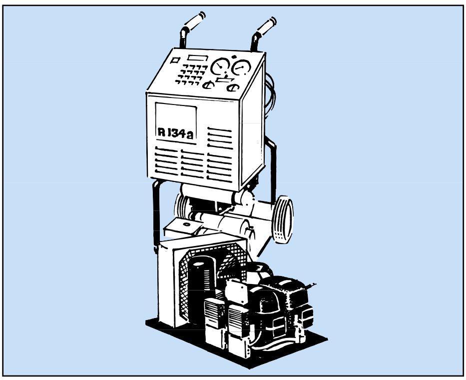
Ac0_0034

Condensing pressure too high

Too high a condensing pressure during the charging process can mean that the system has been over-charged with refrigerant and must be partly drained.

Always use the recycling unit if it becomes necessary to drain off refrigerant.

Too little superheating during the charging process can cause liquid hammer in the compressor.



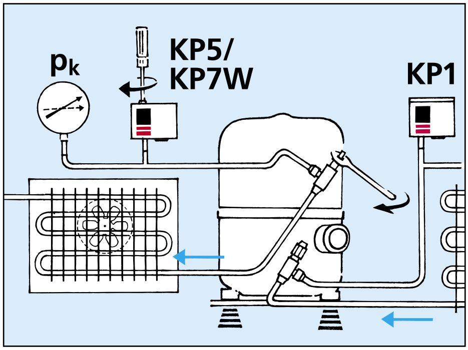
Ac0_0035

Setting and testing safety equipment

Conditions

Final setting and testing of safety equipment must be performed with all mechanical and electrical equipment installed and the system running.

The functions must be checked with accurate instruments. See also „Fitters notes: System Trouble Shooting 1: Measuring Instruments“ with reference to the instructions for the equipment concerned.

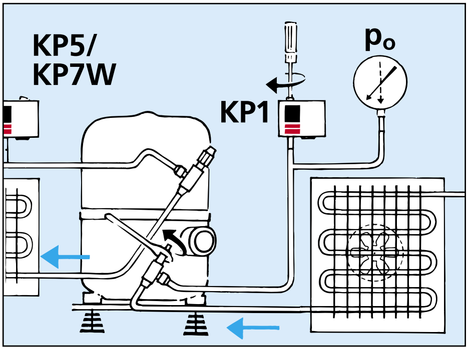


Ac0_0039

Setting and testing regulation equipment

Procedure

- If a constant-pressure valve is installed, make a coarse setting.
- Set the expansion valve superheat.
- Using a pressure gauge, set the constant pressure valve.
- Set the capacity regulator, if installed.
- Set the thermostats (using a thermometer).



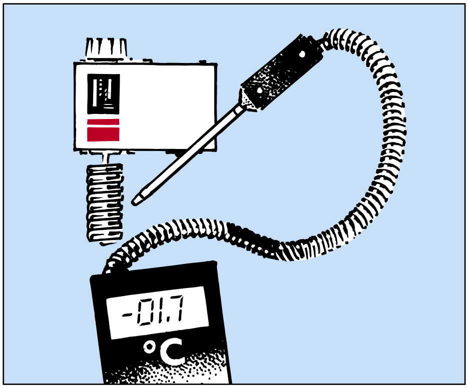
Ac0_0062

Setting the high-pressure control

- Increase the condensing pressure to permissible maximum and use a pressure gauge to set the high-pressure control.

Setting the low-pressure control

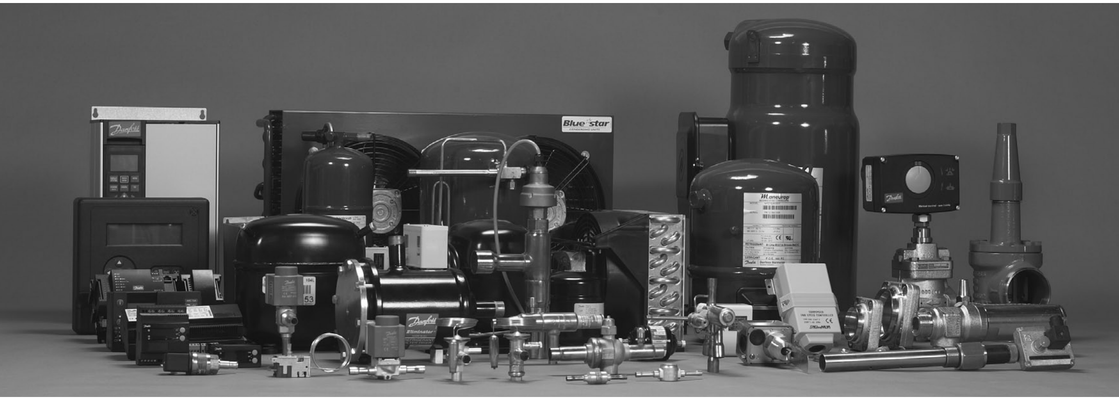
- Reduce the suction pressure to the permissible minimum and use a pressure gauge to set the low-pressure control.



Ac0_0045

Attention:
When making the above settings, constantly check whether the system is operating normally (pressure, etc.).

Finally - ensure that correct refrigerant identification labels are affixed to the system in order that correct future servicing is ensured.



The Danfoss product range for the refrigeration and air conditioning industry

Appliance Controls
General temperature controls for the home appliance industry. The product range comprises CFC-free electromechanical and electronic thermostats for refrigerators and freezers produced to customer specifications as well as service thermostats for all refrigeration and freezing appliances.

Commercial Compressors
Large hermetic reciprocating and scroll compressor technologies for commercial air conditioning and refrigeration. The compressors and condensing units are used in a large array of applications in both businesses. This ranges from water chillers, large packaged air conditioners as well as medium and low temperature refrigeration systems for food storage and processing.

Danfoss Compressors
Hermetic compressors and fan-cooled condensing units for refrigerators, freezers and light commercial applications such as bottle coolers and display counters. Danfoss also produces compressors for heating pump systems as well as 12 and 24 volt compressors for refrigerators and freezers used in mobile applications and solar power. The division has a leading position within energy utilisation, noise filtering and know-how about environment-friendly compressors.

Refrigeration and air conditioning controls
A comprehensive and highly reputed range of self-acting valves, electronic valves and regulators as well as system protectors and line components for the refrigeration and air conditioning market. These products include thermostatic expansion valves, solenoid valves, thermostat and pressure controls, modulation pressure regulators, filter driers, shut-off valves, sight glasses, check valves, non-return valves and water valves. Decentralised electronic systems for full regulation and control of refrigeration applications are also developed and produced at Danfoss.

Industrial Controls
Products and customer specific solutions for industrial monitoring and controls systems based on the principles of pressure and temperature measurement, electrical power and fluid control. Products include a wide range of automatic controls for process control and regulation such as contactors and motor starters, electrically, pneumatically and temperature activated valves as well as temperature and pressure transmitters and switches.