## This chapter is divided into four sections:

**Contents**

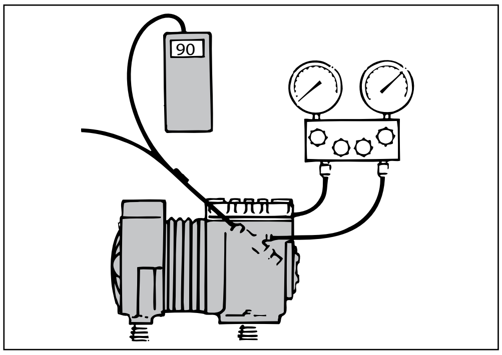
# Notes

## Measuring Instruments

*Instruments for fault location*

The items of equipment most often used for locating faults in refrigeration systems are as follows:

1. Pressure gauge
2. Thermometer
3. Hygrometer
4. Leak detector
5. Vacuum gauge
6. Clamp ammeter
7. Megger
8. Pole finder



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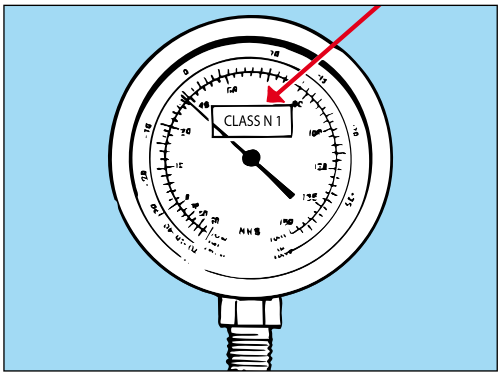
## Classification of instruments

Instruments for fault location and servicing on refrigeration systems should fulfil certain reliability requirements.
Some of these requirements can be categorised thus:

a. Uncertainty
b. Resolution
c. Reproducibility
d. Long-term stability
e. Temperature stability

The most important of these are a, b, and e.



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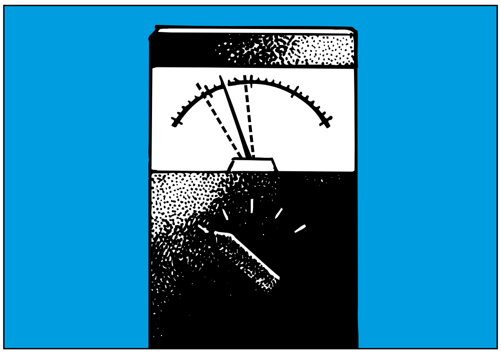
*a. Uncertainty*

The uncertainty (accuracy) of an instrument is the accuracy with which it is able to give the value of the measured variable.

Uncertainty is often expressed in % (±) of either: Full scale (FS) or the measuring value.
An example of uncertainty for a particular instrument is ±2% of measuring value, i.e. less uncertain (more accurate) than if the uncertainty is ±2% of FS.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*b. Resolution*

The resolution of an instrument is the smallest unit of measurement that can be read from it.

For example, a digital thermometer that shows 0.1°C as the last digit in the reading has a resolution of 0.1°C.

Resolution is not an expression of accuracy. Even with a resolution of 0.1°C, an accuracy as poor as 2 K is not uncommon.

It is therefore very important to distinguish between the two.


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*c. Reproducibility*

The reproducibility of an instrument is its ability to repeatedly show the same result for a constant measuring value.

Reproducibility is given in % (±).

*d. Long-term stability*
Long-term stability is an expression how much the absolute accuracy of the instrument changes in, say, one year.

Long-term stability is given in % per year.


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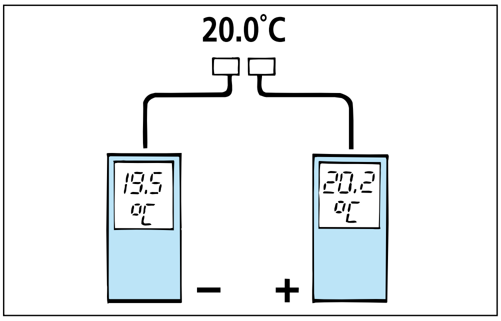
*e. Temperature stability*

The temperature stability of an instrument is how much its absolute accuracy changes for each °C temperature change the instrument is exposed to.

Temperature stability is given in % per °C.

Knowledge of the temperature stability of the instrument is of course important if it is taken into a cold room or deep freeze store.

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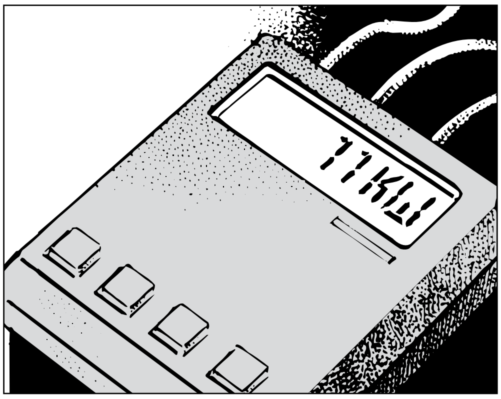
*Electronic instruments*

Electronic instruments can be sensitive to humidity.

Some can be damaged by condensate if operated immediately after they have been moved from cold to warmer surroundings.

They must not be operated until the whole instrument has been given time to assume the ambient temperature.

Never use electronic equipment immediately after it has been taken from a cold service vehicle into warmer surroundings.

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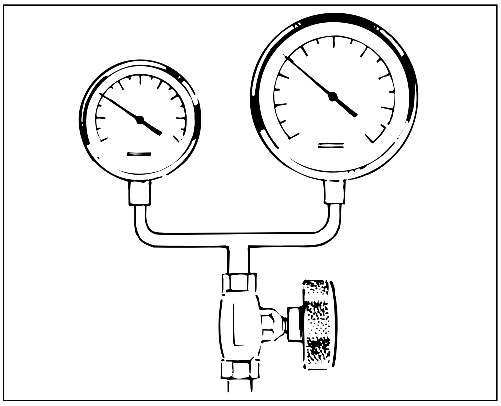
*Check and adjustment*

Readings from ordinary instruments, and perhaps some of their characteristics, change with time.

Nearly all instruments should therefore be checked at regular intervals and adjusted if necessary.

Simple checks that can be made are described below, although they cannot replace the kind of inspection mentioned above.



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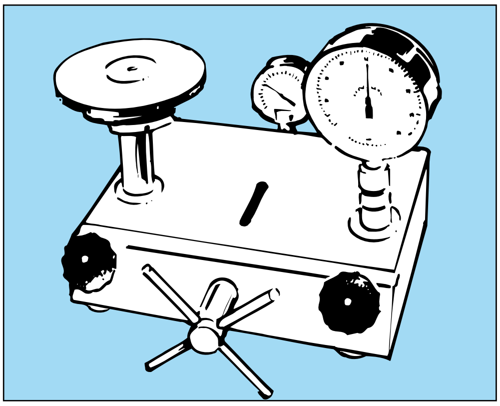
*Check and adjustment (cont.)*

The proper final inspection and adjustment of instruments can be performed by approved test institutions.



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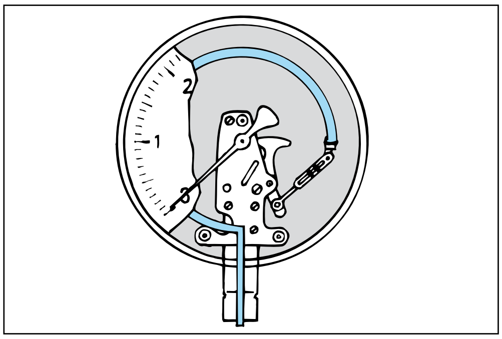
**Adjustment and calibration**

*Pressure gauges*

Pressure gauges for fault location and servicing are as a rule of the Bourdon tube type. Pressure gauges in systems are also usually of this type.

In practice, pressure is nearly always measured as overpressure.
The zero point for the pressure scale is equal to the normal barometer reading.

Therefore pressure gauges have a scale from −1 bar (−100 kPa) greater than 0 to + maximum reading. Pressure gauges with a scale in absolute pressure show about 1 bar in atmospheric pressure.



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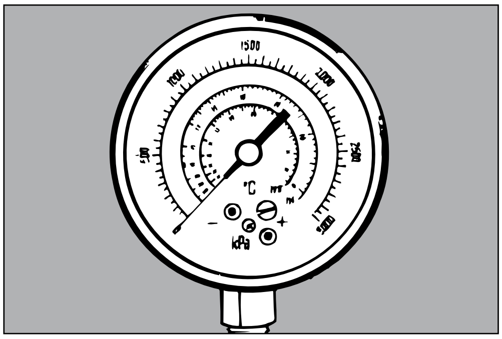
*Service pressure gauges*

As a rule, service pressure gauges have one or more temperature scales for the saturation temperature of common refrigerants.

Pressure gauges should have an accessible setting screw for zero point adjustment, i.e. a Bourdon tube becomes set if the instrument has been exposed to high pressure for some time.

Pressure gauges should be regularly checked against an accurate instrument. A daily check should be made to ensure that the pressure gauge shows 0 bar at atmospheric pressure.

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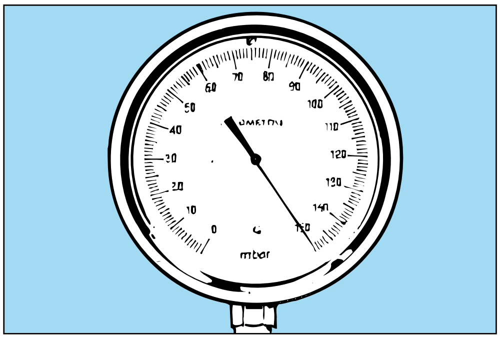
*Vacuum gauges*

Vacuum gauges are used in refrigeration to measure the pressure in the pipework during and after an evacuation process.

Vacuum gauges always show absolute pres-sure (zero point corresponding to absolute vacuum).

Vacuum gauges should not normally be exposed to marked overpressure and should therefore be installed together with a safety valve set for the maximum permissible pressure of the vacuum gauge.

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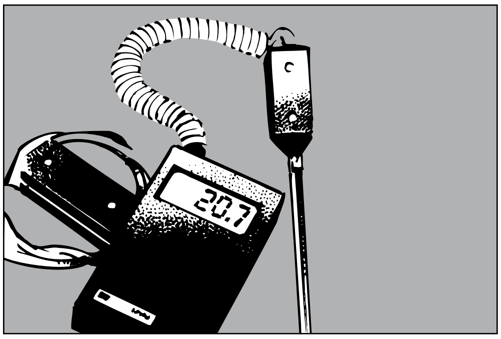
*Thermometer*

Electronic thermometers with digital read-out are in widespread use for servicing. Examples of sensor versions are surface sensors, room sensors and insertion sensors.

Thermometer uncertainty should not be greater than 0.1 K and the resolution should be 0.1°C.

A pointer thermometer with vapour charged bulb and capillary tube is often recommended for setting thermostatic expansion valves.
As a rule it is easier to follow temperature variations with this type of thermometer.



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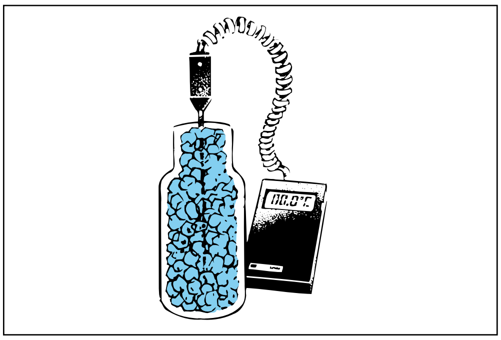
Thermometers can be relatively easily checked at 0°C in that the bulb can be inserted 150 to 200 mm down into a thermos bottle containing a mixture of crushed ice (from distilled water) and distilled water. The crushed ice must fill the whole bottle.

If the bulb will withstand boiling water, it can be held in the surface of boilover water from a container with lid. These are two reasonable checks for 0°C and 100°C.

A proper check can be performed by a recognised test institute.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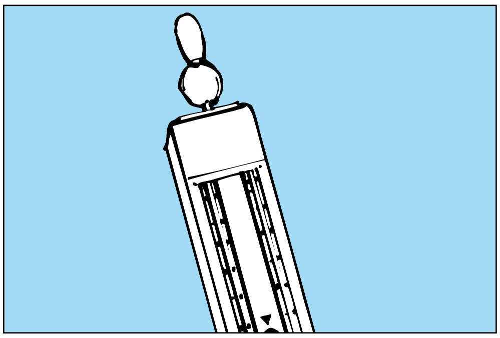
*Hygrometer*

There are different types of hygrometers for measuring the humidity in cold rooms and air conditioned rooms or ducts:

- Hair hygrometer
- Psychrometer
- Diverse electronic hygrometers

A hair hygrometer needs adjustment each time it is used if reasonable accuracy is to be maintained. A psychrometer (wet and dry thermometer) does not require adjustment if its thermometers are of high quality.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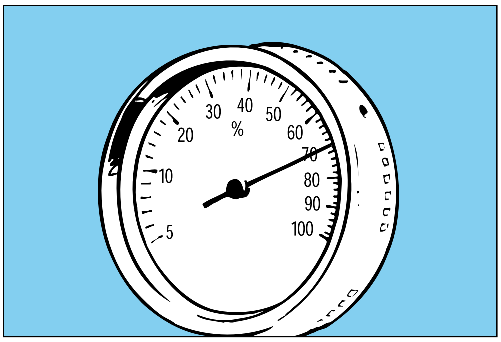
At low temperature and high humidity, the temperature differential between wet and dry thermometers will be small.

Therefore, with psychrometers the uncertainty is high under such conditions and an adjusted hair hygrometer or one of the electronic hygrometers will be more suitable.



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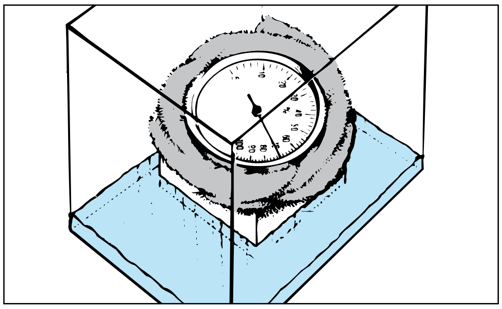
*Hygrometer (continued)*

A hair hygrometer can be adjusted by winding a clean, damp cloth around it and then placing it in an airtight container with water at the bottom (no water must be allowed to enter the hygrometer or come into contact with its bulb).

The container with hygrometer is then allowed to stand for at least two hours in the same temperature as that at which measurements are to be taken.

The hygrometer must now show 100%. If it does not, the setting screw can be adjusted.



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**Contents**

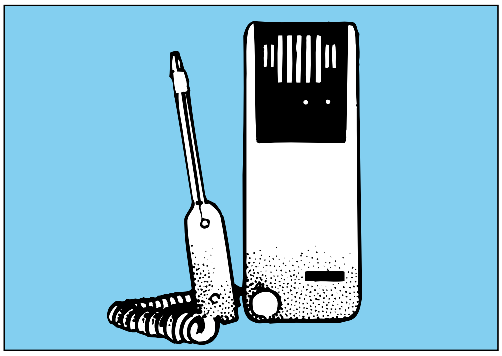
# Notes

**Faults on refrigeration systems, general**

This booklet deals with common faults in small, relatively simple refrigeration systems.

The faults, fault causes, remedies and effects on system operation mentioned also apply to more complicated and large systems.

However, other faults can occur in such systems. These and faults in electronic regulators are not dealt with here.



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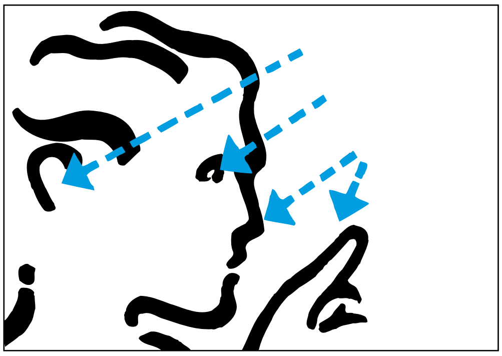
*Fault location without the use of instruments*

After gaining a little experience, many common faults in a refrigeration system can be localised visually, by hearing, by feel, and sometimes by smell. Other faults can only be detected by instruments.



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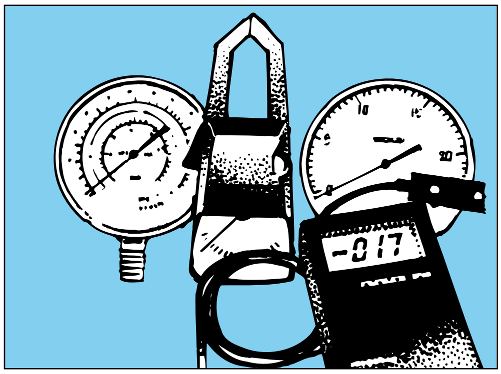
*Categorisation*

This booklet is divided into two sections. The first section deals exclusively with faults that can be observed directly with the senses. Here, symptoms, possible causes and the effect on operation are given.

The second section deals with faults that can be observed directly with the senses, and those that can only be detected by instruments. Here, symptoms and possible causes are given, together with instructions on remedial action.



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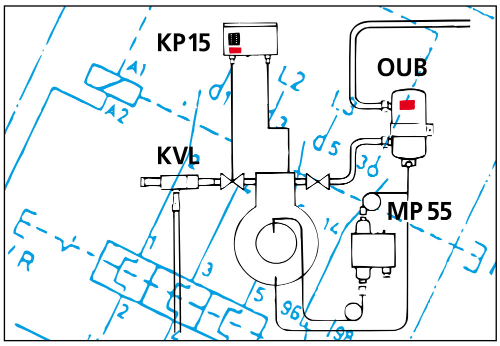
*Knowledge of the system is required*

An important element in the fault location procedure is familiarity with how the system is built up, its function and control, both mechanical and electrical.

Unfamiliarity with the system ought to be remedied by carefully looking at piping layouts and other key diagrams and by getting to know the form of the system (piping, component placing, and any connected systems, e.g. cooling towers and brine systems).

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Trouble shooting

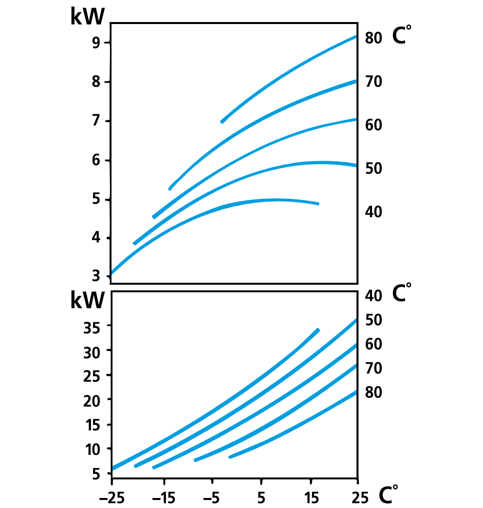
*Theoretical knowledge is necessary*

A certain amount of theoretical knowledge is required if faults and incorrect operation are to be discovered and corrected.

The location of all forms of faults on even relatively simple refrigeration systems is conditional on a thorough knowledge of such factors as:

- The build-up of all components, their mode of operation and characteristics.
- Necessary measuring equipment and measuring techniques.
- All refrigeration processes in the system.
- The influence of the surroundings on system operation.
- The function and setting of controls and safety equipment.
- Legislation on the safety of refrigeration systems and their inspection.

Before examining faults in refrigeration systems, it could be advantageous to look briefly at the most important instruments used in fault location.

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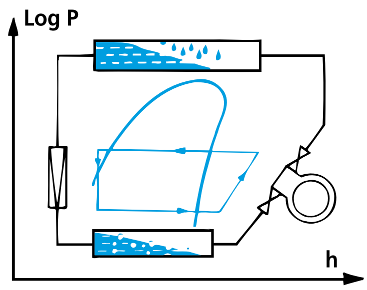


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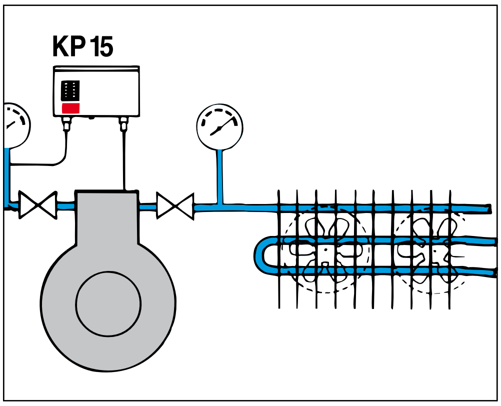
In the following description of faults in refrigeration systems, sections 1 and 2 take as their starting points the piping diagrams, fig. 1, 2 and 3.

The systems are dealt with in the direction followed by the circuit. Fault symptoms that can occur are described in circuit order. The description starts after the compressor discharge side and proceeds in the direction of the arrows.

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**Visible faults and the effect on the system operation**

Text in [ ] indicates fault cause

| Visible faults | Effect on system operation |
|---|---|
| **Air-cooled condenser**<br>a) Dirt, e.g. grease or dust, sawdust, dried leaves.<br>[Lack of maintenance]<br>b) Fan stopped.<br>[Motor defect]<br>[Motor protector cut-out]<br>c) Fan rotates in wrong direction.<br>[Installation error]<br>d) Fan blades damaged.<br>e) Fins deformed<br>[Rough treatment] | Faults under a), b), c), d), e) create:<br>- Increased condensing pressure.<br>- Reduced refrigeration output.<br>- Increased energy consumption.<br>For an air-cooled condenser, the difference between air inlet and condensing temperatures should lie between 10 K and 20 K, preferably at the lower end. |
| **Water-cooled condenser**<br>with sight glass: See "Receiver". | For a water-cooled condenser, the difference between condensing and water inlet temperatures should lie between 10 K and 20 K, preferably at the lower end. |
| **Receiver with sight glass**<br>Liquid level too low.<br>[Insufficient refrigerant in system]<br>[Overcharged evaporator]<br>[Overcharged condenser during cold period]<br>Liquid level too high.<br>[Overcharged system] | <br><br>Vapour/vapour bubbles in liquid line.<br>Low suction pressure or compressor cycling.<br>Low suction pressure or compressor cycling.<br><br>Excessive condensing pressure possible. |
| **Receiver stop valve**<br>a) Valve closed.<br>b) Valve partly closed. | <br>System stopped via low-pressure control.<br>Vapour bubbles in liquid line.<br>Low suction pressure or compressor cycling. |
| **Liquid line**<br>a) Too small<br>[Sizing error]<br>b) Too long<br>[Sizing error]<br>c) Sharp bends and/or deformed<br>[Installation error] | Faults under a), b) and c) cause:<br>Large pressure drop in liquid line.<br>Vapour in liquid line. |
| **Filter drier**<br>Dew or frost formation on surface.<br>[Filter partly blocked with dirt on inlet side] | Vapour in liquid line. |
| **Sight glass**<br>a) Yellow<br>[Moisture in system]<br>b) Brown<br>[Dirt particles in system]<br>c) Pure vapour in sight glass.<br>[Insufficient liquid in system]<br>[Valve in liquid line closed]<br>[Complete blockage, e.g. of filter drier]<br>d) Liquid and vapour bubbles in sight glass.<br>[Insufficient liquid in system]<br>[Valve in liquid line partly closed]<br>[Partial blockage, e.g. of filter drier]<br>[No subcooling] | **Risk of:**<br>Acid formation, corrosion, motor burn-out, water freezing in thermostatic expansion valve.<br>Risk of wear in moving parts and blockage in valves and filters.<br><br>Standstill via low-pressure control or compressor cycling.<br><br>Standstill via low-pressure control.<br>Standstill via low-pressure control.<br>All faults under d):<br>Compressor cycling or running at low suction pressure. |

**Visible faults and the effect on the system operation** *(cont.)*

Text in [ ] indicates fault cause

| Visible faults | Effect on system operation |
|---|---|
| **Thermostatic expansion valve** | |
| a) Thermostatic expansion valve heavily frosted, frost on evaporator only near valve.<br>[Dirt strainer partly blocked]<br>[Bulb charge partly lost]<br>[Previously described faults causing vapour bubbles in liquid line] | Faults under a) cause operation at low suction pressure or compressor cycling via low-pressure control. |
| b) Thermostatic expansion valve without external pressure equalisation, evaporator with liquid distributor.<br>[Sizing or installation error] | Faults under b), c) cause operation at low suction pressure or compressor cycling via low-pressure control. or compressor cycling via low-pressure control. |
| c) Thermostatic expansion valve with external pressure equalisation, equalising tube not mounted.<br>[Installation error] | |
| d) Bulb not firmly secured.<br>[Installation error] | Faults under d), e), f) lead to overcharged evaporator with risk of liquid flow to compressor and compressor damage. |
| e) Entire bulb length not in contact with tube.<br>[Installation error] | |
| f) Bulb placed in air current.<br>[Installation error] | |
| **Air cooler** | |
| a) Evaporator frosted only on inlet side, thermostatic expansion valve heavily frosted.<br>[Thermal valve fault]<br>[All previously described faults that cause vapour in liquid line] | Faults under a) cause:<br>High superheat at evaporator outlet and operation at mostly low suction pressure. |
| b) Front blocked with frost.<br>[Lacking, incorrect or wrongly set up defrost procedure]<br>c) Fan does not run.<br>[Motor defect or motor protector cut-out]<br>d) Fan blades defective.<br>e) Fins deformed.<br>[Rough treatment] | Faults under a), b), c), d), e) cause:<br>- Operation with mostly low suction pressure.<br>- Reduced refrigeration output.<br>- Increased energy consumption.<br>For thermostatic expansion valve controlled evaporators:<br>The difference between air inlet and evaporating temperatures should lie between 6 K and 15 K, preferably at the lower end.<br><br>For level-controlled evaporators:<br>The difference between air inlet and evaporating temperatures should lie between 2 K and 8 K, preferably at the lower end. |
| **Liquid cooler** | |
| a) Thermostatic expansion valve bulb not firmly secured.<br>[Installation error] | Causes overcharged evaporator with risk of liquid flow to compressor and compressor damage. |
| b) Thermostatic expansion valve without external pressure equalising on liquid cooler with high pressure drop, e.g. coaxial evaporator.<br>[Sizing or installation error]<br>c) Thermostatic expansion valve with external pressure equalisation, equalising tube not mounted.<br>[Installation error] | Faults b), c) cause:<br>- Operation with mostly low suction pressure.<br>- Reduced refrigeration output.<br>- Increased energy consumption.<br><br>For thermostatic expansion valve controlled evaporators:<br>The difference between air inlet and evaporating temperatures should lie between 6 K and 15 K, preferably at the lower end.<br><br>For level-controlled evaporators:<br>The difference between air inlet and evaporating temperatures should lie between 2 K and 8 K, preferably at the lower end. |

**Visible faults and the effect on the system operation** *(cont.)*

Text in [ ] indicates fault cause

| Visible faults | Effect on system operation |
|---|---|
| **Suction line** | |
| a) Abnormally severe frosting. | Risk of liquid flow to compressor and compressor damage. |
| [Thermal valve superheat too low] | |
| b) Sharp bends and/or deformation. | Low suction pressure or compressor cycling. |
| [Installation error] | |
| **Regulators in suction line** | |
| Dew/frost after regulator, no dew/frost ahead of regulator. | Risk of liquid flow to compressor and compressor damage. |
| [Thermal valve superheat too low] | |
| **Compressor** | |
| a) Dew or frost on compressor inlet side. | Liquid flow to compressor with risk of compressor damage. |
| [Superheat at evaporator outlet too low] | |
| b) Oil level too low in crankcase. | |
| [Insufficient oil in system] | System stop via oil differential pressure control (if fitted). |
| [Oil collection in evaporator] | Causes wear of moving parts. |
| c) Oil level too high in crankcase. | |
| [Oil overfilling] | Liquid hammer in cylinders, risk of compressor damage: |
| [Refrigerant mixed with oil in too cold a compressor] | - Damage to working valves. |
| [Refrigerant mixed with oil because superheat too low at evaporator outlet] | - Damage to other moving parts.<br>- Mechanical overload. |
| d) Oil boils in crankcase during start. | |
| [Refrigerant mixed with oil in too cold a compressor] | Liquid hammer, damage as under c) |
| e) Oil boils in crankcase during operation. | |
| [Refrigerant mixed with oil because superheat too low at evaporator outlet] | Liquid hammer, damage as under c) |
| **Cold Room** | |
| a) Dry surface on meat, limp vegetables. | |
| [Air humidity too low - evaporator probably too small] | Leads to poor food quality and/or wastage. |
| b) Door not tight, or defective. | Can give rise to personal injury. |
| c) Defective or missing alarm sign. | Can give rise to personal injury. |
| d) Defective or missing exit sign. | Can give rise to personal injury. |
| For b), c), d): | |
| [Lack of maintenance or sizing error] | |
| e) No alarm system. | |
| [Sizing error] | Can give rise to personal injury. |
| **General** | |
| a) Oil drops under joints and/or oil spots on floor. | |
| [Possible leakage at joints] | Oil and refrigerant leakage. |
| b) Blown fuses. | |
| [Overload on system or short-circuiting] | System stopped. |
| c) Motor protector cut-out. | |
| [Overload on system or short circuiting] | System stopped. |
| d) Cut-out pressure controls or thermostats, etc. | |
| [Setting error] | System stopped. |
| [Equipment defect] | System stopped. |

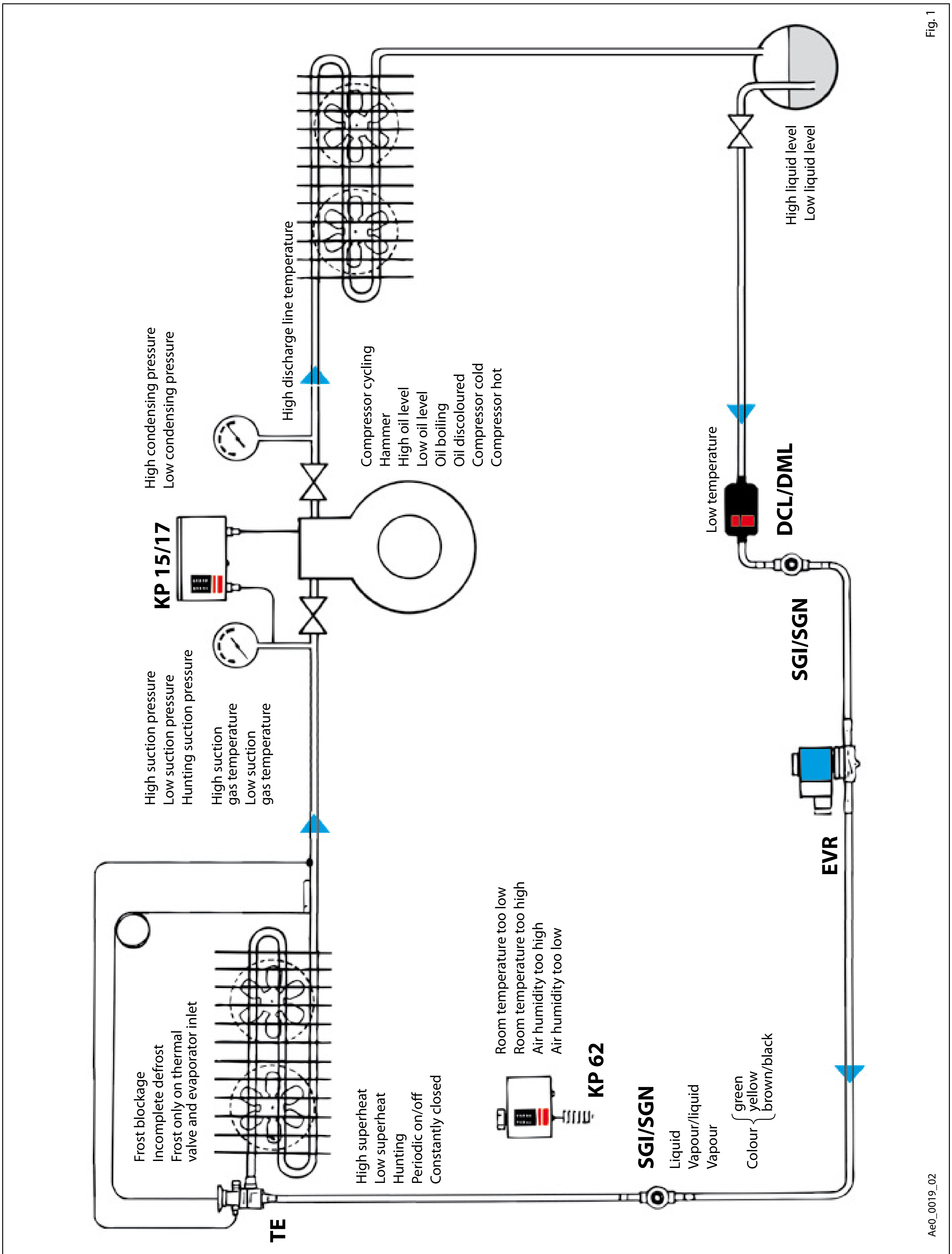
Trouble shooting

**Faults that can be felt, heard or smelled and the effect on the system operation**

Text in [ ] indicates fault cause

| Faults that can be felt | Effect on system operation |
|---|---|
| **Solenoid valve** | |
| Colder than the tubing ahead of the solenoid valve. | |
| [Solenoid valve sticks, partly open] | Vapour in liquid line. |
| Same temperature as tubing ahead of solenoid valve. | |
| [Solenoid valve closed] | System stopped via low-pressure control. |
| **Filter drier** | |
| Filter colder than tubing ahead of filter. | |
| [Filter partly blocked with dirt on inlet side] | Vapour in liquid line. |
| **Faults that can be heard** | **Effect on system operation** |
| **Regulators in suction line** | |
| Whining sound from evaporating pressure regulator or another regulator. | |
| [Regulator too large (sizing error)] | Unstable operation. |
| **Compressor** | |
| a) Knocking sound on starting. | |
| [Oil boiling] | Liquid hammer. |
| b) Knocking sound during operation. | Risk of compressor damage. |
| [Oil boiling] | Liquid hammer. |
| [Wear on moving parts] | Risk of compressor damage. |
| **Cold room** | |
| Defective alarm system. | |
| [Lack of maintenance] | Can give rise to personal injury. |
| **Faults that can be smelled** | **Effect on system operation** |
| **Cold room** | |
| Bad smell in meat cold room. | |
| [Air humidity too high because evaporator too large or load too low] | Leads to poor food quality and/or wastage. |

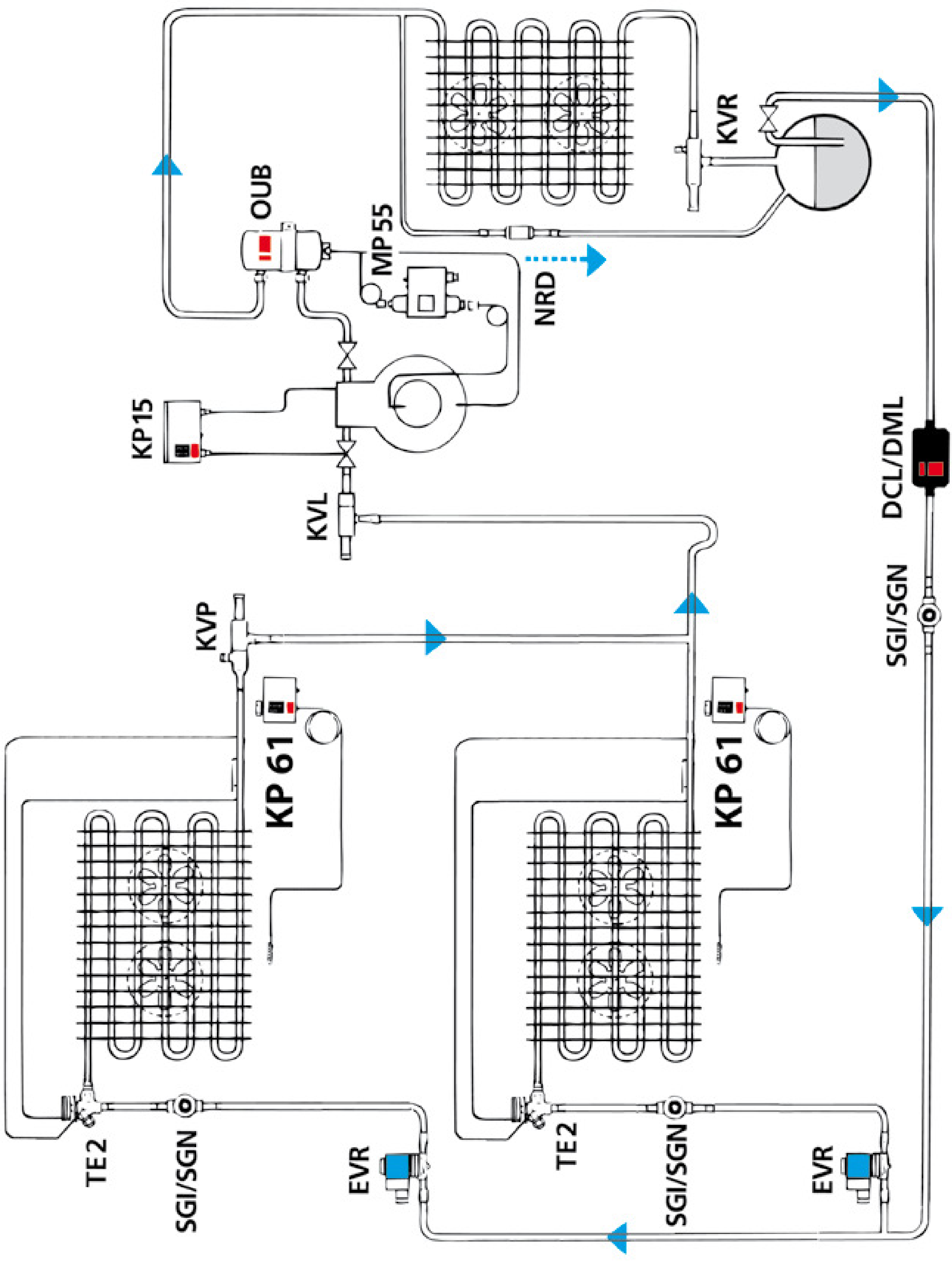
## Refrigeration system with air cooler and air-cooled condenser




Trouble shooting

### Refrigeration system with two air coolers and air-cooled condenser

Fig. 2

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## Refrigeration system with liquid cooler and water-cooled condenser

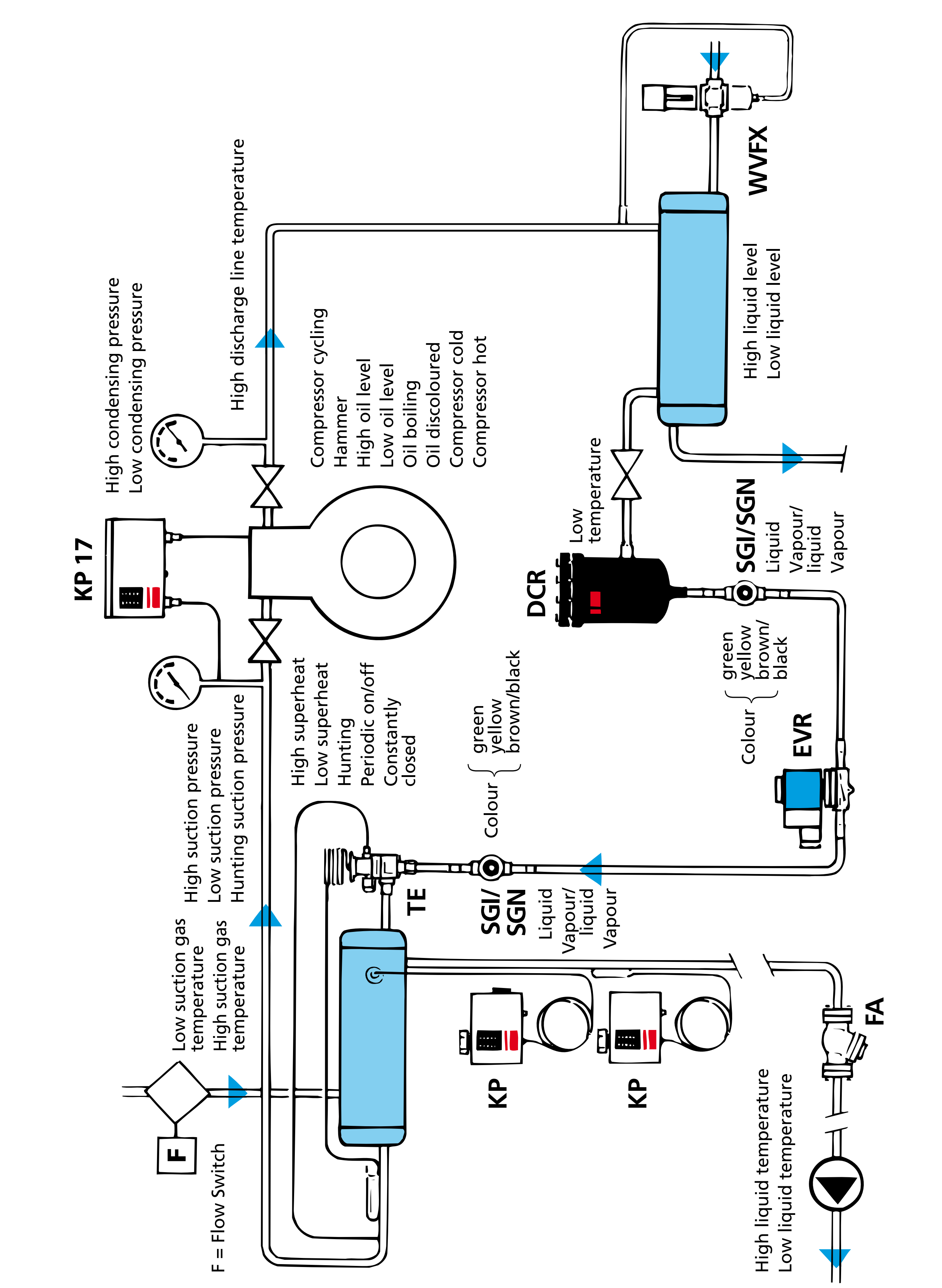


Fig. 3

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**Guide to fault location**

## Follow the arrows in the diagrams, figs. 1 and 3, p. 10/12. Begin after the compressor

## System fault location

| Symptom | Possible cause | Action |
|---|---|---|
| **Condensing pressure too high** Air- and water-cooled condensers. | a) Air or other non-condensable gases in refrigerant system. | Purge the condenser by using reclaim system, start and run system until it reaches running temperature. Purge again if necessary. |
| | b) Condenser surface too small. | Replace condenser with larger size. |
| | c) Refrigerant system charge too large (liquid collection in condenser). | Recover refrigerant until condensing pressure is normal. The sight glass must remain full. |
| | d) Condensing pressure regulation set for too high a pressure. | Set for the correct pressure. |
| **Condensing pressure too high** Air-cooled condensers. | a) Dirt on condenser surface. | Clean condenser. |
| | b) Fan motor or blade defective or too small. | Replace motor or fan blade or both. |
| | c) Air flow to condenser restricted. | Remove air inlet obstruction or move condenser. |
| | d) Ambient temperature too high. | Create fresh air inlet or move condenser. |
| | e) Incorrect air flow direction through condenser. | Change rotation of fan motor. On condensing units, air must flow through condenser and then to compressor. |
| | f) Short-circuit between condenser fan airside pressure and suction sides. | Install a suitable duct, possibly to outdoor air. |
| **Condensing pressure too high** Water-cooled condensers. | a) Cooling water temperature too high. | Ensure lower water temperature. |
| | b) Water quantity too small. | Increase water quantity, possibly using automatic water valve. |
| | c) Deposits on inside of water pipes (scale etc). | Clean out condenser water tubes, possibly by deacidification. |
| | d) Cooling water pump defective or stopped. | Investigate cause, replace or repair cooling water pump if fitted. |
| **Condensing pressure too low** Air- and water-cooled condensers. | a) Condenser surface too large. | Establish condensing pressure regulation or replace condenser. |
| | b) Low load on evaporator. | Establish condensing pressure regulation. |
| | c) Suction pressure too low, e.g. insufficient liquid in evaporator. | Locate fault on line between condenser and thermostatic expansion valve (see "Suction pressure too low"). |
| | d) Compressor suction and discharge valves might be leaking. | Replace compressor valve plate. |
| | e) Condensing pressure regulator set for too low a pressure. | Set condensing pressure regulator for correct pressure. |
| | f) Un-insulated receiver placed too cold in relation to condenser (receiver acts as condenser). | Move receiver or fit it with suitable insulating cover. |
| **Condensing pressure too low** Air-cooled condensers. | a) Temperature of cooled air too low. | Establish condensing pressure regulation. |
| | b) Air quantity for condenser too large. | Replace fan with smaller unit or establish motor speed regulation. |
| **Condensing pressure too low** Water-cooled condensers. | a) Water quantity too large. | Install WVFX automatic water valve or set existing valve. |
| | b) Water temperature too low. | Reduce water quantity by using a WVFX automatic water valve, for example. |
| **Condensing pressure hunts** | a) Differential on start/stop pressure control for condenser fan too large. Can cause vapour formation in liquid line for some time after start of condenser fan because of refrigerant collection in condenser. | Set differential on lower value or use valve regulation (KVD + KVR) or use fan motor speed regulation. |
| | b) Thermostatic expansion valve hunting. | Set thermostatic expansion valve for higher superheat or replace orifice with smaller size. |
| | c) Fault in KVR/KVD condensing pressure regulating valves (orifice too large). | Replace valves with smaller size. |
| | d) Consequence of hunting suction pressure. | See "Suction pressure hunts". |
| | e) Wrong sized or located check valve in condenser line. | Check sizing. Mount check valve below condensor and close to receiver inlet. |

**System fault location** *(cont.)*

| Symptom | Possible cause | Action |
|---|---|---|
| **Discharge line temperature too high** | a) Suction pressure too low because of: | |
| | 1) Insufficient liquid in evaporator. | Locate fault on line from receiver to suction line (see "Suction pressure too low"). |
| | 2) Low evaporator load. | Ditto. |
| | 3) Leaking suction or discharge valves. | Replace compressor valve plate. |
| | 4) Superheat too high in internal heat exchanger or suction accumulator in suction line. | Omit heat exchange or possibly select smaller heat exchanger. |
| | b) Condensing pressure too high. | See "Condensing pressure too high". |
| **Discharge line temperature too low** | a) Liquid flow to compressor (thermal valve superheat setting too low or bulb location incorrect). | See pages 175 and 176. |
| | b) Condensing pressure too low. | See "Condensing pressure too low". |
| **Liquid level in receiver too low** | a) Insufficient refrigerant in system.<br>b) Evaporator overcharged. | Investigate cause (leakage, overcharge in evaporator), repair fault and charge system if necessary. |
| | 1) Low load, leading to refrigerant collection in evaporator. | See pages 175 and 176. |
| | 2) Thermostatic expansion valve fault (e.g. superheat setting too low, bulb location wrong). | See pages 175 and 176. |
| | c) Refrigerant collection in condenser because condensing pressure is too low. | Air-cooled condensers: Establish condensing pressure regulation by fan motor speed regulation, e.g. type RGE. |
| **Liquid level in receiver too high**<br>Refrigeration output normal. | Refrigerant charge in system too large. | Recover a suitable quantity of refrigerant, but condensing pressure must remain normal and the sight glass free of vapour. |
| **Liquid level in receiver too high**<br>Refrigeration output too low (possible compressor cycling). | a) Partial blockage of a component in liquid line. | Find the component and clean or replace it. |
| | b) Thermostatic expansion valve fault (e.g. superheat too high, orifice too small, lost charge, partial blockage). | See pages 175 and 176. |
| **Filter drier cold, dew or frosting possible.** | a) Partial blocking of dirt strainer in filter drier. | Check whether there are impurities in the system, clean out where necessary, replace filter drier. |
| | b) Filter drier completely or partly saturated with water or acid. | Check whether there is moisture or acid in the system, clean out where necessary and replace filter drier (burn-out filter) several times if necessary. If acid contamination is severe, replace refrigerant and oil charge, install DCR filter drier with interchangeable core in suction line. |
| **Moisture indicator discoloured**<br>Yellow. | Moisture in system. | Check system for leakage. Repair if necessary. Check system for acid. Replace filter drier, several times if necessary. In severe cases it can be necessary to change refrigerant and oil. |
| Brown or black. | Impurities, i.e. small particles in system. | Clean out system if necessary.<br>Replace SGI/SGN sight glass and filter drier. |

**System fault location** *(cont.)*

| Symptom | Possible cause | Action |
|---|---|---|
| **Vapour bubbles in sight glass ahead of thermostatic expansion valve** | a) Insufficient liquid subcooling from large pressure drop in liquid line because: | |
| | 1) Liquid line too long in relation to diameter. | Replace liquid line with tube of suitable diameter. |
| | 2) Liquid line diameter too small. | Replace liquid line with tube of suitable diameter. |
| | 3) Sharp bends, etc. in liquid line. | Replace sharp bends and components causing too large a pressure drop. |
| | 4) Partial blockage of filter drier. | Check for impurities, clean out if necessary, replace filter drier. |
| | 5) Solenoid valve defect. | See the chapter "Solenoid valves". |
| | b) Insufficient liquid subcooling because of heat penetration of liquid line, possibly from high temperature around liquid line. | Reduce ambient temperature or install heat exchanger between liquid and suction lines or insulate liquid line, possibly together with suction line. |
| | c) Water-cooled condensers: Insufficient subcooling because of wrong cooling water flow direction. | Swap over cooling water inlet and outlet. (Water and refrigerant flow must be opposite). |
| | d) Condensing pressure too low. | See "Condensing pressure too low". |
| | e) Receiver stop valve too small or not fully open. | Replace valve or open it fully. |
| | f) Hydrostatic pressure drop in liquid line too high (height difference between thermostatic expansion valve and receiver too large). | Install heat exchanger between liquid and suction lines ahead of rise in liquid line. |
| | g) Badly or incorrectly set condensing pressure regulation causing liquid collection in condenser. | Replace or reset KVR regulator at correct value. |
| | h) Condenser pressure regulation by start/stop of condenser fan can cause vapour in liquid line for some time after fan start. | If necessary, replace regulation with condensing pressure regulation via valves (KVD + KVR) or with fan motor speed regulation, type VLT. |
| | i) Insufficient liquid in system. | Recharge system, but first make sure that none of the faults named under a), b), c), d), e), f), g), h) are present, otherwise there is a risk of the system becoming overcharged. |
| **Air coolers**<br>Evaporator blocked by frost. | a) Lack of or poor defrost procedure. | Install defrost system or adjust defrost procedure. |
| | b) Air humidity in cold room too high because of moisture load from: | |
| | 1) Unpackaged items. | Recommend packaging of items or adjust defrost procedure. |
| | 2) Air ingress into room through fissures or open door. | Repair fissures. Recommend that door be kept closed. |
| **Air coolers**<br>Evaporator frosted only on line near thermostatic expansion valve, severe frost on thermostatic expansion valve. | Refrigerant supply to evaporator too small because of: | |
| | a) Thermostatic expansion valve defect, e.g.<br>1) Orifice too small.<br>2) Superheat too high.<br>3) Partial loss of bulb charge.<br>4) Dirt strainer partly blocked.<br>5) Orifice partly blocked by ice. | See pages 175 and 176. |
| | b) Fault as described under "Vapour bubbles in sight glass". | See "Vapour bubbles in sight glass". |
| **Air coolers**<br>Evaporator damaged. | Fins deformed. | Straighten fins using a fin comb. |

Trouble shooting

**System fault location** *(cont.)*

| Symptom | Possible cause | Action |
|---|---|---|
| **Air humidity in cold room too high, room temperature normal** | a) Evaporator surface too large. Causes operation at excessive evaporating temperature during short running periods.<br>Load on room too low, e.g. during winter (insufficient dehumidification because of short total running time per 24 hours). | Replace evaporator with smaller size.<br>Establish humidity regulation with hygrometer, heating elements and KP62 safety thermostat. |
| **Air humidity in room too low** | a) Cold room poorly insulated.<br>b) High internal energy consumption, e.g. lights and fans.<br>c) Evaporator surface too small, causes long running times at mainly low evaporating temperatures. | Recommend improved insulation.<br>Recommend less internal energy consumption.<br>Replace evaporator with larger size. |
| **Air temperature in cold room too high** | a) Room thermostat defect.<br>b) Compressor capacity too small.<br>c) Load on room too high because of:<br>1) Loading of non-cooled items.<br>2) High energy consumption, e.g. for lights and fans.<br>3) Cold room poorly insulated.<br>4) High air ingress.<br>d) Evaporator too small.<br>e) Insufficient or no refrigerant supply to evaporator.<br>f) Evaporating pressure regulator set for too high an evaporating pressure.<br>g) Cut-out pressure on low-pressure control set too high.<br>h) Capacity regulating valve opens at too high an evaporating pressure.<br>i) Opening pressure of crankcase pressure regulator set too low. | See the chapter "Thermostats:".<br>See "Compressor".<br><br>Recommend placing of smaller load or increased system capacity.<br>Recommend reduction of energy consumption or increased system consumption.<br>Recommend better insulation.<br>Recommend repair of fissures and least possible door opening.<br>Replace evaporator with larger size.<br>See "Vapour bubbles in sight glass ahead of thermal valve" and pages 175 and 176.<br>Set evaporating pressure regulator at correct value. Use a pressure gauge.<br>Set low-pressure control at correct cut-out pressure. Use a pressure gauge.<br>Set capacity regulating valve at lower opening pressure.<br>Set valve for higher opening pressure if the compressor will withstand it. |
| **Air temperature in cold room too low** | a) Room thermostat defect:<br>1) Cut-out temperature set too low.<br>2) Bulb location wrong.<br>b) Ambient temperature very low. | See page 180.<br><br><br>If absolutely necessary, establish thermostat controlled electrical heating. |
| **Suction pressure too high** | a) Compressor too small.<br>b) One or more compressor disc valves leaking.<br>c) Capacity regulation defective or incorrectly set.<br>d) System load too high.<br>e) Hot gas defrost valve leaking. | Replace compressor with larger size.<br>Replace valve plate.<br>Replace, repair or adjust capacity regulation.<br>Recommend less load or replace compressor with larger size, or install KVL crankcase pressure regulator.<br>Replace valve. |
| **Suction pressure too high and suction gas temperature too low** | a) Thermostatic expansion valve superheat setting too low or bulb located incorrectly.<br>b) Thermostatic expansion valve orifice too large.<br>c) Leaking liquid line in heat exchanger between liquid and suction lines. | See pages 175 and 176.<br>Replace orifice with smaller size.<br>Replace HE heat exchanger. |
| **Suction pressure too low, constant running** | Low-pressure control set incorrectly, or defective. | Adjust or replace low-pressure control KP 1 or combined pressure control KP 15. |

**System fault location** *(cont.)*

| Symptom | Possible cause | Action |
|---|---|---|
| **Suction pressure too low, normal operation or compressor cycling** | a) Low system load. | Establish capacity regulation or increase lowpressure control differential. |
| | b) Insufficient refrigerant in evaporator, because of: | |
| | 1) Insufficient refrigerant in receiver. | See "Liquid level in receiver too low". |
| | 2) Liquid line too long. | See "Vapour bubbles in sight glass." |
| | 3) Liquid line too small. | Ditto. |
| | 4) Sharp bends, etc. in liquid line. | Ditto. |
| | 5) Filter drier partly blocked. | See "Vapour bubbles in sight glass". |
| | 6) Solenoid valve sticks. | Ditto. |
| | 7) Inadequate liquid subcooling. | Ditto. |
| | 8) Fault at thermal valve. | See pages 175 and 176. |
| | c) Evaporator too small. | Replace with larger evaporator. |
| | d) Evaporator fan defective. | Replace or repair fan. |
| | e) Pressure drop in evaporator and/or suction line too large. | If necessary, replace evaporator and/or suction line. |
| | f) Lack of or inadequate defrosting of air cooler. | Establish a defrost system or adjust defrost procedure. |
| | g) Freezing in brine cooler. | Increase brine concentration and check frost protection equipment. |
| | h) Insufficient air or brine through cooler. | Check cause and correct fault. See "Air coolers" and "Liquid coolers". |
| | i) Oil collection in evaporator. | See "Oil level in crankcase ton low" |
| **Suction pressure hunts** Thermostatic expansion valve operation. | a) Thermostatic expansion valve superheat too low. | See pages 175 and 176. |
| | b) Thermostatic expansion valve orifice too large. | |
| | c) Capacity regulation fault | |
| | 1) Capacity regulating valve too large. | Replace KVC capacity regulating valve with smaller size. |
| | 2) Pressure control(s) for stage regulation incorrectly set. | Set for greater difference between cut-in and cut-out pressures. |
| **Suction pressure hunts** Electronic expansion valve operation. | Hunting normal | None |
| **Suction gas temperature too high** | Refrigerant supply to evaporator too small because: | |
| | a) System refrigerant charge too small. | Charge refrigerant to correct level. |
| | b) Defect in liquid line or components in that line | See these entries: "Liquid level in receiver", "Filter drier cold", "Vapour bubbles in sight glass", "Suction pressure too low". |
| | c) Thermostatic expansion valve super- heat setting too high, or bulb charge partly lost. | See pages 175 and 176. |
| **Suction gas temperature too low** | Refrigerant supply to evaporator too large because: | |
| | a) Thermostatic expansion valve superheat set too low. | See pages 175 and 176. |
| | b) Thermostatic expansion valve bulb located incorrectly (too warm or in poor contact with piping). | See pages 175 and 176. |
| **Compressor** Compressor cycling (cut-out via low-pressure control). | a) Compressor capacity too high in relation to load at any given time. | Establish capacity regulation using KVC capacity regulating valve or parallel-coupled compressors. |
| | b) Compressor too large. | Replace compressors with smaller size. |
| | c) Opening pressure of evaporating pressure regulator set too high. | Using a pressure gauge, set KVP regulator at correct value. |

**System fault location** *(cont.)*

| Symptom | Possible cause | Action |
|---|---|---|
| **Compressor**<br>Compressor cycling (cut-out via high-pressure control). | a) Condensing pressure too high.<br>b) High-pressure control defect.<br>c) High-pressure control cut-out set too low. | See "Condensing pressure too high".<br>Replace high-pressure control KP 5 / 7 or combined pressure control KP 15 / 17.<br>Using a pressure gauge, set pressure control at correct value. Avoid compressor cycling by using high-pressure control with manual reset. |
| **Discharge pipe temperature too high** | Discharge pipe temperature too high. | Replace valve plate. See also "Discharge temperature too high". |
| **Compressor**<br>Compressor too cold. | Flow of liquid refrigerant from evaporator to suction line and possibly to compressor because of incorrectly set thermostatic expansion valve. | Set thermostatic expansion valve for lower superheat using MSS method, see the chapter (Thermostatic expantion valves" or pages 175 and 176.". |
| **Compressor**<br>Compressor too hot. | a) Compressor and possibly motor overloaded because evaporator load and thereby suction pressure too high.<br>b) Poor motor and cylinder cooling because of:<br>1) Insufficient liquid in evaporator.<br>2) Low evaporator load.<br>3) Suction and discharge valves not tight.<br>4) Superheat too severe in heat exchanger, or in suction accumulator in suction line.<br>c) Condensing pressure too high. | Reduce evaporator load or replace compressor with larger size.<br>Locate fault on line between condenser and thermostatic expansion valve (see "Suction pressure too low").<br>Ditto<br>Replace valve plate.<br>Omit heat exchange or possibly select smaller HE heat exchanger.<br>See "Condensing pressure too high". |
| **Knocking sound:**<br>a) Constant.<br>b) During start. | a) Liquid hammer in cylinder because of liquid flow to compressor.<br>b) Oil boiling because of liquid build up in crankcase.<br>c) Wear on moving compressor parts, especially bearings. | Set thermostatic expansion valve for lower superheat using MSS method.<br>Install heating element in or under compressor crankcase.<br>Repair or replace compressor. |
| **Compressor**<br>Oil level in crankcase too high.<br>On high load, otherwise not.<br>During standstill or start | Oil quantity too large.<br>Refrigerant absorption in crankcase oil because of too low an ambient temperature. | Drain oil to correct level, but first ensure that the large quantity is not due to refrigerant absorption in the oil.<br>Install heating element in or under compressor crankcase. |
| **Compressor**<br>Oil level in crankcase too low. | a) Oil quantity too small.<br>b) Poor oil return from evaporator because:<br>1) Diameter of vertical suction lines too large.<br>2) No oil separator.<br>3) Insufficient fall on horizontal suction line.<br>c) Wear on piston/piston rings and cylinder.<br>d) On compressors in parallel:<br>1) With oil equalising tube: Compressors not on same horizontal plane. Equalising pipe too small.<br>2) With oil level regulation: Float valve partly or wholly blocked.<br>Float valve sticking.<br>e) Oil return from oil separator partly or wholly blocked, or float valve sticking. | Fill oil to correct level, but first be sure that the oil quantity in the crankcase is not a result of oil collection in the evaporator. Install oil lock at 1.2 m to 1.5 m from vertical suction lines. If liquid supply is at the bottom of the evaporator it can be necessary to swap inlet and outlet tubes (liquid supply uppermost)<br>Replace worn components.<br>In all circumstances: the compressor started last is most subject to oil starvation.<br>Line up compressors so that they are in same horizontal plane. Install larger equalising pipe. Fit vapour equalising pipe if necessary.<br>Clean or replace level container with float valve.<br>Ditto.<br>Clean or replace oil return pipe or replace float valve or whole oil separator. |

**System fault location** *(cont.)*

| Symptom | Possible cause | Action |
|---|---|---|
| **Compressor**<br>Oil boils during start. | a) High refrigerant absorption in crankcase oil because of low ambient temperature. | Install heating element in or under compressor crankcase. |
| | b) Systems with oil separator:<br>Too much absorption of refrigerant in oil in separator during standstill. | Oil separator too cold during start. Install thermostat-controlled heating element or solenoid valve with time delay in oil return tube. Fit non return valve in discharge pipe after oil separator. |
| **Compressor**<br>Oil boiling during operation. | a) Flow of liquid refrigerant from evaporator to compressor crankcase. | Set thermostatic expansion valve for higher superheat using MSS method. |
| | b) Systems with oil separator: Float valve not closing completely. | Replace float valve or whole oil separator. |
| **Compressor**<br>Oil discoloured. | System contamination arising from: | In all circumstances: Change oil and filter drier. |
| | a) Cleanliness not observed during installation. | Clean out refrigerant system if necessary. |
| | b) Oil breakdown because of moisture in system. | Clean out refrigerant system if necessary. |
| | c) Oil breakdown because of high discharge pipe temperature. | Locate and remedy cause of excessive discharge pipe temperature. See "Discharge pipe temperature too high". Clean out system if necessary. |
| | d) Wear particles from moving parts. | Clean out refrigerant system if necessary. Replace worn parts or install new compressor. |
| | e) Inadequate cleaning after motor burn-out. | Clean out refrigerant system. Fit DA "burn-out" filter. Replace filter several times if necessary. |
| **Compressor**<br>Will not start. | a) Insufficient or no voltage for fuse group. | Telephone electricity company. |
| | b) Blown group fuses. | Locate fault. Have fault repaired and change fuses. |
| | c) Fuse in control circuit blown. | Locate fault. Have fault repaired and change fuses. |
| | d) Main switch not on. | Switch on. |
| | e) Thermal protection in motor starter cut out or defective, e.g. as a result of: | Locate and repair fault or replace protector. |
| | 1) Excessive suction pressure. | See "Suction pressure too high". |
| | 2) Condensing pressure too high. | See "Condensing pressure too high". |
| | 3) Dirt or copper deposition in compressor bearings, etc. | Clean out refrigerant system, replace compressor and filter drier. |
| | 4) Supply voltage too low. | Telephone electricity company. |
| | 5) Single phase drop out. | Locate and remedy fault (often blown fuse). |
| | 6) Short-circuited motor windings (motor burn-out). | Clean out refrigerant system if necessary, replace compressor and filter drier. |
| | f) Motor winding protectors cut out because of excessive current consumption. | Locate and remedy cause of excessive current consumption, start system when windings have cooled down (can take a long time). |
| | g) Contactors in motor starter burnt out because: | |
| | 1) Starting current too high. | Locate and remedy cause of motor overload, replace contactor. |
| | 2) Contactor undersized. | Replace contactor with larger size. |
| | h) Other safety equipment cut out, incorrectly set or defective: | In all circumstances, locate and repair fault before starting system: |
| | Oil differential control. (no oil, oil boiling). | See "Compressor, Oil level too low" and "Compressor, Oil boiling...." |
| | High-pressure control. | See "Condensing pressure too high". |
| | Low-pressure control. | See "Suction pressure too low". |
| | Flow switch. (insufficient brine concentration, brine pump failure, blocked brine circuit filter, evaporating temperature too low). | Locate and remedy cause of reduced or no flow in brine circuit. See "Liquid coolers". |
| | Frost protection thermostat (insufficient brine concentration, brine pump failure, blocked brine circuit filter, evaporating temperature too low). | Locate and remedy cause of excessively low temperature in brine circuit. See "Liquid coolers". |

**System fault location** *(cont.)*

| Symptom | Possible cause | Action |
|---|---|---|
| **Compressor**<br>Will not start. | i) Regulating equipment cut out, incorrectly set or defective: Low-pressure control, Room thermostat. | Locate and repair fault. Start system. See "Suction pressure too low" and page 179. See also pages 175 and 176. |
| | j) Motor windings burnt out. | |
| | 1) Open compressor: | |
| | Compressor and motor overloaded. | Locate and remedy cause of overload, replace motor. |
| | Motor undersized. | Replace motor with larger size. |
| | 2) Hermetic and semihermetic compressor: | |
| | Compressor and motor overloaded. | Locate and remedy cause of overload, replace compressor. |
| | Acid formation in refrigerant system. | Locate and remedy cause of acid formation, remove compressor, clean out refrigerant system if necessary, fit new "burn-out" filter, refill with oil and refrigerant, install new compressor. |
| | k) Bearing or cylinder seizing because of: | |
| | 1) Dirt particles in refrigerant system. | Clean out system and install new filter drier and new compressor. |
| | 2) Copper deposition on machined parts because of acid formation in refrigerant system. | Clean out system and install new filter drier and new compressor. |
| | 3) Insufficient or no lubrication as a result of: | In all circumstances: Locate and remedy the fault, replace defective parts or install new compressor. |
| | Defective oil pump. | |
| | Oil boiling in crankcase. | See "Compressor, Oil boiling". |
| | Insufficient oil. | See "Compressor, Oil level in crankcase too low". |
| | Oil collection in evaporator. | See "Compressor, Oil level in crankcase too low". |
| | Poor or no oil equalisation between parallel-coupled compressors (oil starvation in compressor started last). | See "Compressor, Oil level in crankcase too low" |
| **Compressor runs constantly, suction pressure too low.** | Cut-out pressure of low-pressure control set too low, or defective control. | See "Suction pressure too low". |
| **Compressor runs constantly, suction pressure too high.** | a) Compressor suction and/or discharge valve not tight. | Replace valve plate, |
| | b) Compressor capacity too low in relation to load at any given time. | Recommend lower load, or replace compressor with larger size. |

**Fault location on the thermostatic expansion valve**

| Symptom | Possible cause | Remedy |
|---|---|---|
| **Room temperature too high** | Pressure drop across evaporator too high. | Replace expansion valve with valve having external pressure equalization.<br>Reset superheat on expansion valve if necessary. |
| | Lack of subcooling ahead of expansion valve. | Check refrigerant subcooling ahead of expansion valve.<br>Establish greater subcooling. |
| | Pressure drop across expansion valve less than the pressure drop the valve is sized for. | Check pressure drop across expansion valve.<br>Try replacement with larger orifice assembly and/or valve.<br>Reset superheat on expansion valve if necessary. |
| | Bulb located to far from evaporator outlet or after an internal heat exchanger or too close to large valves, flanges, etc. | Check bulb location.<br>Locate bulb away from large valves, flanges, etc. |
| | Expansion valve blocked with ice, wax or other impurities. | Clean ice, wax or other impurities from the valve.<br>Check sight glass for colour change (green means too much moisture).<br>Replace filter drier if fitted. Check oil in the refrigeration system.<br>Has the oil been changed or replenished?<br>Has the compressor been replaced?<br>Clean the filter. |
| | Expansion valve too small. | Check refrigeration system capacity and compare with expansion valve capacity.<br>Replace with larger valve or orifice.<br>Reset superheat on expansion valve. |
| | Charge lost from expansion valve. | Check expansion valve for loss of charge.<br>Replace expansion valve.<br>Reset superheat on expansion valve. |
| | Charge migration in expansion valve. | Check whether expansion valve charge is correct.<br>Identify and remove cause of charge migration.<br>Reset superheat on expansion valve if necessary. |
| **Room temperature too high** | Expansion valve bulb not in good contact with suction line. | Ensure that bulb is secured on suction line.<br>Insulate bulb if necessary. |
| | Evaporator completely or partly iced up. | De-ice evaporator if necessary. |
| **Refrigeration system hunts** | Expansion valve superheat set at too small a value. | Reset superheat on expansion valve. |
| | Expansion valve capacity too high. | Replace expansion valve or orifice with smaller size.<br>Reset superheat on expansion valve if necessary. |
| **Refrigeration system hunts at too high a room temperature** | Expansion valve bulb location inappropriate, e.g. on collection tube, riser after oil lock, near large valves, flanges or similar or after an internal heat exchanger. | Check bulb location.<br>Locate bulb so that it receives a reliable signal.<br>Ensure that bulb is secured on suction line.<br>Set superheat on expansion valve if necessary. |
| **Suction pressure too high** | Liquid flow<br>Expansion valve too large.<br>Expansion valve setting incorrect. | Check refrigeration system capacity and compare with expansion valve capacity.<br>Replace with larger valve or orifice.<br>Reset superheat on expansion valve. |
| | Charge lost from expansion valve. | Check expansion valve for loss of charge.<br>Replace expansion valve.<br>Reset superheat on expansion valve. |
| | Charge migration in expansion valve. | Increase superheat on expansion valve.<br>Check expansion valve capacity in relation to evaporator duty.<br>Replace expansion valve or orifice with smaller size.<br>Reset superheat on expansion valve if necessary. |

**Fault location on the thermostatic expansion valve** *(cont.)*

| Symptom | Possible cause | Remedy |
|---|---|---|
| **Suction pressure too low** | Pressure drop across evaporator too high. | Replace expansion valve with valve having external pressure equalization.<br>Reset superheat on expansion valve if necessary. |
| | Lack of subcooling ahead of expansion valve. | Check refrigerant subcooling ahead of expansion valve.<br>Establish greater subcooling. |
| | Evaporator superheat too high. | Check superheat.<br>Reset superheat on expansion valve. |
| | Pressure drop across expansion valve less than pressure drop valve is sized for. | Check pressure drop across expansion valve.<br>Replace with larger orifice assembly and/or valve if necessary. |
| | Bulb located too cold, e.g. in cold air flow or near large valves, flanges, etc. | Check bulb location. Insulate bulb if necessary.<br>Locate bulb away from large valves, flanges, etc. |
| | Expansion valve too small. | Check refrigeration system capacity and compare with expansion valve capacity.<br>Replace with larger valve or orifice.<br>Reset superheat on expansion valve. |
| | Expansion valve blocked with ice, wax or other impurities. | Clean ice, wax and other impurities from valve.<br>Check sight glass for colour change (yellow means too much moisture).<br>Replace filter drier if fitted.<br>Check oil in the refrigeration system.<br>Has the oil been changed or replenished?<br>Has the compressor been replaced?<br>Clean the filter. |
| | Charge lost from expansion valve. | Check expansion valve for loss of charge.<br>Replace expansion valve.<br>Reset superheat on expansion valve. |
| | Charge migration in expansion valve. | Check charge in expansion valve.<br>Reset superheat on expansion valve if necessary. |
| | Evaporator wholly or partly iced up. | De-ice evaporator if necessary. |
| **Liquid hammer in compressor** | Expansion valve capacity too large. | Replace expansion valve or orifice with smaller size.<br>Reset superheat on expansion valve if necessary. |
| | Superheat on expansion valve set too low. | Increase superheat on expansion valve. |
| | Expansion valve bulb not in good contact with suction line. | Ensure that bulb is secured on suction line.<br>Insulate bulb if necessary. |
| | Bulb located too warm or near large valves, flanges, etc. | Check bulb location on suction line.<br>Move bulb to better position. |

### Fault location on the solenoid valve

| Symptom | Possible cause | Remedy |
|---|---|---|
| **Solenoid valve does not open** | No voltage on coil | Check whether the valve is open or closed<br>1) use a magnetic field detector<br>2) lift the coil and feel whether there is resistance.<br>**NOTE!**<br>Never take the coil off the valve if voltage is applied - the coil can burn out.<br>Check the wiring diagram and wiring itself. Check relay contacts. Check lead connections. Check fuses. |
| | Incorrect voltage/frequency. | Compare coil data with installation data.<br>Measure operating voltage at the coil.<br>– Permissible variation:<br>10% higher than rated voltage.<br>15% lower than rated voltage.<br>Replace with correct coil if necessary. |
| | Burnt-out coil | See symptom "Burnt-out coil" |
| | Differential pressure too high | Check technical data and differential pressure of valve.<br>Replace with suitable valve.<br>Reduce differential. pressure e.g. inlet pressure. |
| | Differential pressure too low | Check technical data and differential pressure of valve.<br>Replace with suitable valve.<br>Check diaphragm and/or piston rings and replace O-rings and gaskets *)<br>Replace O-rings and gaskets *) |
| | Damaged or bent armature tube | Replace defective components *)<br>Replace O-rings and gaskets *) |
| | Impurities in diaphragm/piston | Replace defective components *)<br>Replace O-rings and gaskets *) |
| | Impurities in valve seat.<br>Impurities in armature/armature | Clean out impurities.<br>Replace defective parts *)<br>Replace O-rings and gaskets *) |
| | Corrosion/cavitation | Replace defective parts *)<br>Replace O-rings and gaskets *) |
| | Missing components after dismantling valve | Fit missing components.<br>Replace O-rings and gaskets *) |
| **Solenoid valve opens partially** | Differential pressure too low | Check valve technical data and differential pressure. Replace with suitable valve.<br>Check diaphragm and/or piston rings and replace O-rings and gaskets *) |
| | Damaged or bent armature tube | Replace defective components *)<br>Replace O-rings and gaskets *) |
| | Impurities in diaphragm/piston | Clean out impurities.<br>Replace defective components *)<br>Replace O-rings and gaskets *) |
| | Impurities in valve seat<br>Impurities in armature/armature tube | Clean out impurities.<br>Replace defective parts *)<br>Replace O-rings and gaskets *) |
| | Corrosion/cavitation | Replace defective parts *)<br>Replace O-rings and gaskets *) |
| | Missing components after dismantling of valve | Fit missing components *)<br>Replace O-rings and gaskets *) |

* See cross section in the instruction. See also the spare parts documentation on http://www.danfoss.com

**Fault location on the solenoid valve** *(cont.)*

| Symptom | Possible cause | Remedy |
|---|---|---|
| **Solenoid valve does not close/ closes partially** | Continuous voltage on coil | Lift coil and feel whether there is any resistance.<br>**NOTE!**<br>Never take the coil off if voltage is applied - the coil can burn out. Check the wiring diagram and wiring itself. Check relay contacts. Check lead connections. |
| | Manual spindle not screwed back after use | Check spindle position. |
| | Pulsation in discharge line. Differential pressure too high in open position.<br>Pressure in outlet side sometimes higher than in inlet. | Check technical data of valve.<br>Check pressure and flow condition<br>Replace with suitable valve.<br>Check remainder of system. |
| | Damaged or bent armature tube | Replace defective components *)<br>Replace O-rings and gaskets *) |
| | Defective valve plate, diaphragm or valve seat | Check pressure and flow conditions.<br>Replace defective components *)<br>Replace O-rings and gaskets *) |
| | Diaphragm or support plate wrong way round | Check for correct valve assembly *)<br>Replace O-rings and gaskets *) |
| | Impurities in valve plate. Impurities in pilot orifice. Impurities in armature tube. | Clean out impurities.<br>Replace O-rings and gaskets *) |
| **Solenoid valve does not close/ closes partially** | Corrosion/cavitation of pilot/main orifice | Replace defective parts *)<br>Replace O-rings and gaskets *) |
| | Missing components after dismantling of valve | Replace missing components *)<br>Replace O-rings and gaskets *) |
| **Solenoid valve noisy** | Frequency noise (hum) | The solenoid valve is not the cause.<br>Check electrical supply. |
| | Liquid hammer when solenoid valve opens | See the chapter "Solenoid valves" |
| | Liquid hammer when solenoid valve closes | See the chapter "Solenoid valves" |
| | Differential pressure too high and/or pulsation in discharge line | Check technical data of valve. Check pressure and flow conditions. Replace with suitable valve. Check remainder of system. |
| **Burnt-out coil**<br>(Coil cold with voltage on) | Incorrect voltage/frequency | Check coil data.<br>Replace with correct coil if necessary.<br>Check wiring diagram or wiring itself.<br>Check max. voltage variation.<br>- Permissible variation:<br>10% higher than rated voltage<br>15% lower than rated voltage. |
| | Short-circuit in coil<br>(can be moisture in coil). | Check remainder of system for short-circuiting.<br>Check lead connections at coil.<br>After remedying fault, replace coil (make sure voltage is correct). Check O-rings fitted on armature tube and inside top nut. |
| | Armature will not lift in armature tube<br>a) Damaged or bent armature tube<br>b) Damaged armature<br>c) Impurities in armature tube | Replace defective components.<br>Clean out impurities *)<br>Replace O-rings and gaskets *) |
| | Temperature of medium too high | Compare valve and coil data installation data.<br>Replace with suitable valve. |
| | Ambient temperature too high | Change of valve position might be necessary.<br>Compare valve and coil data with installation data.<br>Increase ventilation around valve and coil. |
| | Damaged piston, piston rings (on servo-operated solenoid valves type EVRA) | Replace defective parts.<br>Replace O-rings and gaskets *) |

* See cross section in the instruction. See also the spare parts documentation on http://www.danfoss.com

**Fault location on the pressure control**

| Symptom | Possible cause | Remedy |
|---|---|---|
| **High-pressure control disconnected.<br>Warning:<br>Do not start the system before the fault has been located and rectified!** | Condensing pressure too high because:<br>Dirty/clogged condenser surfaces.<br>Fans stopped/water supply failure.<br>Defective phase/fuse, fan motor.<br>Too much refrigerant in system.<br>Air in system. | Rectify the stated faults. |
| **The low-pressure control fails to stop the compressor** | a) Differential setting too high so that cut-out pressure falls below –1 bar.<br>b) Differential setting too high so that compressor cannot pull down to cut-out pressure. | Increase the range setting or reduce the differential. |
| **Compressor running time too short** | a) Differential setting on low pressure control too low.<br>b) High-pressure control setting too low, i.e. too close to normal operating pressure.<br>c) Condensing pressure too high because of:<br>Dirty/clogged condenser surfaces.<br>Fans stopped/water supply failure.<br>Defective phase/fuse, fan motor.<br>Too much refrigerant in system.<br>Air in system. | a) Increase the differential setting.<br>b) Check the high-pressure control setting. Increase it if the system data allows.<br>c) Rectify the stated faults. |
| **Cut-out pressure for KP 7 or KP 17, HP side, does not match the scale value** | The fail-safe system in the bellows element is activated if the deviations have been greater than 3 bar. | Replace the pressure control. |
| **Differential spindle on single unit is bent and the unit does not function** | Tumbler action failure arising from attempt to test wiring manually from righthand side of unit. | Replace unit and avoid manual test in any way other than that recommended by Danfoss. |
| **High-pressure control chatters** | Liquid-filled bellows multifies the damping orifice in the inlet connection. | Install the pressure control so that liquid cannot collect in the bellows element (see instruction).<br>Eliminate cold air flow around the pressure control. Cold air can create condensate in the bellows element.<br>Fit a damping orifice (code no. 060-1048) in the end of the control connection furthest away from the control. |
| **Periodic contact failure on computer-controlled regulation, with minimum voltage and current** | Transition resistance in contacts too high. | Fit KP with gold contacts. |

**Fault location on the thermostat**

| Symptom | Possible cause | Remedy |
|---|---|---|
| **Compressor running time too short and temperature in cold room too high**<br><br>**Refrigeration system runs with too high a temperature differential** | Capillary tube on thermostat with vapour charge touching evaporator, or suction line colder than sensor.<br>a) Reduced air circulation around thermostat sensor.<br>b) Refrigeration system temperature changes so fast that the thermostat can not keep pace.<br>c) Room thermostat mounted on a cold wall in the cold room. | Locate capillary tube so that the sensor is **always** the coldest part.<br><br>a) Find a better sensor location with higher air velocity or better contact with evaporator.<br>b) Use a thermostat with a smaller sensor. Reduce the differential. Ensure that the sensor has better contact.<br>c) Insulate the thermostat from the cold wall. |
| **Thermostat does not start compressor, even when sensor temperature is higher than the set value. The thermostat does not react to hand-warming of the sensor** | a) Completely or partially lost charge because of fractured capillary tube.<br>b) Part of the capillary tube in a thermostat with vapour charge is colder than the sensor. | a) Replace thermostat and mount sensor/capillary tube correctly.<br>b) Find a better location for the thermostat so that the sensor is always the coldest part. Change to thermostat with adsorption charge. |
| **Compressor continues to run, even when thermostat sensor is colder than the set value (range setting minus differential)** | A thermostat with vapour charge has been set without taking account of graph curves in the instruction sheet. | At low range setting the differential of the thermostat is larger than indicated in the scale (See diagram in the instruction sheet). |
| **Thermostat with absorp-tion charge unstable in operation** | Large variation in ambient temperature gives enclosure-sensitivity. | Avoid ambient temperature variations around thermostat. If possible, use a thermostat with vapour charge (not sensitive to ambient temperature variations).<br>Replace thermostat with unit having a larger sensor. |
| **Differential spindle on single unit is bent and the unit does not function** | Tumbler action failure arising from attempt to test wiring manually from righthand side of thermostat. | Replace thermostat and avoid manual test in any way other than that recommended by Danfoss. |

**Fault location on the water valve**

| Symptom | Possible cause | Remedy |
|---|---|---|
| **Condensing pressure too high, water-cooled condensers** | WV water valve set for too high a pressure (water quantity too small). | Increase the water quantity by setting the water valve at a lower pressure. |
| | Filter ahead of WV water valve blocked. | Clean filter and flush water valve after opening it to allow full flow (two screwdrivers, see instruction). |
| | Leaking bellows in WV water valve. | Check bellows for leakage, using a leak detector if necessary. Replace bellows element. See spare parts catalogue*. There must be no pressure on bellows element during removal and refitting. |
| | Capillary tube between WV water valve and condenser blocked or deformed. | Check capillary tube for blockage or deformation. Replace capillary tube. |
| | WV water valve closed because of defective upper diaphragm. | Check water valve for cracks in diaphragm.<br>Replace diaphragm.<br>See spare parts catalogue*.<br>There must be no pressure on bellows element during removal and refitting. |
| **Condensing pressure too low, water-cooled condensers** | Water quantity too large. | Set WV water valve for smaller water quantity, i.e. higher pressure. |
| | WV water valve open because of defective lower diaphragm. | Check water valve for cracks in diaphragm.<br>Replace diaphragm.<br>See spare parts catalogue*.<br>There must be no pressure on bellows element during removal and refitting. |
| | WV water valve cannot close because of dirt in the seat. Valve cone sticks because of dirt. | Check water valve for dirt and clean it.<br>Replace parts as necessary.<br>See spare parts catalogue*.<br>There must be no pressure on bellows element during removal and refitting.<br>Install a filter ahead of the water valve. |
| **Condensing pressure hunts** | WV water valve too large. | Replace water valve with a smaller size. |

*) Find spare part documentation on http://www.danfoss.com

**Fault location on the filter or sight glass**

| Symptom | Possible cause | Action |
|---|---|---|
| **Sight glass indicator shows yellow** | Too much moisture in system. | Replace filter drier* |
| **Insufficient evaporator capacity** | Pressure drop across filter too high. | Compare filter size with system capacity. Replace filter drier* |
| | Filter clogged. | Replace filter drier* |
| | Filter under-sized. | Compare filter size with system capacity. Replace filter drier* |
| **Bubbles in sight glass after filter** | Pressure drop across filter too high. | Compare filter size with system capacity. Replace filter drier* |
| | Filter clogged. | Replace filter drier* |
| | Filter under-sized. | Compare filter size with system capacity. Replace filter drier* |
| | Insufficient sub-cooling. | Check reason for insufficient subcooling. Do not charge refrigerant only because of insufficient sub-cooling. |
| | Insufficient refrigerant charge. | Charge necessary refrigerant. |
| **Filter outlet side colder than inlet side (can be iced up)** | Pressure drop across filter too high. | Compare filter size with system capacity. Replace filter drier* |
| | Filter clogged. | Replace filter drier* |
| | Filter under-sized. | Compare filter size with system capacity. Replace filter drier* |

* Rember to seal the old filter after removal.

**Fault location on the KV pressure regulator**

| Symptom | Possible cause | Action |
|---|---|---|
| **Room temperature too high** | KVP evaporating pressure regulator set too high. | Reduce the setting of the evaporating pressure regulator. The setting should be about 8-10 K lower than required room temperature. Remember to screw on protective cap after final setting. |
| | Bellows leak in KVP evaporating pressure regulator. | Slowly loosen protective cap. If pressure or traces of refrigerant exist under the cap, there is a leak in the bellows. Replace the valve. |
| **Room temperature too low** | KVP evaporating pressure regulator set too low. | Increase the setting of the evaporating pressure regulator. The setting should be about 8-10 K lower than the required room temperature. Remember to screw on protective cap after final setting. |
| **Suction pressure hunts** | KVP evaporating pressure regulator too large. | Replace evaporating pressure regulator with smaller size. Remember to screw on the protective cap after final setting. |
| | KVC capacity regulator too large. | Replace capacity regulator with smaller size. Remember to screw on protective cap after final setting. |
| **Suction pressure too high** | KVC capacity regulator defective or set too high. | Replace capacity regulator. Set capacity regulator at lower pressure. Remember to screw on protective cap after final setting. |
| **Condensing pressure too high, air-cooled condensers** | KVR condensing pressure regulator set too high. | Set condensing pressure regulator at correct pressure. Remember to screw on protective cap after final setting. |
| **Condensing pressure too high, water-cooled condensers** | Bellows in KVR condensing pressure regulator might be leaking. | Slowly loosen protective cap. If pressure or traces of refrigerant exist under the cap, there is a leak in the bellows. Replace valve. |
| **Crankcase pressure regulator setting drift** | Bellows leak in KVL crankcase pressure regulator. | Slowly loosen protective cap. If pressure or traces of refrigerant exist under the cap, there is a leak in the bellows. Replace the valve. |
| **Compressor discharge pipe too hot** | Probable bellows leak in KVC capacity regulator. | Slowly loosen protective cap. If pressure or traces of refrigerant exist under the cap, there is a leak in the bellows. Replace valve. |
| | Hot gas quantity too large. | If necessary, set the KVC capacity regulator at lower pressure. An injection valve (e.g. TE2) can be installed in the suction line. |
| **Temperature in receiver too high No subcooled liquid** | KVD receiver pressure regulator set for too low a pressure. | Set the receiver pressure regulator at a higher pressure. It might also be necessary to increase the setting of the condensing pressure regulator. |
| | Bellows in KVD receiver pressure regulator might be leaking. | Slowly loosen protective cap. If pressure or traces of refrigerant exist under the cap, there is a leak in the bellows. Replace valve. |

**Contents**

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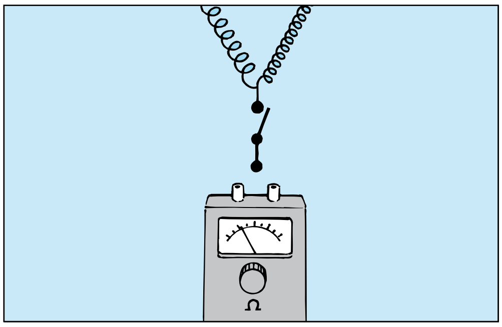
# Notes

## 1.0 Compressor/system does not run (start)

| | |
|---|---|
| Main switch drop-out | Blown fuse<br>Short-circuiting to frame<br>Motor defect<br>Defective current lead-in<br>Electrical equipment |
| Compressor | Compressor motor/motor protector mechanically blocked.<br>Overload<br>Voltage/frequency<br>Pressure irregularity<br>Refrigerant type<br>Pressure equalisation<br>Fan drop-out |
| High and low-pressure switches | Mechanical defect<br>Incorrect connection<br>Incorrect differential setting<br>Incorrect cutout setting<br>Pressure irregularity |
| Thermostat | Mechanical defect<br>Incorrect connection<br>Differential too small<br>Incorrect cutout value |

### 1.1

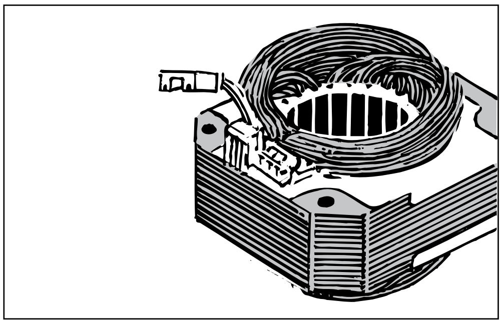
If the main fuse blows, the cause must be found. This will most often be a defect in the motor windings or motor protector, short-circuiting to frame or a burnt current lead-in which, in turn, causes main fuse drop-out. If a compressor motor refuses to start, always check the resistances first. All compressors have their main and start windings located as shown in the sketch. Resistance values are stated in the individual data sheets.




Am0_0075

### 1.2

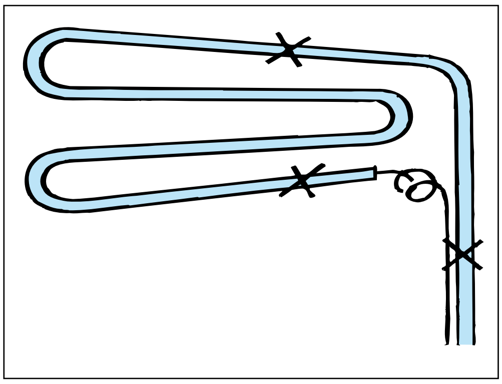
As a rule, a motor protection is built into all compressor motors. If the winding protector cuts out the motor, due to the heat accumulated in the motor the cut-out period can be relatively long (up to 45 minutes). When the motor will no longer run, resistance measurement will confirm whether a motor protector has cut out or whether a winding is defective. A mechanical seizure in the compressor will show itself by repeated start attempts accompanied by high current consumption and high winding temperatures that cause motor protector cutout.



Am0_0076

### 1.3

Compressor overload can be recognised by the compressor refusing to start or by starting and then stopping again after a very short time (via the motor protector). If the com-pressor is used outside its allowed application limits the usual result is overload. Application limits such as voltage tolerances, frequencies, temperature/ pressure and refrige-rant type are given in the individual data sheet. In systems not protected by a high-pressure cut-out switch on the discharge side, a fan motor which is defective or cut out via a motor protector can lead to compressor overload. Generally, the refrigerant quantity must be determined precisely. In capillary tube systems the most certain method is to take temperature measurements on the evaporator and suction line.



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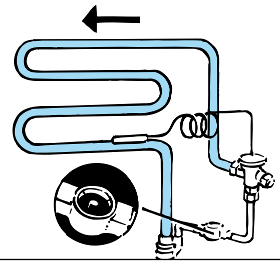
1.4

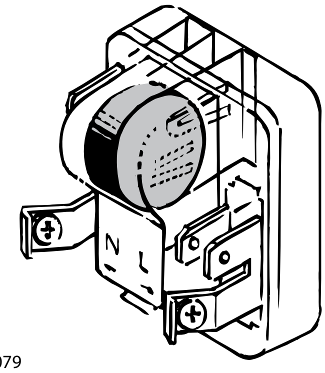
In systems with thermostatic expansion valve, charging must be checked using a sight glass. In both systems, the refrigerant quantity must be less than the quantity that can be accommodated in the free volume on the discharge side.



Am0_0078

1.5

Compressors for capillary tube systems are usually equipped with a PTC LST starting device. Starting via a PTC requires complete pressure equalisation between the high and low-pressure sides on every start. In addition, before it can operate, the PTC requires a standstill time of about 5 minutes to ensure that the PTC component is cooled down in order to achieve maximum starting torque. When a "cold" compressor is started and the current is cut off a short time after, conflict can arise between the PTC and the motor protector. Because the motor retains heat, up to approx. 1 hour can elapse before normal start is possible.

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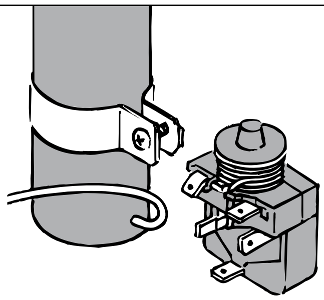
1.6

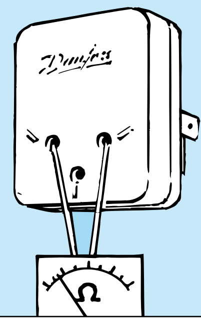
In systems where pressure equalisation on starting is not certain, the compressor must be equipped with an HST starting device. This also applies to capillary tube systems with a standstill time of less than 5 minutes. Defective or incorrect relays and starting capacitors can cause starting problems or that the compressor is cut out via the motor protector. Note the manufacturer's compressor data. If the starting device is thought to be defective the whole equipment must be replaced, including the relay and starting capacitor.



Am0_0080

1.7

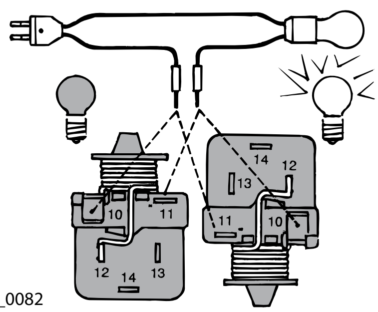
The PTC (25 Ω for 220 V mains and approx. 5 Ω for 115 V mains) can be checked using an ohmmeter.




Am0_0081

1.8

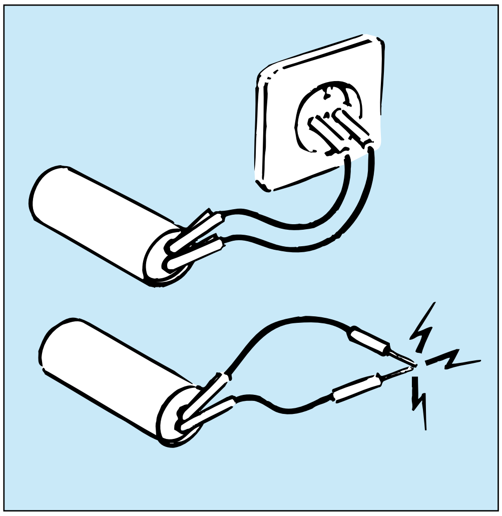
A starting relay can be checked with a lamp, see sketch. The relay is in order if the lamp does not light up when the relay is upright. The relay is also in order if the lamp lights up when the relay is upside down.




Am0_0082

**1.9**

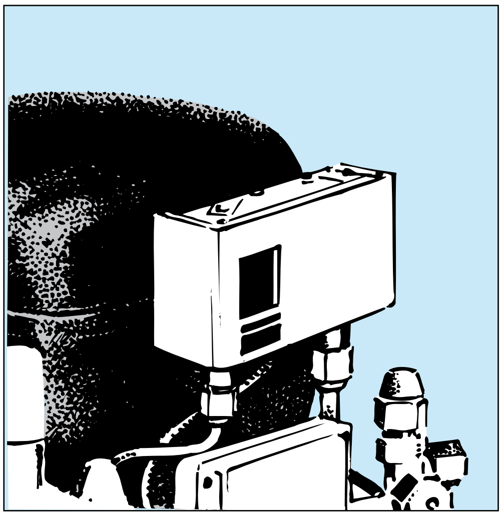
A starting capacitor can also be checked by applying rated mains voltage to it for a few seconds and then short-circuiting the leads. If sparks appear, the capacitor is in order.



Am0_0083

**1.10**

In some markets, Danfoss offers condensing units with combined high and low-pressure switches that protect the compressor against excessive pressure on the discharge side and too low pressures on the suction side. If the high-pressure switch has cut out the system, a check should be made to see whether pressure irregularity is occurring. If the low-pressure switch has cut out, the cause can be insufficient refrigerant amount, leakage, evaporator icing and/or partial blockage of the throttling device.
If there is no pressure irregularity on the high or low-pressure sides, the pressure switch itself must be checked. See also the chapter "Pressure controls".

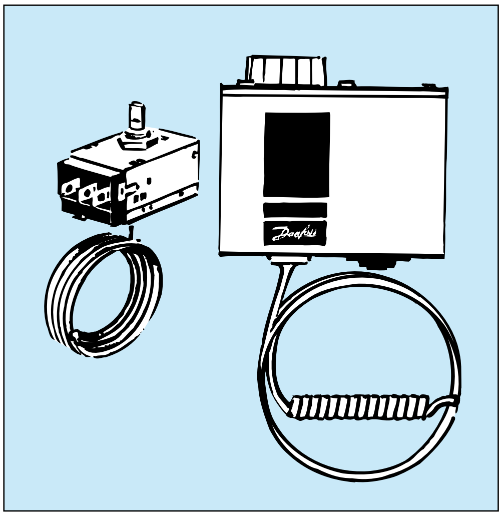


Am0_0084

**1.11**

The system can also cut out because of a defective or incorrectly set/sized thermostat. If the thermostat loses charge or if the temperature setting is too high, the system will not start. If the temperature differential is set too low, compressor standstill periods will be short and there might be starting problems with an LST starting device and shortened compressor life with an HST starting device. The guideline for pressure equalisation time using an LST starting device is 5 to 8 minutes for refrigerators and 7 to 10 minutes for freezers.

If an HST starting device is used, the aim is to keep the cut-in periods per hour as few as possible. Under no circumstances must there be more than ten starts per hour. See also the chapter "Thermostats".



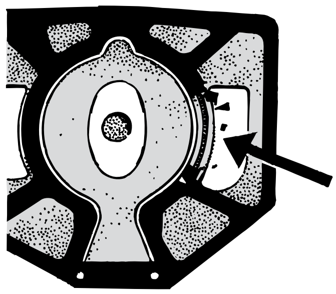
Am0_0085

## 2.0 The compressor/system runs, but with reduced refrigeration capacity

| | |
|---|---|
| Compressor | Leakage<br>Coking |
| Pressure irregularity | Blockage<br>Non-condensible gases<br>Moisture<br>Dirt<br>Fan defect<br>Refrigerant loss<br>Refrigerant overcharge<br>Icing |
| Throttling device<br>Capillary tube/thermostatic expansion valve | Static superheat setting<br>Orifice size/diameter |

**2.1**

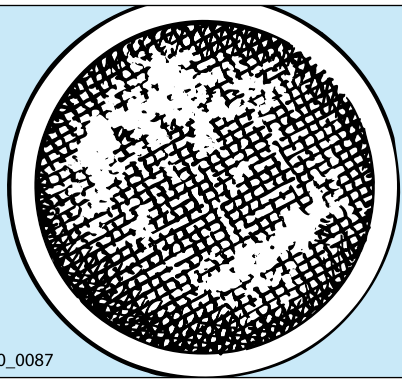
Frequent causes of reduced refrigeration capacity are coking, and copper plating which lead to reduced life time of the compressor and burst gaskets in the compressor valve system.
Coking occurs mainly as a result of moisture in the refrigeration system. In high temperatures, the presence of moisture also causes copper plating on valve seats. The burst gaskets are the result of an excessive condensing pressure and excessively high short-lived pressure peaks >60 bar (liquid hammer).



Am0_0086

**2.2**

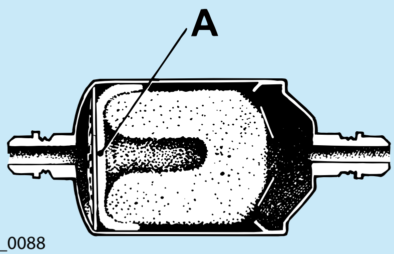
We recommend the installation of good quality filter driers. If the filter material is of poor quality, wear will occur which will not only cause the partial blockage of capillary tube and the filter in the thermostatic expansion valve, but it will also damage the compressor (mainly seizure).



Am0_0087

**2.3**

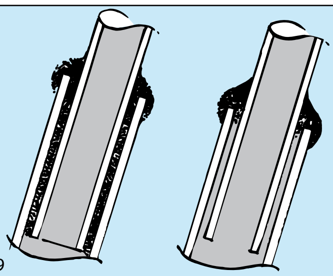
In general, commercial refrigeration systems must be equippd with filters having a solid core, e.g. type DML. See also the chapter "Filter driers & sight glasses".
The filter drier must be replaced after every repair. When replacing a "pencil drier" (often used in refrigerators) care must be taken to ensure that the filter material used is suitable for the refrigerant and that there is sufficient material for the application.




Am0_0088

**2.4**

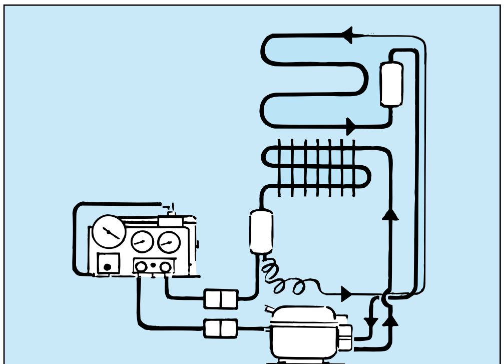
Poorly soldered joints can also cause system blockage. Making good soldered joints is conditional on using the correct soldering metal containing the correct percentage of silver.
The use of flux should be limited and kept to as minimum as possible.



Am0_0089

**2.5**

Poorly soldered joints can also cause leakage and thereby coking. In a refrigeration circuit the proportion of non-condensible gases should be kept below 2%, otherwise the pressure level will rise. The main purpose of evacuation is to remove non-condensible gases before the refrigerant is charged. This also produces a drying effect in the refrigeration system. Evacuation can be performed either from both discharge and suction sides, or from the suction side only. Evacuation from both sides gives the best vacuum. Evacuation from the suction side only makes it difficult to obtain sufficient vacuum on the discharge side. Therefore, with one-sided evacuation, intermediate flushing with dry Nitrogen is recommended until pressure equalisation is achieved.



Am0_0090

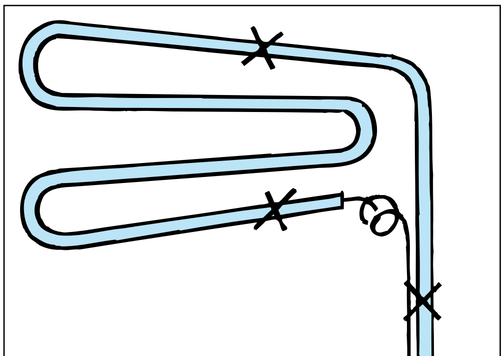
**2.6**

Dirt on the condenser and a fan motor defect can cause excessive condensing pressure and thereby reduced refrigeration capacity. In such cases the built-in high-pressure switch provides overload protection on the condenser side.
**Note:** The built-in motor protector does not give the compressor optimum protection if the condensing pressure rises as a result of a fan motor drop-out. The temperature of the motor protector does not rise quickly enough to ensure the protector cutout. This also applies when the refrigerant quantity is greater than can be accommodated in the free volume on the discharge side.

Am0_0091

**2.7**

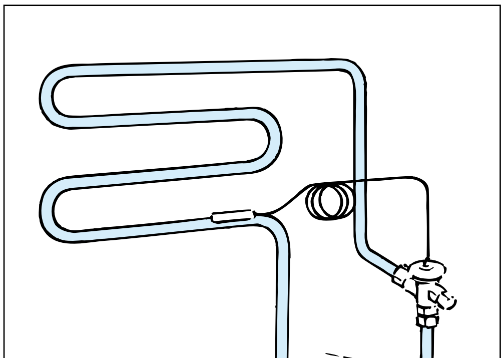
It is important to determine the quantity of refrigerant precisely – especially in capillary tube systems. The guidelines are that the temperature on the evaporator inlet must, as far as possible, be the same as the temperature at its outlet, and that as much superheating as possible must be obtained between the evaporator outlet and the compressor inlet. (The inlet temperature on the compressor must be about 10 K less than the condensing temperature).



Am0_0092

**2.8**

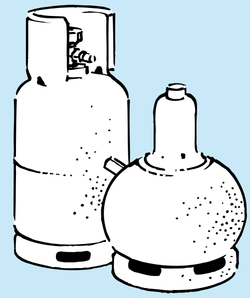
Overcharging of a refrigeration system equipped with a thermostatic expansion valve becomes critical when the charging quantity in liquid condition is greater than can be accommodated by the free volume in the receiver, i.e. the condenser area is reduced and the condensing pressure rises.



Am0_0093

**2.9**

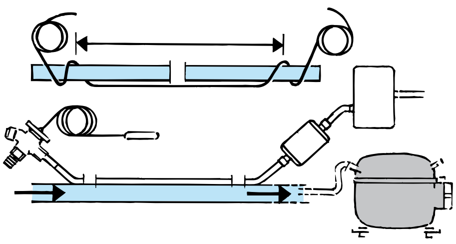
It is very seldom that there is too little refrigerant in a system, unless leakage occurs. Irregular icing on the evaporator is often a sign of insufficient refrigerant. This irregular icing does not only reduce the refrigeration output, it can also give problems in evaporator defrosting because the defrost thermostat sensor does not register the presence of ice. Therefore, precise determination of the refrigerant charge is recommended as a way of making sure that ice on the evaporator is evenly distributed.



Am0_0094

**2.10**

The optimum system efficiency is obtained when a heat exchanger is fitted to ensure subcooling: about 5 K in systems with thermostatic expansion valve and about 3 K in systems with capillary tube. In systems with a thermostatic expansion valve the suction and liquid lines must be soldered together over a distance of 0.5 to 1.0 m. In capillary tube systems the capillary tube and suction line must be soldered together for 1.5 to 2.0 m.



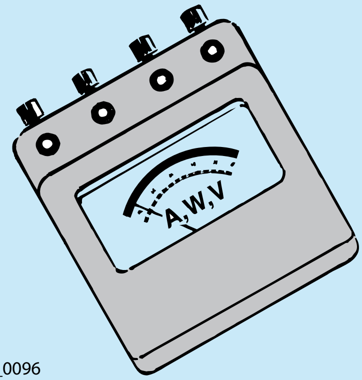
Am0_0095

**3.0**
**Power consumption too high**

| | |
|---|---|
| Compressor | Signs of compressor wear<br>Motor defect<br>Reduced refrigeration capacity<br>Compressor cooling |
| Pressure irregularity | Blockage<br>Non-condensible gases<br>Moisture<br>Dirt<br>Fan defect |
| Overload | Application limits exceeded<br>Voltage/frequency<br>Pressure irregularity<br>Temperature<br>Refrigerant type |

**3.1**

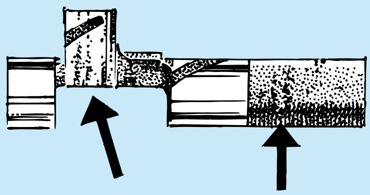
Pressure irregularity and overload often cause compressor defects that show themselves in the form of increased power consumption. Refer to the previous pages for information on problems with pressure irregularity and compressor overload seen from the system side.
Excessive evaporating and condensing pressures cause compressor motor overload which leads to increased power consumption. This problem also arises if the compressor is not sufficiently cooled, or if extreme overvoltage occurs. Undervoltage is not normally a problem in Western Europe because here the voltage rarely drops below 198 V.



Am0_0096

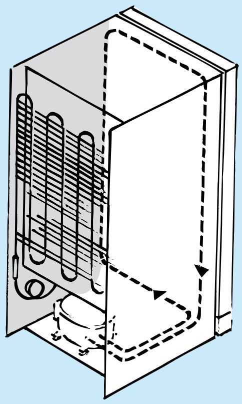
**3.2**

Constant overload will give signs of wear in compressor bearings and valve systems. Overload that causes frequent winding protector cutouts can also produce an increased number of electrical drop-outs.
In cases where the application limits are exceeded, the system must be adapted. For example, by the use of a thermostatic expansion valve with an MOP that will limit the evaporating pressure, a pressure regulator, or a condensing pressure regulator. See also the chapter "Thermostatic expansion valves" and the chapter "Pressure regulators".


Am0_0097

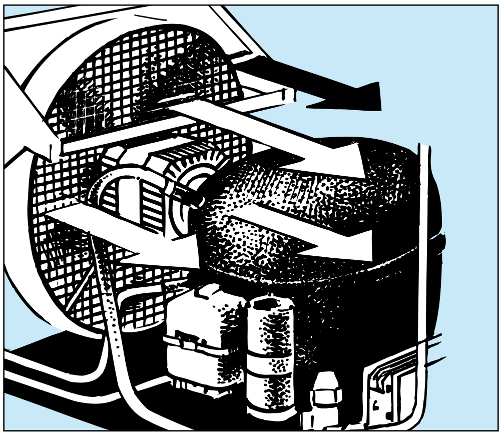
**3.3**

Static cooling (in certain circumstances an oil cooler) is sufficient for most household refrigeration appliances, provided that the clearances specified by the manufacturer are maintained, especially where a built-in appliance is concerned.


Am0_0098

**3.4**

Commercial equipment should be fan-cooled. The normal recommended air velocity across condenser and compressor is 3 m/s.



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**3.5**

A further recommendation is regular service on the refrigeration system, including cleaning of the condenser.

Am0_0100

## 4.0 Noise

| | |
|---|---|
| **Compressor** | Pressure circuit<br>Oil level<br>Clearance: piston/cylinder<br>Valve system |
| **Fan** | Deformed fan blades<br>Bearing wear<br>Baseplate |
| **Valves** | Whistling« from thermostatic expansion valves<br>»Chatter« from solenoid and check valves |
| **System noise** | Liquid noise<br>(mainly in evaporator) |
| **Installation** | Piping<br>Compressor, fan and condenser brackets |

**4.1**

Danfoss compressors and condensing units do not normally give rise to complaints about noise. The noise level of compressors and, above all, fans is well in agreement with the demands made by the market. If occasional complaints are received, they usually arise from installation or system errors.


Am0_0101

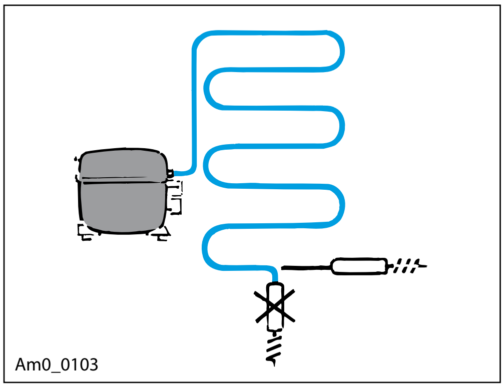
**4.2**

The rare noise problems that do occur are mostly because of production faults, e.g. discharge line touching the compressor housing, oil level too high/low, too much clearance between piston and cylinder, faulty assembly of the valve system. Such noise is easy to diagnose with a screwdriver used as a "stethoscope".


Am0_0102

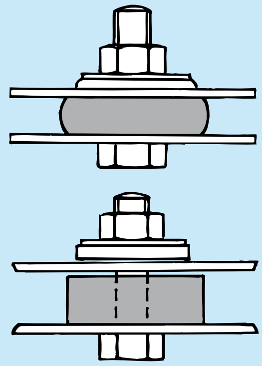
**4.3**

System noise is a critical factor in household appliances. Here, liquid noise at the evaporator inlet is characteristic. On the system side it is difficult to remedy this problem because what is involved is a mass produced equipment. If the filter is mounted vertically, it might help to mount it horizontally instead. However, it should be remembered that noise can be amplified by structure, e.g. with a built-in appliance. In such a situation, the manufacturer should be contacted.


Am0_0103

**4.5**

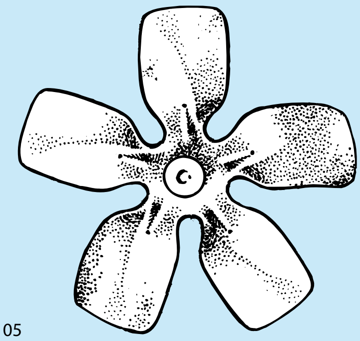
To prevent noise transfer, pipework should not be allowed to touch the compressor, the heat exchanger or the side walls.
When installing a compressor, the fittings and grommet sleeves supplied must be used to avoid the rubber pads being compressed so much that they lose their noise-suppression properties.



Am0_0104

**4.6**

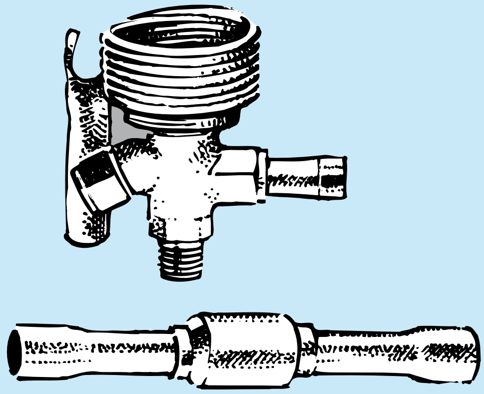
Fans are used mostly in commercial refrigeration systems. Noise will be generated if the fan blades become deformed or touch the heat exchanger fins. Worn bearings also produce a great deal of noise. Additionally, the fan unit must be firmly secured so that it does not move in relation to its mounting bracket. Normally, fans have a higher noise level than compressors. In some circumstances, it is possible to reduce the noise level by installing a smaller fan motor, but this can only be recommended when the condenser area is over-sized.



Am0_0105

**4.7**

If the noise comes from the valves, the cause is usually incorrect sizing. Solenoid and check valves must never be sized to suit the pipe connections, but in accordance with the $k_v$ value. This ensures the min. pressure drop necessary to open the valve and keep it open without valve "chatter". Another phenomenon is "whistling" in thermostatic expansion valves. Here a check should be made to ensure that the size of the orifice corresponds to the system characteristics and that above all there is sufficient liquid sub-cooling ahead of the expansion valve [approx. 5 K].



Am0_0106

## Contents

# Notes

## General

This section is directed especially to the service network, for household appliances and similar. It deals mainly with PL, TL, NL and FR compressors for 220-240V.
For detailed information on compressors see the data sheets.

Compressors type PL, TL, NL, FR and partly SC are equipped with a PTC starting device (fig. 1) or a relay and start capacitor (fig. 2). The motor protector is built into the windings.

In the event of a start failure, with a cold compressor, up to 15 minutes can elapse before the protector cuts out the compressor.

When the protector cuts out and the compressor is warm, it can take up to 1 hour before the protector cuts in the compressor again.

The compressor must not be started without the electrical equipment.

*Fig. 1: PTC starting device*

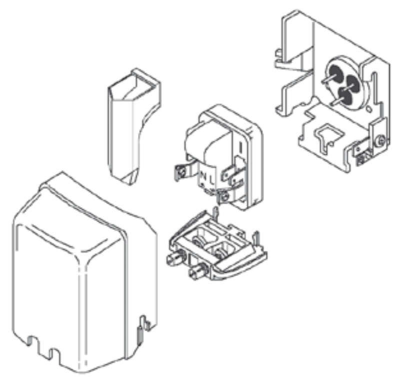


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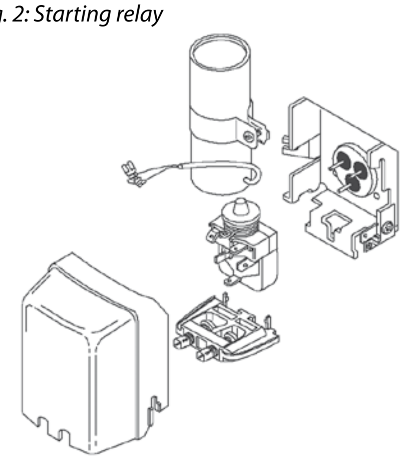
*Fig. 2: Starting relay*



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## Fault location

Before beginning systematic fault location, a good rule is to cut the supply voltage for at least 5 minutes. This ensures that the PTC starting device has cooled off and is ready for start.

A voltage drop or blackout within the first minutes of a pull down of the appliance with cold compressor, can lead to an interlocking situation.

A compressor with PTC can not start at non equalized pressure and the PTC does not cool down so fast. It can take more than 1 hour until the appliance then operates normally again.

## Electrical compressor quick check

To avoid unneccessary protector operation and consequent waiting time, it is important to carry out fault location in the sequence given below. Tests are made according to desriptions on following page.

- Remove electrical equipment
- Check electrical connection between main and start pins of compressor terminal
- Check electrical connection between main and common pins of
- Compressor terminal
- Replace compressor, if above connection checks failed
- Else, replace electrical equipment

If the compressor still does not operate, most probably it is no electrical compressor failure. For more detailed fault location, see the tables.

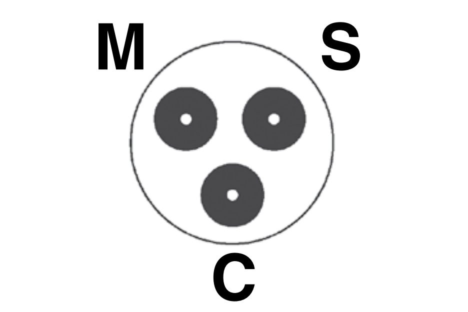
**Check main and start winding**

- Resistance between pins M (main) and S (start) on compressor terminals is measured with an ohm-meter, see fig. 3.

| | | | |
|---|---|---|---|
| Connection → | Main and start windings normally OK → | Replace relay | |
| No connection → | Main or start winding defective → | Replace compressor | |

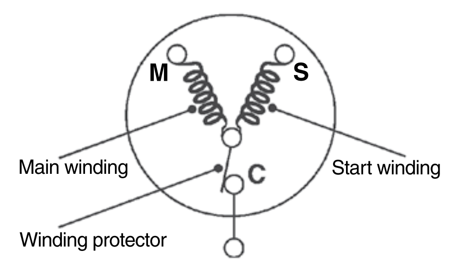
At cold compressor (ca. 25°C) the values are ca. 10 to 100 Ohm for 220-240 V compressors. For partial short circuit detection, exact values are needed from data sheets of the specific compressor, which can be found on the Danfoss Compressors homepage.

*Fig. 3: Compressor terminals*




Am0_0071

*Fig. 4: Windings and protector*

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**Check protector**

- Resistance between pins M (main) and C (common) on compressor terminals is measured with an ohm-meter, see fig. 3 and 4.

| | | | |
|---|---|---|---|
| Connection → | Protector OK | | |
| No connection → | Compressor cold → | Protector defective → | Replace compressor |
| | Compressor hot → | Protector could be OK, but cut out → | Wait for reset |

**Check relay**

- Remove relay from compressor.
- Measure connection between connectors 10 and 12 (see fig. 5):

| | | | |
|---|---|---|---|
| No connection → | Relay defective → | Replace relay | |

- Measure connection between connectors 10 and 11:
- In normal vertical position (like mounted, solenoid upward):

| | | | |
|---|---|---|---|
| Connection → | Relay defective → | Replace relay | |
| No connection → | OK | | |

- In top-down position (solenoid downward):

| | | | |
|---|---|---|---|
| Connection → | OK | | |
| No connection → | Relay defective → | Replace relay | |

**Check PTC**

- Remove PTC from compressor.
- Shake by hand. Pin C can slightly rattle.

| | | | |
|---|---|---|---|
| Internal rattle noise (except pin C) → | PTC defect → | Replace PTC | |

- Measure resistance between pins M and S, see fig. 6.
- Resistance value between 10 and 100 Ohm at room temperature for 220 V PTC.

| | | | |
|---|---|---|---|
| Connection → | PTC working → | OK | |
| No connection → | PTC defect → | Replace PTC | |

*Fig. 5: Relay connections*

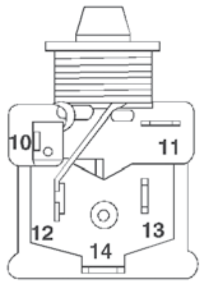


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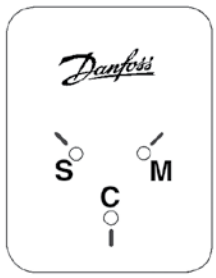
*Fig. 6: PTC connections (backside)*




Am0_0074

## Fault location

*Most common fault reasons, detectable before dis-mounting compressor.*

| Customer claim | First analysis | Possible cause | Check | Activity (depends on result) |
|---|---|---|---|---|
| **No/reduced cooling** | Compressor does not run | Compressor gets no or bad power supply | Voltage at plug and fuse | |
| | | | Aplicance energized | |
| | | | Thermostat function | |
| | | | Cables and connections in appliance | |
| | | | Voltage at compressor terminals | |
| | | Defective relay | Relay function by shaking to hear if armature is working | Replace relay |
| | | Defective start cap | Start capacitor function | Replace start capacitor |
| | | PTC defective | PTC by shaking | Replace if noise appears |
| | | | PTC resistance 10 to 100 Ohm between M and S pin | Replace PTC, if not 10 to 100 Ohm |
| | | Compressor with PTC can not start at pressure difference | Stop time long enough for pressure equalization | Adjust thermostat difference |
| | | PTC defective | PTC resistance 10 to 100 Ohm between M and S pin | Replace PTC |
| | | Relay defective | Relay function by shaking, to hear moving of armature | Replace relay and capacitor |
| | | Compressor overloaded | Condenser pressure and ventilation | Ensure proper ventilation |
| | | | Ambient temperature too high according to type label of appliance | |
| | | Defective motor windings | Check winding resistances | Replace compressor |
| | | Defective protector | Check protector with ohmmeter | Replace compressor |
| | | Mechanically blocked compressor | Start with proper starting equipment, voltage and conditions, windings and protector OK | Replace compressor |
| | Compressor runs 100% | No or low refrigerant charge | Recharge and search for leaks | Ensure leakfree system and proper charge |
| | | Too high ambient temperature | Ambient temperature according to type label of appliance | Replace drier |
| | | Too high condensing temperature | Condenser and compressor ventilation | Ensure proper ventilation and wall distance |
| | | Capillary partly blocked | Recharge and search for leaks, measure suction pressure. Capillary blocked, if pressure very low | |
| | | Valves coked or damaged | Recharge and search for leaks | Replace compressor, if still not cooling properly |
| | Compressor runs on/off | Thermostat not OK | Thermostat type and function | Replace thermostat |
| | | Wrong refrigerant charge | Recharge and search for leaks | Ensure leakfree system and proper charge, |
| | | Ice block built up on evaporator | Check for ice on evaporator | Replace drier |
| | | | Thermostat function and settings | Defrost properly |
| | | | Internal no-frost fan function | Replace thermostat |
| | | Compressors trips on motor protector | Compressor load, compressor and condenser ventilation | Ensure proper ventilation and wall distance |
| | | | Compressor voltage supply for minimum 187 V | Ensure proper power supply |
| | | | Compressor voltage supply for drop outs. Check thermostat and appliance cables for loose connections | Fix all connections |
| | | | Motor windings resistance for partly short circuit or earth connection | Replace compressor |

## Fault location
*(continued)*

| Customer claim | First analysis | Possible cause | Check | Activity (depends on result) |
|---|---|---|---|---|
| **Noise** | Rattle or humming | Tube touching cabinet | Tube placing | Bend tube to their right place, carefully |
| | | Compressor touching cabinet | Compressor mounting and rubber feet | Place rubber feet and mounting accessories correctly |
| | | Broken internal suspension spring or discharge tube | Listen to compressor with screw-driver against compressor with edge and to your ear with grip | Replace compressor, if abnormal sounds |
| | | Resonance | Find vibrating mounting parts | Place or fix correctly |
| | | Fan noise | Vibration of fan or fan mounting | Fix fan and blade, replace, if defective |
| | Banging at start or stop of compressor | Compressor block hitting housing internally | Compressor overload by pressure | Clean condenser if dusty. Make sure, that ventilation gaps for air circulation are satisfactory |
| | | | Fan function | |
| | | | Refrigerant charge | Recharge, if too high |
| | | | Pressure equalization before start and number of on/off cycles | Adjust thermostat, if stop time less than 5 min |
| | | | Ambient temperature according to type label | Take appliance out of function, if ambient too hot |
| | Relay clicking frequently after start | Compressor overloaded | Ventilation to compressor and condenser. Check fan function | Clean condenser if dusty. Make sure, that ventilation gaps for air circulation are satisfactory |
| | | Relay defective | Right relay type for compressor | Replace relay, if wrong |
| **Fuses are blown by appliance** | Short circuit in appliance | Defective cabling in appliance | All connecting cables and power supply cord for loose connections, short circuits | Fix connections properly |
| | | Defective thermostat | Thermostat connections | Fix connections properly |
| | | Ground connection | Resistance from line/neutral to earth | |
| | Short circuit in compressor | Defective terminals | For burns on the terminal pins | Replace electrical accessories |
| | | Short circuit between cables at terminals | Connectors and cables at compressor | Insulate cables and connectors |
| | | Short circuit in compressor motor | Resistance values in windings | Replace compressor, if short circuited |
| | | | Resistance between terminals and earth | |
| | Fuse blows at compressor start | Supply voltage too low | Supply voltage at compresor start >187 V | |
| | | Fuse loaded by too many appliances | Total fuse load | Connect appliance to different fuse |
| | | Resettable fuse too quick acting | Fuse load and type | If possible replace by slightly slower type |
| | | Partly short circuit to earth | Resistance between terminals and earth | Replace compressor, if short circuited |
| | Starting capacitor exploded | Defective relay | Relay function by shaking, to hear moving of armature | Replace relay and capacitor |
| | | Wrong relay type | Relay type | Replace relay and cap |
| | | Extremely many starts and stops of compressor | Relay type | Replace relay and cap |
| | | | Thermostat defect or differences too small | Adjust or replace thermostat |
| | Starting relay cap blown off | Short circuit in compressor motor | Compressor motor resistances | Replace compressor |