

Danfoss

Commercial Compressors

Parallel Application Guidelines

Maneurop[®]

RECIPROCATING COMPRESSORS



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1. INTRODUCTION

A parallel compressor installation refers to a system of compressors interconnected and working together. Though several benefits exist for parallel installation, the primary reason is reduced operating cost through greater control of capacity and power consumption. This is achieved by staggering compressor switch-on sequences that allow the parallel system to match its power with the capacity needed.

The following sections will provide detailed information for installation and operation of parallel compressor installations:

- 2: Oil Equalization systems and their particularities.
- 3: Suction and Discharge Lines of parallel compressors.
- 4: Compressor Switch Sequence of compressors in parallel.

- 5: Additional information about System Components.
- 6: Installation and Service requirements.
- 7: Maneurop Compressor Characteristics.

The number of compressors in a parallel system along with specific operational needs varies greatly from operation to operation.

That is why the information contained in this leaflet provides a generalized overview only. For more specific details pertaining to individual needs please contact your local Danfoss application engineering support team.

Note:

To ensure proper parallel installation and running conditions, the following

recommendations must be followed:

- It is essential to respect all instructions given in this document, the installation instruction leaflet delivered with every compressor, and the compressor's Selection & Application Guidelines.
- This application guideline concerns single stage parallel systems for reciprocating compressors only. It is not valid for two-stage or cascade systems (or so-called booster systems) which require more specific installation precautions.
- For additional system components (i.e. oil level regulator, oil separator, etc.), the supplier recommendations must always be respected.

2. OIL EQUALIZATION

Oil equalization is one of the most critical aspects in parallel installations. Oil returning from the system must be controlled otherwise improper oil amounts will flow to and damage compressors. Therefore, to achieve equal oil distribution between all compressors, the two most popular solutions are:

- Oil equalization line system.

This economical system for oil equalization connects the compressors crankcases' via an oil line. The oil equalization line system should be used for installations of no more than 3 compressors of the same size / capacity.

- Oil level regulator system. This more complex system provides stable, predictable oil

management under nearly all circumstances. An oil level regulator is mounted on each individual compressor and is fed oil via an oil separator in the discharge gas line. The oil level regulator system should automatically be used for installations of 4 or more compressors.

2.1 Oil equalization line system

This system insures oil supply and oil equalization in all compressor crankcases through the oil equalization connections.

For this system it is important that the crankcase pressure (suction pressure) in all compressors is equal. If this is not the case uneven oil distribution will occur. If no precautions are taken, the internal suction pressure of

parallel compressors may vary. These variations, though small, can create considerable differences in oil levels. Example, a pressure difference of 0.001 bar causes an oil level difference of 1.1 cm.

The following points are guidelines for proper installation of oil line equalization systems. Please refer to figure 2.1:

- The oil equalization line must be installed in the horizontal plane.

- The oil equalization lines should never rise above the horizontal plane of the oil equalization connections.
- Oil equalization lines between the compressors must be flexible. The use of vibration absorbers may be required in some cases.
- The oil equalization line diameter must be 3/8". If a smaller oil equalization line is used, oil flow will be restricted. If a larger oil equalization line



Figure 2.1 Example of correctly mounted oil equalization line system.
Note all compressors are of equal size/capacity and mounted on the same level.

is used, cold suction gas is allowed to circulate just above the oil level. This cold suction gas will condense inside idle compressors and in time dangerous amounts of liquid refrigerant will build up.

- The oil sight glass must never be used in place of the oil equalization connection.
- Only ball valves are allowed in the oil equalization lines to

provide compressor isolation capability. The use of other valves, such as rotolock valves, may create undesirable pressure drops.

In parallel installations an oil separator is strongly recommended. In parallel installations with either long pipelines, multiple condensers or multiple evaporators an oil separator is required. In

an installation having multiple oil traps, an oil separator, or the possibility of slow oil return an oil reservoir is often required.

The two most common methods for oil separation, which will be explained in detail, are the following:

- Individual oil separator
- Common oil separator

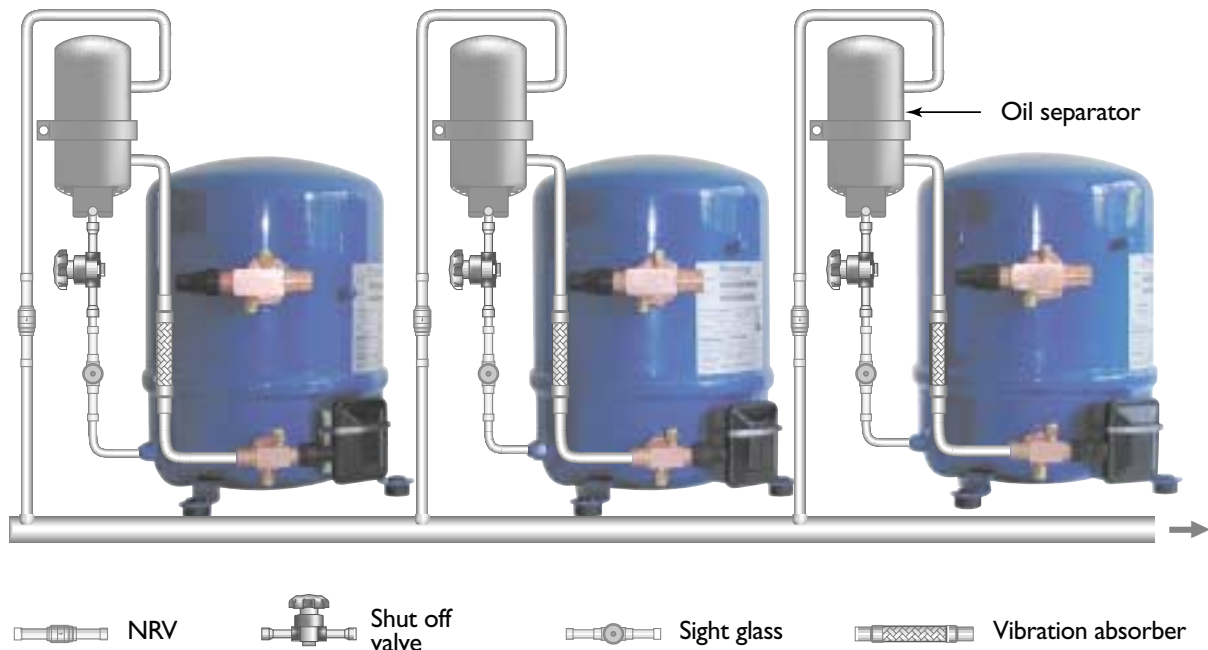


Figure 2.2 Individual oil separators.

2.1.1 Individual oil separator

The individual oil separator method allows for each compressor to have its own oil separator. These separators return oil directly to each compressor's oil equalisation port (see figure 2.2).

Note: The size of the discharge line between compressor and oil separator must never be smaller than the rotolock discharge port.

Remark: If an oil separator malfunction occurs, oil

distribution and balanced oil levels will be strongly affected.

2.1.2 Common oil separator

The common oil separator method allows for one oil separator to be used by the entire system. The oil is fed into the compressors via the suction line, though it should be noted that the oil return tube must intercept the suction line at least one meter before the suction header (see figure 2.3 page 6). If oil separator floating valve leakage occurs, a hot gas

bypass can be avoided by the use of an oil injection sequence. This injection sequence, through a normally closed solenoid valve located in the oil return line, is recommended 5 seconds for every 10 minutes of run time.

In either the individual oil separator method or the common oil separator method, be sure to add an additional amount of oil for reliable operation. The amount of extra oil needed is indicated in the oil separator's instructions. It is also good practice to fit an oil filter in the oil return line.

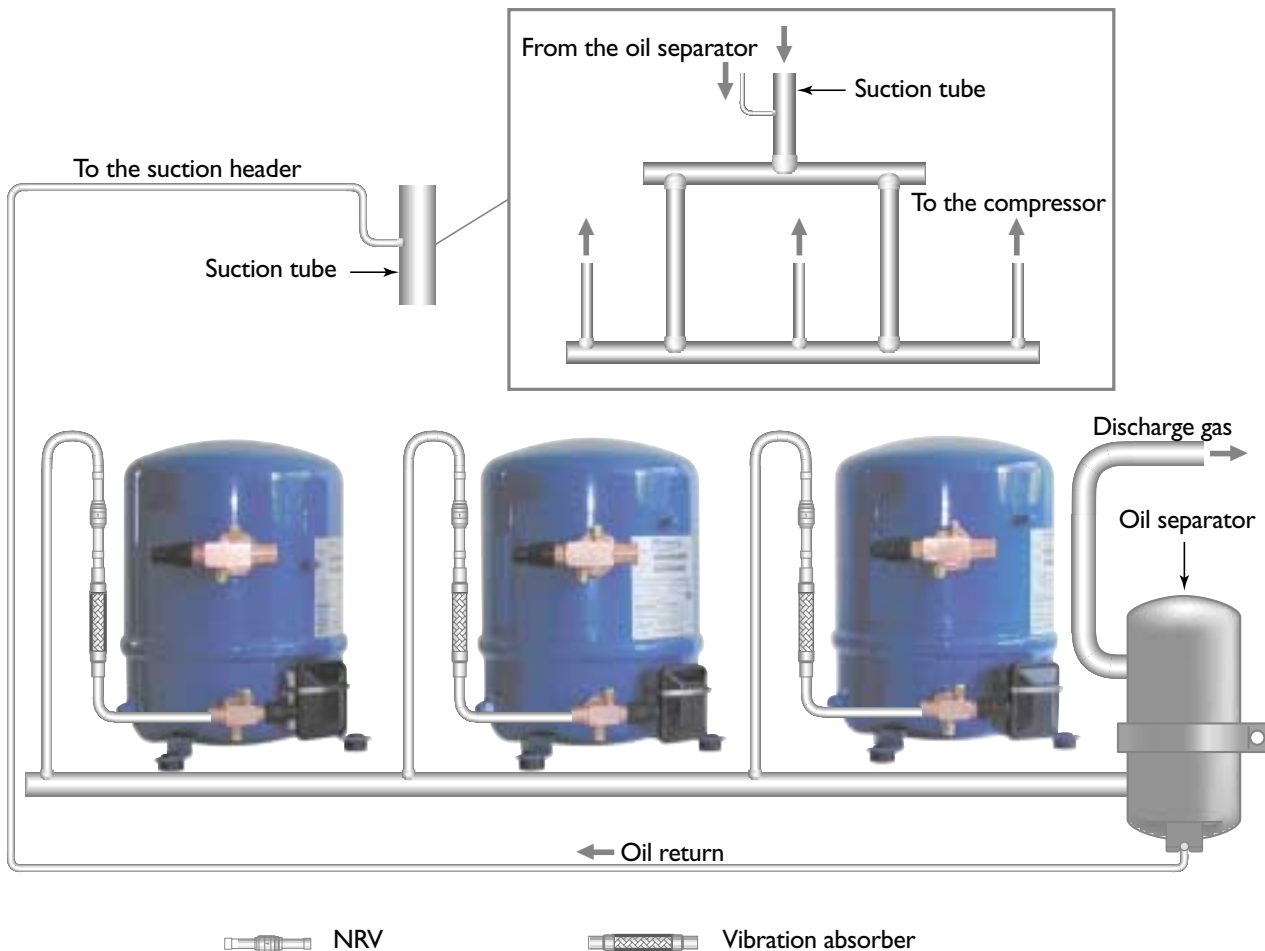


Figure 2.3 Common oil separator

2.2 Oil level regulator system

If a parallel system consists of 4 or more compressors, compressors of different size/capacity, or if the quantity of oil return from the system is in question, oil level regulators in combination with an oil separator must be used. Under these conditions the crankcase pressure difference will not influence the oil equalization level.

The oil level regulator must be mounted on the compressor

oil sight glass connection. Oil is trapped in the oil separator. From the oil separator it flows to the oil reservoir. From the oil reservoir it flows to the oil regulator before entering the compressor. For proper flow, the oil reservoir must maintain a higher pressure than the suction pressure (standard difference is 1.4 bar).

The two most common methods of oil level regulators, which will be explained in detail, are the following:

- Individual oil level regulators

- with individual oil separators
- Individual oil level regulators with common oil separator

2.2.1 Individual oil level regulators with individual oil separators

This method introduces one oil separator and one oil level regulator for every compressor. The oil separator feeds the oil level regulator that in turn feeds the compressor. Refer to §2.1.1 for information regarding individual oil separators.

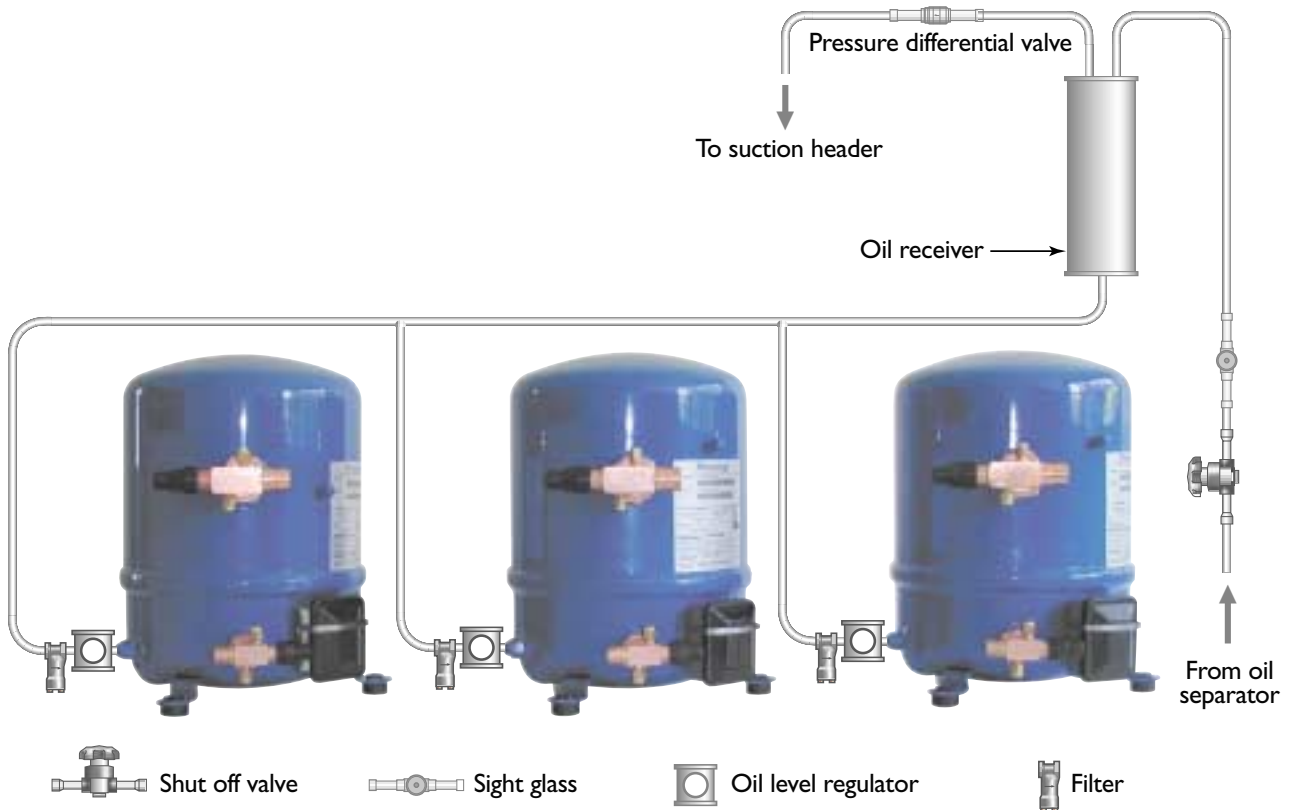


Figure 2.4 Individual oil level regulators with common oil separator

2.2.2 Individual oil level regulators with common oil separator

This method introduces one oil separator for the system and one oil level regulator for each compressor. The common oil separator feeds the individual oil level regulators that in turn feed the compressors. Oil separator selection must be made

regarding the capacity range of the parallel system to ensure a proper oil separation at both part load and full load. See figure 2.4 for a detailed drawing of a correctly assembled example of this system.

Always be sure your selected method is in accordance with the manufacturer recommendations.

When the parallel system is installed in cold ambient the oil separator must be insulated to avoid efficiency losses and refrigerant liquid condensation during off cycle periods. A check valve (Danfoss NRV) located in the discharge line after the oil separator can reduce such a risk. In some situations, separator heating may be required.