

# ET 460

## Oil return in refrigeration systems



### Learning objectives/experiments

- fundamentals of the oil return in refrigeration systems
- effect of the rising pipe diameter on the oil transport
- effect of partial and full load operation on the oil transport
- principle of operation of a double rising pipe
- separate or parallel operation of the compressors

### Description

- transport of lubricants soluble in refrigerant in refrigeration systems
- transparent material for monitoring the transport states in the rising pipes
- monitoring of the processes in a double rising pipe during partial and full load operation
- separate or parallel operation of two compressors for partial and full load

The oil return in refrigeration systems is of key importance for the service life of the compressor and thus for a secure constant supply of refrigeration.

In most compressors some lubrication oil is carried along with the compressed refrigerant. In the liquid refrigerant the oil is dissolved in the refrigerant and is

transported without problems. In the vaporised refrigerant the oil remains liquid in the lower parts of the system. This can result in lack of oil in the compressor. To return the oil to the compressor, a minimum velocity must be maintained in the pipes. If the velocity in the rising pipe on the intake side of the compressor is too low (partial load), the oil is not returned to the compressor due to its higher density.

The velocity in the rising pipe depends on the pipe diameter and the refrigerant mass flow. A small diameter of the rising pipe results in a high velocity and ensures the return of the oil even under partial load. However, at full load the pressure loss increases due to the small diameter.

To compensate for this disadvantage, double rising pipes are used. During partial load oil gathers in a bend at the bottom of the double pipe. The oil in the bend blocks one of the two pipes so that the refrigerant flows at high velocity through the other pipe and transports the oil to the compressor. At full load the oil in the bend is pressed upwards so that the refrigerant flows through both pipes.

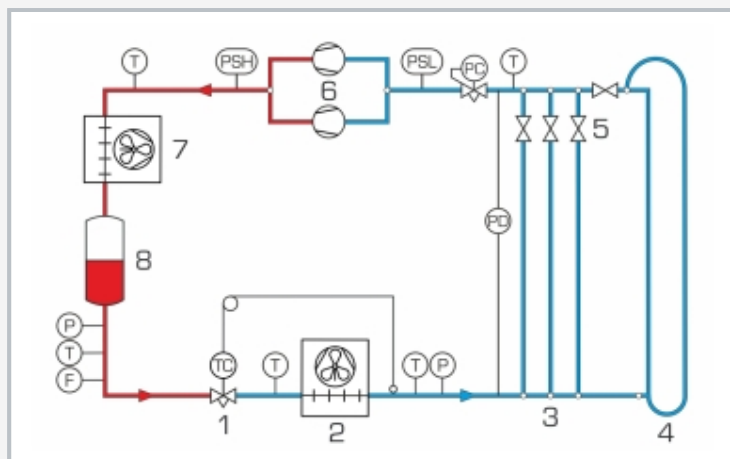
At the front of the ET 460 three transparent rising pipes with different diameters and a double rising pipe have been arranged. The rising pipe selection is via valves. This allows for the oil transport at different velocities to be observed. The other components of the refrigeration circuit are at the back of the trainer. The separate or combined operation of two compressors connected in parallel enables operation at partial or full load.

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1 manometer differential pressure, 2 manometer delivery side, 3 manometer intake side, 4 flow meter, 5 display and control elements, 6 rising pipe Ø 6mm, 7 rising pipe Ø 10mm, 8 rising pipe Ø 14,4mm, 9 double rising pipe, 10 valve for rising pipe selection



1 expansion valve, 2 evaporator, 3 rising pipes, 4 double rising pipe, 5 valves for rising pipe selection, 6 compressor, 7 condenser, 8 receiver; P pressure, PD differential pressure, F flow rate, T temperature, PSH, PSL pressure switch; blue: low pressure, red: high pressure

### Specification

- [1] investigation of the oil return to the compressor in refrigeration circuits with oil soluble in refrigerant
- [2] refrigeration circuit with 2 compressors connected in parallel, condenser with 2 fans, evaporator with fan and thermostatic expansion valve
- [3] 3 single and 1 double rising pipes from glass in the suction pipe of the refrigeration circuit
- [4] rising pipes selectable via valves
- [5] flow rate in the refrigeration circuit adjustable by single or combined operation of the two compressors
- [6] fan speed adjustable
- [7] temperature measurement with thermowells
- [8] refrigerant R513A, GWP: 631

### Technical data

- 2 compressors with condenser
- refrigeration capacity: 1920W at 5/55°C
  - power consumption: 1190W bei 5/55°C
  - volumetric air flow rate fan: 1300m<sup>3</sup>/h

### Evaporator

- transfer area: 5,7m<sup>2</sup>
- volumetric air flow rate fan: 720m<sup>3</sup>/h

### Rising pipes

- Ø 14,4mm; L=1110mm
- Ø 10mm; L=1110mm
- Ø 6mm; L=1110mm
- Ø 8/10mm (double rising pipe); L approx. 1300mm

### Refrigerant

- R513A
- GWP: 631
- filling volume: 1,5kg
- CO<sub>2</sub>-equivalent: 0,9t

### Measuring ranges

- pressure: -1...9bar; -1...24bar; 0...0,6bar
- flow rate: 2...27L/h
- temperature: 5x -50...100°C

230V, 50Hz, 1 phase  
 230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase  
 UL/CSA optional  
 LxWxH: 1410x800x1900mm  
 Weight: approx. 216kg

### Scope of delivery

- 1 trainer
- 1 set of instructional material