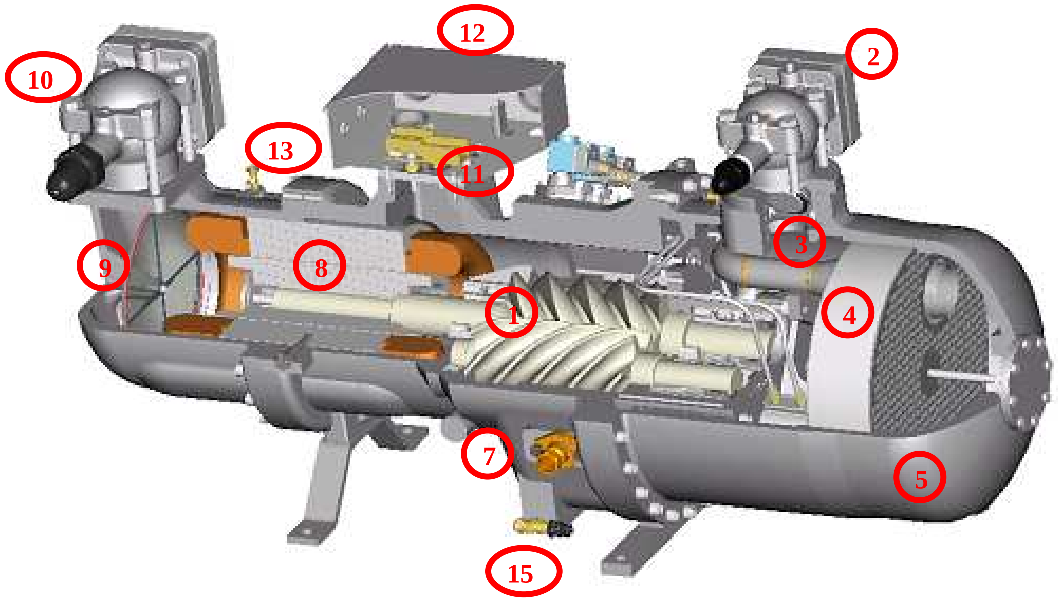
134-XS and 134-S series compressors
General
(EA-01-01-E)

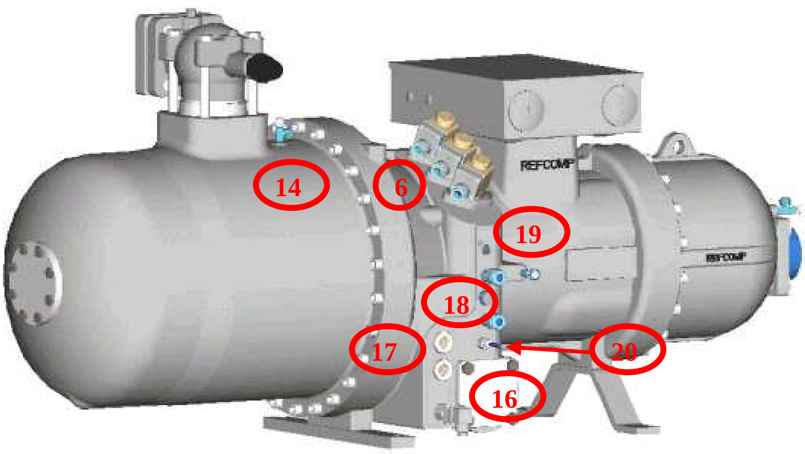
1. General

1.1 Introduction

The RefComp 134-S and 134-XS series screw compressors (picture 1-A shows an example with all the main parts and assemblies) are oil-injected helical twin screw compressors. The compressors feature a semi-hermetic construction, and are fitted with a three-phase asynchronous two-pole motor (2900 rpm at 50 Hz) directly coupled to the male rotor, which in turn drives the female rotor. The 134-S and 134-XS series compressors are fitted with a high-efficiency oil separator that allows the compressor to be installed in the refrigerant circuit without requiring any additional components. The motor is cooled by the intake gas that flows through special holes and grooves. For the 134-S models, the capacity control is made through a slide valve controlled by a hydraulic piston via the oil pressure. The mentioned piston reduces the suction volume. On the contrary, for the 134-XS models, pistons moved by the refrigerant gas generate a by pass through which part of the compressed fluid flows back to the suction side. The compressor is expressively designed and optimised for working with refrigerant R-134a. The compactness, low noise, efficiency, completeness of the range and simple installation make these series compressors ideal for the construction of a high-efficiency and modern range of water/water and air/water chillers and heat pumps.

134-S series compressor with main design features:





Picture-1-A: Schematic drawing of an 134-S series compact screw compressor;

Key

1. Rotors;
2. Discharge shut-off valve;
3. Check valve;
4. Oil separator ("Demister");
5. Oil reservoir / separator;
6. Solenoid valves;
7. Connection for liquid injection or economiser circuit;
8. Electrical motor;
9. Suction filter;
10. Suction shut-off valve
11. Motor protection device;
12. Terminal box;
13. Low pressure connection port;
14. High pressure connection port;
15. Oil charge/discharge valve;
16. Oil filter;
17. sight glass for oil level control;
18. Oil cooling connection port;
19. Pressure port downstream the oil filter;
20. Oil temperature sensor.

1.2 The compression process

The rotors are housed inside horizontal cylindrical chambers, fitted with a suction port (on the electric motor side) and a discharge port (on the oil separator side). Tightness against leakage through the extremely reduced clearance between the rotors and the chambers is guaranteed by a film of oil that is injected directly onto the screw threads.

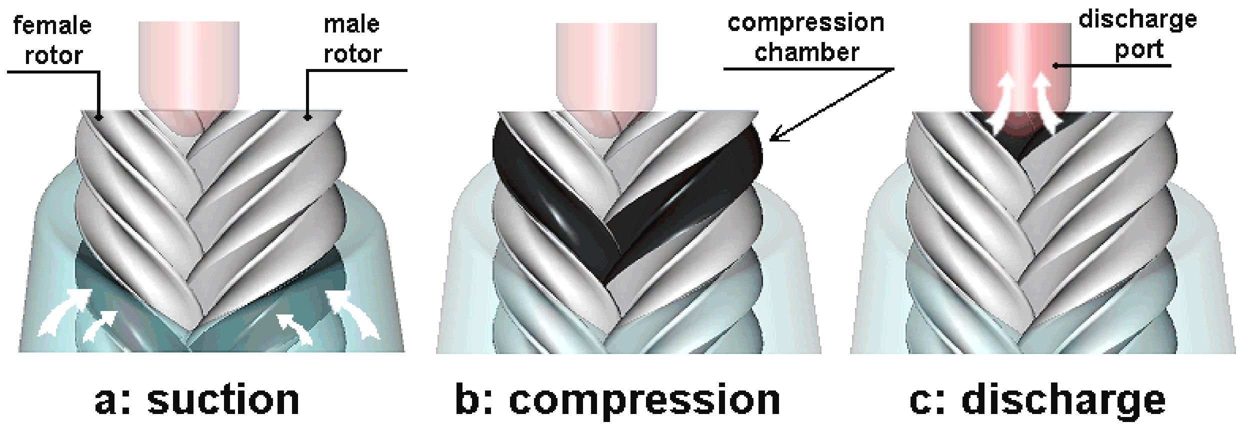
The compression process essentially involves the following three phases (for reasons of clarity, the following description is limited to one lobe on the male rotor and one flute on the female rotor):

a. suction;

b. compression;

c. discharge (to the compressor discharge port).

The described compression steps are shown in the following picture 1-B.



Picture 1-B: Compression process sep sequence;

Suction

When the lobe on the male rotor is unmeshed from the flute on the female rotor, the suction port opens into the compression chamber and, due to the rotation of the screws, the suction volume increases, creating negative pressure that draws in the refrigerant fluid. The suction phase ends when, due to rotation, the suction port is closed.

Compression

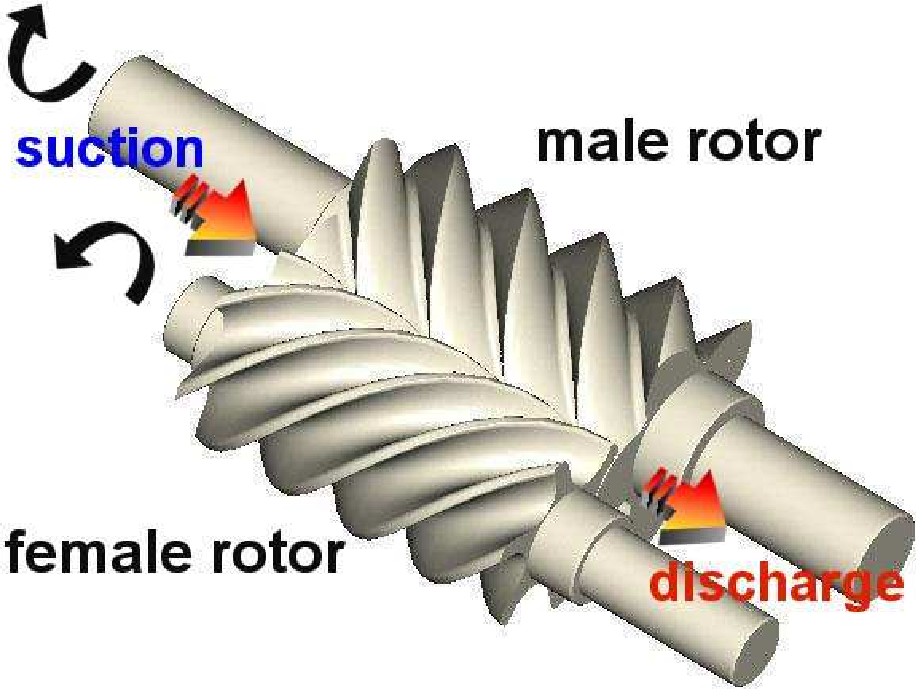
As rotation continues in the compression chamber, both the suction and the discharge ports are closed, the volume inside the chamber progressively decreases and the trapped gas moves in the longitudinal direction of the rotors, towards the discharge port. In other words, the trapped gas is compressed.

Discharge

The rotation continues until the discharge port opens, and the compressed gas is completely expelled, due to the progressive intermeshing of the lobe and the flute. As the gear ratio is 5/6 (5 lobes on the male rotor and 6 flutes on the female rotor) and the rotation speed is around 3000 rpm at 50Hz (asynchronous motor), each minute there will be 3000 x 5 = 15000 discharge cycles, which means an almost complete absence of pulsation at the discharge. A reciprocating compressor operating at 1500 rpm would require 10 cylinders to achieve the same result.

1.3 Rotors

The rotors, see picture 1-C, have an asymmetrical shape with 5 lobes and 6 flutes, and are made entirely by RefComp. The perfect intermeshing between the suitably lubricated rotors ensures extremely smooth and silent compressor operation. The figure also shows the correct directions of rotation.

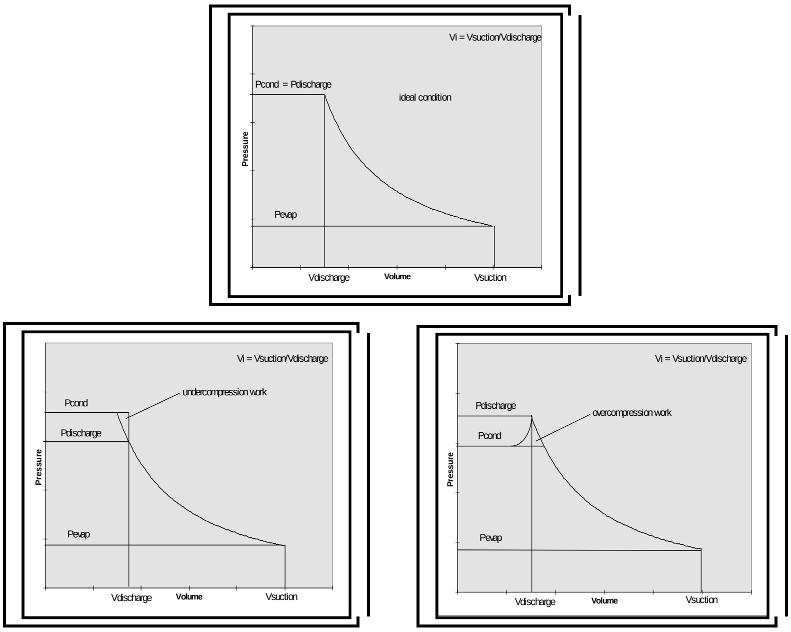


Picture 1-C: view of the rotors and the correct direction of rotation;

1.4 The built-in volumetric ratio

The size and the shape of the discharge port determine the value of the so-called “V_i”: the “built in volumetric ratio”, defined as the ratio between the volume of the gas at the start and the end of the compression process. This ratio does not depend on the operating conditions, but rather corresponds, according to the type of refrigerant gas, to a precise compression ratio between the compressor discharge pressure and suction pressure. When this compression ratio coincides with the ratio between the condensing pressure and the evaporation pressure, the compression process is running at maximum efficiency. Indeed, the gas discharged from the compression chamber is at the same pressure of the compressor outlet (condensing pressure) and the work required to compress the gas is minimum. When, on the other hand, the pressure at the outlet differs from the discharge pressure of the gas from the rotors, there is over compression or under compression (instantaneous when the discharge port opens), which means a waste of energy, see picture 1-D.

The 134-XS e 134-S series compressors have a built in volumetric ratio optimized for air conditioning, as well as mid and high temperature applications. The value is V_i = 3,2.



Picture 1-D: the compression process on the p-V diagram;