SRC-XS and SRC-S series compressors

General

(SA-01-02-E)

1. General

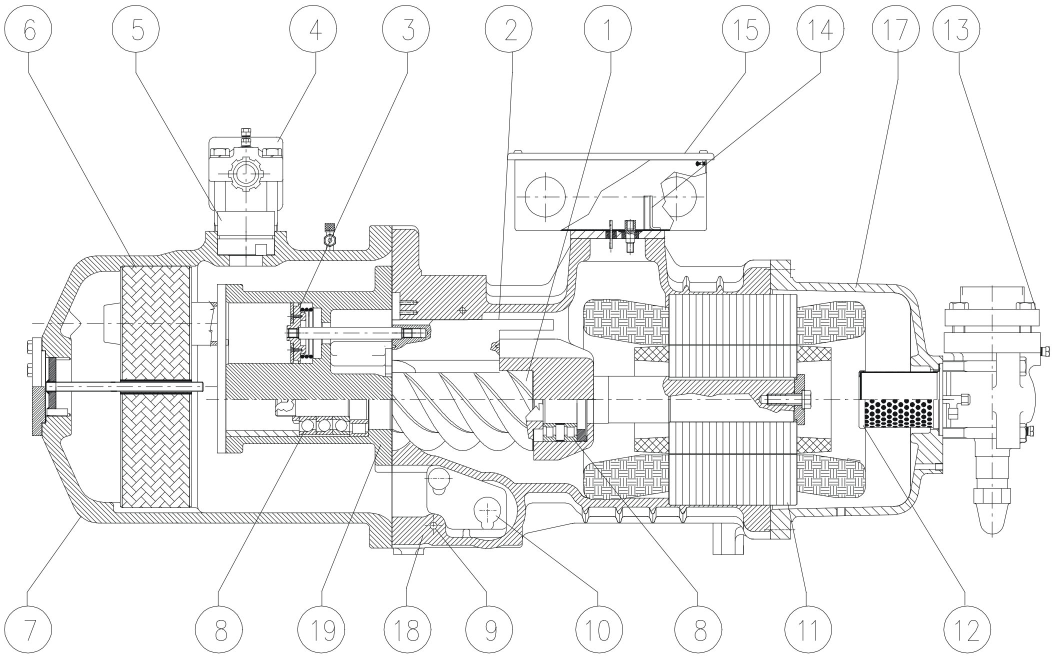
1.1 Introduction

The RefComp SRC-S and SRC-XS series screw compressors are helical twin screw oil-injected compressors (Picture 1-A shows an example with all the main parts and assemblies). 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. These compressors are fitted out with a high-efficiency oil separator, whose position is different depending on the series (see chapter SA-02: "*Lubrication*") and that allows the compressors 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 SRC-S series the capacity control is achieved by using a slide valve, which is moved by a hydraulic piston and which ensures part load operation by controlling the suction volume. For the SRC-XS series the capacity control is provided by a by-pass system, instead. In fact in these compressors part of the refrigerant mass flow is by-passed towards the suction side by suitable cylinders controlled by the refrigerant pressure.

The compressors of the SRC-XS and SRC-S series can operate with R22, R407C, R134a, R404A and R507 refrigerants.

The compactness, low noise, efficiency, completeness of the ranges and their simple installation make these series compressors ideal for the construction of a range of high-efficiency and modern water/water and air/water chillers and heat pumps. Moreover the SRC-XS series is specifically characterized by a high compactness because of the lateral oil separator, which in the SRC-S series is frontal, instead.



1 Rotors;

2 Slide valve for capacity control (only for SRC-S series);

3 Slide valve control piston (only for SRC-S series);

4 Discharge shut off valve;

5 Check valve;

6 Oil separator “Demister” (lateral position in the SRC-XS series compressors);

7 Oil reservoir / separator;

8 Rolling bearings;

9 Crankcase heater;

10 Oil filter;

11 Electrical motor;

12 Suction filter;

13 Suction shut off valve;

14 Motor protection device;

15 Terminal box;

17 Suction bell;

18 Rotor housing;

19 Bearings housing (discharge side).

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

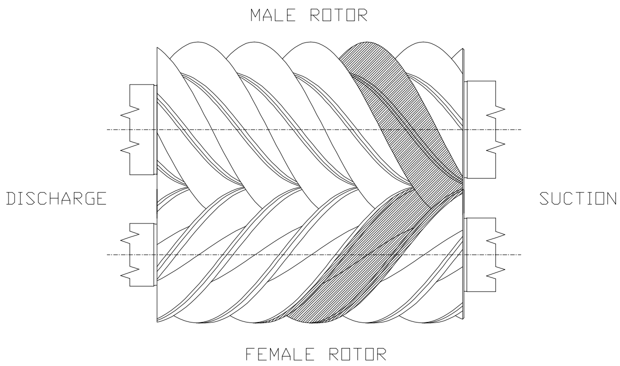
1.2 The compression process

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 profile.

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):

- **Suction**

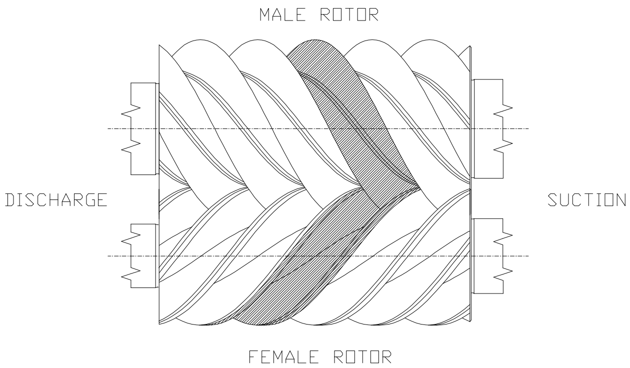
With reference to picture 1-B, when the lobe on the male rotor is unmeshed from the flute on the female rotor, the suction port opens into the compression chamber and, due to the rotation of the screws, the suction volume increases, creating negative pressure that draws in the refrigerant fluid. The suction phase ends when, due to rotation, the suction port is closed.



Picture 1-B: chamber at the end of the suction phase;

- **Compression**

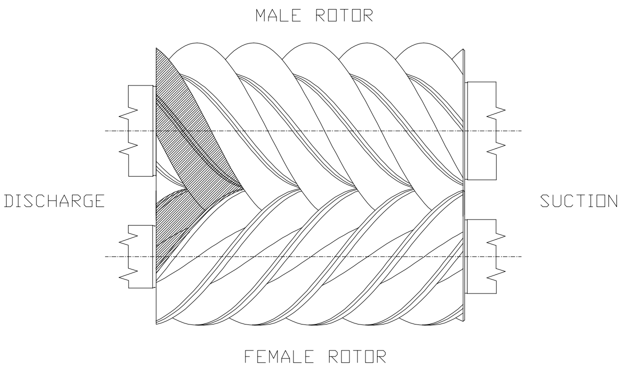
With reference to picture 1-C, as rotation continues in the compression chamber, both the suction and the discharge ports are closed, the volume inside the chamber progressively decreases and the trapped gas moves in the longitudinal direction of the rotors, towards the discharge port. In other words, the trapped gas is compressed.



Picture 1-C: chamber during the compression phase;

- **Discharge**

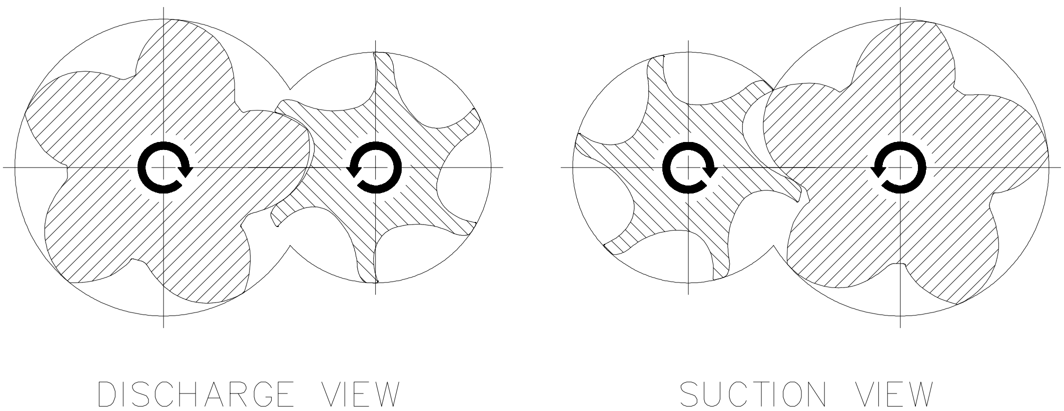
With reference to picture 1-D, the rotation continues until the discharge port opens and the compressed gas is completely expelled, due to the progressive intermeshing of the lobe and the flute. As the gear ratio is 5/6 (5 lobes on the male rotor and 6 flutes on the female rotor) and the rotation speed 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.



Picture 1-D: chamber at the start of the discharge phase;

1.3 The rotors

The rotors, see picture 1-E, 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 picture shows also the correct directions of rotation.

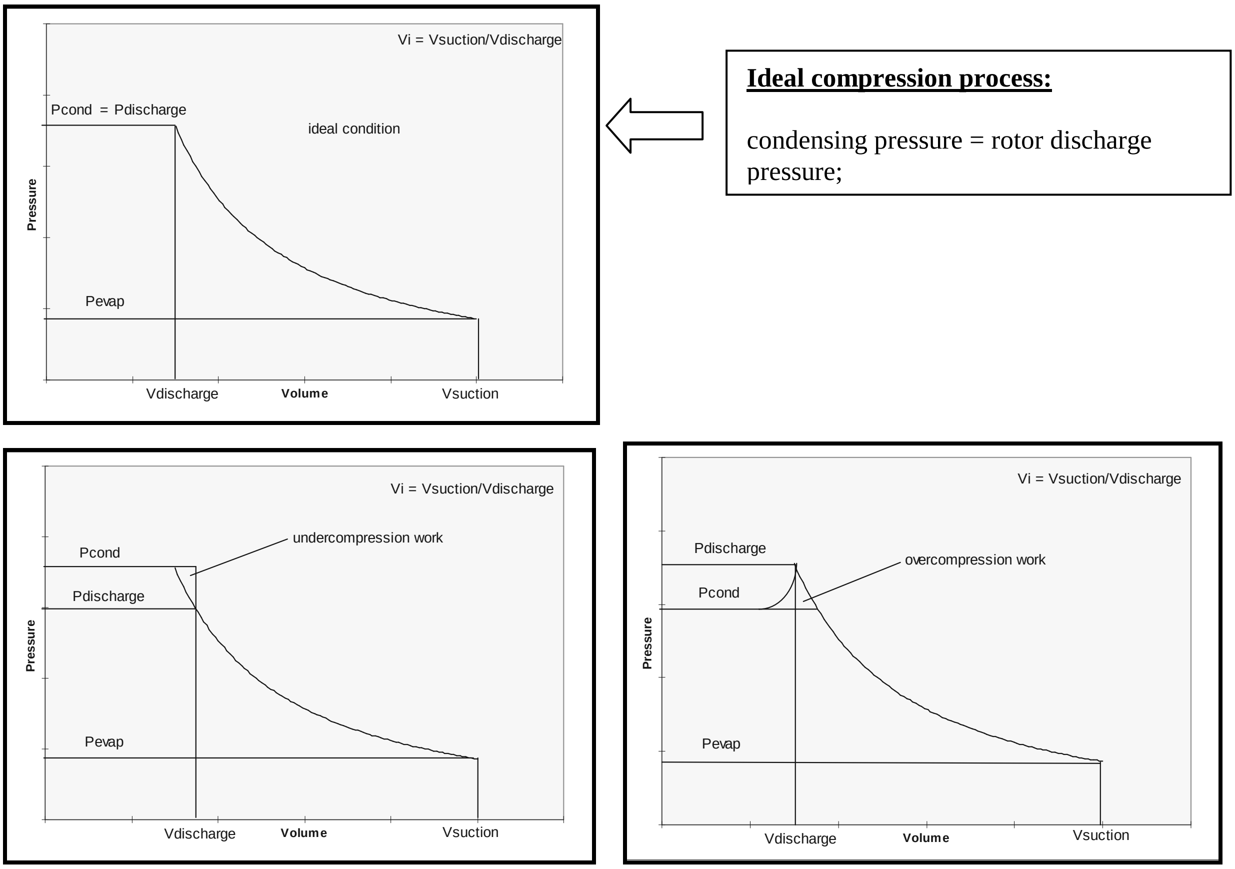


Picture 1-E: view of the rotors and correct direction of rotation;

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-F.

Therefore, the choice of the most appropriate “Vi” ratio to suit the application ensures that energy wastage can be avoided or at least minimised.



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

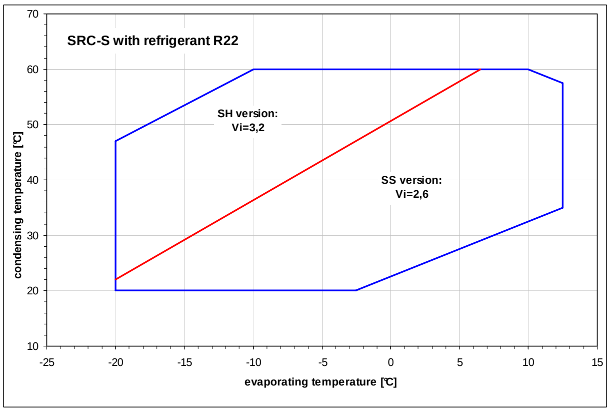
As standard, RefComp uses a Vi ratio in the SRC-S series compressors that is optimised for water/water or water/air chiller applications, featuring low compression ratios. Consequently, to maximise the compression efficiency in special applications with high pressure ratios (tropicalized chillers, heat pumps), the SRC-S series compressors are also available with higher “Vi” ratios.

The SRC-S series compressors thus have the following built-in volumetric ratio:

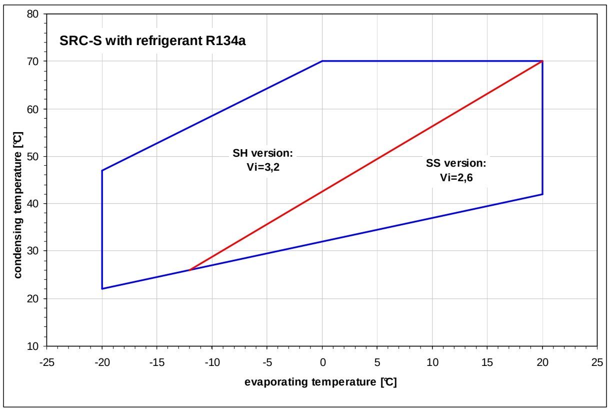
- ✓ **Vi = 2.6: “SS” models;**
- ✓ **Vi = 3.2: “SH” models;**

But the SRC-XS series is characterized by one built-in volumetric ratio Vi = 2.6, instead.

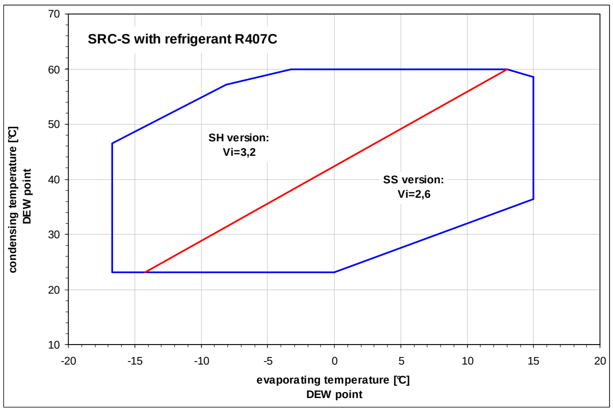
The following diagrams show the recommended fields of application for the two built-in volumetric ratios (V_i) of the SRC-S series. These fields are expressed according to the condensing and evaporating temperatures of the specific used refrigerant:



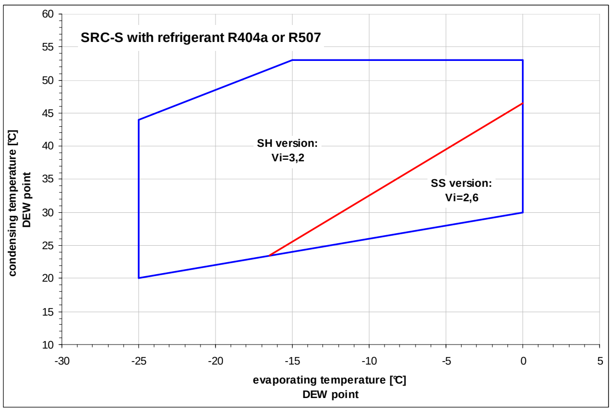
Picture 1-G: V_i values recommended by RefComp when using R22 refrigerant;



Picture 1-H: V_i values recommended by RefComp when using R134a refrigerant;



Picture 1-I: V_i values recommended by RefComp when using R407C refrigerant;



Picture 1-L: V_i values recommended by RefComp when using R404A or R507refrigerant;