

Screws or recips – the customers' choice

The discussion concerning the choice between screw or reciprocating compressors for air conditioning or refrigeration applications has been going on for decades. There is no single answer to this question, as the most optimum choice depends on application, operating conditions and human attitudes.

Some compressor manufacturers have claimed that reciprocating compressors are not future-oriented. Some companies have even tried to remove these compressors from the market, but in vain. The reciprocating compressors still exist.

The sale of Sabroe reciprocating and screw compressors shows a positive development. If we look at the future market in for instance Europe and the Middle East we believe that this trend will continue. Sabroe has more than 100 years of experience in producing refrigeration compressors, and the R&D function in Aarhus has enormous experience with both recips and screws.

Screws or recips?

There is no general answer to this question. Each compressor type has its particular advantages, depending on the required operating conditions.

To make an optimum selection the actual application conditions must be analysed. All relevant criteria, such as required capacity, operating conditions, part load, energy consumption, temperature levels, refrigerant, ease of maintenance, investment and available space should be taken into consideration.

Temperature level and plant size

For air conditioning and other "high" temperature applications (evaporating temperatures higher than -15 °C) reciprocating compressors will typically have 5-15% lower energy consumption than small screw compressors with capacities lower than approx. 1200 kW. On the other hand screw compressors will have lower energy consumption in larger applications and in lower temperature applications.

Part load

Another important issue is the load profile for the application. If the compressor has to run at part load for many hours a year, reciprocating compressors will be the optimum choice. Part load efficiencies are very different for the two compressor types. Typically, the relative energy consumption at 25% part load will increase by 35% for recips and by 75% for screws.

In air conditioning applications the compressor will run at part load for most of the year.

Off-design conditions

Due to the basic working principles of the two compressor types their ability to operate efficiently under off-design conditions are very different. All recips will by nature automatically adjust to the actual evaporating and condensing pressures. Small screw compressors and in particular air conditioning screw compressors are typically made with fixed internal volume ratios, which means that the gas will always be compressed at the

same pressure ratio, no matter what the evaporating/condensing pressures in the plant are. This fact results in less energy efficiency for screw compressors running off-design conditions. For air conditioning applications the compressor will run off-design 99% of the time according to ARI Standards.

Large industrial screw compressors will typically be equipped with devices for adjustment of the internal volume ratio to ensure that efficient operation can be kept within a certain range around the design conditions.

Refrigerant

In general, the refrigerant does not have much influence on the optimum choice of compressor type. There will only be a difference for high pressure refrigerants, such as R410A and R774 (CO₂). Reciprocating compressors will typically have significantly lower energy consumption than screw compressors with these refrigerants.

Maintenance

Reciprocating compressors have many moving parts compared with screw compressors, and due to wear on moving parts the maintenance requirements are more rigorous on reciprocating compressors. The suction and discharge valves, in particular, have to be replaced frequently in recip. However, the maintenance work on recip is quite simple and can always be done on site.

Screw compressor parts and assembly are exceptionally precise, and replacements and main overhauls usually require that the compressor is sent back to the factory.

At short sight a recip will typically incur about twice the maintenance costs of a screw, but seen over a 40000 – 50000 h operation period the maintenance costs will even out and the recip will typically incur 20-30% higher maintenance costs.

However, after the same number of operating hours the energy savings with a recip will typically be 3–5 times larger than the higher maintenance costs.

Space requirements

Screw compressors are much more compact than reciprocating compressors when we talk large capacities. Two recip may typically be replaced by one screw compressor having the double capacity.

Conclusion

At Johnson Controls we produce both screw compressors and reciprocating compressors, and we are committed to allowing our customers to choose the compressor type that best meets their needs. We will always be happy to assist our customers in making the optimum choice for the actual application.