Technology Comparison for Compressing Natural Gas

Gas Compression Article | Brahma Compression

Brahma Compression Ltd. | 1310 - 43rd Avenue SE, Calgary, Alberta, Canada T2G 2A2
t. (403) 287-6990 | f. (403) 243-4085 | Toll Free. 1-800-230-6056 | www.gascompressors.ca

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Which compressor is right for your application?

Natural gas compressors are commonly used for compressing natural gas from their source (a gas well, an oil well, a stock tank, a solution tank, etc.) into a pipeline.

When evaluating your application, there are many different types of compressors that could be used – reciprocating compressors, rotary vane compressors, scroll compressors, or rotary screw compressors. The question is, which compressor is best for your application? Not all compressors are created equal. Each technology type has its strengths, weaknesses, and limits. It's important to understand what the technology limits of each compressor type are so that the compressor you purchase for compressing natural gas is the best fit for your application.

Technology Comparison

The chart below indicates the technical limits of four common compressor technologies.

	Reciprocating Compressor	Vane Compressor	Scroll Compressor	Screw Compressor
Max Suction	500 psig+	10 psig	10 psig	100 psig
Max Discharge	6000 psig	150 psig	175 psig	400 psig
HP Range	5000 hp	200 hp	15 hp	1000 hp

Reciprocating Compressor Technology

How it Works

A reciprocating compressor is a positive-displacement compressor that uses pistons driven by a crankshaft to compress natural gas. The intake gas enters a suction manifold, then flows into the compression cylinder where it gets compressed by a piston driven in a reciprocating motion via a crankshaft, and is then discharged.

Strengths and Weaknesses of Reciprocating Compressor Technology

Reciprocating compressors are the best choice for applications that require compressing natural gas to discharge pressures of greater than 350 psig. In fact, in many cases, they are the only valid option for such applications.

The main advantage of a reciprocating compressor is that it can achieve high pressure ratios by means of multi-staging. The weakness of reciprocating compressors is in the many wearing components innate within the design. A reciprocating compressor consists of many parts - piston rods, pistons, piston rings, cylinders, valves, connecting rods, crankshafts, etc. - all of which are wearing components that need to be replaced over time. For this reason, reciprocating compressors can be expensive to maintain. Rotary type compressors, by comparison, can be much less expensive to operate.

Rotary Vane Compressor Technology

How it Works

The operating principle for a vane compressor is the same as for many compressed air motors. A rotor with radially moveable vanes is eccentrically mounted in a stator housing. When it rotates the vanes are pressed against the stator walls by centrifugal force. Gas is drawn in when the distance between the rotor and stator is increasing. The gas is captured in different compressor pockets, which decrease in volume with rotation. The gas is discharged when the vanes pass the outlet port.

Strengths and Weaknesses of Rotary Vane Compressor Technology

Rotary vane compressors have a limited number of wearing parts and are generally reliable. Their original design was intended for air compression applications, and for this reason, they have a limited range of operating conditions (suction and discharge pressures) when used for natural gas compressing applications. Although there are many different types of vane compressors, each with their own limitations, many rotary vane compressors are limited to suction pressures of 10 psig, and a discharge pressure of 150 psig.

Rotary vane compressors are best used for compressing natural gas in low production systems where suction pressures are near zero, and where discharge pressures are never likely to operate above 150 psig.

Scroll Compressor Technology

How it Works

Scroll compressors work to compress natural gas by moving one spiral element inside another stationary spiral to create a series of gas pockets that become smaller and increase the pressure of the gas. The largest openings are at the outside of the scroll where the gas enters on the suction side. As these gas pockets are closed off by the moving spiral they move towards the center of the spirals and become smaller and smaller. This increases the pressure on the gas until it reaches the center of the spiral and is discharged through a port near the center of the scroll.

Compression in the scroll is created by the interaction of an orbiting spiral and a stationary spiral. Gas enters the outer openings as one of the spirals orbits.

The open passages are sealed off as gas is drawn into the spiral.

As the spiral continues to orbit, the gas is compressed into two increasingly smaller pockets.

By the time the gas arrives at the center port, discharge pressure has been reached.

Strengths and Weaknesses of Scroll Compressor Technology

Scroll compressors were designed for use in refrigeration applications. Although they are smooth operating and highly reliable, they have limited application in gas compression do to their operational restrictions. The maximum horsepower size of a single scroll compressor is 15 bhp. The maximum suction pressure is 15 psig, and the maximum discharge pressure limit is 175 psig. As a result, they are useful for compressing natural gas in applications requiring very low flows – like single well casing gas applications.

Screw Compressor Technology

How it Works

A screw compressor is a positive displacement volume reduction machine in which compression is achieved by the enmeshing of two helical grooved rotors positioned in a tight tolerance housing fitted with an inlet and outlet port.

The screw element's main parts are the male and female rotors, which move towards each other while the volume between them and the housing decreases. Gas fills the space between the rotors, and for each turn the space decreases more and more.

Strengths and Weaknesses of Rotary Screw Compressor Technology

Rotary screw compressors are ideal for gas compression applications. The have taken over nearly all of the standard gas compressor applications where discharge pressures are less than 300 psig and horsepower requirements are less than 600 bhp. The ability of screw compressors to handle a wide range of operating conditions and the reliability of these compressors, coupled with reduced maintenance and lower initial cost, are key factors driving this trend.

When it comes to operating conditions, these compressors can handle suction pressures of up to 100 psig, and discharge pressures of up to 400 psig.

Rotary screw compressors have an inherently smooth running design and 100% duty cycle. They do not require valves and have no mechanical forces that cause unbalance. This means they can work at variable shaft speeds and combine a large flow rate with small exterior dimensions.

When it comes to maintenance costs, rotary screw compressors have an advantage over reciprocating compressors, which typically require more periodic maintenance than rotary screws. Valves, piston rings, and other consumables on a reciprocating compressor need expensive routine maintenance.

Summary of Gas Compressor Technologies

The two most frequently used gas compressor technologies for compressing natural gas are the reciprocating compressor and the rotary screw compressor. This is due to their operational flexibility. Where discharge pressures are greater than 300 – 350 psig, reciprocating compressors are clearly the best choice. In most other gas compression applications, rotary screw compressors are most commonly used due to their high reliability, operational flexibility and low cost. In applications where very low flow rates are required, and the operating conditions are limited to low suction and discharge pressures, both rotary vane compressors and scroll compressors can be viewed as suitable options.

For a more detail analysis of your gas compressor application, a Brahma gas compression expert can assist you in the evaluation of your project.