How to Choose a Compressed Air System
How to Choose a Compressed Air System?

While there is no one commonly accepted answer as to when it is time to replace your compressed air system, there is general agreement around many of the points to consider when that time arrives. This consensus on what to consider when buying a new air compressor is helpful in ensuring that you get the operational savings you need to quickly pay back your investment in the new compressor.

The place to start is with measuring and understanding your demand.

Analyzing Your Demand

There are multiple ways in which you can determine the demand for a new compressed air system. The options available include:

♦ Surveying the consumption levels of the tools used and their utilization rates to calculate demand.
♦ Measuring the current system demand.

Surveying the performance of your existing air compressor system can be a quick and easy way to estimate demand. To start this process, you first need to create a list of all the supported tools and pneumatic equipment along with their air consumption ratings. Once compiled this information should be further enhanced by taking into account the utilization factor (what % of the time the tool or equipment is in use) for the equipment and multiplying this by the consumption ratings previously obtained.

In many cases, precise information related to either consumption or utilizations rates may be difficult to obtain for a particular application. In these cases, it may be beneficial to create an estimate for these values based on those for a similar application where the figures are known.

The survey method is not as accurate as the measurement option, however, it does have the benefit of convenience and speed in getting to the results.

One concern with this method of demand calculation is the variability that exists in most compressed air system demand concerning slack and peak usage which is difficult to capture with the survey/calculation method.

A more accurate way to determine your compressed air demand is to continuously measure it. Using this method solves the problem with the survey/calculation approach whereby it does not account well for the changes in compressed air requirements over time.

Continuously measuring the compressed air flow is accomplished by attaching recording devices to the existing compressed air system. The installation of the recording devices can be done by the employees currently using the existing compressed air system. Alternatively many suppliers
will manage the implementation and management of the recording devices.

As mistakes can be made in the interpretation of the results of a comprehensive measurement survey, it may be wise to have an experienced technician manage the overall survey.

The second option regarding compressed air measurement is non-continuous and involves taking regular readings at various times and operational levels. While not as complete, or accurate, as a full system continuous based survey taking scheduled measurements will provide for an understanding of demand usage and the costs associated with its delivery.

Having this information in hand provides the basis for understanding the potential savings available from a new compressed air system.

**Compressor Capacity**

Once the demand for your compressed air system is understood, you can then match the demand with compressor capacity as the second step in determining what compressed air system you should use.

The stated output flow of any compressor considered should match, and indeed exceed, the demand statistics you determined. There is no hard and fast rule to determine the excess, or reserve, capacity for your compressed air system should have.

Standard industry practice calls for planning on a 10% to 15% excess of compressor capacity above the stated requirements. This estimate is based on issues such as unpredicted demand surges and loses due to leaks within the system.

It is always important to keep in mind the potential losses to your operations that could result from insufficient compressed air delivery. This cost will vary widely for individual applications, however, where such losses would be significant (as in well beyond the additional compressed air capacity cost) additional excess capacity beyond the stated industry standards may be well worth considering.

**Compressor Types**

With an understanding now in place concerning the compressor capacity that you require it is time to give some consideration to the type of compressor to utilize for your application. Air compressors come in three standard types. Before moving on to discuss the compressor types, it is worth taking a moment to understand a crucial difference regarding air compressors.

Air compressors are differentiated based on how they apply pressure to the air stream. The two forms of compression are Positive Displacement (PD) and Dynamic Compression (DC).

Positive displacement creates compression in the air stream by mechanical means utilizing a pump and piston to achieve compression just as in your car. Positive displacement based compressors feature
the ability to convert small amounts of air into high pressures in a very economical fashion.

Dynamic compression differs in that it creates compression by speeding up the air to high speeds and then restricting the flow of the fast-moving air to achieve compression.

1. Reciprocating Compressor

These are compressors based on the positive displacement principle. These compressors are typically available in a one, or two-stage, configurations and capable of generating outputs in the one to fifteen horsepower range.

Reciprocating compressors utilize one of two piston types, these being:

♦ Non-lubricated
This design makes use of teflon piston rings instead of lubricating oil. As no oil is required these systems tend to be lighter in weight and eliminate one potential contamination source.

♦ Oil-Lubricated
This compressor design uses oil to provide lubrication to the system parts that are under friction, including the cylinder, piston and piston rings.

Oil-lubricated systems provide a maintenance advantage in that they generally require minimal maintenance.

2. Rotary Screw Compressors

The second type of (PD) compressors is rotary screw compressors. These compressors are known for their ease of operation and maintenance making them highly reliable. This reliability is based in part on a design feature which delivers cooling within the compressor itself which means individual parts of the system are subjected to less fatigue over time.

These air compressors typically deliver outputs in the seven and one-half to one hundred horsepower range.

Just as with reciprocating compressors, rotary screw compressors come in two general designs.

♦ Flooded
This compressor design is based on the mixing of oil in combination with the pressurized air in the system. The resultant mixture is filtered before discharge and before recycling it back into the system to be used again.

♦ Oil-Free
The difference between the flooded system and the oil-free system is that oil is substituted in this design with carbon ring seals which act to prevent oil from entering the air stream during compression.

A potential weakness of this type of system is the heat generated which can result in a reduced useful life for
Centrifugal Compressors

Centrifugal compressors differ from reciprocal and rotary screw compressors in that they operate on dynamic compression. Centrifugal compressors are the largest of the three compressor types regarding output producing output levels of one hundred horsepower up to five hundred horsepower.

As might be expected the larger capacity delivered by centrifugal compressors makes them more applicable to large-scale manufacturing applications. This higher capacity also means this type of compressor tends to be more costly with respect to the upfront costs and ongoing maintenance.

Higher maintenance costs are driven from the continuous use, and high-velocity operation associated with centrifugal compressors.

Specifications and Analysis

There are several factors which can be used to provide comparisons between the different compressor types. These factors provide differentiation both in terms of value and function.

Power

The three general sources of power available for your compressed air application include gas, diesel and electric power.

In terms of some very general qualifications, higher output requirements will tend towards a diesel power source as contrasted with electrical power as diesel powered compressors provide more horsepower. Additionally, the environment in which your application will operate may also be a qualifier in that enclosed spaces are better suited to electrical power given their lack of exhaust gases.

Once beyond these initial qualifiers, the three types of compressor power are described below:

♦ Gas Powered

Gaspowered compressors are available in two different designs; those with a generator and those without. Generator based gas compressors use the generator to power the cylinder while non-generator based air compressors provide power directly to the cylinder.

A major benefit of this type of compressor power is that it facilitates portability given the nature of its readily available power source. This makes this type of compressor suitable for applications where an electrical power source is unavailable, or portability is a key concern.
The downside to this form of power is that it can generate a considerable noise level when operating. The requirement to transport the fuel for the compressor, in addition to the compressor itself, is also a consideration with gas powered air compressors.

♦ Diesel Powered

Diesel powered air compressors are the most powerful of the three power types.

As expected, there are similarities between diesel and gas powered compressors regarding portability given the freedom from electrical requirements. As with gas powered options, the need to transport the diesel fuel is a requirement.

In terms, if output diesel powered compressors deliver cubic feet per minute (CFM) ratings in a range from 185 up to 1,600.

♦ Electric Power

Electrically powered air compressors tend to be far more compact and lightweight in comparison to fuel based alternatives. Electric power also means no exhaust fumes from the burning of fuel.

There is an obvious disadvantage related to portability given the need for connection to the power grid.

The majority of these types of compressors may be plugged directly into the commercial power grid leading to a high level of convenience which helps to drive their popularity.

One consideration with this type of power source is proximity. As there may be limits to the length of the actual power cord connection longer air hoses may be required limiting the physical reach for electrically powered air compressors.

CFM & PSI Considerations

Beyond the power supply source of your compressed air system, there are other specifications that need to be considered.

One specification that must be considered in the acquisition of your compressed air system is the cubic-feet-per-minute (CFM), or flow rate of the air stream. CFM is measured from the air inlet of the system.

Beyond CFM and flow requirements, it is also important to consider the resistance to the air flow. This resistance is measured in terms of pounds-per-square-inch (PSI). PSI is determined by the pressure created by one pound of pressure within one square inch of volume.

Your system’s PSI requirement can be determined by checking the manufacturer’s
specifications concerning your highest rated PSI pneumatic applications.

PSI requirements are also a key consideration for whether a one-stage or two-stage compressor is required. As a general rule one-stage compressors will provide up to 135 PSI, while two-stage compressors can provide up to 175 PSI.

Of the two measures, CFM vs. PSI, CFM is the more important of the two. This is so because in most situations the air compressor will exceed any stated PSI requirements. For example, the majority of tools serviced by a typical compressed air system will require 90 PSI. Most compressors will supply a PSI figure above this 90 PSI requirement as a standard feature of the system. As a result, more focus should be given to the CFM requirements which can vary to a large degree based on the specifics of your applications requirements.

Calculating your CFM requirements can be done by totaling the CFM need for each pneumatic device connected to the system as noted previously.

**Compressor Stages Considerations**

Stages with respect to air compressors refer to the number of cylinders incorporated into the compressor design. One-stage compressors have one cylinder while two-stage compressors have two cylinders.

As may be expected one-stage compressors deliver less power than do two-stage compressors. Generally, a one-stage compressor will max out at approximately 135 PSI.

One advantage of one-stage compressors is that being smaller they are more mobile for those applications requiring portability.

Two-stage compressors are larger and deliver PSI levels in excess of the 135 PSI common to one-stage compressors. As a result of their higher capacity, and more moving mechanical parts, two-stage compressors create more heat that one-stage compressors and hence require a cooling capability.

**Horsepower Requirements**

As a general rule, horsepower requirements are decided for you based on the CFM generated by the compressor. There is a direct relationship between horsepower and the CFM rating of the compressor.

It is advisable to base your requirements on CFM and PSI as opposed to horsepower.

**Air Tank Requirements**

Air tanks perform multiple roles within your compressed air system. Firstly, air tanks provide compressed air storage for those times when the requirements of the system exceed the ability of the compressor to meet the demand on the system.

Secondly, air tanks help to smooth air steam delivery by eliminating pulsing along the system.

In terms of a system design consideration the larger the air tank storage available, the less work has to be done by the compressor. This can be a significant consideration where demand is not well understood, or varies considerably.

**Electrical Requirements**
One aspect of electrical requirements as they relate to air compressors is that voltage is a key limiting factor of horsepower capacity.

The standard 110 volts electrical supply will service compressed air systems of up to three horsepower. For applications requiring more than three horsepower changes would be required to the standard commercial electrical supply.

Control System Requirements

As their name implies compressed air control systems balance the supply of compressed air with the demand for compressed air within the system. As such, control systems have a significant role to play in the overall operational efficiency of the system.

Reciprocating air compressors may be served by one of three control system types.

♦ Start/Stop Control
  This type of control system is commonly used for those situations that do not require a constant air stream.

  With this type of control system values are established for both startup and cut-off pressures with the control system starting and stopping the compressor when these values are reached.

♦ Constant Speed Control
  In contrast with the start/stop control system, this option limits the constant starting and stopping of the compressor.

  This type of control system serves to reduce the mechanical wear on the compressor and reduces electrical costs.

♦ Dual Control
  As may be expected the dual control system offers both start/stop and constant speed control.

Variable Speed Drive

For compressed air systems supporting multiple applications, there is a higher requirement for the system to operate at a constant speed. Variable speed drives address this issue by adapting the air stream to the demand on the system. This allows for very precise delivery of the compressed air required to power the applications in use at any one time.

As a result of the matching of production to demand established with variable speed drives there are significant operational savings possible from reduced electrical and fuel needs. Estimates for these savings are in the range of 35% when contrasted with constant speed compressors.

How to Select a Compressed Air Supplier

In selecting a service provider, a compressed air user should consider the following guidelines:
Compressed Air Assessment Services

It is important to understand the depth of assessment services available from a potential compressed air service provider. This is an important consideration as assessment services are crucial to obtaining the optimal operation and value from your compressed air system.

Knowledge and Expertise

This qualifier is concerned with issues such as the experience the potential provider has with your equipment. This goes further to considering the experience and training level of the technicians.

Ancillary Component Expertise

This aspect of provider evaluation is concerned with the ability of a prospective provider to be able to service all the components of a complete compressed air system.

Examples of the type of ancillary components would include:

♦ Control systems
♦ Dryers
♦ Filters
♦ Monitoring

Company Expertise

A well-documented history of dealing with compressed air systems is essential to ensure the ongoing support of your compressed air system.

Beyond this consideration an examination of the services provided should be undertaken and include:

♦ Emergency response capabilities
♦ Emergency supply capability
♦ Inventory levels to facilitate speedy repairs and urgent new applications.
♦ Proactive assessment capabilities
♦ Remote monitoring
♦ System installation

Company Capabilities

Company information related to the following factors should also be reviewed:

♦ Brands carried
♦ Dedicated support capabilities
♦ Financial stability
♦ Financial terms/flexibility
♦ Geographical service coverage
♦ Industries served
♦ Insurance coverage
♦ Number of employees
♦ Regulatory compliance

By taking into consideration the points outlined in this document you will be much better positioned to get the compressed air system that best meets your specific needs.