Cost of Ownership: The Definitive Guide

Let's look at three different 5 HP compressors, two will be reciprocating and one will be a rotary screw. First, we are going to look at the initial purchase price of all three, secondly, the operation cost (electrical cost) over a five year period, and third, the maintenance cost (including parts and fluids), also over a five year period. We won't get into disposal cost of maintenance fluids and/or condensate which will vary from location to location.

All of the above will help you decide which compressor is better for your operation and application, but a few basic steps can help ensure you understand the entire cost of ownership of your new compressor. Follow these steps to see the savings when comparing compressors:

How to determine what compressor you need…

Step 1:

- Determine the voltage and phase where the compressor will be installed.
  - Determining this prior to quoting and/or ordering your compressor will keep you from having any surprises upon installation
  - An example of voltage at a location would be *230 volt – 3 phase*. We will use this in our example below.

Step 2:

- Determine how much air you need for your application or plant.
  - How much air you need can be determined by the volume of air measured in cubic feet per minute, or CFM. This can be calculated by adding up the air requirements of the tools you use most frequently, divide by 35%. 35% is a utilization factor which means that any one tool will be used 35% of the work day. This is a very quick way to determine air demand. See example below
    - Small die grinder uses 7.0 cfm @ 125 psi
    - 1/4 Inch impact wrench uses 8.0 cfm @ 125 psi
    - 3/8 inch drill uses 9.0 cfm @ 100 psi
    - 2 inch horizontal grinder 11.0 cfm @ 100 psi
    - So, 7.0 + 8.0 + 9.0 + 11.0 equals a total of 35 cfm
    - Next, take 35 X .35(utilization factor) = 12.25 cfm air demand

Step 3:

- Determine the air pressure required for your application or plant.
    - Look at your tools to determine their pressure requirements.
    - The tool with the highest pressure requirement will be the minimum pressure you require.
    - Most single stage compressors (including rotary screws) have a continuous pressure rating of 125 psig maximum.
    - Most two stage reciprocating compressors operate at 175 psig
        - A two stage compressor can be regulated down to lower pressures
        - The advantage is that you store more air at a higher pressure in an air receiver (tank).
    - If you look at the example above, the die grinder and impact wrench require 125 psi. This means that you require a minimum line pressure of 125 psi from the compressor. A single stage compressor could possibly handle the application discussed above; however, since the required 125 psi is also the maximum output for a single stage compressor, most people would consider a two stage compressor, which can deliver air at 175 psi.
        - Benefits of a two stage compressor in the applications discussed above:
            - More air can be stored in the same amount of space at higher pressures, which means that a two stage compressor will not run as often as a single stage and save you money.
            - The two stage compressor runs cooler than a single stage, which equals longer compressor life and reliability.

- Now compare your requirements to the output of the compressors you are considering to purchase. A good rule of thumb is to have a 75% duty cycle. This means the compressor will be running and compressing air 75% of the time and off, sitting idle, 25% of the time. To determine how much air you need the compressor to deliver to maintain a 75% duty cycle, divide your estimated air demand by .75 (see example below).

12.25 cfm / .75 = 16.3 cfm

So you'll need a compressor that will deliver at least 16.3 cfm and have an output pressure of at least 125 psi. The table below shows three compressors that will handle our application quite nicely.

Compressor Comparasion			
	Horsepower	Delivered CFM	Output pressure
Compressor #1 Two Stage Recip	5	17.2	175
Compressor #2 Single Stage Rotary Screw	5	16.6	150
Compressor #3 Two Stage Recip	5	16.5	175

Step 4:

- Check with a certified electrician to ensure you have enough electrical service to handle the compressor you are looking to purchase.
    - The electrician will require the full load amperage rating that is listed on the electric motor nameplate as well as the voltage and phase discussed in step 1.

How to determine true cost of ownership…

Step 5:
Once you have determined your air volume and compressor size (from the exercise above we determined that you need a 5 HP compressor), we can examine the compressor's five year operating cost.

The basic formula to calculate operating cost is:

Full load kw X total running time X cost per kwh

Full load kw formula is:

Full load brake horsepower X .746 kw (conversion factor) / .875 motor efficiency*
*this is the motor efficiency rating that can be found on a typical 5 hp motor nameplate

Most air compressor manufacturers do not publish full load brake horsepower for reciprocating compressors. If the outlet that you are purchasing the compressor from can not provide you with full load brake horsepower, you can take the horsepower rating times 1.1; so for 5 HP, we calculate it to be 5 X 1.1=5.5 full load brake horsepower. For our compressor examples we do know the full load brake horsepower for one of the recip compressors and for the rotary screw, but not the second reciprocating compressor; the full load brake horsepower(FL BHP) is 5.13 FL BHP and 5.5 FL BHP respectively, and the second recip will also be 5.5 FL BHP (5 X 1.1).

Compressor 1: full load kw = 5.13 X .746 / .875 = 4.37 kw

Compressor 2 & 3: full load kw = 5.5 X .746 / .875 = 4.69 kw

5 year operating cost
Compressor 1 (reciprocating) = 4.37 kw X 2000 hour per year X .75 duty cycle X $.11/kwh = $721.05 per year X 5 years = $3605.25

Compressor 2 (rotary screw) & 3 (reciprocating) = 4.69 kw X 2000 hour per year X .75 duty cycle X $.11/kwh = $773.85 per year X 5 years = $3869.25

You can see how critical using a compressor that delivers the most air and requires the lowest brake horsepower is for reducing energy consumption. In our example, you save $264.00 over five years, or $52.80 per year.

The full cost of ownership includes proper maintenance of the compressor per the manufacturer's specifications. This commonly includes: changing oil at recommended intervals, replacing valves when needed, replacing air filter elements and with the rotary screw replacing the oil separator element.

- Compressor 1 routine maintenance is $315.60.
- Compressor 2 routine maintenance is $379.30.
- Compressor 3 routine maintenance is $365.41.

Now we need to add the initial purchase price to our 5 year operating cost and routine maintenance cost to determine what the actual cost of ownership is:

- Compressor 1 purchase price is $2203.00
- Compressor 2 purchase price is $3985.00
- Compressor 3 purchase price is $1970.00

Adding all together to get 5 year cost of ownership:

- Compressor 1 five year cost of ownership is $3605.25 + $315.60 + $2203 = $6123.85
- Compressor 2 five year cost of ownership is $3869.25 + $379.30 + $3985 = $8233.55
- Compressor 3 five year cost of ownership is $3869.25 + $365.41 + $1970 = $6204.66

This exercise shows that the compressor with the lowest purchase price is not necessarily the most economical compressor to own and operate. With a little homework, you can purchase and operate a compressor that will help reduce energy consumption, which helps our planet stay “green.”