

Design of an Air Compressor

Compressed Air

Compressed air is widely used as a power source in industry, to power tools, in many types of conveyors, in manufacturing and converting processes, and in filtration, refrigeration, and aeration processes.

Compressed air is often manufactured on site, while other utilities such as electricity, natural gas, and water are often purchased from outside the industrial facility.

The cost of its production is often not clear. A common perception is that the compressed air is free. No. The cost of using compressed air is about 10 times the cost of using another utility such as electricity, because of the inefficiencies of the motor and drive, the compressor itself, leaks in the system, air pressure reductions, and the inefficiencies of the device or process where the compressed air is applied.

Air Tools Advantages

- More powerful than electric tools
 deliver higher torque and higher rotary speed
- versatile and easily interchangeable
- safe alternative to other sources
- adapt poor application environment
- Robust under extreme loading

Type of Air Compressors

- Reciprocating
- Rotary Screw
- Rotary Centrifugal

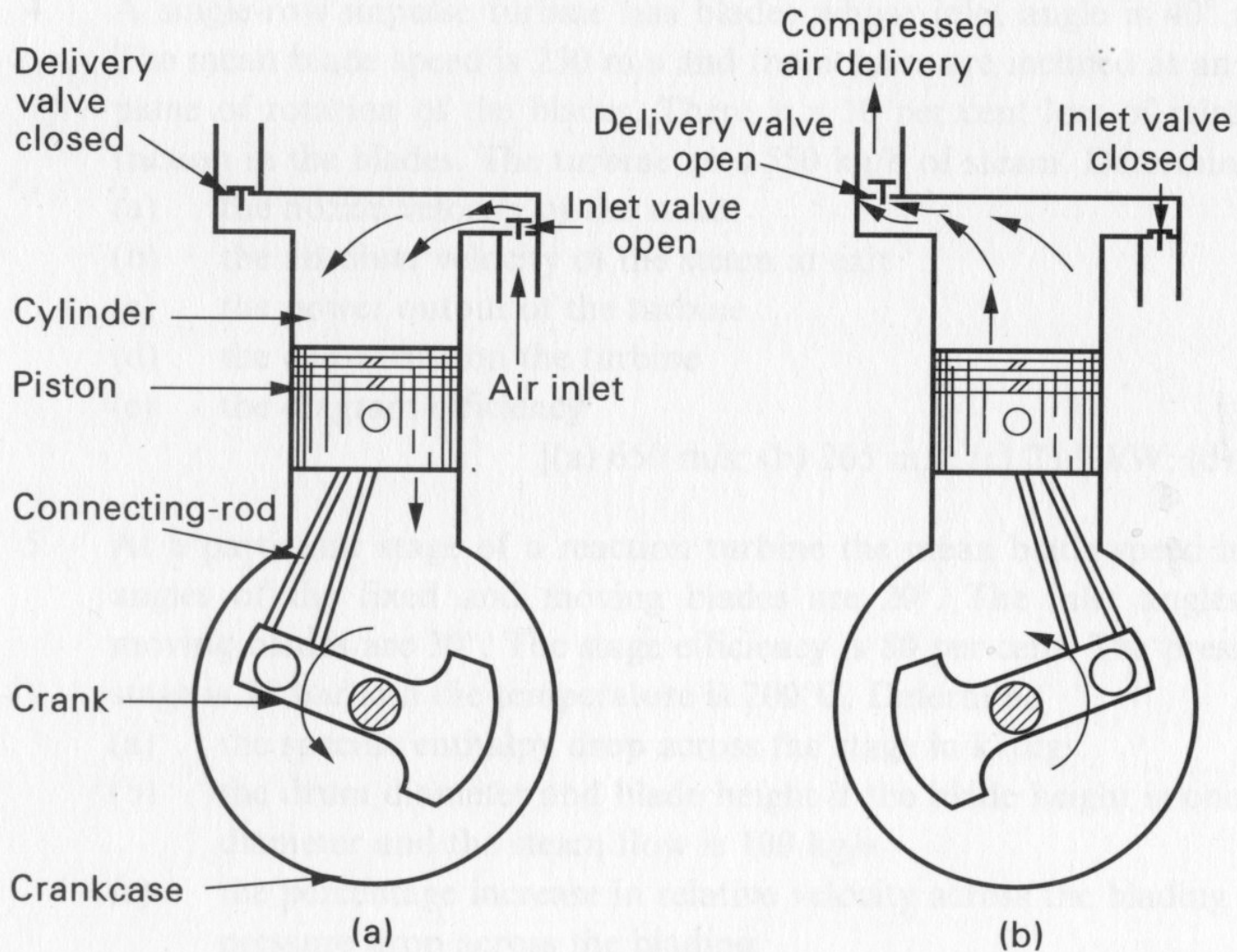
Further specified by

- the number of compression stages
- cooling method (air, water, oil)
- drive method (motor, IC engine, etc)
- lubrication (oil, oil-free)

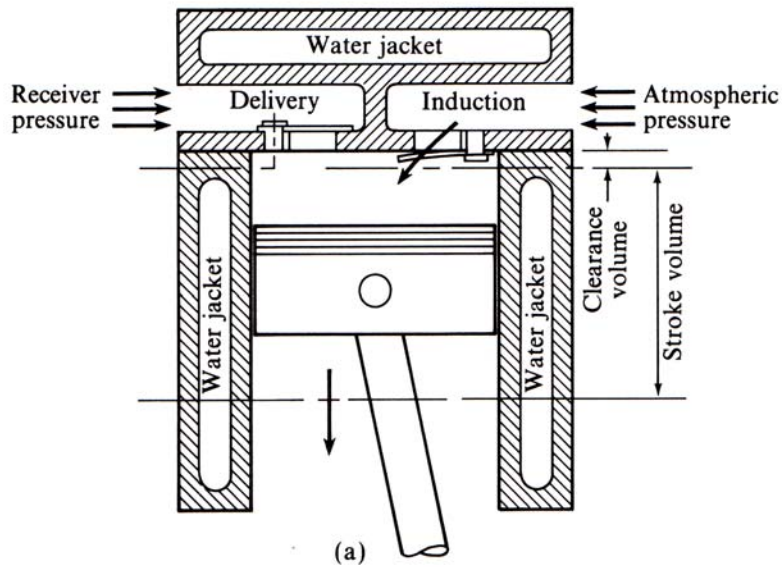
The function of a compressor is to take a definite quantity of fluid (usually a gas, often air) and deliver it at a required pressure.

Reciprocating type – low mass flow rate and high pressure ratio

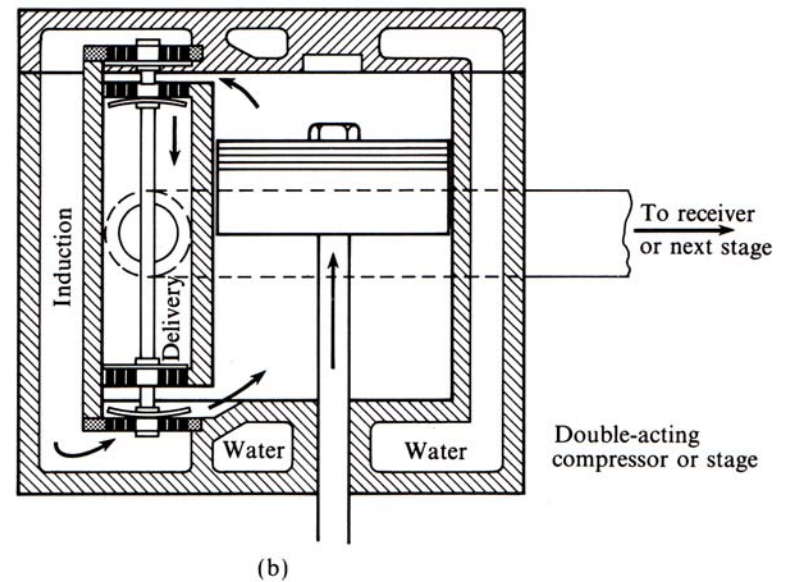
Rotary type – high mass rate but low pressure ratio.



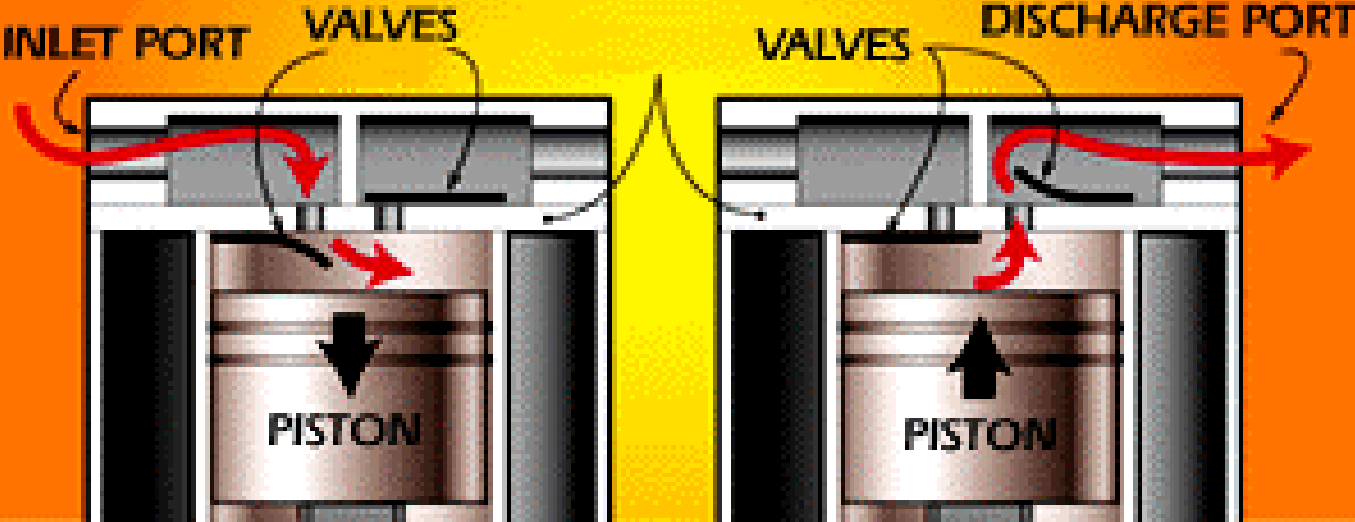
Single-stage air compressor: (a) induction stroke; (b) compression stroke



Single-acting (a) and double-acting (b) reciprocating air compressors

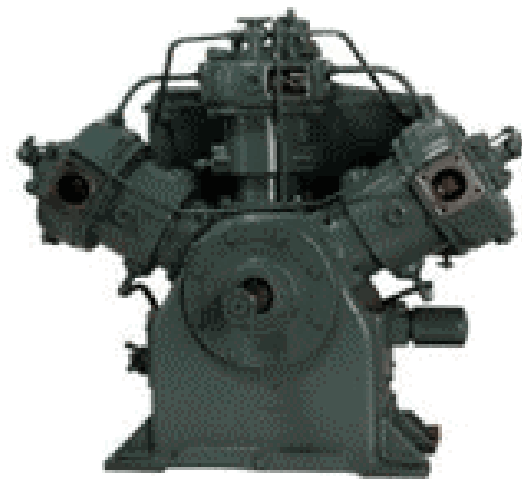
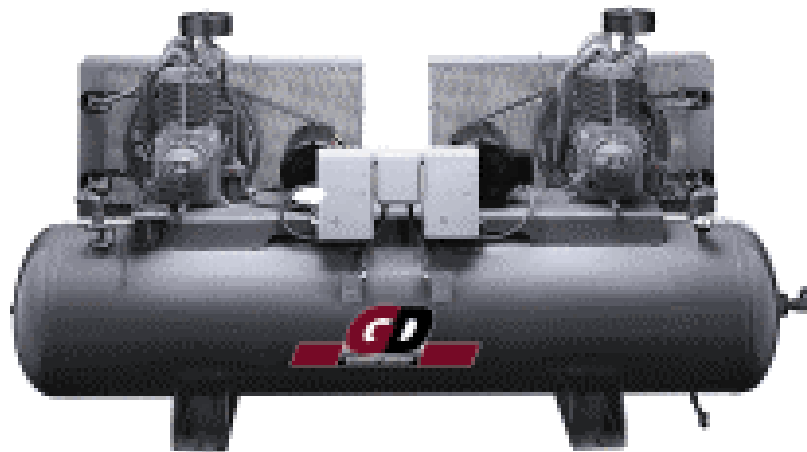


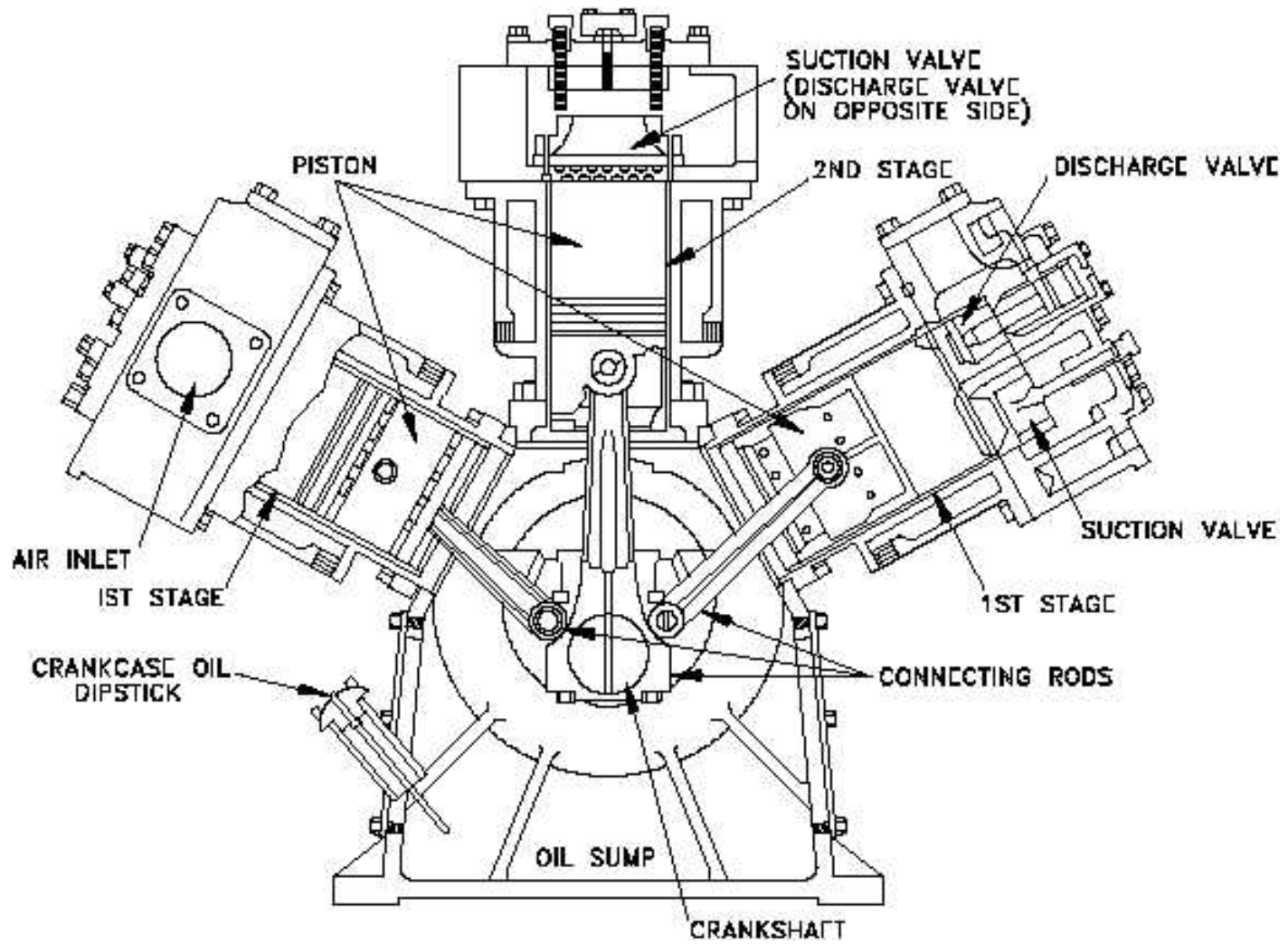
VALVE DETAIL





The air compressor in Sussex boiler's house





Rotary screw air compressor

The rotary screw air compressor has become the most popular source of compressed air for industrial applications.

Air enters a sealed chamber where it is trapped between two contra-rotating rotors. As the rotors intermesh, they reduce the volume of trapped air and deliver it compressed to the proper pressure level. This allows the rotary screw air compressor to operate with temperatures approximately one half that generated by a reciprocating compressor.

This enables the compressor to operate in a continuous duty. Its ability to operate for extended periods of time makes the rotary compressor ideal for demanding industrial applications.

Advantages

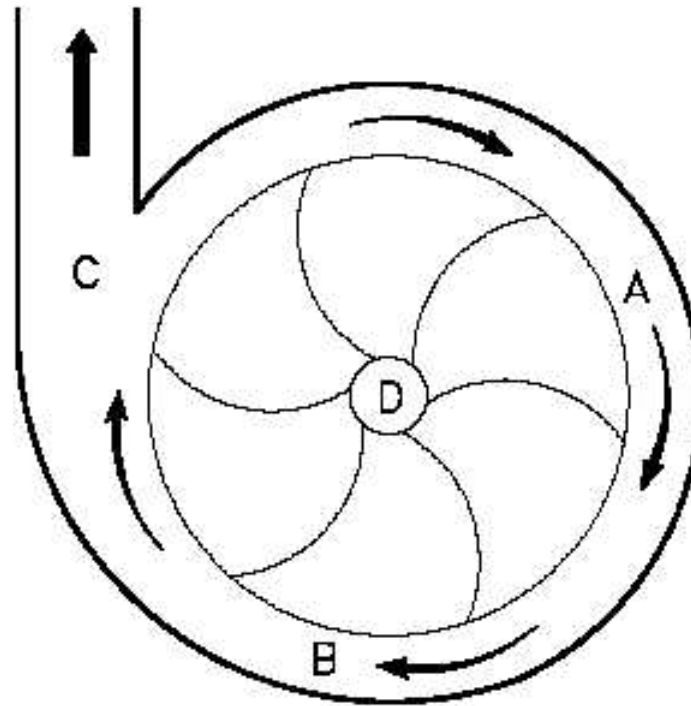
- Designed to provide pulsation-free air 24 hours a day
- 100% continuous duty
- Quiet operation
- Energy efficient at full load
- Extended service intervals
- Reliable long life
- Improved air quality





Centrifugal Compressors

Oil free
discharge pressures up to 3,500 psig
smooth discharge of the compressed air



Compressor power

One of the factors used to designate compressor power is motor/drive engine horsepower.

However, this isn't the best indicator. You really need to know the amount of air the compressor can deliver at a specific pressure.

Campbell Hausfeld® 2.5 HP Contractor Air Compressor (EX8001)



Price:\$339.99

4-gallon twin-stack

- **Maximum pressure 125 PSI**
- **Air delivery 6.3 SCFM @90PSI**
- **120 voltages**
- **Low maintenance oil free pump**
- **3.25 HP**
- **Includes 2 universal couplers, roll bar with control panel**
- **Boxed**

SCFM

Definition SCFM -- The term SCFM stands for Standard Cubic Feet Per Minute, referenced to a pre-specified pressure, temperature, and relative humidity. In most cases, SCFM is referenced to 14.7 PSIA, 68° F(20 ° C) and 0% relative humidity. By specifying these parameters, the mass flow of compressed air and gas systems is clearly defined.
(Corresponding to ‘free air delivery’)

PSIA

pounds per square inch, absolute (referenced to a vacuum)

HP

1 Horse power = 550 foot-pounds/second = 746 N-m/s (watts)

Design Procedure

Market research

Decision on capacity and pressure of the compressor

Power calculation

Calculations for compressor's parts

Parts drawings

Choose motor, transmission

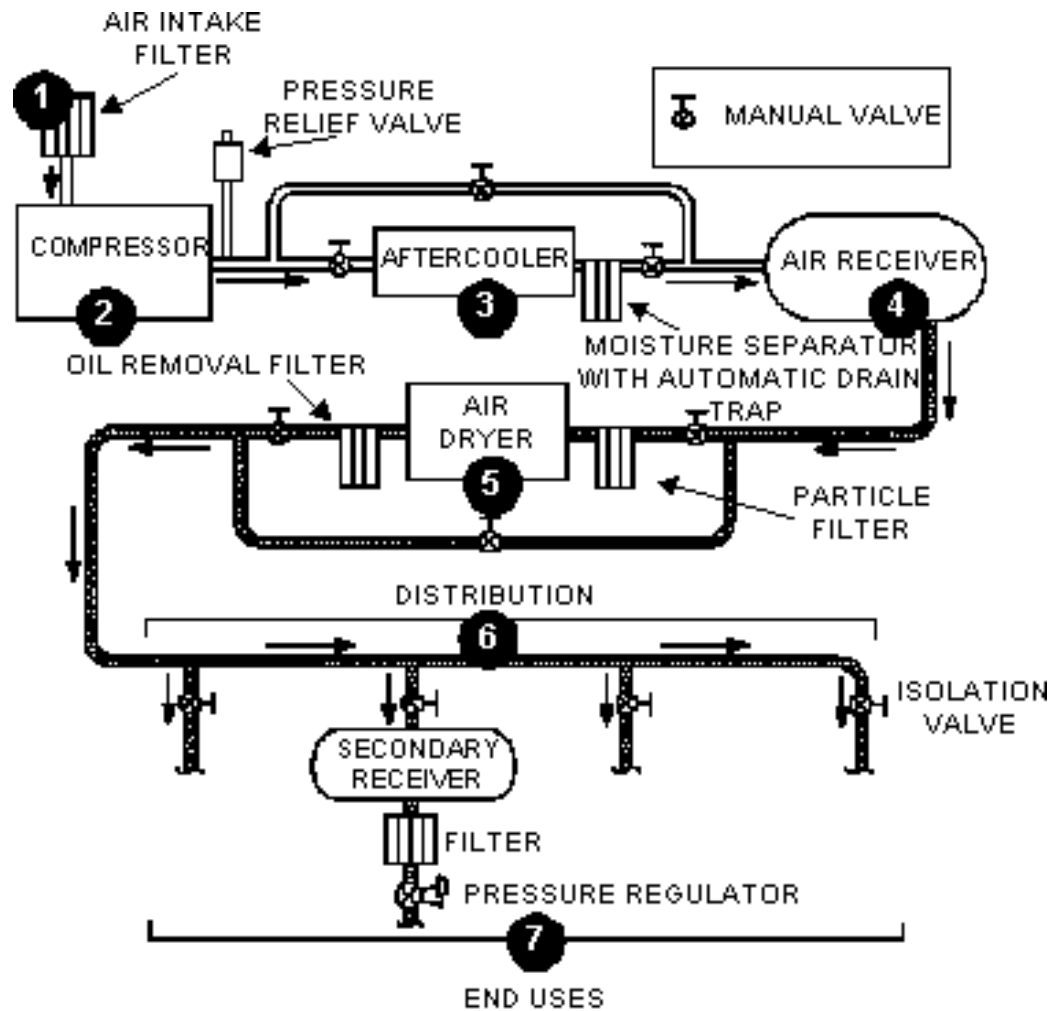
Lubrication, safety issues

Condition monitoring (Optional)

Unit assembly

Costing

Compressed Air System Components



Typical Applications

The type of compressor depends largely on size, cost, and reliability requirements:

- Rotary screw compressors in sizes up to 500-600 hp are very popular because of their high reliability and low maintenance requirements.
- Centrifugal compressors are often used in sizes ranging from about 150 hp up to over 10,000 hp. The larger size models are relatively low in cost and small in physical size compared to reciprocating compressors.
- Reciprocating compressors are commonly used today only in sizes up to 25 hp. These compressors are often used for light-duty applications or in startup industrial enterprises because they are reliable and low cost.

Air Tool Description	Average CFM @ 90 PSI
Angle Disc Grinder - 7"	5-8
Brad Nailer	0.3
Chisel/Hammer	3-11
Cut-Off Tool	4-10
Drill, Reversible or Straight-Line	3-6
Dual Sander	11-13
Framing Nailer	2.2
Grease Gun	4
Hydraulic Riveter	4
Impact Wrench - 3/8"	2.5-3.5
Impact Wrench - 1/2"	4-5
Impact Wrench - 1"	10
Mini Die Grinder	4-6
Needle Scaler	8-16
Nibbler	4
Orbital Sander	6-9
Ratchet - 1/4"	2.5-3.5
Ratchet - 3/8"	4.5-5
Rotational Sander	8-12.5
Shears	8-16
Speed Saw	5