

# Air Compressors

# Compressed Air

Compressed air is widely used as a power source in industry to power tools in

- many types of conveyors
- manufacturing and converting processes
- filtration, refrigeration, and aeration processes
- vehicle and machine doors.

Compressed air is often manufactured on site  
(other utilities such as electricity, natural gas, and water are often purchased from outside)

## Cost of its production often unclear

**A common perception:** it is free.

**Actually the cost of using compressed air:** 10 times the cost of using another utility such as electricity.

**Reasons:** in-efficiency 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
- Robust under extreme loading
- Versatile and easily interchangeable
- Safe alternative to other sources
- Adapt poor application environment

# Type of Air Compressors

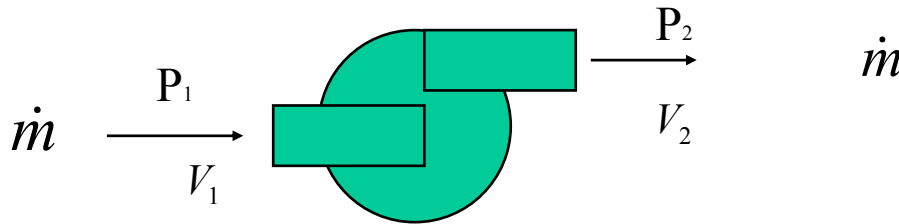
- Reciprocating
- Rotary Screw
- Rotary Centrifugal

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

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.



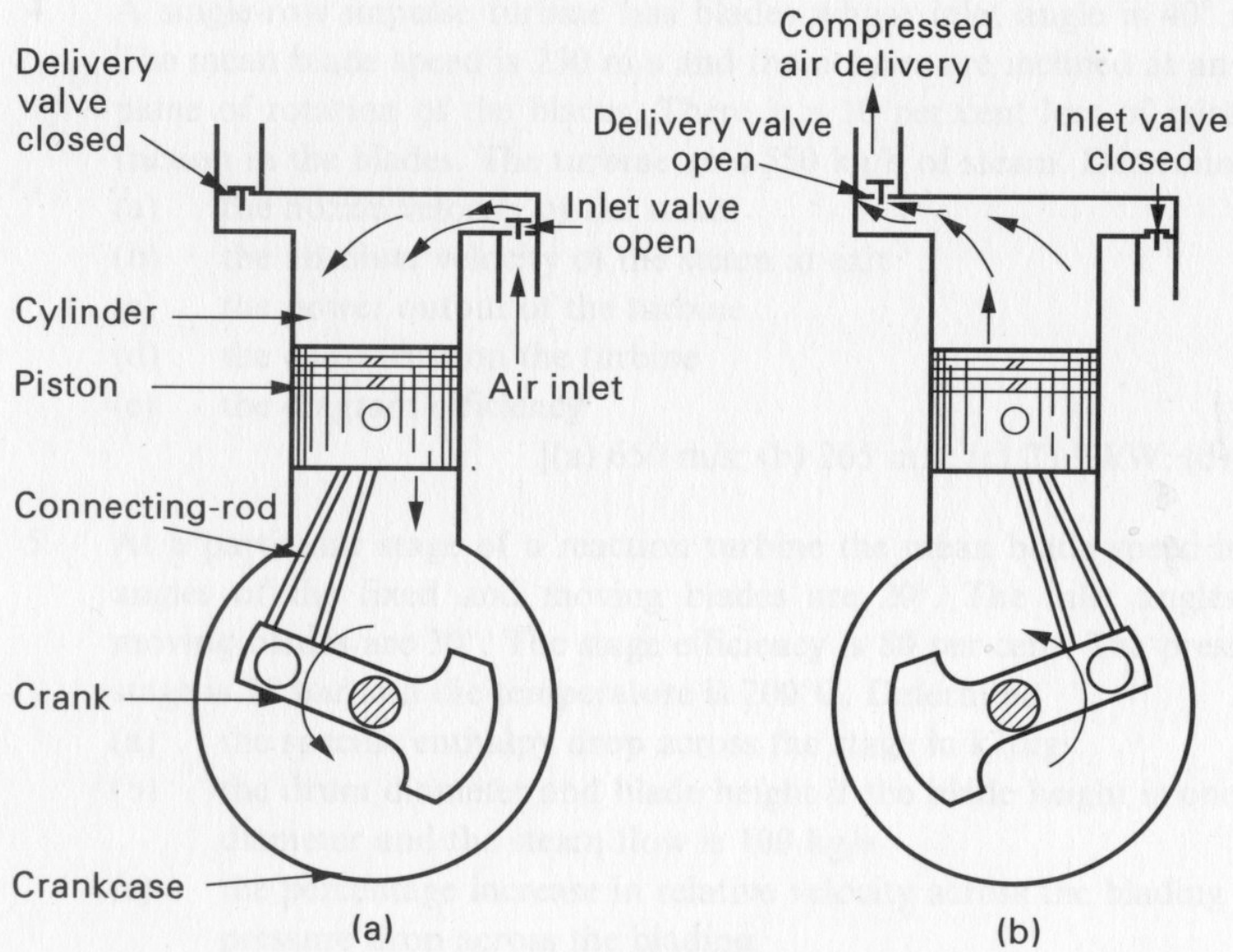
Reciprocating type – low mass flow rate (kg/s) and high pressure ratio

Rotary type – high mass rate but low pressure ratio.

## Applications

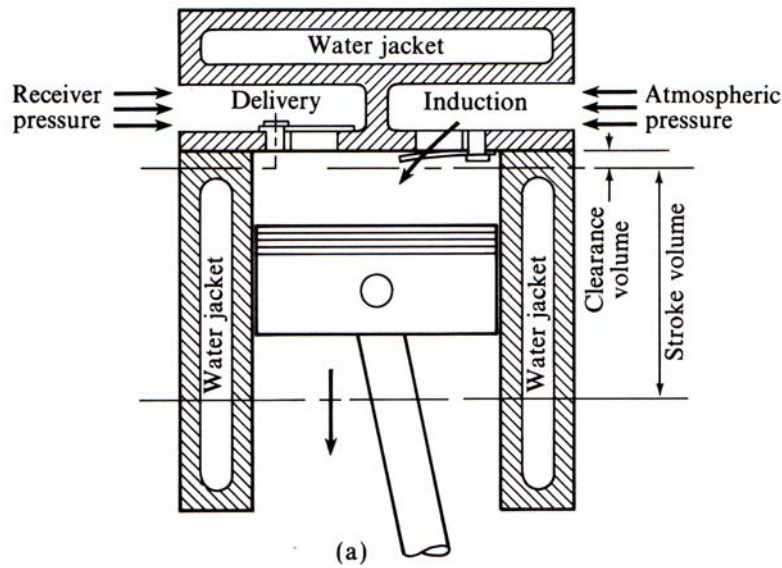
The selecting the type of compressor depends largely on size, cost, and reliability requirements:

- Rotary screw compressors in sizes from small (in cars) 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.

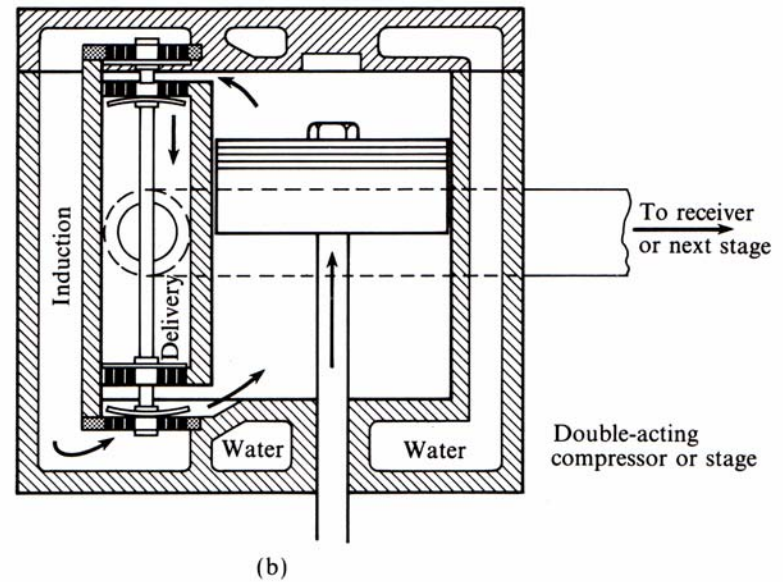


Single-stage air compressor: (a) induction stroke; (b) compression stroke

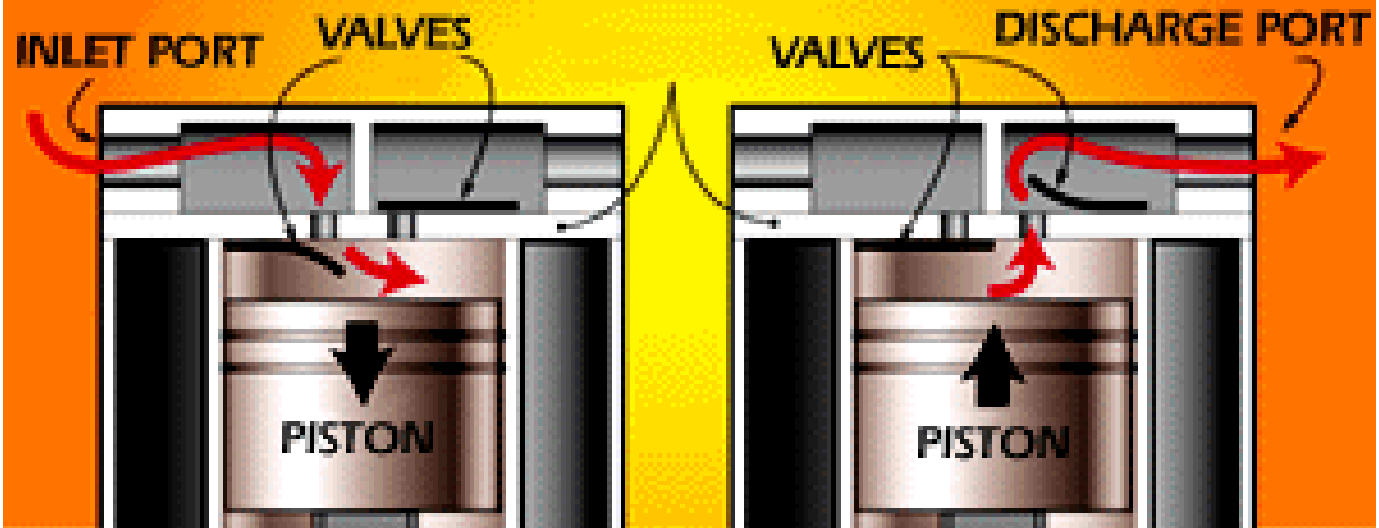




Single-acting (a) and  
double-acting (b)  
reciprocating air  
compressors

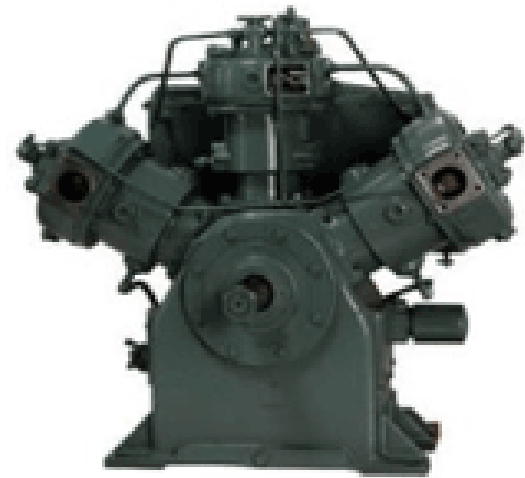
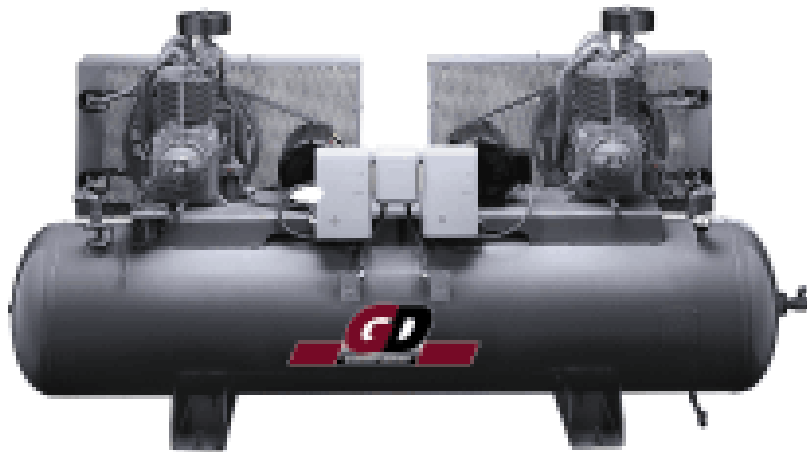


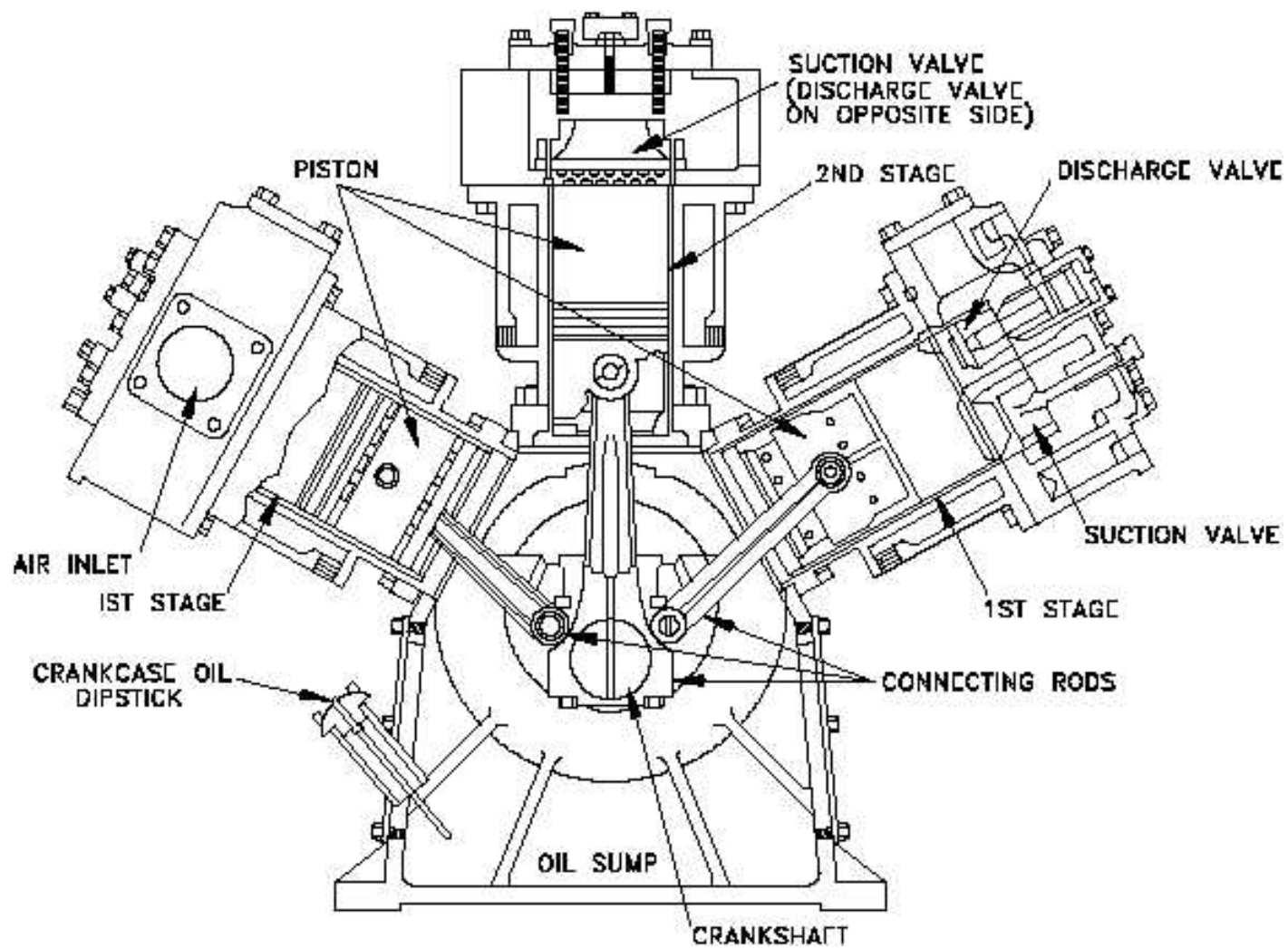
## VALVE DETAIL





The air compressor in Sussex boiler's house





## Rotary screw air compressor

The rotary screw air compressor has become 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.

### 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



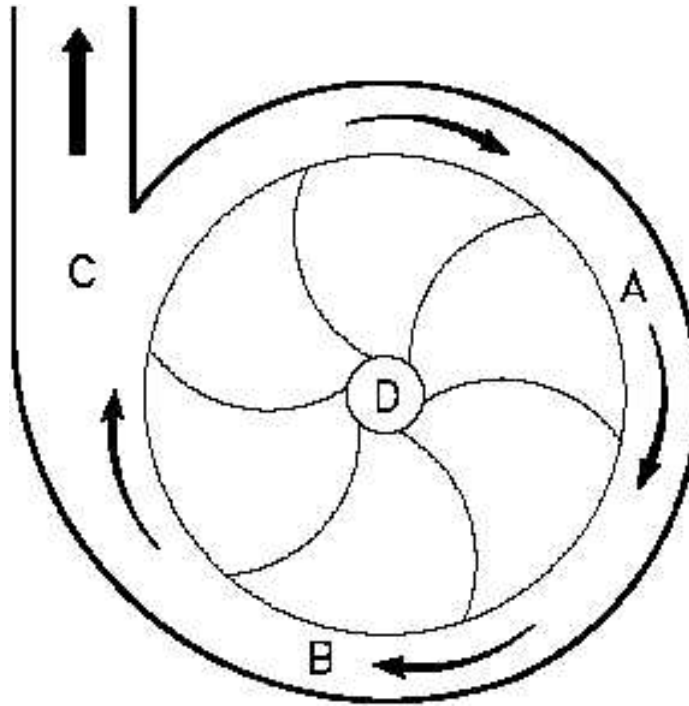


# Centrifugal Compressors

Oil free

discharge pressures up to 3,500 psig

smooth discharge of the compressed air





# Compressor's power

Factors used to designate compressor's power

- Motor/drive engine horsepower.
- The amount of air the compressor can deliver.
- Delivery pressure.

# Campbell Hausfeld® 2.5 HP Contractor Air Compressor (EX8001)

**Price:** \$339.99

**4-gallon twin-stack**

- **Maximum pressure 125 PSI (8.62bar)**
- **Air delivery 6.3 SCFM @90PSI (6.21bar)**
- **120 voltages**
- **Low maintenance**



## HP

Horse power,  $1 \text{ hp} = 550 \text{ foot-pounds/second} = 746 \text{ N-m/s (watts)}$

## SCFM

SCFM -- 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,  $20^\circ \text{ C}$  ( $68^\circ \text{ F}$ ) 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)

Air Tool Description	Average SCFM Required Pressure 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



# Design Procedure

Market research

Decision on capacity and pressure of the compressor

Power calculation

Calculations for compressor's parts

Choose motor

Transmission design

Parts drawings

Unit assembly

Manufacturing issues

Lubrication

Safety, Maintenance

Packaging

Costing