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**AIRPOWER/DONALDSON OPENDAY 1ST SEPTEMBER 2010**

Presented by Willem Cillié, MD Airpower.

Qualifications and experiences:

1978 - B. Engineering Mechanical Industrial – University of Stellenbosch
1983 - Mechanical Engineer's Certificate of Competency
1985 - Registered as Professional Engineer

1979 – 1980 Industrial engineer on Iscor Sishen Iron Ore mine
1981 – 1988 Mechanical engineer at PPC Western Cape operations.
1988 until today: Founder and owner of Airpower Western Cape (Pty) Ltd.

Welcome to the Airpower and Donaldson open day. I will cover the following areas. Please ask questions as we carry on.

1) Different type of air compressors with the advantages and disadvantages of each type.
2) Determine the air output of a compressor.
3) Determine the air consumption of an air tool or factory.
4) Electrical supply to compressors.
5) Air lines in factories, design and pressure drops.
6) Spray guns and other air users.
7) Behaviour of compressed air. Drying and cleaning will be delivered by:

## 1. Different type of compressors:

### 1.1 Turbine compressors:

This compressor works like a jet engine. It is just a fan spinning at 66000 r.p.m. I think there are 4 of these units sold in the Western Cape. Please, stay away from these units. We are in Africa and Boeing mechanics are not very many around.

### 1.2 Vane compressors:

There were four vane compressors manufacturers in the world. Hydrovane, Mattei, Fluidair and Puska. Today only Hydrovane and Mattei exist and they share most manufacturing facilities.

The vane compressor is a rotor with vanes. The vanes run in and out of the rotor as the housing allows it. Between the vanes and the housing the oil seals it. Note the cutting action on the oil.

The air is sucked in where the chamber is the largest and get compressed and released where the chamber is the smallest. The ratios between the chambers are more or less 1 to 7. If the backpressure is 7bar, the air is just rotated and the machine is cavitating. (Not delivering any air)

**Advantages:**

If you use all the air the vane compressor is delivering, this compressed air is energy wise, the cheapest air you can produce. You can run a vane compressor without an air receiver. You do get compressed air immediately when starting the compressor.

**Disadvantages:**

When you start a vane compressor until you switch it off, it consumes almost full load from the electrical supply point. If you use one litre of air, or the full capacity of what the compressor can deliver, your electrical bill will be the same.

Because you do not use an air receiver, all the moisture and some oil gets pushed down your airlines.

Because of the cutting action on the oil, the oil has a very limited life expectancy. On this point, I will give more later.

### 1.3 Piston compressors: (Reciprocating compressors)

This is still the good old faithfull for Africa

**Advantages:**

Almost any motor mechanic can service a piston compressor, up to a point. Most piston compressors only run to fill up the air receiver and is ideal for a workshop where the air requirements vairy a lot. It only uses electricity when running and delivering air.

**Disadvantages:**

The piston compressor is about 80 to 90% as efficient as a screw vane compressor. This means it will use more electricity to deliver the same air and the compressed air is therefore warmer.

Today most manufacturers only manufacture piston compressors up to 20 to 30 horsepower. (22kW)

With a piston compressor, you get a displacement figure and a free air delivered figure.

The displacement figure is the volume the intake piston is displacing when the compressor is rotating. This is the theoretical figure and most salesmen quote this figure. It looks good, but is worthless. The (f.a.d.) free air delivered is the most important, because this is the useable air.

What happen to the air, from displacement to f.a.d?
When the piston comes down, it sucks air in. Before the cylinder is full, it comes up again and before all the air has flown out of the cylinder, it goes down again. Then there is a little leakage pass the rings and valves.

The faster a piston compressor runs, the lower the efficiency between displacement and f.a.d. This is also why the air delivered by a fast running compressor is much hotter than a slow running compressor. Hot air we will touch on later.

A one-stage compressor takes the atmospheric air and pushes it to your air receiver pressure in one go.

A two-stage compressor takes the atmospheric air with the low pressure piston and brings it to half the tank pressure, put it through the intercooler and then into the high-pressure piston, that takes it to tank pressure.

If your LP piston and your HP piston work 180° apart from one another, the LP pumps into the HP while the HP is moving down. It makes space for the air. These types of compressors have a relative high efficiency and the delivered air is relative cold.

You do get a very popular two-cylinder piston block where the two pistons run on the same journal on the crankshaft. The V is 90°. This means The LP is pumping into the HP while the HP is coming up. The two pistons is working against one another. This is why those types of compressors are delivering very hot air and the efficiency is low.

If you have a 4 cylinder V unit, it is 100% balanced again because it is a LP and HP on two different journals and 180° apart. One piston works every 90° of the crankshaft.

**1.4 Screw compressors:**
All over the world, this type of compressor is winning market share. It works on two screws, a male and a female, rolling against one another, with oil sealing in between the screws and casing. The oil has a rolling action and the same quality oil, lasting 2000 to 3000 hours on a vane compressor, will last 6000 to 8000 on a screw compressor.

**Advantages:**

Oil lasting longer than on any other compressor type.
Very high efficiency and deliver cold air

**Disadvantages:**
High tech equipment and needs qualified artisans to service.

**2. Determine the air output of a compressor:**
We use the pump up test. For every bar pressure increase in the air receiver, you do need the volume of the air of the receiver, to be compressed into the receiver. A 100litre tank at atmospheric pressure, has a 100litre of air in it, but it is difficult to use. To get this receiver to one bar pressure, you must put another 100litre air into the tank. To raise it to two bars, you must push another 100litre into the tank.

What we do is, we empty the compressor air receiver, no water, no air above atmospheric pressure. We close all the outlets, run the compressor and take the time the gauge goes from say 5bar to 7bar. Then by dividing the volume of air put into the receiver by the time, we can calculate the air delivered of this compressor at 6bar in this case.

**Example:**
200litre receiver
Pump from 5bar to 7bar in 130seconds
(7bar – 5bar) x 200litre/130sec.
= 3,0769litre/sec
or 184litre/min f.a.d.

The norm for a piston compressor is approximately 100litre/min per horsepower compressor.

If you want to calculate the speed, a compressor must run. You work on approximately 120litre/min displacement/horsepower of the motor.

**3. Determine the air consumption of an air tool or factory:**
You pump up an air receiver as in previous case. Switch compressor off, set regulator at pressure required on the air tool and take the time the pressure drops one or two bar on the receiver gauge. For every one bar pressure drop, you consumed the volume of the air receiver.

**Example:**
300litre air receiver
Air tool run 67sec to drop air receiver from 10bar to 7bar.
(10bar – 7bar) x 300litre/67sec
900litre
= 67sec
=13,437litre/sec
or 806litre/min.

Once you determined the output of a compressor, you can run a complete factory from the compressor and measure the time the compressor run and the time the compressor stops.

**Example:**
Run 10min, stop 2min.
Calculated out put of compressor was say 900litre/min in 2 above.
The factory consumes - 10/12 x 900
= 750litre/min

Once you have calculated these figures, you can determine the size of compressor required.

**4. Electrical supply to a compressor:**
Customers always say, I have 3phase power. It does not mean a thing.

Once you determined the size of the compressor, you multiply the horsepower by two. This will give you the electrical breaker required for a 3phase 380/400 Volt compressor. The kW x 2 gives the full load Amps.

**Example:**
15hp compressor is an 11kW unit.
Breaker must be 15 x 2 = 30Amps.
Full load current 11 x 2 = 22Amps

Always insist on a slow curve breaker. (a 5 or 6kA unit)
A compressor starting with DOL (direct on line), need a larger breaker.

**5. Airline in a factory, design and pressure drop:**
There is normally air and water in airlines. The air you want to get to your equipment and the water you want to drain.

Thanks to gravity, the water is in the bottom of the airline and the air on top. The water will collect in the lower point. At this point you need a place where water can accumulate and where you can drain it. If you do not drain the water at each and every low point, water will collect until it forms a plug of solid water. At one stage the air will push up this plug and push it all the way, through any filter into your expensive pneumatic equipment and cause damage.

No filter can create air to send on, while it only receives a stream of water coming into it. The air for your machine must be taken from the top of your airline and then down to the equipment. Water can pass this point without going to your equipment.

Pressure drop is very important. All I can say is, go to www.airpower.co.za and use the pressure drop calculator. Use different size pipes and get the best pipe for an acceptable pressure drop. Less than 0,3bar pressure drop from compressor to the furthest point in factory is normally acceptable.

**Note:** If there is airflow, there will be a pressure drop.

**6. Spray guns:**
You do get low pressure or internal mix spray guns, and high pressure or external mix spray guns.

The low-pressure spray gun is old technology. You put pressure on the liquid, force it into an air stream, through a nozzle and out like an aerosol can. The liquid and the air mix inside the nozzle and come out together.

A high-pressure spray gun works on a venturi. Air blows through the venturi and sucks the liquid out of the pot and the air and liquid mix for the first time outside the gun in front of the venturi nozzle.

You do get HVLP high volume low-pressure spray guns. It works on the same principle as a high-pressure spray gun, but it works on very low pressure and makes less dust. The least dust, the least waist of paint.

A gravity gun can spray at very low pressure, because the liquid runs down to the venturi and less air is required to get the paint into the air stream.

**Donaldson will conduct the drying and cleaning of compressed air after the break.**

Regards

Willem Cillié