



# CASHFLO *for Compressed Air*

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## Dictionary of Terms commonly used in Compressed Air Systems

### Some Previous Projects

*Many of these terms apply to other gases.*

#### Introduction:

It is fairly easy to find out what most European compressed air abbreviations and terms actually mean. It is less easy if you are buying large volume machines made outside the EEC. The European compressor market is not so metric as you think, many large volume machines sold throughout Europe are made in the USA. American compressed air plant and equipment manufacturers use good old-fashioned imperial terminology. The following terms and descriptions will help you decipher a quotation for compressed air plant and equipment so that proper comparisons can be made to ensure a prospective purchaser makes the right choice. It also details some of the UK and European terms that may be confusing to our American counterparts.

More projects >>

### Compressed Air Audits

Find out more >>

A new 'green' addition is the addition of terminology with respect to refrigerants and other gases that affect the ozone layer. This may be of particular interest to companies that use refrigerated air dryers. Some

Government funding is also available to UK businesses, to carry out energy surveys upon their compressed air systems. Brief details have been included for completeness.

Last update - 17th February 2006.

[A](#) | [B](#) | [C](#) | [D](#) | [E](#) | [F](#) | [G](#) | [H](#) | [I](#) | [K](#) | [L](#) | [M](#) | [N](#) | [O](#) | [P](#) | [R](#) | [S](#) | [T](#) | [V](#) | [W](#) | [Z](#) | >> [top](#)

## A

### Absolute Pressure:

This is a pressure measured from a base of absolute zero. We breathe air at a pressure of approximately 14.7 pounds per square inch absolute (psia). We don't notice this pressure because it is always around us - and its called atmospheric pressure. However, if we look at an unused pressure gauge it reads 0 psi. The absolute pressure of a system therefore equals the sum of the local Atmospheric Pressure plus the Gauge Pressure. (Also see Atmospheric Pressure, Bar and PSIG.)

### Technical database

During the course of a year we are repeatedly asked similar questions, some technical and some pretty fundamental. To assist compressed air users everywhere, we have compiled a Technical Database. Find out more >>

- Dictionary of Compressed Air Terms.
- The History of some Compressor types.
- The Properties of Air.
- The Discovery and make-up of our Atmosphere.
- An Introduction to Compressed Air Dryers.
- A Theoretical Energy Calculation for a compressor.
- Safety, Health and The Environment with respect to the compressed air user.
- UK Statutory Legislation.

### **Absolute Temperature:**

This is a temperature measured from absolute zero which is approximately -273.15 deg C and is usually referred to as 0 deg K. (ie 0 deg K = - 273.15 deg C)

### **Action Energy:**

A former UK energy programme funded by The Carbon Trust. The programme replaced the Energy Efficiency Best Practice Programme and has now been re-branded under the banner of The Carbon Trust. It is available to all manufacturing industries that reside within the UK and assists those industries to reduce energy consumption by increasing efficiency. Several schemes exist to fully or partly fund site-wide energy surveys. Detailed surveys for compressed air systems are one of the part-funded schemes and a pdf application form can be requested by emailing us at [enquiry@cashflo.co.uk](mailto:enquiry@cashflo.co.uk)

### **Aerodynamic Compressors:**

These are either axial or centrifugal machines. Pressure is imparted to the air by speeding the air up, and then diffusing the velocity head into static head. These machines will ultimately stall, unlike a positive displacement machine.

### **Aftercooler:**

A heat exchanger fitted after a compressor to cool down the discharged compressed air. An aftercooler is usually either air-blast, or water cooled.

### **Air:**

Three letters which require a volume to accurately define. Generally accepted as the mixture of gases found on the earth's crust. The water vapour content of air varies dramatically and when considering alternate bids for a new compressor, the moisture content (RH) stated by each prospective supplier should be the same, as should the inlet pressure and inlet temperature. For a technical analysis of air, together with other general facts and figures, click on the little blue word 'Air'. For a breakdown on the history of the people that discovered the component gases that form air, plus an explanation regarding the terminology of our atmosphere, click on the word 'Discovery'. **Discovery:**

### **Air 'Over-the-Wall':**

Sometimes called 'over-the-fence' or an 'air-supply-scheme'. The user purchases compressed air rather than being responsible for generating it. Unfortunately, even though the user may not own the air generation equipment, if it is on their land they still have an overall H&SE responsibility. For this reason, many users 'sub-let' the compressor house to the provider, for a peppercorn rent.

### **ANR:**

Atmosphere normale de reference. The term ANR is not usually applied to cfm, it is the new (sick) European replacement for FAD and usually follows the metric measurement of air flow, such as Cu Metres per Minute ANR.

### **Anti-Pulsation Tank:**

Sometimes called a pulsation damper this is a small receiver fitted on the inlet or discharge of a reciprocating compressor. The device is designed to remove the resonance from the compressor thereby reducing noise.

### **Atmospheric Pressure:**

This pressure varies the world over and fluctuates with weather conditions, it is also dependent upon altitude. However by International agreement we have a reference atmospheric pressure which is used in many theoretical calculations for brochures and sales leaflets. The reference atmospheric pressure is 14.6959494 psi. If you want to be really precise, 1 atmosphere exactly equals 101325 Pa. (Also see Bar)

### **Audit:**

An official examination to determine inputs and outputs of a system in a manner that can illustrate the current situation. Compressed air audits are becoming fairly common and many reports are based upon simple ultrasonic leak tests.

A 'proper compressed air audit' should depict hard information in the same way that twin entry book-keeping shows the in's and out's of money flowing through a business. Inputs to the compressor house include energy, water, labour, oils, spare parts, repair costs, etc. Outputs include compressed air for production, air leaks, heat losses, filtration/drying costs, emissions to air/land/water, noise emissions, transmission and distribution losses etc. From this information, the Conversion Efficiency for the compressed air system can be calculated. The client / consultant can then review the findings of the audit with a view towards increasing the Conversion Efficiency. More and more compressed air audits encompass SHE investigations. This additional information may not increase compressor conversion efficiency, but it does ensure that the client is up to date with the Safety, Health and Environmental aspects of producing and using compressed air. Funding is now available for UK industry to subsidise compressed-air audits (surveys). See Action Energy.

### **Auto Ignition Temperature (AIT):**

The temperature at which a mixture of air and flammable gas/material will spontaneously ignite, without the assistance of spark or flame.

### **Axial Compressor:**

An aerodynamic machine, usually multistage. The air is drawn through a series of rotors (propeller like) and stators until the desired working pressure is achieved. It is called axial because the air essentially enters one end of the compressor and is ejected at pressure from the other end.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)|>>[top](#)

## **B**

### **Bar:**

A measurement of pressure, 100kPa = 1 bar. This corresponds very closely to 1 atmosphere and the two are often confused. 1 bar = 14.50377439 psi. (1 reference atmosphere = 14.6959494 psi).

#### **Bar(a) also bara:**

The pressure of a system or device measured from absolute zero.

#### **Bar(g) also barg:**

The pressure of a system as viewed on a pressure gauge, which does not include atmospheric pressure.

### **Blower:**

A compressor that is designed to operate at lower pressures. Usually a blower is an air compressor that operates below 2 barg, although this figure is quite loose and depends upon the respective manufacturer.

### **Brake horsepower:**

In our metric terms this is obsolete. However, it refers to the amount of power that is available from the drive shaft of the electric motor connected to the compressor.

### **Breathing Air:**

Two standards exist that require the quality of breathing air to be evaluated, these are BS4275 and BS-EN 12021. COSHH also requires the airstream to be sampled and the degree of monitoring is highly dependent upon the nature of the contaminant. Generally the frequency of testing should be a minimum of once per month, unless the air source is a portable compressor. If the source is from a portable compressor, then the frequency of testing will be once per month plus once everytime the compressor is moved.

### **Bunding:**

The relatively new UK (1999) regulations require that the bund must be capable of containing 110% of the liquid contained in a single tank. Multiple tanks must be banded so that 110% of a single tank plus 25% of each of the remaining tanks can be contained. If these regulations are applied to a packaged screw compressor, then the enclosure should be designed so that it will contain 110% of the oil capacity without releasing discharge to the ground.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)|>>[top](#)

## **C**

### **CAES:**

Compressed Air Energy Storage. The concept of recovering large quantities of energy using compressed air that has been stored underground in caverns or porous rock. The compressed air is generated 'off-peak' and then used to supply a fired turbine during premium hours. Pressurising the caverns produces large volumes of hot water as a by-product from water-cooled compressors. The same waste heat can be used to warm up the compressed air during the expansion phase, or supplied to 'mutual-venture' industries that require large quantities of low grade or medium grade heat. In such cases the hot water can be used for back-to-back industrial process applications, or provided to a nearby population for sanitary and domestic purposes.

### **Capacity:**

An Americanism, which refers to the amount of compressed air delivered by a compressor or required by a system. The term capacity is usually qualified by something else, such as SCFM, ICFM etc.

### **Carbon Trust (The):**

A non-profit company set up and funded by the UK Government, to promote the development and application of 'low carbon'

technologies, thereby allowing Britain to meet its Carbon Emission targets. Also see Action Energy and ECA's.

### **CDM Regs:**

See Construction (Design & Management) (Amendment) Regulations 2000, and also see Planning Supervisor.

### **CFM: (Cubic feet per minute)**

The imperial method of describing the volume flow rate of compressed air. It has to be defined further to take account of pressure, temperature and relative humidity. For example:

- **CFM (FAD)**. Cubic feet per minute, free air delivered. This is the amount of compressed air measured in cubic feet per minute, converted back to the actual inlet (free air) conditions before it was compressed.
- **ACFM**. Actual cubic feet per minute. This is the flow rate measured under stated operating conditions. This would be the actual volume flow rate that you could observe if the pipework after the compressor was transparent and you measure the actual flow rate under pressure. However, some American compressor manufacturers use the same term to describe the amount of air entering the compressor under Normal conditions. Always check what the supplier means.
- **ICFM**. Inlet cubic feet per minute, this appears to be the same as CFM (FAD) but it may hold a trick up its sleeve depending upon the type of compressor that's being offered. If the compressor uses labyrinth seals, the ICFM figure is probably 1% or 2% higher than the true air volume coming out of the other end. This is because the labyrinth seals inside the compressor will be wasting about 1% or 2% of the volume flow.
- **SCFM**. Standard cubic feet per minute. This is the actual flow rate, converted back to standard inlet conditions. Also see Standard Reference Atmosphere.

### **Choke:**

This term is used for turbo compressors and represents the maximum flow condition. It is sometimes also referred to as stonewalling.

### **Climate Change Levy:**

Announced in March 1999, this was introduced in April 2001. The target is to save 1.5 million tonnes (UK only) of carbon (emission) per annum. Essentially the 'Carbon Tax' will be structured to bring in £1.75b to the exchequer and will be returned to employers via a proposed 0.5% reduction in employers NI contributions, (now reduced to 0.3%).

### **Competent Person:**

The Pressure Systems Safety Regulations 2000 requires that a compressed air system is inspected by a person, and once it has been inspected the same named person signs a document declaring that the system is safe. The signatory is required by law to be 'Competent', in practice this means a person with a Higher Qualification in Mechanical Engineering together with a minimum of 5 years experience in the relevant field of engineering. Ask to see the 'Blue Card' which would have been issued to a prospective 'competent person' by the Engineering Council. The competent person is responsible in law if the system is subsequently found not to be safe. See Safety of Pressure Systems Regulations.

### **Compressor:**

A machine which usually sucks in air and compresses same so that it ultimately occupies a smaller volume. The resulting air will not only occupy a smaller volume, it will have a higher pressure and a higher temperature. See blower.

### **Condensate:**

The liquid that forms when compressed air is cooled, or when air is compressed at constant temperature. The condensate produced by compressed air is water, although it may be contaminated with oil, dirt or other materials. See mayonnaise.

### **Condensate Management:**

A relatively new term that has come into force because of the Water Resources Act 1991. The condensate from a compressor, dryer or filter has to be treated before it can be discharged down a foul drain (sewer). The level of permissible contamination varies from one regional Water Authority to another. It is absolutely prohibited to discharge condensate, treated or otherwise, down a rain water drain.

### **Construction (Design and Management) (Amendment) Regulations 2000:**

The original 1994 Regulations have been amended in light of a decision by the Court of Appeal, which was contrary to the HSE's original intention of the law. This now means that designers who arrange for employees or other persons to prepare a design, still have a duty under the revised CDM Regulations. These Regulations also place duties upon clients to ensure that construction & demolition is carried out under prescribed conditions by competent persons. These regulations specifically apply to compressed air systems and not only include design and installation, but are also applied to service work and maintenance. The Regs require...

- Appointment of a Planning Supervisor Allocation of adequate resources. Production of a Health & Safety Plan. Appointment of a Principle Contractor.

- Development of an ongoing H&S File (based upon the initial H&S Plan).

### ***CIMAH Control of Industrial Major Accident Hazards Regulations.***

European Community (EC) Directive adopted in the UK in 1984 and called the CIMAH Regs. Operators of certain hazardous industrial installations must prepare a written safety case, similar to a Risk Assessment. Such installations may include the use of compressed air plant and equipment in 'zoned' areas. The operator must...

1. Identify nature and scale of hazard. Outline arrangements for safe operation. Identify and evaluate type and consequences of a major accident.
2. Demonstrate appropriate controls are in place.  
Note: The safety case did not focus on management systems, after Piper Alpha disaster, the regs changed to COMAH 1994.

### ***COMAH Control of Major Accident Hazards Regulations 1994.***

Administered by the Competent Authority. (The H&S plus the EPA). Based upon CIMAH but to include.....

1. Identify major hazards. Ensure that risk to personnel has been analysed and appropriate controls provided. Adequate provision for evacuation, rescue etc in the event of a major emergency.
2. The Safety Management System (SMS) is adequate and the design operation of the installation is safe.

### ***COSHH Control of Substances Hazardous to Health.***

This requires a Risk Assessment. However, it only applies to chemicals, for example molten lead would not require a COSHH assessment. The five outcomes suggested by H&SE are...

1. No risks now, unlikely to change in the future.
2. Risks are high, there is inadequate control.
3. The risks are controlled, but may increase in the future.
4. There is a hazard, the risks are uncertain.
5. There is insufficient data to ascertain the risks.

The response to any risk assessment must be one of...

1. No action if substances/activities do not change.
2. Immediate action.
3. No action now, but future changes should minimise risk.
4. More info needed.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[J](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## **D**

### ***Deliquescent dryers:***

A dryer which employs a chemical in the form of a tablet to absorb moisture. The chemical degrades into a liquid which is drained off periodically. Similarly the dryer has to be 'topped up' with new tablets to continue working. See **dryers**.

### ***Desiccant dryers:***

Also called pressure swing dryers, these use a chemical which can be repeatedly dried out. See **dryers**.

### ***Demand:***

The flow of air required to satisfy usage at specified temperature and pressure conditions.

### ***Dewpoint:***

When air is cooled it eventually reaches a point where the moisture contained within it condenses into liquid. This temperature is called the dewpoint. See **pressure dewpoint**.

### ***Diffuser:***

An item within an aerodynamic compressor which converts the velocity head into a static head. The diffuser usually consists of a set of vanes at specific angles so that the discharged air is efficiently slowed down.

### **Discharge Pressure:**

The actual pressure that is available from the air compressor. This is not the same as the system pressure or the required pressure. It is important to ensure that a new compressor has a discharge pressure which is great enough to overcome losses through pipes and any air treatment, so that it can meet the required system pressure.

### **Discharge Regulations:**

See Water Resources Act - 1991.

### **Displacement:**

Otherwise referred to as swept volume. All air compressors have losses due to slippage, valve losses and clearances. These cause in-efficiencies and reduce the actual amount of air that the compressor will deliver. The displacement or swept volume is the theoretical amount of air that the compressor could deliver if these in-efficiencies did not exist.

### **Dryers (Driers):**

A separate section of its own. Briefly, a device which lowers the pressure dewpoint of the compressed air in a system. If you need more information, click on the little blue words.

### **Dual Control:**

An Americanism which refers to the method upon which the compressor is controlled. This control system is sometimes called on-line/off-line control and means that the compressor either produces air at full capacity, or it runs off-load. An example would be a butterfly valve being either fully open, or fully closed.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## **E**

### **ECA:**

Enhanced Capital Allowance. A scheme introduced by the UK Government that will allow businesses to deduct some capital allowances from their corporation tax. Qualifying energy saving technologies includes some compressed air products. This list contains variable speed drive compressors, zero loss drains, desiccant dryer control systems, variable speed refrigerant dryers and ultrasonic leak detectors. A detailed list can be obtained from [www.ECA.gov.uk](http://www.ECA.gov.uk)

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## **F**

### **Flow Rate:**

See CFM and Volume Delivered.

### **Free Air Delivery:**

See CFM.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## **G**

### **Global Warming Potential**

Not to be confused with Ozone Depletion Potential. This is the ability of a 'lower emitting' green-house gas to trap heat in the atmosphere. This is expressed as a number based upon the GWP of carbon dioxide being 1. The GWP is calculated over a 100 year time horizon. For example:

Carbon Dioxide = 1

Nitrous oxide = 310 (ie Traps 310 x as much heat).

See ozone depletion potential for a comparison.

### **Guide Vanes (Inlet):**

These are fitted on the inlet throats of aerodynamic compressors. The air approaching the compressor is spun in the same direction as the rotation of the impeller, prior to reaching the impeller. This makes the machine slightly more efficient. However as the IGV's

begin to close, the approaching air is throttled which not only reduces flow rate, it reduces overall compressor efficiency.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/>>>[top](#)

## H

### *Halogen:*

The collective term used to describe the five non-metallic elements...

- Astatine Bromine Chlorine Fluorine
- Iodine

### *Halogenated Hydrocarbons*

A group of chemicals, including some refrigerant gases. Many arise as unwanted by-products such as from the manufacture of pesticides and the incineration of polychlorinated biphenyl (PCB). Some are exceptionally hazardous.

### *Heat Sink*

An application or process that can make use of the heat produced from an air compressor (for example). Successfully identifying a suitable heat sink will increase overall site efficiency and dramatically reduce energy bills.

### *Hyperbaric*

A term to be treated with care because it has a multitude of meanings. The standard dictionary definition simply means a pressure greater than normal. In tunnelling it means that the atmospheric environment of the tunnel is elevated to a pressure that allows personnel to work comfortably inside the tunnel, but is high enough to prevent the ingress of water etc. In medicine it means an ultra-high pressure, typically pressurised oxygen chambers that people sit inside for medical treatment.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/>>>[top](#)

## I

### *I.B.V:*

Inlet butterfly valve. These are fitted on the inlet of most types of compressor and the valve opens and closes to throttle the air flow. However, the term IBV is usually associated with turbo compressors.

### *I.G.V's:*

See Guide Vanes (inlet).

### *Inlet Pressure:*

This is usually measured at the inlet to the compressor and will not include any losses due to the efficiency of the air intake filter unless otherwise stated.

### *Inter-cooling:*

A multi-stage compressor will have separate coolers between each stage of compression. These inter-coolers attempt to reduce the temperature of the compressed air as low as possible prior to the next stage of compression. This increases efficiency, and also unfortunately the cost of the compressor.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/>>>[top](#)

## K

### *Kg*

The SI unit of mass established in 1889. 1 Kg = 2.20462262185 lb.

### *Kg*

The constant for gaseous explosions. This is measured in bar metres/sec. It is defined as the rate of change, that is pressure/time, multiplied by the volume of the container to the power of 0.333. Also true for Kst. See zone.

**Kst**

The constant for dust explosions. The 'st' stands for STAUB which is German for dust. This is measured in bar metres/sec. Unlike the classification for gases, the explosion classes are in reverse order with ST 0 having no possibility of explosion, and ST 3 being explosive. See zone.

**Kyoto Protocol**

Signatories to the United Nations Framework Convention on Climate Change met at Kyoto, Japan in 1997. The resulting treaty was later termed the Kyoto Protocol. The US proposed a scheme to rank greenhouse gases according to their level of destructiveness. i.e. CO<sub>2</sub> = 1. Methane = 11, each called the Global Warming Potential. The treaty committed the industrialised countries to reduce emissions of six gases by an average of 5.2% by the year 2012. The treaty also allowed countries to bank or borrow credits in respect of carbon emissions.

**A|B|C|D|E|F|G|H|I|K|L|M|N|O|P|R|S|T|V|W|Z|>>top**

**L****L/sec ANR:**

Volume flow rate measured in litres per second related back to ANR conditions.

**Leq - Equivalent noise level:**

This is the sound level, averaged over an 8 hour day - that would be equivalent to the effects of a varying sound level that a person would be exposed to, over an 8 hour period.

**Lower Explosive Limit (LEL):**

Also called the Lower Flammable Limit. Flammable gas or vapour will only burn in air over a limited range of concentrations. If the mixture is too 'lean' to burn it is below the lower explosive limit. Also see Upper Explosive Limit.

**Lower Flammable (LEL):**

See above.

**A|B|C|D|E|F|G|H|I|K|L|M|N|O|P|R|S|T|V|W|Z|>>top**

**M****M3/min ANR (also M3/hr ANR):**

Volume flow rate measured in cubic metres per minute (or per hour) related back to ANR conditions.

**Mayonnaise:**

The oily condensate discharged by lubricated air compressors. The name is derived from the appearance of the condensate. Under normal conditions oily condensate should just be cloudy, like a small amount of milk in a bucket of water. When a lubricated compressor goes wrong, then the condensate becomes thick and sticky. In fact almost identical in appearance to the name it has been given.

**Minimum Ignition Energy (MIE):**

The minimum energy required to produce a spark strong enough to ignite an optimum concentration of material and air, under optimum atmospheric conditions. The MIE will reduce as the temperature and pressure of the mixture increases.

**Modulating Control:**

A description of the intake control system fitted to a compressor where the inlet valve hunts and throttles so that the amount of air delivered matches the demand. Similar to a butterfly valve being half shut so that it reduces flow.

**Montreal Protocol:**

Signed in 1987 in Montreal Canada, the protocol originally aimed to reduce the production of ozone deleting chemicals by 35% by 1999. The protocol was reviewed in 1992 (under the Vienna Convention for the Protection of the Ozone Layer) and various amendments plus another 11 chemicals were added to the list. The revised agreement resolved to stop the manufacture of ozone depleting chemicals within developed countries by the year 2000.

**Multi-Stage:**

An air compressor is not very efficient if you attempt to compress the air from (say) atmospheric pressure to 7 barg in one go. It is better to compress the air in two or more goes (called a stage), cooling the hot air between the stages. A compressor which reaches the final working pressure using two or more stages of compression is called a multi-stage compressor. Generally speaking, two stage compression is better than one. Three stage is even better.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## N

### *N cu m/min (also N cu m/hr):*

Volume flow rate measured in normal cubic metres per minute (or hour), i.e. related back to normal inlet conditions.

### *NTP:*

Normal Temperature and Pressure. This is based upon a temperature of 32 deg F (0 deg C) and a pressure of 1 bara.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## O

### *Oil-free:*

The term generally applies to the condition of the air either when it leaves the compressor, or after filtration. An oil-free compressor will have no lubrication on the compression side of the machine. However this may not result in oil-free compressed air, simply due to the fact that the ambient air being sucked into the compressor will contain hydrocarbons which will condense into liquid oil further down stream.

### *Oil-less:*

A term applied to compressors that contain no oil. A small reciprocating compressor with PTFE piston rings and PTFE bearer rings, sealed for life bearings and no sump oil would be called an oil-less compressor.

### *Ozone Depletion Potential:*

Not to be confused with Global Warming Potential. Ozone depletion is caused by a particular group of gases, such as refrigerants, that enter the upper atmosphere and destroy the ozone layer. ODP is a yardstick that uses CFC11 as the base for comparison between various gases. The banned refrigerant, CFC11 = 1. The following table clearly shows the differences between ODP and GWP.

Substance	O.D.P.	G.W.P.
CFC11	1	4000
CFC12	1	8500
CFC13	1	11700
CFC14	1	1400
HCFC22	0.05	1700
Carbon Tet.	1.1	1400
1,1,1,-Thrich.	0.1	110

### *Owner:*

This term is being bestowed upon more and more Senior Engineers by major energy users who wish to define the responsibilities of their staff. In such cases the owner of the compressed air system may be a Mechanical Engineer who shall accept overall responsibility (for example) for the compressed air system. Although this may help define operational roles, under UK law it does not transfer the legal H&SE responsibilities away from the employer. The prospective 'owner' of a pressurised system should not accept the title lightly. Although this may not transfer legal H&SE responsibilities away from his/her employer, it does add to the list of names that can be held accountable in the unfortunate event of a mishap. For this reason the 'owner' should carry adequate professional indemnity insurance and feel comfortable with the age and condition of the equipment under their control.

### *Ozone Secretariat:*

This is the Secretariat for the Vienna Convention for the Protection of the Ozone Layer (in accordance with Article 7), and the

Secretariat of the Montreal Protocol (in accordance with Article 12). It is based at the UNEP offices in Nairobi, Kenya and its main duties are to arrange and service meetings of 'The Conference of the Parties', arrange for the implementation of decisions, monitor implementation, receive and analyse data and to provide information.

**A|B|C|D|E|F|G|H|I|K|L|M|N|O|P|R|S|T|V|W|Z|>>top**

## P

### ***P&ID - Piping and Instrument Diagram:***

A schematic diagram showing the position of valves, switches, pumps etc in a flow or process.

### ***Package Power:***

The total power absorbed by a compressor, including the power absorbed by all pumps, fans, coolers and the like. This is the figure to look for when buying a compressor.

### ***Particulate Matter:***

BS3045 defines particle sizes as follows.

- Grit greater than 75 microns
- Dust between 1 and 75 microns
- Fume smaller than 1 micron.

### ***Pascal:***

SI unit of pressure equal to one Newton per square metre. 1 Pa is a very small unit of pressure. For this reason kPa (1000 Pascal's) is more often used. 1 psi = 6.8948 kPa. Also see bar.

### ***Peltier dryer:***

A refrigerated air dryer that uses the 'Peltier Effect' to produce chilling. French physicist Jean Charles Peltier discovered that a combination of certain materials produced a strange effect when an electrical current was passed through them. The composite product radiated heat from one side, drawing the heat from the other. This discovery allowed a 'chip' to be produced that gets hot on one side and freezes on the other.

### ***Pipe:***

This may seem a funny thing to define but new legislation requires it. The pipe is the tube which transmits compressed air (amongst other things) from A to B, but not across a boundary.

### ***Pipeline:***

The new legislation in the UK defines a pipeline as a pipe which conveys a liquid or gas across a boundary. This means that the pipe around a factory wall is not a pipeline. See PSSR2000.

### ***Pipework:***

The new legislation in the UK defines pipework as the whole pressurised system, excluding a couple of items such as air receivers and protective devices. See PSSR2000.

### ***Planning Supervisor:***

The CDM Regulations in the UK, requires the appointment of a person (or company) who is competent in the area of work applicable to that project. This appointment carries the title 'Planning Supervisor', and also carries the duty to advise the client upon specialist areas of Health & Safety. Major compressed air projects should engage a Planning Supervisor who has specialist compressed air expertise. See Construction (Design & Management) (Amendment) Regulations 2000.

### ***PM10:***

Particulate Matter below 10 microns in aerodynamic diameter.

### ***Positive Displacement:***

This describes reciprocating, rotary lobe, rotary vane and screw type compressors. This type of compressor does not 'stall' and potentially can reach pressures well in excess of the design pressure.

### ***Pressure:***

This is stated as absolute or gauge. It is most important to ensure any tender documents specify gauge rather than absolute, unless

you know what you're doing. It should also be the total of static head and velocity head and several different units of measurement are used throughout the EEC.

**Pressure Dewpoint:**

In some sales leaflets this is referred to as PDP and you're supposed to guess what it means. The PDP is the temperature at which water will condense out of the pressurised compressed air.

**Pressure Swing Dryer:**

A desiccant dryer either heatless or heat reactivated. See dryers.

**Pressure Equipment Directive 97/23/EC (PED)**

This piece of legislation was formalised on 29th May 1997 and will be implemented in the United Kingdom via the Pressure Equipment Regulations 1999. Other EEC member states must introduce their own statutory legislation to enable the Directive to be implemented in their own National Countries.

**Pressure Equipment Regulations 1999 (SI1999/2001).**

PED is the EEC Directive, and the UK conduit for implementing the directive is the Pressure Equipment Regulations 1999. The regulation became law in the UK during November 1999, however a transitional period was granted so that it did not become mandatory until May 2002. PER 1999 requires a supplier to document and demonstrate that 'pressurised assemblies' are safe, have been designed & manufactured according to required engineering practice. This regulation has curtailed the activities of some businesses because depending upon the size pressure of the system, the supplier must have in place a formally certified ISO9000 Quality Control System administered by a UKAS accredited inspection body. Indeed, some even larger systems will require the use of 'Notified Bodies' to CE mark the assembly.

**Pressure Systems Safety Regulations 2000:**

This updated and replaced the old Pressure Systems and Transportable Gas Containers Regulations 1989 and ironed out some of the irregularities. The regulations are mandatory and require the user to have a Written Scheme of Examination which has been signed by a Competent Person. This Person is not usually an employee of the user because conflict can arise. Can you imagine the Competent Person approaching his employer to tell him to shut the factory down because he is unhappy with a component within it?

**Protective Device:**

The new legislation in the UK defines a protective device as an item which keeps a system within its operating limits. This includes such things as pressure gauges, relief valves and the like.

**PSIA:**

Pounds per square inch, absolute. This is the pressure of a system measured from absolute zero. It is exactly 1 atmosphere less than PSIG.

**PSIG:**

Pounds per square inch, gauge. This is the pressure of a system which you would see displayed on a normal pressure gauge. It is the pressure of the system, over and above the local atmospheric pressure that surrounds the pressure gauge.

**PSSR2000:**

See Pressure Systems Safety Regulations 2000 (above).

**A|B|C|D|E|F|G|H|I|K|L|M|N|O|P|R|S|T|V|W|Z|>>top**

## R

**Receiver:**

The vessel used to contain compressed air, referred to as a 'tank' in the USA. As a general rule of thumb most systems need a minimum of a 'one minute receiver'. Although technically inaccurate, the following will provide the basis of most systems. 700 cfm compressor at 7 barg.  $700/7 = 100$  cubic ft receiver. 700 cfm compressor at 10 barg.  $700/10 = 70$  cubic ft receiver. A 'two minute receiver' has a capacity exactly double.

**Refrigerated dryer:**

A dryer which chills compressed air, forcing the air to produce condensate thereby drying it. See dryers.

**Relief Valves:**

A device fitted to receivers and the like that allows the system pressure to vent before the safe working pressure is reached.

**RH (Relative Humidity):**

Air has a natural ability to hold water. Its ability is dependent upon temperature and to a lesser degree pressure. Whenever air has absorbed as much water as it can hold, it is called saturated. Or even 100% saturated. In this condition it is ready to produce condensate, but not quite ready enough. Air in this condition has a 100% RH. If the air had absorbed only half as much water as it could theoretically hold, then the air would have a 50% RH.

**Risk Analysis:**

Risk is the probability of failure, and the term risk is often confused with the term 'hazard'. For a more detailed overview on risk analysis and hazard identification, click on the little blue words.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)>>[top](#)

**S****Safety of Pressure Systems Regulations:**

The Pressure Systems and Transportable Gas Containers Regulations 1989 has now been replaced. See Pressure Systems Safety Regulations 2000.

**Separator:**

The term used to describe the filter inside an oil injected screw compressor which removes the hot oil from the hot compressed air. The separator element is a consumable component which traps oil (and dirt) particles down to 1 micron. This means that a separator element may last for years in a clean factory and only months in a dusty factory.

**Short Term Exposure Limit (STEL):**

These provide guidelines for the short term exposure to a substance. A worker should not be exposed to a maximum STEL for more than 15 minutes, for 4 times per 8 hour shift. For example, the STEL for mineral oil vapour is 10 mg/cu.m. What concentration are you exposing your Service Engineers to? Also see TWA.

**S.I.**

Systeme International. The international system of unit measurement.

**Slippage:**

This refers to the compressed air lost due to in-efficiency in the design of the compressor. In a reciprocating compressor, some of the air will seep back past the gaps in the piston rings. In a screw compressor, some air will slip back through the small gaps which exist between the screw compressor rotors. This loss is called slippage.

**Snifting Valve:**

This is a safety relief valve which works backwards and is used in vacuum systems. Instead of venting compressed air out of the system like a normal safety relief valve, it lifts at a pre-set vacuum to allow air into the system thereby protecting the vacuum pump.

**Sound Power Level (SPL):**

By definition this is the measurement of the power source. The unit is the Watt, to take account of the range we select the picowatt as the reference standard. The power level doesn't mean that much without knowing the surroundings. A 3 kW fire in a small room produces useful heat. The same 3 kW fire in the middle of a field is pretty useless. Also see SPL.

**Sound Pressure Level (SPL):**

This is a pressure and by definition must be measured as PSI or something similar. The units chosen are Newtons/sq.m. The exact figure is  $2 \times 10^{-5}$  N/sq.m. This is the unit that is more useful for the ear. It takes account of the surroundings. A gunshot in a cupboard sounds louder than the same gun being fired in a field, even though you may be the same distance away from the gun in each case. Also see SWL.

**Specific Power Consumption (Also Specific Efficiency):**

A quick and easy way of comparing compressor efficiencies, as long as you have exactly the right information before you start. The total package power is divided by the actual volume delivered at a specified pressure. This provides a figure of xxx kW per cfm or 100 cfm. In Europe, ISO 3857-2 shows that Specific Efficiency should be stated as Joules/litre. (kWseconds/cu.metre). 1 Joule per litre / 21.1888 = 1 kW / 100 cfm. Therefore a compressor consuming 100kW and producing 550 cfm will have a specific efficiency of 18.18 kW per 100 cfm or 385.2 Joules/litre.

### **Stall Pressure:**

A term used on 'air movers' such as axial or turbo compressors. Imagine a fan sucking air into a sealed room. Eventually the pressure in the sealed room equals the duty of the fan, although the fan continues to operate it cannot move any more air. The fan has reached its stall pressure.

### **STP:**

Standard Temperature and Pressure. This was based upon a standard temperature of 62 deg F and a standard pressure of 14.7 psia, but for compressor testing purposes it has been unified and updated. See Standard Reference Atmosphere.

### **Standard Reference Atmosphere:**

The Standard Reference Atmosphere to all intents and purposes replaces the old STP. Four committees were set up to define the standard, resulting in two different standards. I suppose it could have been worse. ISO8778 is the standard to which test results for compressors and other compressed air equipment is referred. This corresponds to an ambient inlet condition of 1 bara, 20 deg C and a 65% RH. ISO2787 is the standard for air tools and the like, it uses the same reference inlet conditions as ISO8778. The aerospace industry uses ISO2533 which corresponds to ambient inlet conditions of 1013 mbar, 15 deg C and 0% RH. The petroleum industry uses ISO5024 which uses the same reference inlet conditions as ISO2533. Also see CFM - Scfm.

### **Static Head:**

This is indicated by a pressure gauge on a pipe or system. It is not necessarily the total pressure of the system, particularly if the velocities are high. See velocity head.

### **Stored Energy Procedures:**

Formal documented procedures for installing and maintaining all forms of stored energy systems, this should include compressed air. Some forms of maintenance, such as upon High Voltage systems, have statutory legal requirements covering minimum training qualifications and formal hand-over procedures. Personnel that are involved with servicing and maintaining compressed air systems should adopt similar hand-over and lock-out procedures.

### **Surge:**

This is a term frequently used with centrifugal compressors and refers to the separation of air from the surface of the impeller or diffuser. Ideally the design of the compressor should be such that the air flows smoothly through the system, and the air will hug the surface of the impeller. To achieve this the angle of incidence must be zero, or marginally negative. If the angle of incidence becomes positive, then lift-off will occur which creates a wake in the moving air stream. This instability causes pressure fluctuations and hunting.

### **Swept Volume:**

Outside of a design office, this term is mainly used by companies selling small compressors because it makes their compressors look bigger than they really are. The swept volume is the actual displacement of the piston, forgetting such losses as bumping clearances, valve clearances, ring losses and the like. It's not unusual to see an advertisement offering a compressor with (say) a delivery of 30 cfm, swept. In reality the compressor will only deliver about 20 Scfm.

### **System Pressure:**

The minimum pressure that the system requires to operate satisfactorily. The compressor must be capable of supplying enough volume at a sufficiently high pressure so that all losses can be met, and the resulting pressure still exceeds the required system pressure.

**A|B|C|D|E|F|G|H|I|K|L|M|N|O|P|R|S|T|V|W|Z|>>top**

## **T**

### **Tank:**

An Americanism meaning air receiver.

### **Thermal Load:**

Compressor fires are not too common, however when a flammable substance burns in air, the nitrogen content is inert. Nitrogen makes up a large part of the overall content of air and will be heated up as a result of the combustion. The heat absorbed by the nitrogen reduces the overall temperature of the combustion and is called a thermal load.

### **Torr:**

A unit of pressure used with vacuum pumps, equal to 1mm of mercury and 133.3223684 Pascal's. (If you need to be exact, it is 101325/760)

### ***Transportable Gas Container Regulations:***

Now replaced by the Pressure Systems Safety Regulations 2000. Despite the title, for many years this regulation had nothing to do with transportable gas containers because the section which referred to gas containers was repealed shortly after the introduction of the Act. See Pressure Systems Safety Regulations.

### ***Tundish:***

An receptacle, open to atmosphere, that is used to collect condensate. For example, two or three drain pipes from various filters may be discharging into a funnel. In this case the funnel is a tundish.

### ***Turbo Compressor:***

A machine which uses an impeller to speed up the velocity of air. The air radially leaves the tips of an impeller at high speed and the speeding air is slowed down in a diffuser. This causes the velocity head to be converted into a static head.

### ***TWA (8-hour Time Weighted Average):***

The long term exposure limited for an 8 hour day. For example, the maximum daily exposure limit to mineral oil is 10 mg/cu.m.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## **U**

### ***Upper Explosive Limit (UEL):***

Also called the Upper Flammable Limit. Flammable vapour or gas will only burn within a limited concentration range in air. If the mixture is too rich to burn, it is above the Upper Explosive Limit. Also see Lower Explosive Limit (LEL).

***Upper Flammable Limit.*** See above

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## **V**

### ***Vacuum (vacuum pump):***

Absolute vacuum is a theoretical void in which no particles exist. However, even outer space contains pressure, 10<sup>\*\*(-12)</sup> torr, although scientists state this varies greatly throughout the universe. A vacuum pump is a machine which sucks in air from a closed or restricted space. The harder it works, the closer it gets to absolute vacuum. The air delivered from a vacuum pump is called 'aspired air'.

### ***Velocity Head:***

This is best explained by analogy, imagine a fireman's hose. The pumps are delivering water through the hose at 100 psig, however you can easily cup your hands around the water jet. Stand in front of the jet and you end up on your back. The pressure from the hose is almost entirely velocity pressure which is the same as velocity head.

### ***Vienna Convention for the Protection of the Ozone Layer:***

Set up in 1981 by the UN Governing Council, its task was to secure a general treaty to tackle ozone depletion. This proved difficult and The Vienna Convention & etc was finally signed by only 20 nations in 1985. The convention provided the way forward for future protocols, including the very important Montreal Protocol.

### ***Volume Delivered:***

This is often confused by the layman with pressure. Just because a compressor can deliver 100 psig, it doesn't mean that it is big enough to supply the quantity of air required for a process. A bicycle pump may be able to deliver 100 psig but it can't support the air requirements of a factory, even though the factory only needs 100 psig to operate. Volume delivered is measured in CFM or units similar.

### ***Volumetric Efficiency:***

This is the ratio between the actual volume delivered and the swept volume.

### ***Vortex tube:***

A device that uses compressed air to produce 'spot' cooling. Sometimes called a Ranque tube (named after the physicist who discovered the principle) the assembly exhausts hot air from one end of the tube and cold air from the other. Chilled air

temperatures down to -40 deg C can be obtained whilst the other end of the tube can simultaneously exhaust air at +100 deg C.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## W

### ***Water Resources Act - 1991:***

This Act of Parliament defines what you can do and what you can't do with condensate from an air compressor. The old days of simply pouring it down a drain, or even pouring on to the ground have long gone. To do so may cost you a £20,000 fine in a Magistrates Court, or even three months in jail. The act has introduced a new buzz phrase called 'Condensate Management'.

### ***Work in Compressed Air Regulations 1996:***

This piece of legislation provides the H & S framework to manage the risks associated with personnel working inside a compressed air environment. For example, hyperbaric tunnelling systems and the like.

### ***Written Scheme of Examination (WSE):***

This is a formal procedure required under the Safety of Pressure Systems Regulations for ensuring that the entire pressurised system is safe. The procedure allows for the documentation, testing and recording of items contained within a system. The WSE must be signed off by a Competent Person.

[A](#)/[B](#)/[C](#)/[D](#)/[E](#)/[F](#)/[G](#)/[H](#)/[I](#)/[K](#)/[L](#)/[M](#)/[N](#)/[O](#)/[P](#)/[R](#)/[S](#)/[T](#)/[V](#)/[W](#)/[Z](#)/[>>top](#)

## Z

### ***Zone:***

Hazardous area classifications. For gases, we have three hazardous zones, for dusts we have two hazardous zones. For gases we have...

- Zone 2 is the lowest with an explosive mixture unlikely to occur during normal operation.
- Zone 1 is an area where an explosive mixture is likely to occur during normal production.
- Zone 0 is an area where an explosive mixture is continually (or may be continually) present.

For dust we have...

- Zone Z. An area in which combustible material is or may be present as a cloud during normal operations, is sufficient quantity to produce an explosive concentration with air.
- Zone Y. An area not classified as zone Z, in which accumulated layers of combustible material may be present under abnormal conditions, giving rise to an ignitable mixture with air.

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