Module 8 Safety

Unit 8.3 Pressurised Units

Revised September, 2000

Contents

Introduction

About this unit

Welcome to Unit 8.3 on pressurised units.

This unit teaches you about pressurised units and their safe use. You will be given information about the different types of air powered tools and equipment that are commonly used in a workshop.

How to use this book

Additional to the information about pressured systems, this book also contains activities and exercises.

These activities and exercises don't play a part in your assessment for this unit, but they will to help you find out how much you have learned.

Read the information, and then answer the questions as you work through the book.

Answers and examples are provided for you to check your progress.

Your tutor will give you assessment tasks to check what you have learned about pressurised units

These tasks will determine your competence in this unit.

How you'll be assessed

To be assessed for this unit you will be given certain tasks.

You will do these tasks when you have finished certain parts of the work in the book.

Your tutor will help you understand what you need to do for the tasks — ask your tutor to explain anything you don't understand.

Finding your way

As you work through the text you'll see symbols in the left margin of some pages. These symbols or "icons" guide you through the content.

Read

Important- take note!

Self-checking question/activity

Assessment task

Things to do

Things not to do

Competency

The content of this training programme for Technical and Vocational teachers is based on the skills that you need to develop. The skills for each unit are set out as things that you must have learned or are able to do.

The assessment by your tutor will test what you have learned and your level of skill.

Each unit sets out the skills needed. If you already think you know enough about the unit to show that you have the skills needed, you may be able to get your tutor to test you without studying the unit.

Learning outcomes

When you have completed this unit you should be able to:

Identify the safety precautions to be observed when operating or servicing pressurised units.

Take appropriate action in cases of emergency.

Assessment criteria

Your tutor will assess what you have learned by getting you to:

Identify, in accordance with appropriate regulations and provided information, safety precautions to be observed when operating or servicing pressurised units.

Explain, without error, how the identified safety precautions ensure the safety of the operator.

Given a case study of an accident involving a pressurised unit, outline the appropriate emergency procedures.

Assessment methods

Your tutor may test your skills by:

- giving you an oral or written test
- giving you an assignment.

Your tutor may also use points in this book as a guide to finding out what you have learned and what your skills are.

Other resources you may find useful

- information from local suppliers of compressed air systems or pneumatic tools
- information on health and safety with pressurised units from national or local government
- information on health and safety with pressurised units from large industries in your local area

Reference Books:

Occupational Safety Management and Engineering 4th ed.
Author: Willie Hammer
ISBN: 0-13-629379-4
Publisher: Prentice Hall

Occupational Safety and Health: for Technologist, Engineers, and Managers
3rd ed.
Author: David L. Goetsch
ISBN: 0-13-924085-3
Publisher: Prentice Hall

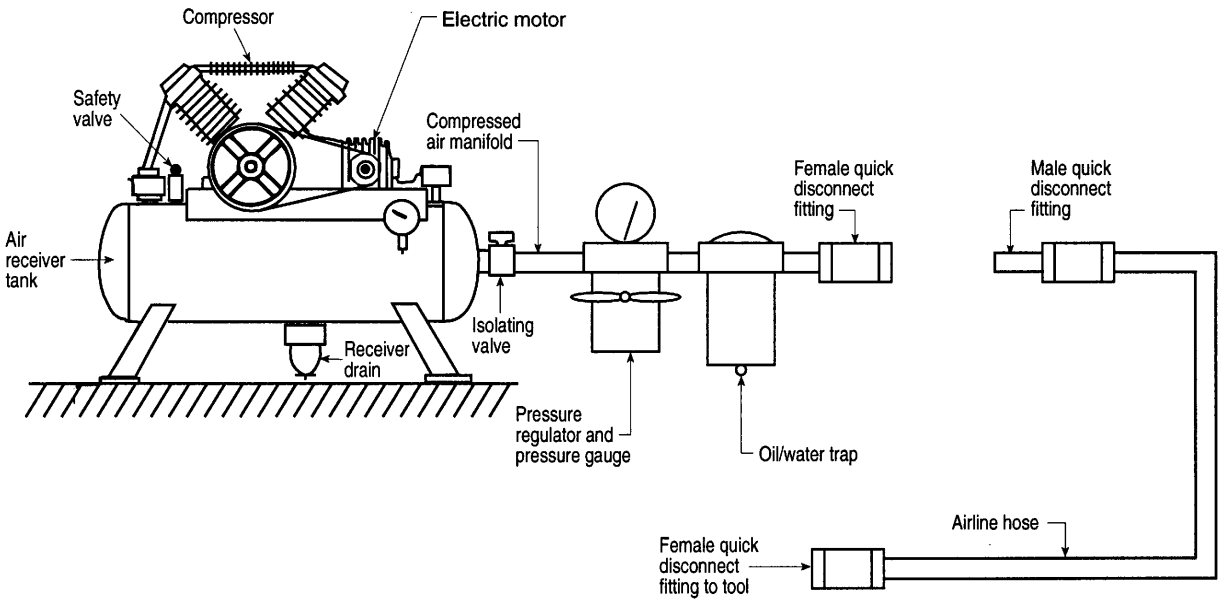
Web page address: - **http://www.safetyinfo.com**

Section 1

Components of a compressed air system

Typical compressed air system

Air compressors can vary from small portable units used to operate only one piece of equipment, to very large built-in systems that provide compressed air throughout a large workshop or factory. Fixed compressors are normally powered by electric motors, while some portable units, especially those used on construction sites, may be diesel or petrol powered. For this discussion, petrol and diesel powered mobile compressors will not be covered. This section will concentrate on the typical built-in compressed air systems commonly found in many factories, shops and garages. A simplified typical compressed air system is shown here.



For larger compressed air systems intended to operate multiple tools, such as in a large repair shop, the system air compressor, receiver tank and manifolds must have the capacity to deliver compressed air at adequate flow rates and pressures to operate several tools at the same time.

Regardless of size, a compressed air system has several common components:

A source of energy and means to compress the air (air compressor)

The source of energy to compress the air is usually an electric motor, although internal combustion engines can also be used. Small low pressure/low volume systems may use diaphragm pumps, but most shop and factory compressors are piston-type compressors.

A piston compressor works like a piston engine in a car, but instead of the piston generating power from burning fuel, the external energy from the electric motor uses the pistons to squeeze the air into a smaller volume in the piston chambers, in other words, to compress the air. As the air is compressed, it gets hot. Thus, special high temperature compressor oil must be used to lubricate the pistons. Use of improper oil, or solvents to clean compressor parts could create an explosion hazard in the air receiver.

Air receiver

Piston valves release the hot compressed air into a tank or "receiving chamber," typically called the ***air receiver***. The receiver stores the compressed air, and acts as a reservoir of compressed air to supply the compressed air system. Typically, the compressed air in the receiver will range from a pressure of 100 to 150 pounds per square inch (psi) (690-1035 kPa).

Because the receiver is a ***pressure vessel*** the receiver must be fitted with a safety valve. The safety valve serves to prevent over pressurising and possible rupturing of the receiver. If the receiver pressure exceeds 110% of the maximum allowable working pressure, the safety valve vents off excess air pressure. For the safety valve to function properly, it must be directly connected to the receiver. No other valve or fitting should be placed between the air receiver and the safety valve.

Pressure gauge

Compressed air receivers used for operating pneumatic tools are fitted with a readable pressure gauge to allow monitoring of the receiver air pressure. Pressure gauges monitor the air pressure in various parts of the system. A simple system may only have one pressure gauge, while large systems may have a pressure gauge at every connection point.

The pressure of the air in the system is commonly given in units of kilopascals (kPa) or pounds per square inch gauge (psig).

NB: gauge pressure = (pressure inside system) – (atmospheric pressure)

Atmospheric pressure is 101.4 kPa (14.7 psi).

Pressure regulator

The maximum air pressure in the air receiver and manifold is usually higher than the air pressure needed to operate pneumatic tools. An air pressure regulator can be manually adjusted to reduce the air pressure from the manifold to the operating pressure of the pneumatic tool.

Filter bowl (oil /water trap)

An in-line air filter and a liquid drain bowl are fitted into systems to remove contaminants and collect condensed water and oil. The filter bowl is usually mounted at the outlet of the compressed air tank on small portable compressors. On larger built-in systems, filter bowls are usually located along the compressed air manifold at each airline hose connection point.

Air manifold

Smaller compressors may connect directly to an air hose and tool. However, larger systems distribute the compressed air through a rigid pipe system, termed an air manifold. A manifold system typically has multiple air hose connection points. The air manifold is sometimes coloured blue for easy identification.

Air hose

Compressed air hoses are usually made up of three layers. An inner rubber lining on the inside of the hose, a layer of fabric or wire reinforcement, and an outer layer of rubber. Formerly, most airline hoses had threaded end fittings. At present the safer and more convenient quick disconnect self-closing fittings (couplings) are commonly used.

Air powered devices

Air powered (or pneumatic) tools are simply a wide variety of hand tools and devices powered by the energy of compressed air. This subject is covered more fully below.

Installation, operation and maintenance of a compressed air system

The basic requirements for safe installation and operation of a compressed air system include:

- ensure correct installation and commissioning
- establish safe operating limits
- ensure that the plant is properly maintained
- provide adequate operating instructions
- develop emergency procedures

The manufacturer's operating manual provides the basic information for installation, operation and maintenance of the air compressor. However, this basic information is often supplemented by experience, on-the-job training and adequate staff supervision. Servicing should be done at recommended intervals and any breakdowns fixed as they develop. Maintenance records should include a maintenance history, notes on regular inspections (for example, at least once a year) documentation of routine checks and descriptions of any major repairs or modifications.

Safe operating limits are the range of pressure for which the system was designed to operate. The upper limit of pressure will be the manufacturer's safe working pressure, which may be found in the manufacturer's manual, or on the plate mounted on the compressor.

Handling compressed air hoses

Injuries can occur if pressurised hoses break. A whipping hose is very dangerous! The loose hose can cause injury by the whipping action itself, by materials released from the hose, or by airborne debris stirred up by the blast of air from the hose. The sudden noise is startling. Whipping hazards can be limited by securing the hose to fixed objects at short intervals. This can be done with sandbags, clamps, rope or sturdy tape.

If an airline breaks, **do not** try to grab the flailing hose. Instead, get everyone clear of the danger and then shut off the compressed air at the source.

There are several ways to avoid hazards from broken hoses:

- do not use damaged air hoses
- check hoses regularly
- discard and replace defective or damaged hoses

Wear and tear or an accident that damages or severs the hose causes most hose failures. Daily, or before each use, inspect the hose, looking for indications of weakness. If a torn outer jacket, damaged reinforcing, bulges or soft spots are found, remove the hose from service.

Take care when stringing a compressed airline to the work area. If possible, keep the hose off the floor to avoid damage to the hose or tripping hazards for people. Nearby structures, such as pillars, roof beams, or hose stands can be used to keep airlines off the floor.

If it is not possible to keep the hoses off the floor, place the air hose in areas where they are not likely to be walked on or driven over. For example, if a hose needs to be run down a passage, run it along the corner of the floor and wall, and secure it with tape. When passing temporary airlines through a room, drape it over a doorway, instead of across the threshold.

Avoid sharp bends in airline hoses. These can cut the hose or damage the reinforcement. If a hose gets caught on something, don't just give it a tug, go back and free it from where it is jammed.

Do not shut off the airflow by bending the hose over or crimping it with pliers. This may cause major hose damage that could lead to a hose failure under pressure.

Using airlines

When a limp hose is first pressurised, it can move in response to the internal air pressure. This can sometimes cause twist type junction fittings to separate. One way to help prevent separation is to pin or wire the fitting together using the lugs provided. Both twist and quick disconnect type fittings may also separate when a hose is first pressurised if the fittings were not properly secured.

If the hose internal diameter is greater than 12 mm (1/2") it should have a safety device at the air supply, designed to reduce the pressure in the event of a hose failure. This device can be an adjustable pressure regulator or a fixed orifice valve.

For safety, use air supply hoses that are rated either for:

- a minimum working pressure rating of 1035 kPa (150 psig) or
- 150% of the maximum pressure produced in the system, whichever is higher.

Occasionally, safely blow out the airlines to clear them of any accumulated dirt.

Hose connections

Use the proper hoses and fittings of the correct diameter for the hose. Make sure the hose connections fit properly and are equipped with a mechanical means of securing the connection (for example, chain, wire, or positive locking connector). This will prevent whipping hoses in the event of a failure of a hose connection.

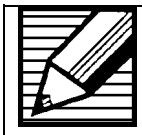
Quick disconnect fittings are a very convenient and commonly used means to attach airlines to manifolds, to join airlines together, and to connect airlines to tools.

The female part of the fitting has a valve that closes off the airline when the connection is broken. Thus, it is important to attach the female end of the disconnect fitting to the air manifold and to the end of the airline that connects with the tool — that is, attach the male end of the connector to the tool, **not** the hose. If the female end is connected to the tool, a charge of compressed air is retained within the tool. If this tool were then triggered, it would operate, possibly causing injury. This is especially important for pneumatic nail guns, since a cycling of the tool would eject a nail with potentially deadly force.

Remember

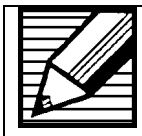
Keep airlines tidy; avoid creating trip hazards from hoses on the floor or in areas where people pass through.

Now complete the activities that follow.



Activity 1

Find out who are the local suppliers of compressed air systems in your area. Ask them if they are able to service compressed air systems for you.



Activity 2

1. Name nine major parts of a compressed air system.

2. At what pressure should the safety valve vent (discharge)?

3. The safety valve should be directly connected to the receiver tank.
   Circle your answer — yes or no **YES** **NO**

3. Give three reasons why a break in an airline hose can cause injury.

4. Give three ways you can avoid hazards from broken hoses.

Compare your answers with those on the next page.

Activity 2 Answers

1. The nine major parts of a compressed air system are:
   - *air compressor*
   - *receiver tank*
   - *safety valve*
   - *air manifold*
   - *pressure regulator*
   - *pressure gauge*
   - *oil and water trap (filter)*
   - *airline hose*
   - *quick disconnect fitting (couplings).*

2. *The safety valve should vent at 110% of the maximum allowable working pressure.*

3. *YES – to operate correctly the safety valve must be connected directly to the air* receiver.

4. The three reasons why a broken airline hose can cause injury are because of
   - *the whipping action of the hose*
   - *the materials released from the hose*
   - *the airborne debris stirred up from the blast of air from the hose.*

5. The three ways to avoid hazards from damaged hoses:
   - *do not use damaged air hoses*
   - *check hoses regularly*
   - *discard and replace defective or damaged hoses.*

If you didn't answer all the questions correctly then read the section again before going to Section 2.

Section 2

Hazards of compressed air

Blow cleaning objects, machinery, bench tops, clothing and other things with compressed air is dangerous. Injuries have been caused by the air jet and by particles made airborne. Do not use compressed air to blow debris or to clean dirt from clothes. This can cause injury from the compressed air itself, and from particles driven by the air jet.

Compressed air must be handled with care. Horseplay with a compressed air hose, however innocent the intent, may end in tragedy. It may seem amusing to blow a jet of air at someone, but this has caused severe internal injury and death. Some incidents are outlined below.

Examples

- *A schoolboy entered a garage and joined some young workers who were using a compressed airline used for inflating tires. The airline pressure was about 150 psi. One of the workers "goosed" (goosed means to put the compressed air jet close to somebody's bottom) the schoolboy with the air hose. He died in hospital a few hours later.*
- *While a workman was dusting himself off with a compressed airline, a colleague asked him to blow some dust out of an empty milk bottle. As he did so the bottle burst, and one man suffered permanent eye damage.*
- *An apprentice fitter was bent over a washbasin when one of his work mates goosed him with an air hose. The compressed air ruptured his rectum. He was rushed to hospital with severe internal injuries, but he survived.*

Parts cleaning

Cleaning parts with compressed air is dangerous. Do not blow-clean parts with compressed air unless certain precautions are taken.

1. Compressed air may be used only if no alternate method of cleaning is available.
2. The nozzle pressure **must** be kept below 200 kPa (30 psi).
3. The air gun nozzle must be fitted with "dead end protection" to prevent air injection injury (see below) if the nozzle is pressed against the skin.
4. Personal protective equipment (PPE) such as hearing protectors and safety glasses to protect against hazards such as noise and flying particles.

Two acceptable methods of meeting the 200k Pa (30 psi) requirement include:

- setting the manifold supply regulator to 200 kPa (30 psi) and using a dead end protected air nozzle
- using air guns that incorporate both a pressure-limiting device and dead end protection.

Compressed air and injection injury hazards

Compressed air is extremely forceful. Depending on its pressure, compressed air can drive particles at very high velocity. These particles are hazardous, primarily to the eyes. Air pressure above 200 kPa (30 psi) is hazardous. High-pressure pneumatic equipment such as grease guns and paint and solvent sprayers are in widespread use. Because of the tremendous pressure fluid in these systems, protective gloves may not be an effective barrier against injury.

Under some conditions of pressure, driven materials can enter the bloodstream through the skin or through a body opening. An air bubble in the bloodstream is known medically as an ***embolism***, a dangerous medical condition in which a blood vessel is blocked by an air bubble. An embolism can cause coma, paralysis or death.

Compressed air entering and rupturing the bowel from horseplay (for example, "goosing" someone with a blast from an air hose) has caused serious injuries and fatalities.

Puncture wounds that result in the injection of fluid or other material through the skin are serious injuries that can result in blood poisoning,

destruction of internal tissues and bacterial infection. The hand and fingers are the most frequent the location of air injection injuries. The potential for amputation exists if treatment is not administered promptly and properly.

If a high-pressure injection injury occurs seek professional medical treatment immediately! First aid treatment includes ice packs, compression and elevation of the injection site. Medical treatment may include tetanus or antibiotic injections, and surgery to remove any damaged tissue and drain any injected material.

Pneumatic tools

Air powered tools are powered by the energy of compressed air. If the system air pressure or flow rate exceeds the manufacturer's rating, the tool could be over powered, creating excessive force. This increases the danger of tool breakage and operator injury. On the other hand, too little airflow or pressure results in an underpowered tool.

As mentioned, it is important to adjust the air pressure supplied to the tool to the range supplied by the tool manufacturer. Adjusting the airline pressure via the pressure regulator at the manifold connection is the normal way to do this.

Common types of air-powered tools and devices include:

- air impact wrenches
- nailing and stapling guns
- paint and coating sprayers
- buffers, sanders and grinders
- drills
- jack hammers and chipping hammers
- riveting guns

Safety with pneumatic tools

Generally, you must follow the manufacturer's instructions. Keep tools clean and properly lubricated. Also, use only attachments that the manufacturer recommends for the tool. And finally, do not operate the tool at an airline pressure above the manufacturer's rating.

Use only compressed air (regulated to the proper pressure) to power pneumatic tools. Do not use compressed gas cylinders or compressed flammable gases, such as bottled cooking gas, to power pneumatic tools. Compressed gas cylinders have too great a pressure for pneumatic tools, and use of other gases could create toxic, fire or explosion hazards.

Noise and vibration hazards

Pneumatic tools can be sources of hazardous noise and vibration. The most important noise source is the spent air discharge, usually at the tool itself. Although newer tools are equipped with noise mufflers, many tools in current use are not. Noise levels can range from 85 to over 100 decibels on the “A” scale (dBA). Repeated exposure to noise of these levels can permanently damage your hearing.

The vibration from pneumatic tools, if excessive, can cause injury over time. One example of this is temporary numbness and tingling in the hands and fingers after prolonged tool use. If allowed to continue, this can lead to permanent nervous system damage in the hands. Raynaud’s disease, also known as “vibration white finger disease” is a type of illness often associated with prolonged use of vibrating hand tools.

You should consider the following precautions:

- purchase new tools with integral noise muffling and vibration dampening
- install noise mufflers on existing equipment where possible
- wear hearing protection
- avoid excessive or prolonged use of pneumatic tools
- wear vibration dampening gloves

Potential air quality hazards from compressed air

Compressed air intended to operate pneumatic tools is **not** to be used for breathing. This is because typical shop or factory compressed air contains compressor oil vapours and other contaminants that can cause serious – even fatal – consequences.

Shop compressed air can be used for breathing, such as through an air-supplied respirator, **only** if the air supply hose to the respirator is fitted with a special breathing air purifying filter.

Air supplied to respirators must be regularly tested by a competent person to check that it does not contain harmful contaminants.

The discharged air from tools causes a localized air quality hazard. For example, if you use a pneumatic tool in an enclosed space, the oil mist and other contaminants could build up to hazardous levels. Thus special precautions, such as local air extraction or respirators, may be needed if pneumatic tools are used in confined or poorly ventilated spaces.

The oil-contaminated air discharge may also make the tool slippery. To reduce problems it helps to frequently clean your hands and the tool itself.

Air temperature

At one end of the system, the air compressor and receiver can get hot enough to cause burns. On the other end, the spent air discharge from a pneumatic tool is cold. The cold could affect the operator's ability to grip the tool over time. Further, in combination with tool vibration, cold may increase susceptibility to long-term injuries of the fingers, hand and wrist. The tendency to cause this type of injury may also indicate problems with tool design. Gloves may help if they can be worn without creating additional hazards.

Electric shock hazards

Air powered tools are not grounded or double insulated, so if contact is made with a live wire while working with a pneumatic tool, a dangerous electric shock could result. When using pneumatic tools in building trades work, you should ensure that all electric power in the immediate work area is identified and wherever possible, shut off.

Also, static electricity can build up in a pneumatic system, which can cause a startling but non-hazardous electric shock.

Personal protective equipment

You should wear suitable safety glasses or goggles when using pneumatic tools. Compressed air may drive particles from equipment such as chipping hammers, rock drills, rotary drills or sanders, and cause eye irritation or injury.

Wearing hearing protection is recommended if tool noise exceeds 85 dBA, or if it is annoying. In general, gloves and safety shoes or boots are also often advised.

Summary of safety precautions for pneumatic tools

- Read tool instructions before use.
- Do not use tool if untrained or if uncertain of its operation.
- Know the safe operating limits of the system and tools.
- Operate the tool in the recommended pressure range.
- Do not use a damaged tool.
- Always wear the recommended personal protective equipment.
- Ensure that the tool is fitted with the male end of a quick disconnect coupling.
- Do not point a tool or airline at yourself or anyone else.
- Do not engage in horseplay with compressed air lines or pneumatic tools.
- Do not modify or tamper with the tool.
- Have the tools maintained by a qualified service staff with original parts.

Disconnect the tool from the compressed air source whenever:

- loading or unloading
- clearing a jam
- doing maintenance
- when the tool is not in use or left unattended

Now complete the activity below.

Activity 3

1. List the precautions to be taken if compressed air has to be used for cleaning.

2. List five (5) types of injuries that can be caused by compressed air.

3. It is OK to use compressed flammable gas cylinders to power pneumatic tools.

   Circle your answer — yes or no **YES** **NO**

4. List the two things that must be done before shop compressed air can be used for breathing.

Compare your answers with those on the next page.

Activity 3 Answers

1. The precautions to be used if compressed air is used for cleaning are:
   - *The nozzle pressure **must** be kept below 200 kPa (30 psi).*
   - *The air gun nozzle must be fitted with "dead end protection".*
   - *Personal protective equipment such as hearing protectors and safety glasses should be worn.*

2. The types of injury that can be caused by compressed air are:
   - *injury, especially to the eyes, from flying particles.*
   - *air or materials can be driven into the bloodstream*
   - *air can rupture parts of the body such as the bowel*
   - *noise from pneumatic tools can damage hearing*
   - *vibration from pneumatic tools can cause long-term injuries to fingers, hands and wrists.*

3. The answer is **NO** because
   - *the pressure of these cylinders is too great*
   - *there is a risk of fire or explosion from the flammable gas*
   - *some gases may also be toxic.*

4. Shop compressed air can be used for breathing **only if**:
   - *the air supply hose is fitted with a special purifying filter*
   - *the air is checked by a competent person to make sure it does not contain harmful contaminants.*

If you didn't answer all the questions correctly then read the section again before going to Section 3.

Section 3

Compressed gas cylinders

The use of compressed gases in portable cylinders is widely used in workshops particularly in the area of gas welding. It is therefore advisable that teachers be familiar with their characteristics, hazards, safety features, and precautionary measures, which should be observed in their use.

There are no uniform standards for cylinder sizes even though different gas companies offer standards within their own organisation. There is a standardised identification system. Either the total name of the gas or international chemical symbol of the gas is required on each cylinder. Each cylinder must carry a label showing the hazardous classification of the gas and precautionary measures that should be taken. The valve connections of different gas cylinders have been standardised so regulations for the same gas can be readily attached to cylinders supplied by different gas producing companies.

Pressurised gas

The properties of two of the most common pressurised gases generally transported and handled in portable cylinders are oxygen (O_2) and acetylene (C_2H_2).

Oxygen

This colourless, odourless, tasteless gas supports life and makes combustion possible. Oxygen is a non-flammable gas; however, it is highly oxidizing and combines readily with most metals at room temperature. It is very important to note that many materials that do not normally burn in air, and other materials that are combustible in air may burn violently in an atmosphere of high oxygen. As a result, combustibles must be kept away from oxygen. All organic materials and flammable substances, such as oil grease, kerosene and paint must be kept away from oxygen. An accumulation of oxygen can be hazardous, and therefore proper ventilation is required.

Oxygen should never be used in place of compressed air. Oxygen is stored at high cylinder pressure with a maximum value of 2640psi. (1,820kPa). Its physical state in the cylinder is in the form of gas.

Acetylene

Acetylene gas is a compound of carbon and hydrogen. It is a colourless and flammable gas. Commercial acetylene has a distinctive garlic flavour. Acetylene burns in air with and intensively hot, yellow, luminous, and smoky flame. For safety reasons, acetylene is never compressed above 15 psi (103kPa). Otherwise it will decompose and explode violently. Acetylene cylinders are therefore filled with calcium silicate, an inert porous material, which is saturated with acetone. Acetylene dissolves in acetone and in this mode can be compressed to 250 psi (1724kPa) at 70^0F (21.1^0C) without danger. Acetylene physical state in the cylinder is in the form of dissolved gas.

Acetylene is non-toxic, however it is an anaesthetic and if present in sufficiently high concentration, it is an asphyxiant in that it replaces oxygen and will cause suffocation.

Safety Devices

Some types of pressure relieving devices used on compressed gas cylinders are safety relief valves, rupture disks, and fusible metals. Rupture disks are set to burst at pressures far above those of the gases contained in the cylinder but below the pressure at which the cylinders must be hydrostatically tested periodically. Any cylinder might also rupture if intense localised heating occurs which weakens the cylinder so it fails before any pressure relief device is actuated.

Precautionary measures for use with compressed gas cylinders

- Compressed gas cylinders should be operated and handled only by personnel who have been instructed in proper procedures for their use and in the hazards involved.
- Personnel using the contents of a compressed gas cylinder should be familiar with the properties of the contents, the hazards involved, and precautionary and emergency measures to be taken for those hazards.
- Cylinders should not be banged, dropped or permitted to strike each other or against other hard surfaces.
- Cylinders should be secured by chain to a fixed support to prevent them from being dropped or from falling over. The cylinder valve should never be opened unless the cylinder is secured since the thrust from the gas might cause the cylinder to fall.

- Cylinders should not be dragged, slid, or rolled. Small cylinders may be carried by one man; larger ones by two men or by a suitable truck on which the cylinder can be secured firmly.
- Cylinders should be protected from anything that will cut, gouge, or damage the metal and reduce the strength of the cylinder. No one should bang the cylinder with a hard object to determine how full it is.
- Protective caps should be kept on the cylinders at all times the cylinders are not in use, and any time a cylinder is to be transported from one place to another.
- The cylinder valve should be kept closed any time that the cylinder is not in actual immediate use.
- Cylinders should be protected against heat, which would increase their gas temperature and pressure. Outdoors they should be stored in shaded locations and not where direct rays of the sun could hit them. They should not be stored near other sources of heat, such as boilers furnaces, radiators or hot process equipment.
- Cylinders should not be stored near sources of ignition or near flammable materials such as oil, gasoline or wastes. Cylinders containing flammable gases should not be stored near cylinders containing oxygen or other oxidizers. Inside buildings, there should be a separation of at least 20 feet between oxygen and fuel gas cylinders unless there is a fire resistant partition between the two. Cylinders should not be permitted to come in contact with electrical circuits.
- No tampering of safety relief devices should be permitted, and no attempt should be made by the user to remove, repair or modify cylinders, valves, or safety relief devices. In case of any problems, the cylinder should be capped and returned to the supplier.
- The user should examine the label and markings on the cylinder prior to connection to make certain that it contains the gas s/he intends to use. Any cylinder whose content is not positively identifiable by markings should be returned to the supplier.
- The cylinder valve should be opened slowly and the valve and fittings watched closely for signs of leaks. If the valve leaks it should be closed stored in a location where leakage will not constitute a hazard, marked as leaking, and returned to the supplier.
- If a valve sticks, never hit it with a hard object to loosen it. Return the cylinder to the supplier.
- Acetylene cylinders should always be kept in an upright position - to avoid loss of the acetone in which the acetylene is dissolved.

- Acetylene should not be used at a pressure exceeding 15psi.
- Oil, grease, or other combustible material should never be used to lubricate or clean valves, regulators, gauges, or fittings on cylinders holding oxygen or other oxidizer.
- Before an attempt is made to remove a regulator from a cylinder, make certain the regulator is depressurised by closing the cylinder valve and releasing all pressure from the regulator.
- When a toxic or highly reactive gas it to be used, a cylinder holding the smallest amount necessary for the operation should be used.
- Cylinders should not be kept in unventilated enclosures such as cabinets or lockers.

Activity 4

1. State the chemical symbols that are used to represent oxygen and acetylene?

2. Acetylene can be safely used at a pressures exceeding 15psi (103kPa)

   Circle your answer - yes or no YES NO

3. Name three types of relieving devices that are used on compressed gas cylinders.

4. List ten precautionary measures to be taken with gas cylinders.

Compare your answers with those on the next page.

Activity 4 Answers

1. The chemical symbols are:
   - Oxygen - O2
   - Acetylene - C2H2
2. The answer is NO because acetylene will decompose and explode violently at pressures above 15psi (103kPa)
3. Three types of relieving devices used on compressed gas cylinders are:
   - *Safety relief valves*
   - *Rupture disks*
   - *Fusible metals*
4. See section 3.4 for a listing of the precautionary measures for gas cylinders.

If you didn't answer all the questions correctly then read the sections again.

Assignment No. 8.3-1

Unit 8.3 Pressurised units

You are now required to do the Assignment 8.3 – 1 that can be found at the end of this unit or will be distributed by your tutor.

Assignment No. 8.3-1

Unit 8.3 Pressurised units

To be completed and returned to your tutor for assessment.

This is an open book assignment and you may refer to whatever references you have at your disposal.

Name: _____ **Due Date:**_____

Question 1

Fill in the blanks to these questions

1.1 Air supply lines are usually coloured _____ identify them.

1.2 Air pressure above what the system is designed for may cause _____ or _____ to explode.

1.3 Hoses and connections should not be _____or _____.

1.4 Connections must not be_____ or show signs of _____.

1.5 The most important protective equipment to wear when working with units under pressure is _____.

1.6 Some compressors can be_____ so hearing protection may need to be worn when checking the compressor.

1.7 All valves and gauges fitted to the system must _____ before the system is used.

1.8 Stop valves should be fitted in positions where they can _____ the system from the _____.

1.9 If there are different pressure systems in the same workshop the connections should be _____ so that only the right equipment can be connected.

1.10 Using compressed air to clean work surfaces can cause _____ and should not be allowed.

1.11 Using compressed air to clean yourself can cause _____.

1.12 People should not play with compressed air lines because _____.

1.13 Compressed air equipment should be clearly marked with _____ pressure.

1.14 Wherever possible compressed air systems should be serviced only when the system is not running and _____.

1.15 Lever type shut off valves should be able to be _____ in the off position.

1.16 Compressed air equipment should only be serviced by a person who has _____.

Question 2

For questions 1.3 to 1.16 inclusive, explain how the safety precautions keep the operator safe.

(You do not have to answer for questions 1.1 or 1.2)

Question 3

A damaged flexible air line hose has ruptured at the connection point with a blow gun. The operator was not wearing eye protection at the time and has got some particles in his eyes. The hose is whipping and snaking on the floor.

Outline the appropriate emergency procedures.