

sasol
reaching new frontiers



sasol mining

oxy-fuel gas welding and cutting safety

learner guide



Training and development department • sasol mining
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Approval Page

Manual compiler

Name _____

Designation _____

Area _____

Senior Manager Engineering

Name _____

Designation _____

Area _____

General Manager

Name _____

Designation _____

Area _____

Revisions

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Revision No	Date	Description	Author
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draft

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Learner Guide Description

The purpose of this Learner Guide is to provide knowledge and skills to the Learner to enable him / her to identify the Oxy-acetylene equipment correctly, as well as to become familiar with safety associated to welding and cutting.

Learning Method

1. The learner will be tested theoretically and practically on the procedures covered in this module. No deviations from the safety procedures will be allowed.

Unit Standard Alignment

This Learner Guide is intended to provide foundational knowledge for the attainment/not attainment of the ----- (*insert name of qualification here*) qualification.

In order to achieve the abovementioned qualification, the following unit standard/s is applicable to this Learner Guide (*complete where applicable / delete if not applicable*)

Table 1 Unit Standard

SAQA US ID	
US title	
NQF level	
Credits	

How to use the Learner Guide

To make it easier for you a number of different ICONS have been used throughout the learning material. Refer to the table below for the ICONS and their meanings.

Table 2 ICON Meanings

	Group Discussion. Keep notes of what the group does in the exercise
	Reading or research activity
	When you see this icon, you are required to complete workbook activities
	When you see the icon you are required to completed the activity in real life scenario or workplace
	Glossary of terms
	Tools and Templates that can be copied and re-used throughout the learning programme

Table 3 ICON Descriptions

ICON	Description
	Index
	Unit Standard
	CBT Training
	Individual activity
	Group activity
	Notes
	Safety rules / regulations or tips
	Warning / Dangerous substances
	Self-assessment
	Self-assessment information

Learner Support

To support you with your learning process, the following resources are available :

1. *Learner Guide*
2. *Training Officer / Assessor*
3. *Senior Artisan*
4. *Supervisor*

You can contact your learning practitioner via phone or email :

Name of Learning Practitioner	e-Mail Address	Contact Number
		

Activities related to this Learner Guide

You are required to complete the following activities.

- Activities in the learner guide**

These activities relates to the knowledge component of this learning programme.

- Workplace Activities**

These activities related to the actual application of skills in the workplace.

Table 4 Workplace Activities

	Workplace Activities These activities must be completed in the workplace. Number your documents clearly.		
---	--	--	--

USID	SO	LO	What to do	
Module 1 :				
1	1		identify the oxy-acetylene equipment correctly	
	1		do inspections on oxy-acetylene equipment	
	2		assemble the equipment correctly	
	3		operate the oxy-acetylene equipment safely and correctly	
	4		recall safety hazards related to oxy-acetylene equipment	

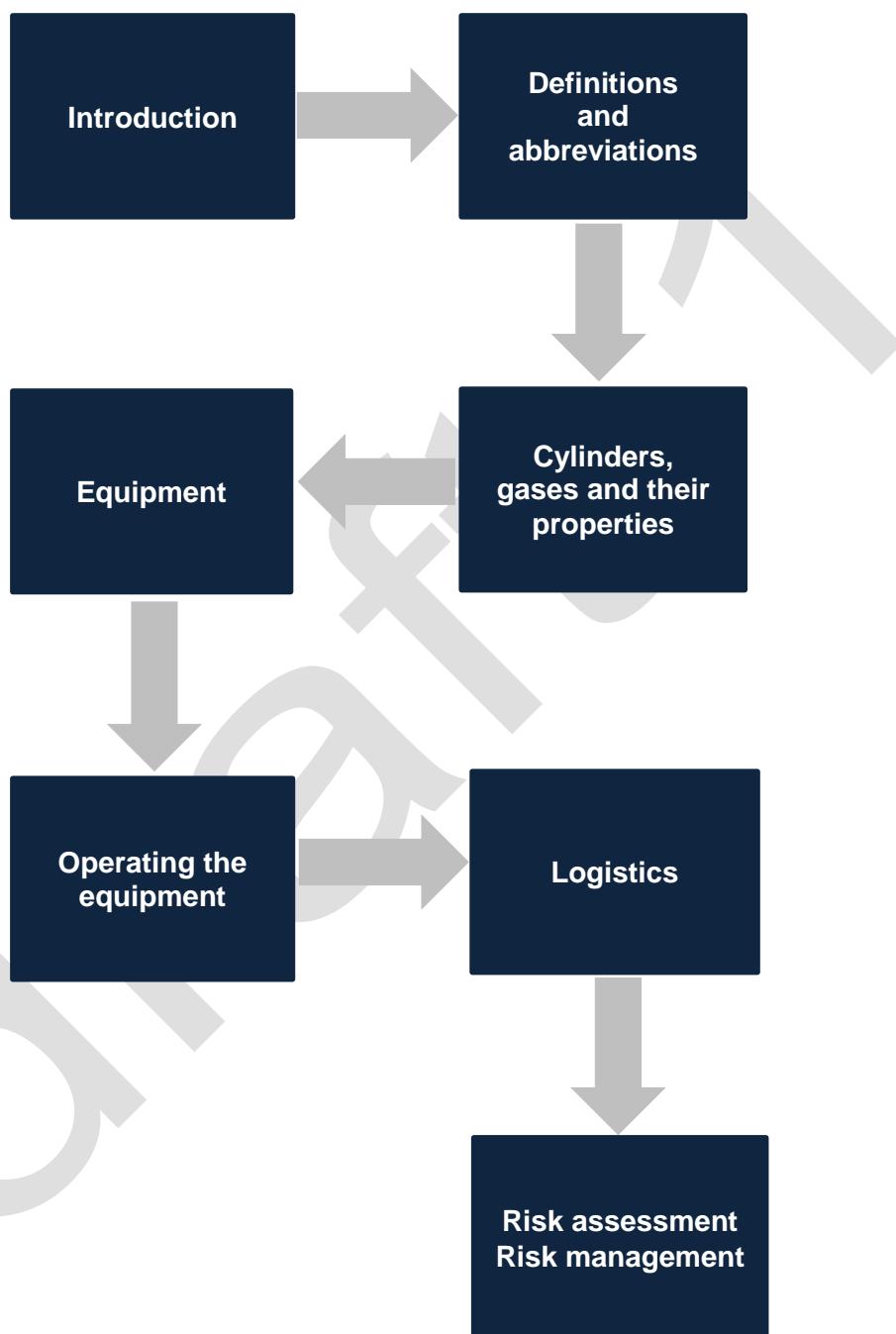
Safety, Health and Environmental Aspects

Personal protective equipment must be worn always when you are on the plant and during the practical performance. This includes hard hat, leather gloves, safety shoes, overalls with long sleeves and hearing protection. Safety glasses / goggles and PVC gloves must be worn where applicable.

It is very important that you know which is the correct type of PPE for a particular hazard, and the correct way of wearing it.

draft

Course map



The sleeping giant

- I am a compressed gas cylinder
- I weigh up to 70kg when filled
- I am pressurised from 18 000 kPa
- I have a wall thickness of about 6.5mm
- I stand 150cm high
- I am 230mm in diameter
- I wear valves, regulators and hoses when at work
- I wear many colours and bands to tell what tasks I perform
- I am ruthless and deadly in the hand of the careless or uninformed
- I am too frequently left standing alone on my small base by an unthinking workman
- I am ready to be toppled over – where my naked valve can be snapped off and all my power released through an opening no larger than the diameter of a pencil
- I have been known to jet away – faster than a dragster
- I smash my way through the air and reach distances of half a kilometre or so
- I spin, ricochet, crash and slam through anything in my path
- I scoff at the puny efforts of human flesh, bone and muscle to alter my erratic course
- I can, under certain conditions, rupture or explode, you read of these exploits in the newspapers

You can be my master **ONLY** under my terms :

- Full or empty – never leave me standing alone
- Keep me in secure rack or tie me so that I cannot fall
- Only work with me if you are trained to do so
- **TREAT ME WITH RESPECT : I AM A SLEEPING GIANT**

Explosion of gas cylinders



Cylinders exploded due to overheating / extreme external heat source or due to over-pressurising.



Combustion triangle



Off-the-Job Safetygram



Rockdale Operations
Safety and industrial Hygiene Department
2003 August 12

- Do **NOT** leave pressurised containers (If any kind) in your vehicle where they can be exposed to sunlight!
- You should always read and follow the manufacturer's safety recommendations that come with the can.
- Reporting incidents such as this can help inform personnel of possible risks and dangers both inside and outside the workplace!



Dräger X-plore 1320 Filtering face piece FFP2



To meet the demands of today's industrial workplaces, Dräger has developed a new range of filtering face pieces, the Dräger X-plore 1300 Series. With end-user requirements in the forefront, the focus of this respirator series is safety and comfort. The result: a comfortable, ergonomically designed filtering face piece for use against solid or liquid particles. Advanced filter media combined with a modern design guarantees maximum comfort, safety and user acceptance.

Whenever respiratory protection for dust is needed, e.g. in the metal industry or working with concrete, Dräger X-plore 1320 filtering face pieces provide you with a perfect solution.

without the climate control comfort valve. This exhalation valve reduces moisture and hot air build-up inside the mask, allowing you to breathe easier.

Major features include the flexible, textile head harness which doesn't pull on your hair - and the straps don't break. Also, an extra-wide nose sealing strip ensures leak free sealing and an optimal fit with safety glasses.

Dräger X-plore 1320 filtering face pieces are available in one size designed to fit a wide variety of different face shapes and sizes.

Discover the benefits of Dräger X-plore 1320 for yourself.

Dräger X-plore 1320 is available with or



ST-116-2005

X-plore 1320 FFP2: Without exhalation valve



ST-115-2005

X-plore 1320 FFP2 V: With exhalation valve

FEATURES & BENEFITS

Colour Coded Nose Clip & Valve	Light blue colour coding. Easy to distinguish between FFP1, FFP2, and FFP3.
Plastic Coated Nose Clip	No sharp edges get in your way!
Wide Nose Seal	Ensures a secure seal on your nose.
Ergonomic Design	Comfortably and securely fits a wide range of face shapes.
Climate Control Comfort Valve	Low breathing resistance without heat build-up.
Advanced Filter Media	Filters out both solid and liquid particles.
Flexible, Textile Head Harness	Added comfort. No hair pulling, straps don't break.
One Size Fits All	Keeps logistics easy.
Fit with safety goggles	Good nose sealing and no fogging.

TECHNICAL DATA

Head harness	Synthetic elastics
Nosepiece	Plastic-coated metal wire
Filter media	Synthetic filter media
Exhalation valve (V-models)	Polyamid/Rubber
Weight FFP2	11 g
Weight FFP2 V	14 g
Approvals	The X-plore 1320 masks are tested against and approved to EN 149:2001 and fulfil the safety demands in EU directive 89/686. The products are CE-marked.

ORDER INFORMATION AND RESTRICTIONS

Filter class	Multiples ¹⁾ of the limit values ²⁾	Product name	Pcs/Box (minimum order)	Order-No.
FFP2	12	X-plore 1320 FFP2	20	39 51 203
FFP2 V	12	X-plore 1320 FFP2 V	10	39 51 204

¹⁾ Subject to modification based on national regulations.

²⁾ Limit values can e.g. be MAK-values (MAK = German acronym, concentrations at the workplace) and values such as O.E.L. (Occupational Exposure Limit). In this respect it is possible that for some substances special workers' protection rules apply.

For more information, please visit Dräger Voice at <http://www.draeger.com/voice>



Beware of aerosol cans



Off-the-Job Safetygram



Rockdale Operations
Safety and Industrial Hygiene Department
2003 August 12



Do you keep WD-40, hair spray, Off, Fix-A-Flat, etc. in your vehicle? If so, you might want to reconsider. The picture above is of a pressurised can that exploded in a person's vehicle and imbedded itself in the back seat of the car. The temperature outside of the closed up vehicle was about 100 degrees F. What if you or a loved one had been sitting in that seat? Do any of your family members keep aerosol cans in their vehicles? If they do, please pass this warning along to them!

The incident pictured happened at a refinery in Beaumont. A deodorant spray can was left in the back of the vehicle that was parked in an open space in the middle of a hot, sunny day.

Without warning the can exploded inside the car. Fortunately, no one was inside or near the car when it happed.

Module 1

Introduction

Purpose of module

This module provides you the Learner with the knowledge and understanding to identify the Oxy-acetylene equipment correctly.

Module duration

Self-study

Learning outcomes

The learning outcomes identify what you, as a Learner, will be able to achieve on completion of this module.

You will be able to

1. identify the oxy-acetylene equipment correctly
2. do inspections on oxy-acetylene equipment
3. assemble the equipment correctly
4. operate the oxy-acetylene equipment safely and correctly
5. recall safety hazards related to oxy-acetylene equipment

Procedures relating to this module

- A theoretical test will be set at the end of the module, and must be completed with an achievement of 100% mastery.
- All answers must be correct and in accordance with the module content.

Additional resources

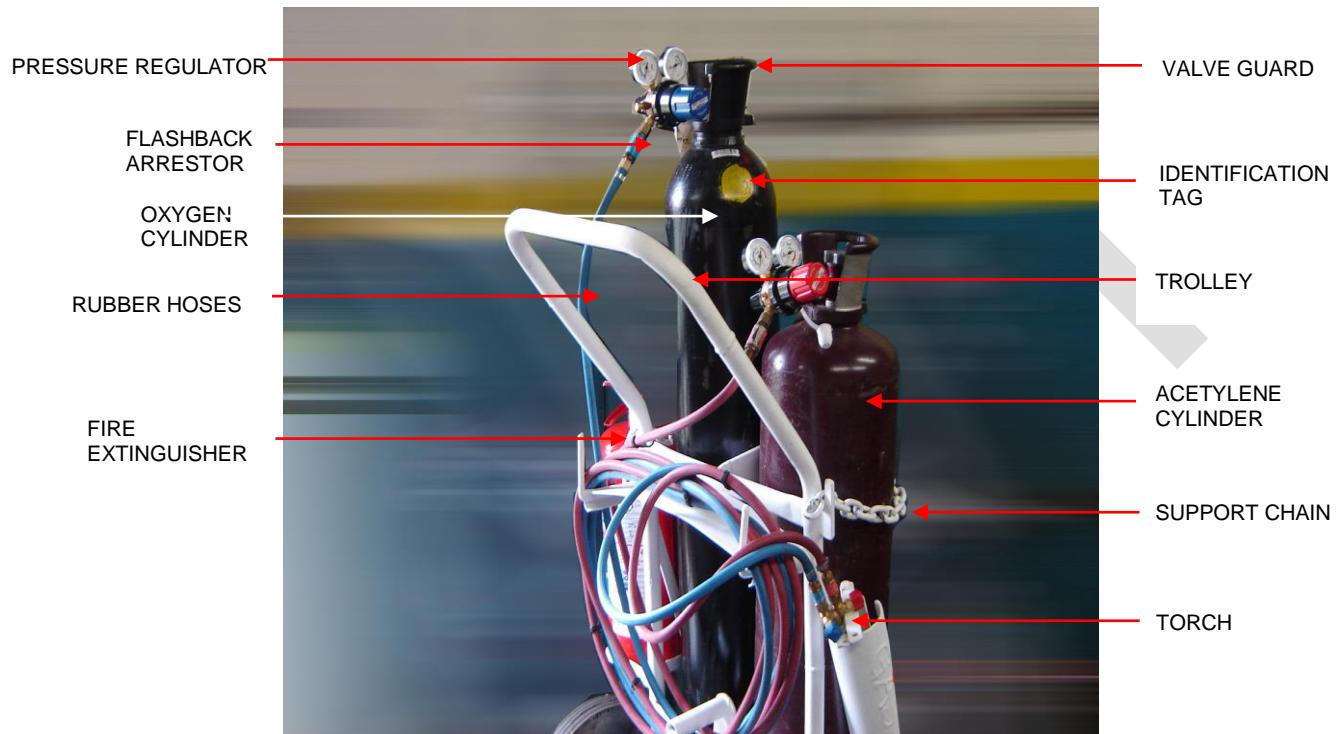
- Mines Health and Safety Act

1. Introduction to the Oxy-acetylene gas cutting process

- 1.1 Oxy-acetylene gas cutting is a process, which entails the use of a fuel gas in conjunction with pure Oxygen to give a flame with a temperature high enough to bring steel to a kindling temperature of 884°C, at which the metal will oxidise rapidly in the presence of pure Oxygen. Different types of fuel gases can be used for the process; however the most commonly used is acetylene.
- 1.2 Liquefied petroleum gas is either Propane or Butane or a mixture thereof. Commercial LPG usually contains trace quantities of a strengthening agent, which imparts a characteristic fish odour. This gas has the disadvantage of being heavier than atmospheric air, which in case of a leak will cause an accumulation of gas in low lying areas such as on shop floors, trenches and man holes or between structural members where it will violently explode in the presence of sparks or flames. Therefore LPG is not commonly used on construction sites due to the explosion hazard of the gas. When using LPG, sufficient ventilation is of paramount importance.
- 1.3 Acetylene is a highly flammable fuel gas with a garlic odour which cannot be stored in a hollow cylinder at a pressure above 103.5 kPa in a gaseous form due to its explosive nature, therefore Acetylene are stored in cylinders which are filled with porous material at a maximum pressure of 1720 kPa. The porous material is saturated with Acetone where after Acetylene is pumped into the cylinder, resulting in the Acetylene to be absorbed by the Acetone. Acetylene cylinders must never be utilised near any heat source as it may cause the cylinders to explode. Acetylene must not come into contact with unalloyed copper, silver, mercury or brass containing more than 66% copper as it may lead to an explosion. The gas is a strong reducing agent and reacts violently with oxidants.

2. Identification and selection of equipment

The photo image below shows the basic equipment required for Oxy-acetylene gas cutting :



3. Cylinder identification and pressures

Gases	Cylinder colour	Content pressure (kPa)
Oxygen Industrial	Black	18 000 kPa
Oxygen medical	Black with white top	18 000 kPa
Acetylene	Maroon	1 800 kPa
Argon	Turquoise/Blue	20 000 kPa
Carbon Dioxide (CO2)	Green	5 800 kPa
Nitrogen	Grey with black top	20 000 kPa
Compressed air	Beige	20 000 kPa
Helium	Light brown	20 000 kPa
Hydrogen	Red	20 000 kPa
LPG	Variable according to distributor (Grey/Silver)	48 kg, 19 kg, 9 kg.
Methane	Pink with red top	20 000 kPa
Shielding Gas 1 (Fluxshield)	Dark Blue	20 000 kPa

4. Selection of equipment

4.1 Identification of gas cylinders

Cylinders are colour-coded in accordance with SABS specifications in order to identify the type of gas contained in the cylinder. The following chart indicates the colour codes of the gas cylinders :

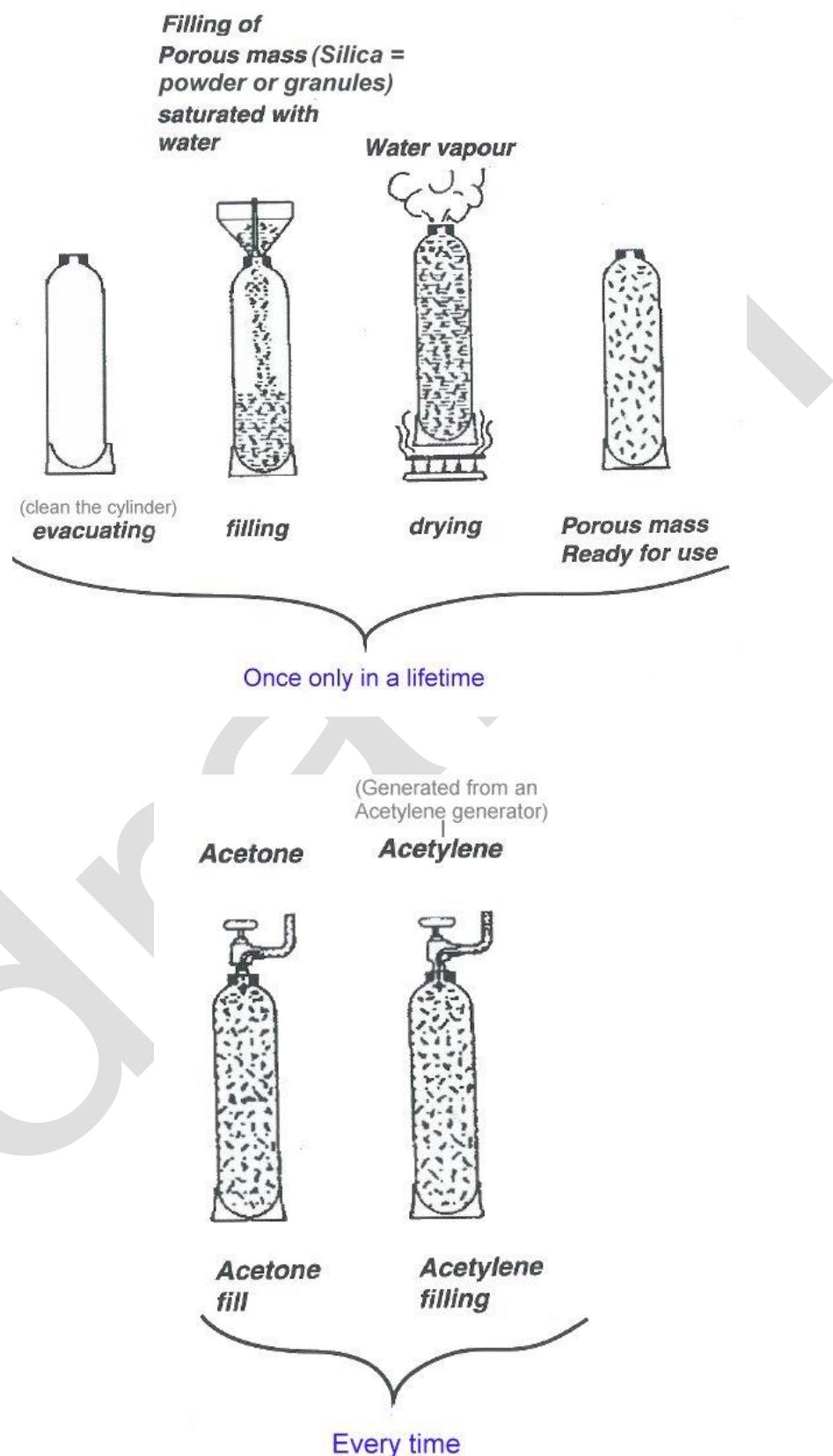
Exterior colour of cylinder	Type of gas	Pressure
Black	Oxygen	18 000 kPa
Maroon	Acetylene	1800kPa

Cylinders must not be used if the colour of the cylinder is unrecognisable. Mark such cylinders with chalk "DO NOT USE" and report it to the Learning Practitioner. Never make any alterations to the colour code, valve threads or markings on gas cylinders.

4.2 Content of cylinders

- Oxygen – pure Oxygen
- Acetylene – view the images below (Processing of an Acetylene cylinder)

5. Processing of an Acetylene cylinder



6. Forbidden use of Oxygen



Hazard :

Oxygen shall not be used to replenish atmospheres or as an alternative for pressurised air in connection with :

- a) spray painting
- b) driving air tools
- c) No dusting off with Oxygen (never use compressed oxygen (with torch) to dust off overalls or cool yourself down)
- d) cleaning of the work area
- e) substances containing hydro-carbons are not allowed with Oxygen under pressure
- f) do not start diesel engines with Oxygen

7. Forbidden use of substances containing hydro-carbons

Substances containing hydro-carbons shall not be used with Oxygen under pressure such as :

- oil
- grease
- thinners
- alcohol
- methanol
- petrol
- diesel
- paraffin
- loctite
- vaseline
- plastics
- rubber
- butter
- hand cleaner
- soap
- epoxy compounds (glue)
- thread tape (PTFE), etc.



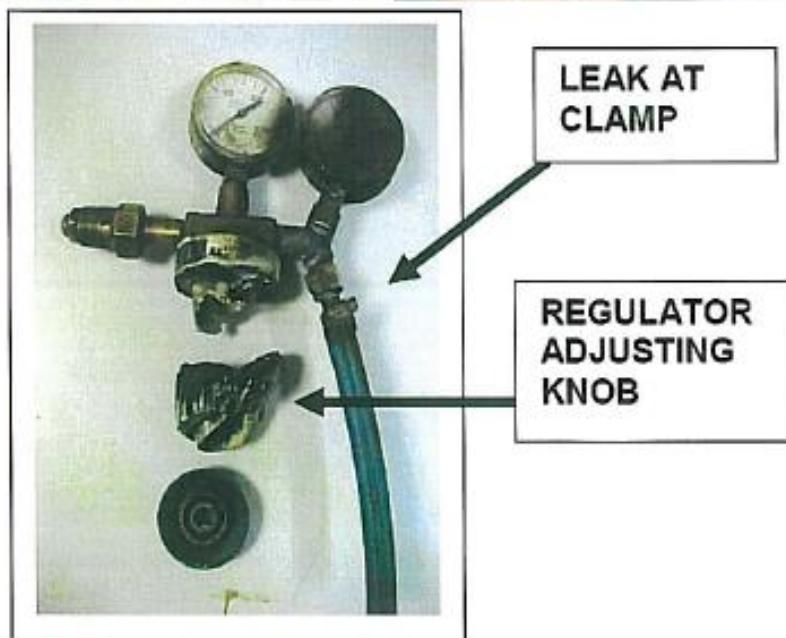
Hazard :

This can lead to an explosion.

COMPRESSED GAS SAFETY

The following incident involved a welder (not on a Sulzer facility) who was adjusting the pressure on an oxygen regulator.

The welder had oil on his hand and there was an oxygen leak from the hose clamp.

**General Precautions**

Oxygen under pressure and hydrocarbons (oil and grease) can react violently, resulting in explosions, fire and injury to personnel and damage to property.

Never allow oil or grease to come into contact with oxygen under pressure.

8. Cylinder identification tags

8.1 Oxygen



8.2 Acetylene



9. Pressure regulators

9.1 Regulators

- 9.1.1 The function of a pressure regulator is to reduce and regulate the gas pressure from full cylinder pressure to the required pressure for the cutting task at hand.
- 9.1.2 Pressure regulators are obtainable with pressure gauges or without gauges. The latter is known as the gauge-less type. Both types are shown in the photo below :



- 9.1.3 Colour coding of regulators :

Select the correct pressure regulator for the type of gas that is to be used, i.e. :

- regulators with blue markings for Oxygen
- regulators with red markings for Acetylene
- regulators with orange markings for LP gas

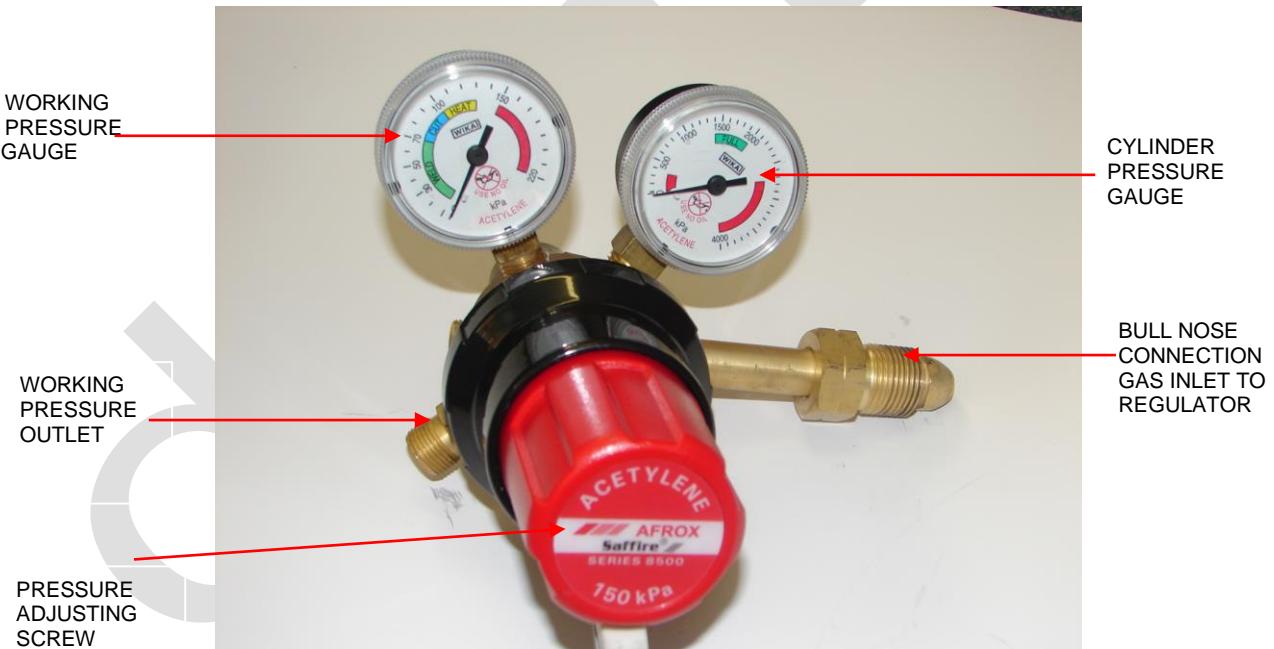
For cutting of thick material it is essential to select an Oxygen regulator, which allows a sufficient high rate of flow to ensure efficient operation. Low-pressure regulators can be utilised for Oxy-acetylene gas welding purposes.

Regulators which have been used for air or nitrogen should not be subsequently used with Oxygen and also, regulators which have been used for Acetylene should not be used for LP gas.

Always treat regulators as precision instruments, do not subject this equipment to knocks, jars or sudden pressure, caused by the rapid opening of the cylinder valve.

Do not use defective regulators. Report any irregularities to your Learning Practitioner.

The various parts of a typical pressure regulator is shown in the pictures below :



9.2 Hexagon nuts

- Acetylene - groove around the nut which indicates it is left hand thread.
- Oxygen - no groove around the nut which indicates it is right hand thread.

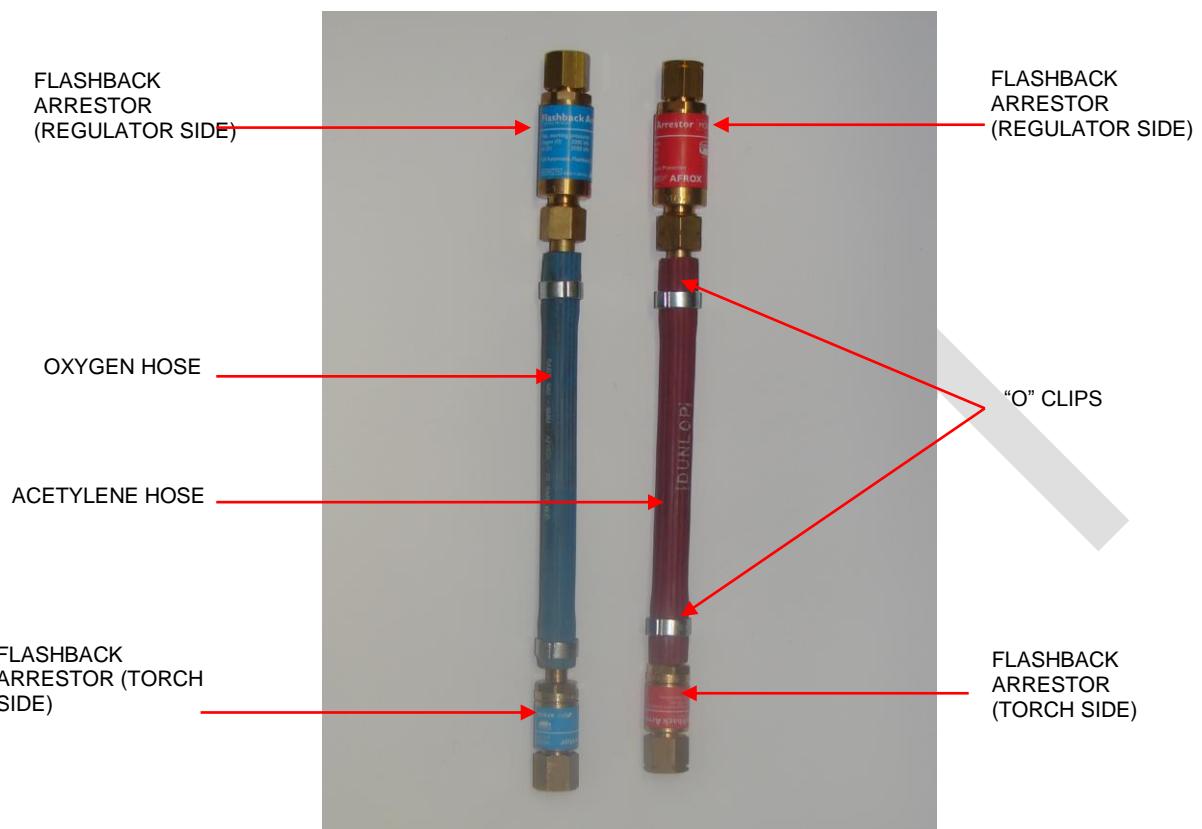


Note :
Always use the correct size spanner to tighten the regulator nuts on the cylinder.

Never use tools such as shifting spanners, etc.



9.3 Rubber hoses



9.3.1 Select the correct colour hoses for the type of gas that is to be used, i.e. :

- Blue hose for Oxygen
- Red hose for Acetylene

9.3.2 Use only hoses of approved quality, which is manufactured in accordance to SABS specifications.

9.3.3 Connections must be secured with suitable "O" clips.

9.3.4 Use parallel hose clips, spaced equally over the full length of the fuel and Oxygen hoses to keep it neat and tidy.

9.3.5 Never use Oxygen or acetylene hoses on LP gas equipment; the latter requires hoses of a special composition.

9.3.6 Do not expose hoses to heat, people and vehicle traffic, oil, grease, slag and sparks. Damaged hoses must be replaced immediately.

9.4 Specifications for flashback arrestors

EN – European Norm

9.5 Flashback arrestors



- 9.5.1 Ensure that they are fitted.
- 9.5.2 Body and connections undamaged
- 9.5.3 Flashback arrestors are fitted to the regulators and the torch (blowpipe).
- 9.5.4 Its purpose is to prevent gas reverse flow, as well as arresting a flame travelling backwards into the hose and / or regulator, cylinders which would cause an explosion.
- 9.5.5 They allow flow of gas in one direction only.
- 9.5.6 Flashback arrestors are safety devices shall be fitted to both ends of the hoses.
- 9.5.7 Flashback arrestors should be tested on a yearly basis to ensure functionality.
- 9.5.8 If a flash back has occurred, the entire equipment must be removed, checked and tested. If faulty, it must be replaced.

	<p>Hazard : The Supervisor must be notified after a flashback has occurred, as it is classed as an incident. The entire equipment must be inspected after the occurrence of a flashback.</p>
---	---

- 9.5.9 The arrow on a flashback arrestor shows the direction of flow. The arrow must always point away from the regulator.
- 9.5.10 Prior to re-lighting the torch, the entire equipment must be inspected to verify if it is in correct working order.
- 9.5.11 Inspection or testing of flashback arrestors :

- To check if flashback arrestors are working correctly, you feed the Oxygen or Acetylene gas against the direction of flow. If the gas leaks through the arrestor it must be replaced immediately.
- Flashback arrestors should be tested on a yearly basis or immediately after being subjected to flashback.
- Flashback arrestors should be inspected by a designated person, annually.

9.5.12 Four criteria :

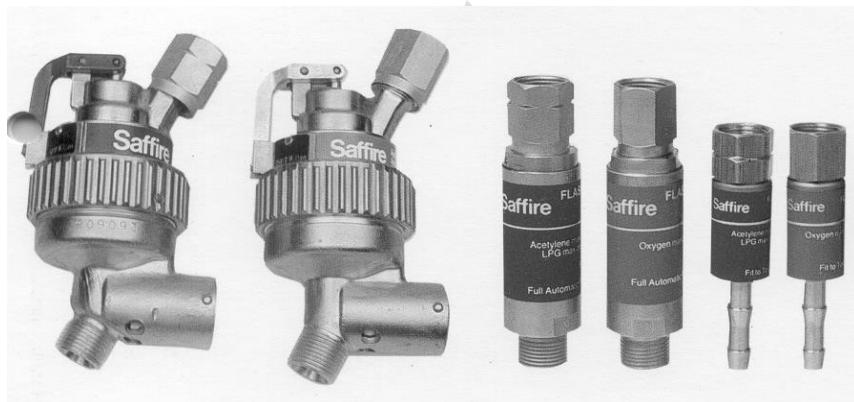
- check for through flow
- check for reverse flow
- check for leaks
- check for flashbacks, which may have occurred

9.6 Threads on equipment

9.6.1 All flammable liquids = Left hand threads
All non-flammable liquids = Right hand threads

9.6.2 The photo below shows three types of safety devices that are used to minimise the chances of a flashback.

9.6.3 The photos below show the internal workings of the flash back arrestors :



CHECK VALVES
(REGULATOR SIDE)

TEMPERATURE ACTIVATED FLASH
BACK ARRESTOR
(REGULATOR SIDE)

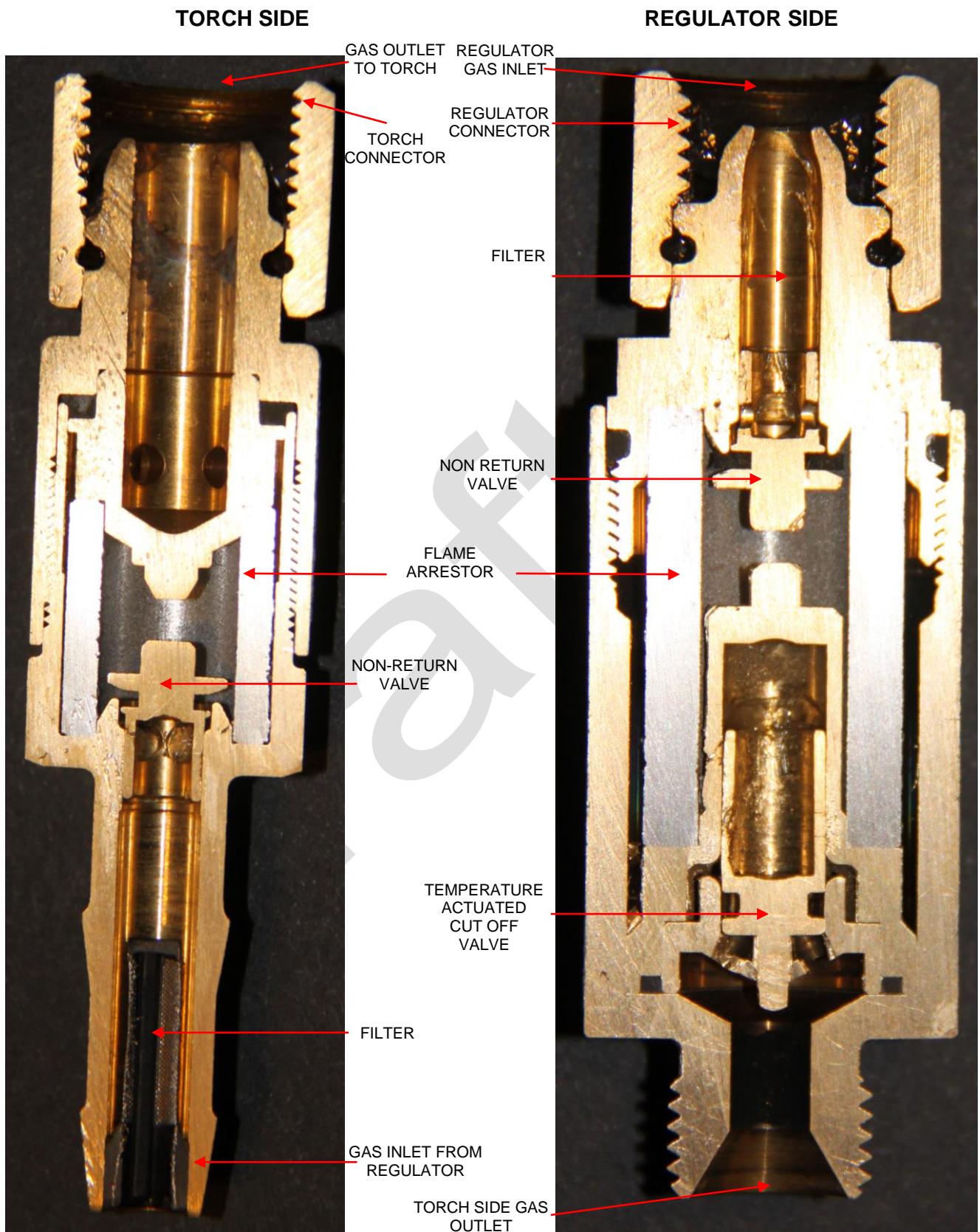
PRESSURE ACTIVATED FLASH
BACK ARRESTOR
(TORCH SIDE)

10. Flashback arrestor

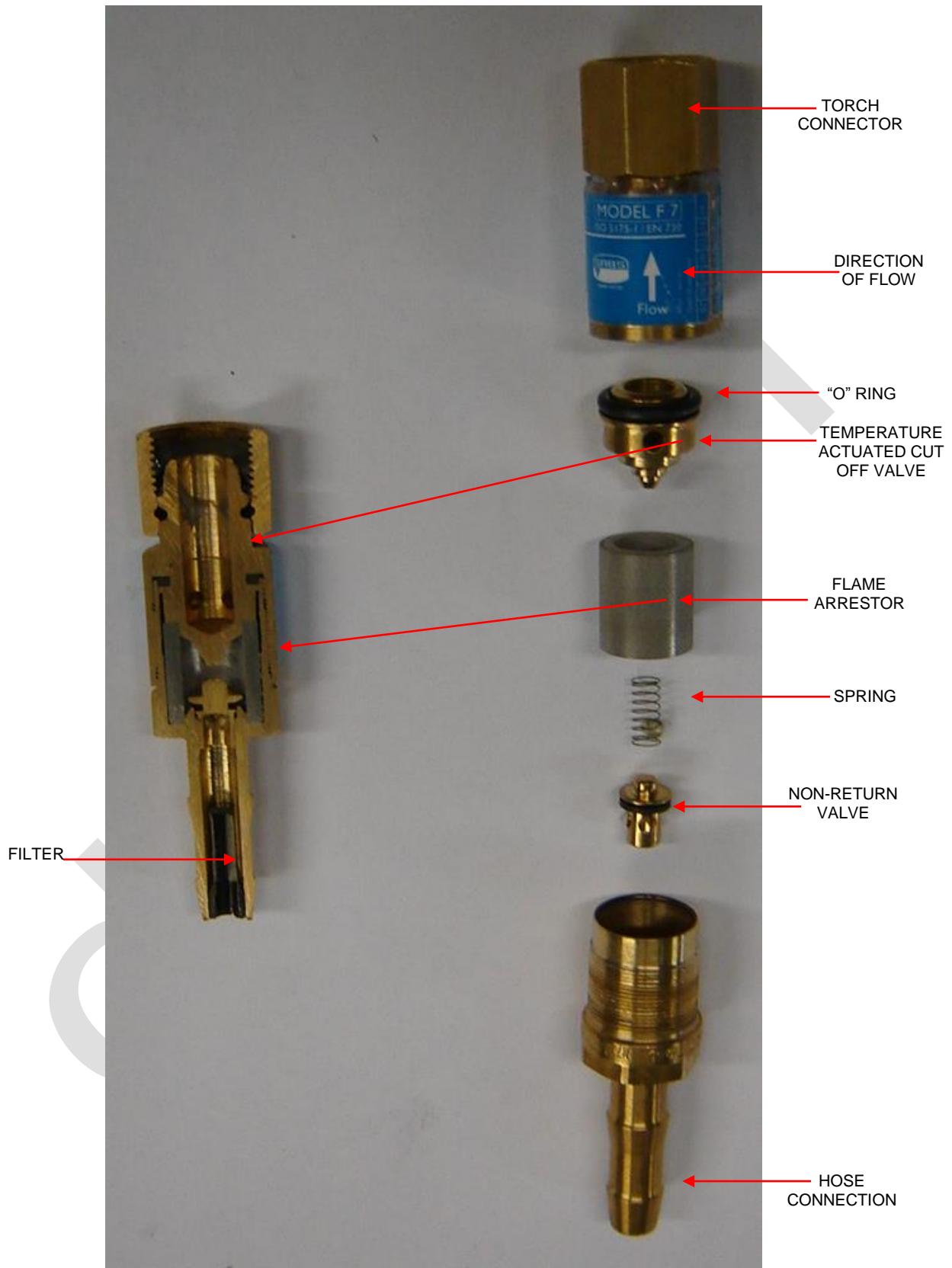




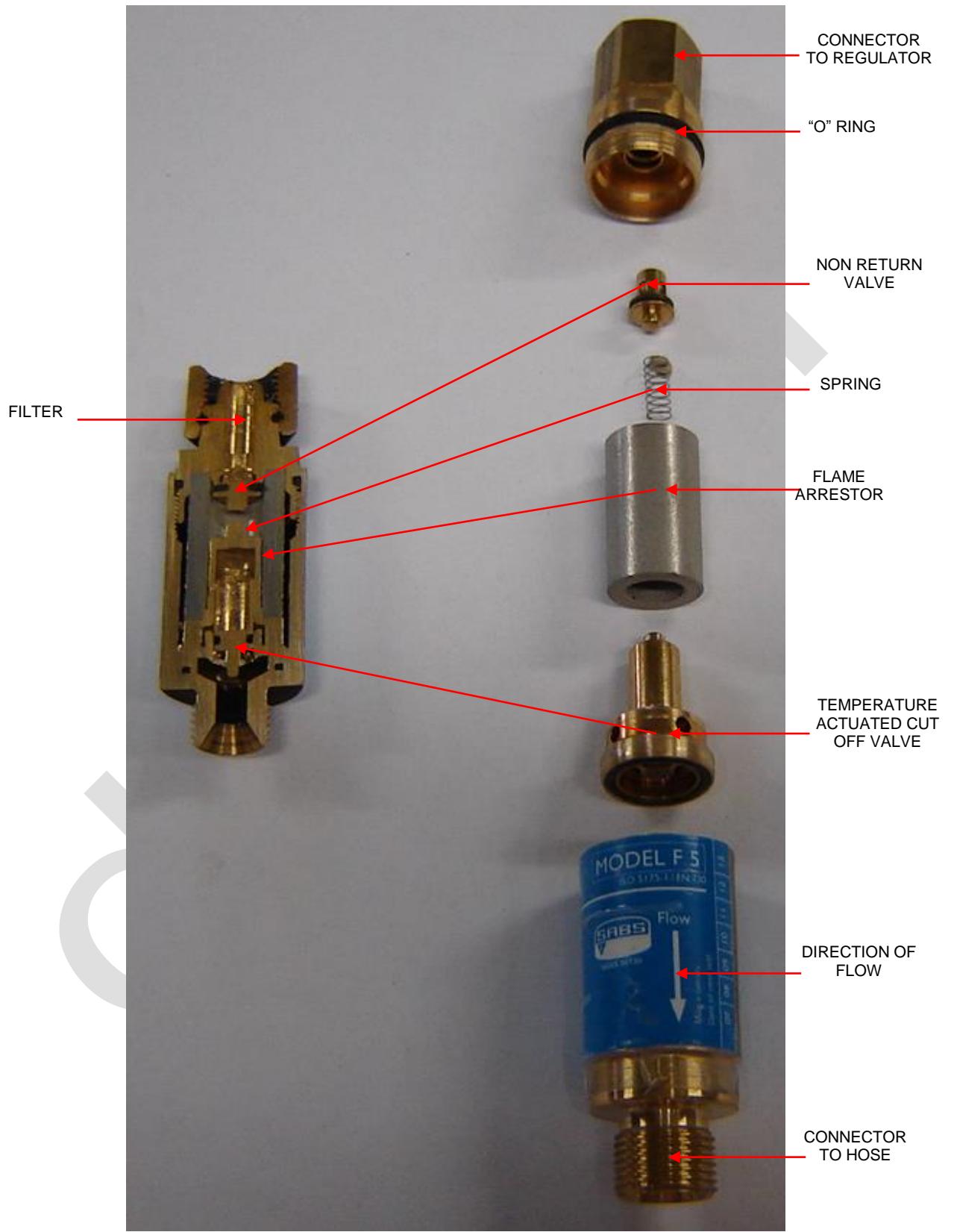
11. Pressure activated flashback arrestors



11.1 Torch side

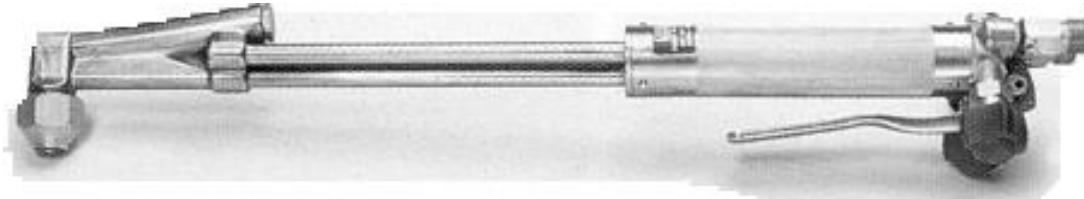


11.2 Regulator side

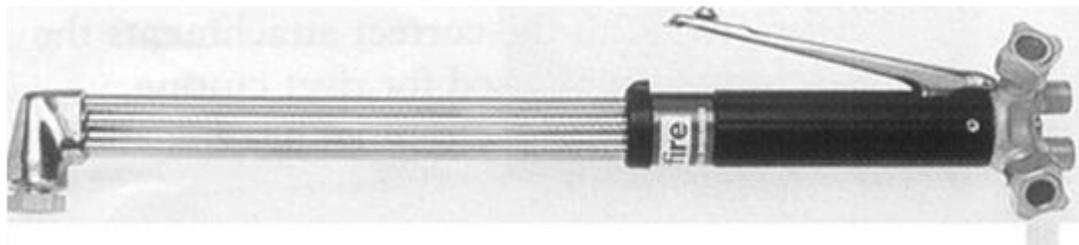


12. Cutting torches

- 12.1 Cutting torch design differs from one manufacturer to the next, although the basic construction and controls of torches are very much the same.
- 12.2 The photos below show torches used for Oxy- acetylene gas cutting :



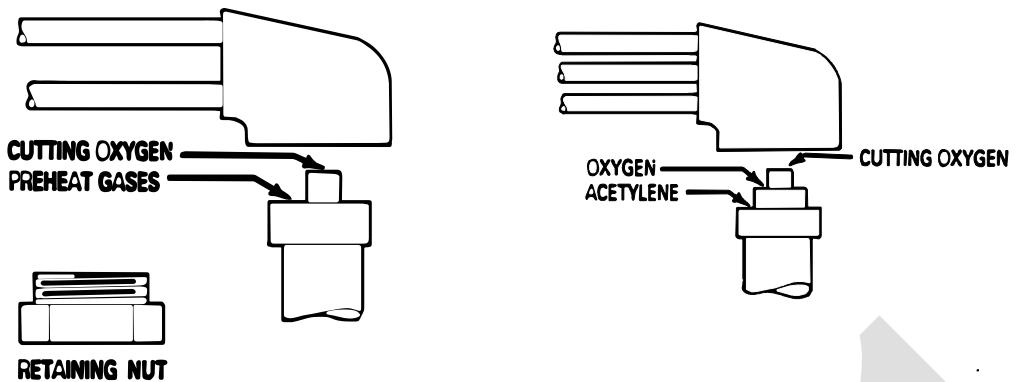
Oxy-LPG torch



Oxy-acetylene cutting torch

- 12.3 The function of a cutting torch is to supply fuel gas and Oxygen to the nozzle where the gases are ignited by means of a spark lighter.
- 12.4 The mixing of the gases for the pre-heat flame is done in two possible ways, according to the torch design. The most common design is that with a gas-mixing chamber at the front end of the torch body, with two tubes conveying the gas from the torch shank to the mixing chamber. Another design is where the gas is conveyed in three separate tubes to the torch head and mixing of the fuel and oxygen takes place in the cutting nozzle.





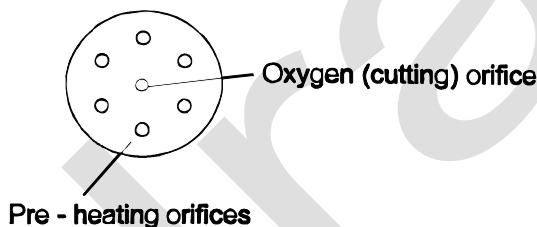
Note :

It must be emphasized that the nozzle-retaining nut must always be secured properly in the cutting torch head but care must be taken not to over-tighten the nut.

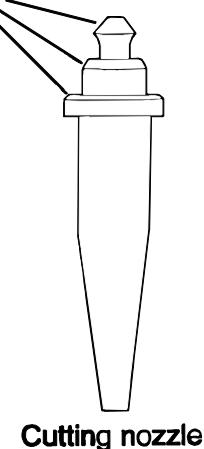
13. Cutting nozzles (cutting tips)

- 13.1 Nozzles are manufactured for specific torches and fuel gases and should be used in accordance to the manufacturer's specifications.
- 13.2 A typical cutting nozzle is equipped with several gas orifices. An orifice usually slightly larger is positioned in the centre of the nozzle for the cutting oxygen and is surrounded with various smaller orifices for the pre-heating flame.
- 13.3 It is important to ensure that the seating surfaces of the nozzle and inside the torch head are undamaged prior to installing the nozzle in the torch. These surfaces ought to form a gas tight seal and any leaks may cause ignition of the gases inside the torch head. A tell-tale sign of the latter is a black deposit on the seating surfaces of the nozzle and torch head. Report any damaged seating surfaces to the Learning Practitioner.
- 13.4 Nozzles where the gases are mixed internally, the fuel gas and oxygen enters the nozzle body in separate annular chambers, is mixed internally and then exits the nozzle via the pre-heating orifices.
- 13.5 A separate chamber in the torch head delivers a jet of pure oxygen into the centre orifice of the nozzle when the cutting lever of the torch is depressed.
- 13.6 The following information should be indicated on a nozzle :

Cutting nozzle (End - view)



Seating surfaces



Cutting nozzle

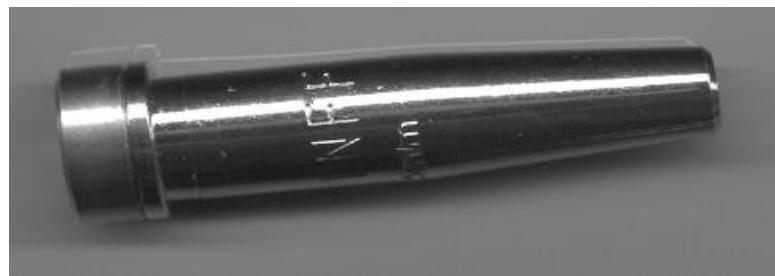
13.7 Function of cutting nozzle

The main function of a nozzle is to accelerate the outflow of a gas mixture **beyond** the speed of a flame burning back.



Nozzle Size	Material thickness mm	Oxygen pressure kPa	Acetylene pressure kPa	Cutting speed mm/min	Gas consumptions			No.
					Oxygen		Acetylene	
					Cutting Kg/hr	Heating Kg/hr	Heating Kg/hr	
0,8	6	150	15	500-850	1,13	0,41 0,69	0,31 0,52	005/014
1,2	12	250	15	440-700	2,45	0,49 0,82	0,37 0,62	005/015
1,6	25	300	15	300-610	5,37	0,56 1,06	0,44 0,76	005/016
1,6	50	300	20	230-400	6,23	0,60 1,06	0,46 0,76	005/016
1,6	75	350	30	180-300	7,03	0,76 1,06	0,56 0,87	005/016
2,0	100	350	30	180-250	9,55	0,76 1,17	0,56 0,87	005/017
2,4	150	400	30	150-180	13,92	1,17 1,62	0,87 1,20	005/018
3,2	250	560	35	100-125	29,84	1,65 2,06	1,23 1,54	005/020
3,2	300	560	35	90-125	34,48	1,88 2,42	1,39 2,00	005/020

**Gas pressure chart for Oxy-LPG cutting nozzles type :
PVH – Saffire Cutobut Torch**



Nozzle size	Max material thickness (mm)	Oxygen pressure (kPa)	Acetylene pressure (kPa)	Cutting speed (mm/min)
1	0-8	250	15	720-500
2	8-15	500	15	650-450
3	15-35	700	15	550-360
4	35-75	700	15	480-220
5	75-150	700	15	220-160
6	150-200	650	15	200-150

Nozzle for Oxy-acetylene cutting

- A = Nozzle to be used for Acetylene fuel gas only
- NM = Nozzle mix / gases are mixed in the nozzle
- 6 = Number of pre-heat orifices
- 0,8 = Actual size of the cutting orifice in mm

Nozzle for oxy-LPG cutting

- 000 6 = Size of the nozzle
- NFF = High pre-heating
- NX = Normal pre- heating



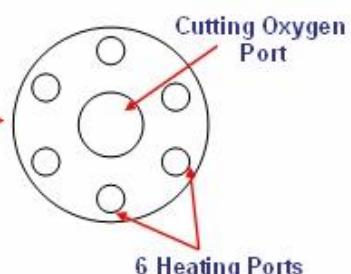
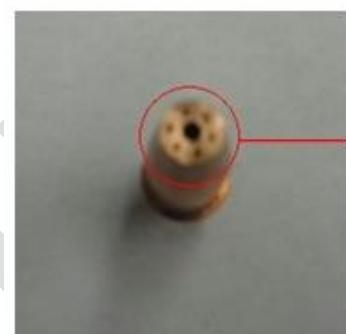
0506 – Month/Year of manufacturing

AFROX

ANM6 – Acetylene Nozzle Mix/6 Heating Ports

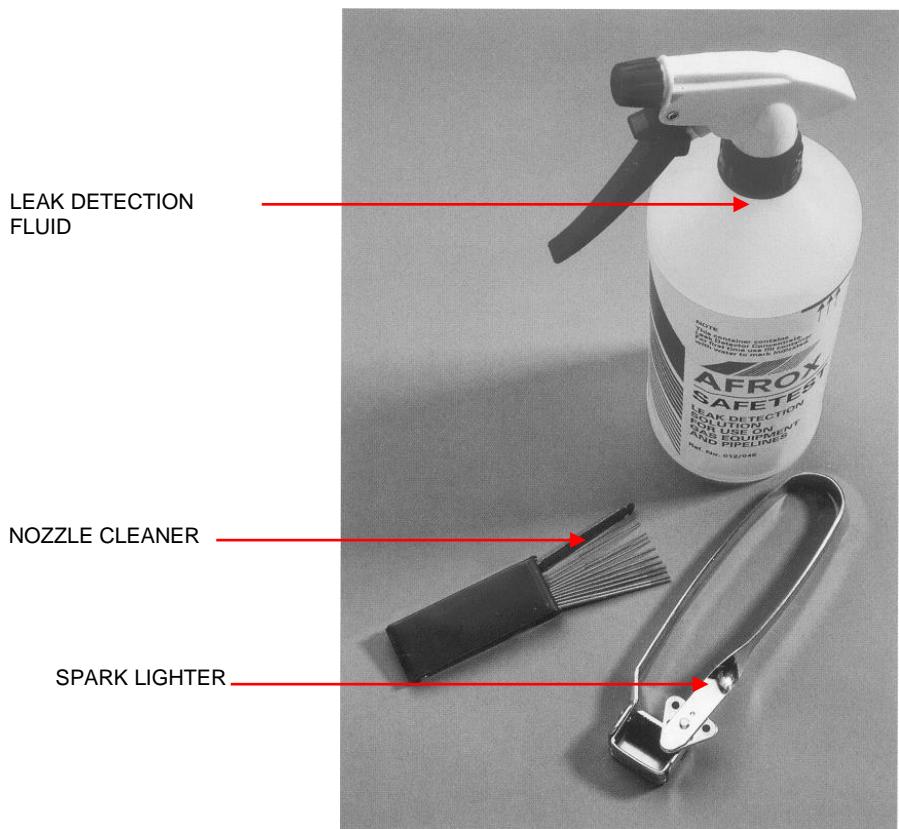
3.2 – Diameter of Cutting Oxygen Port (mm)

150 - 300mm (Plate thickness)



14. Miscellaneous





- 14.1 **Leak detection fluid** is a non-oil based soap solution mixed with water and is used to check Oxy-acetylene gas equipment for leaks. The equipment should first be pressurised and then the solution is applied to all joints, connections, valves or any suspicious areas to check for gas leaks, which will be visible as bubbles.
- 14.2 **A nozzle cleaner** is used to remove slag or foreign material from the nozzle orifices. First insert a needle two sizes smaller than that of the orifice and work it carefully up and down. Now repeat the action with the needle one size smaller than the orifice and then lastly use the needle with the same diameter as the orifice.



Note :
Avoid excessive use of a nozzle cleaner as it leads to altering the orifice's shape and size, which ultimately renders the nozzle unusable.

- 14.3 **Spark lighters**, also known as flint lighters are used to ignite the fuel gas when executing the lighting up procedure.



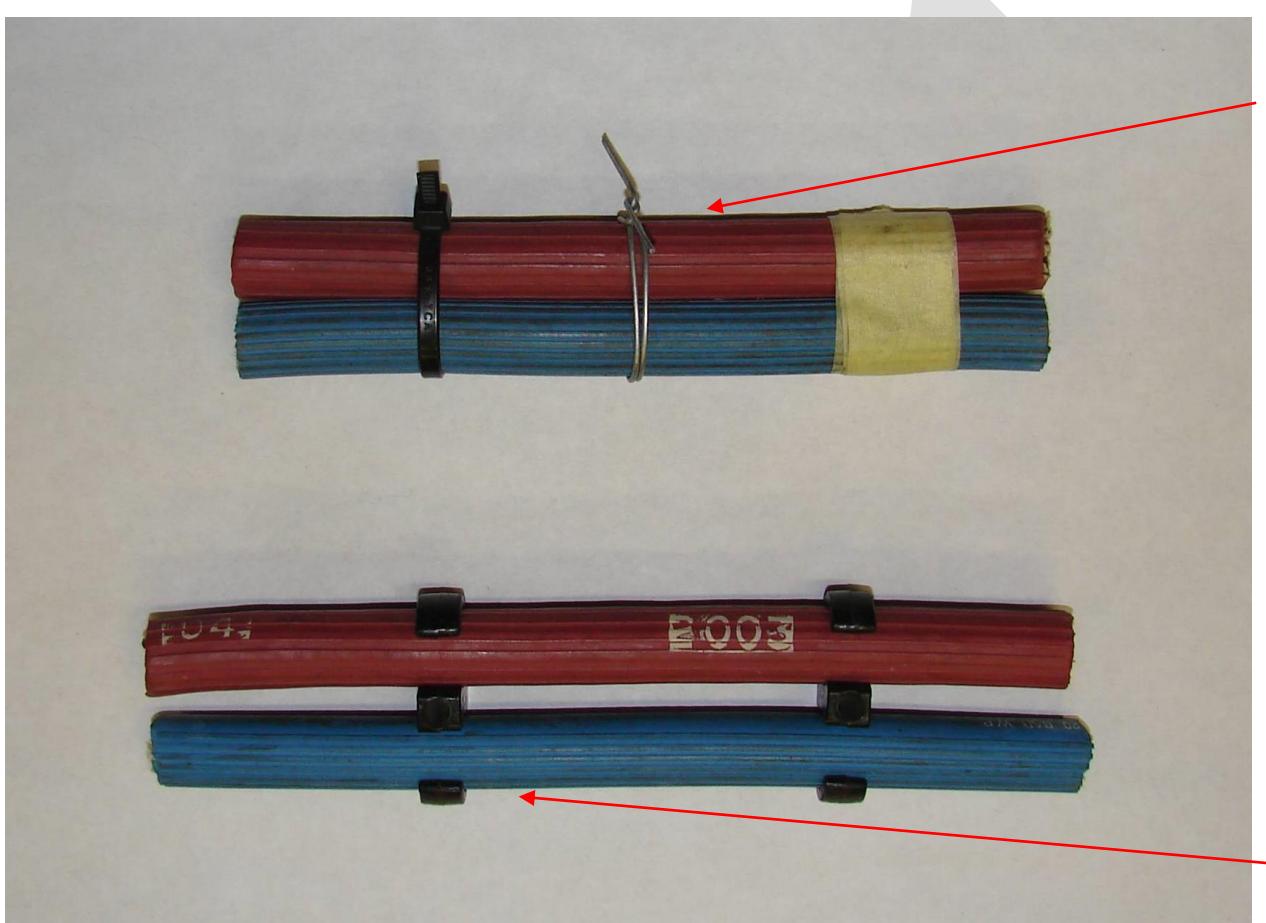
Note :
Normal cigarette lighters must never be used for Oxy-acetylene gas cutting equipment as these lighters can explode in a person's pocket when coming into contact with hot sparks.

15. Safety

15.1 Securing of hoses

Never use the following to secure hoses in parallel position. :

- (a) cable ties
- (b) wire
- (c) masking tape



Always use approved parallel hose clips to secure hoses in parallel position.

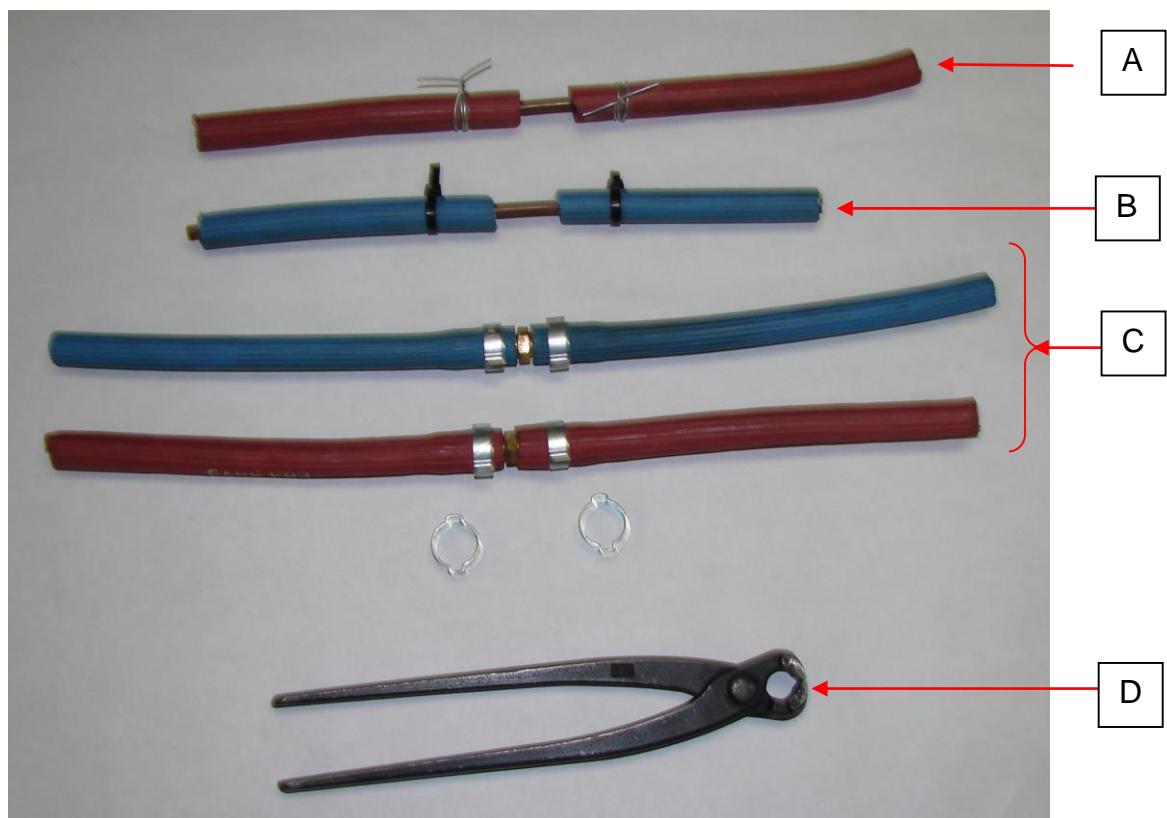
15.2 Joining of hoses

15.2.1 Never use wire to join hoses (see A)

15.2.2 Never use cable ties to join hoses (see B)

15.2.3 Use only approved hose joiners with an "O" clip (see C)

15.2.4 Use only an approved "O" ring pliers to crimp the "O" clips around the hoses (see D)



15.3 Hose joining material

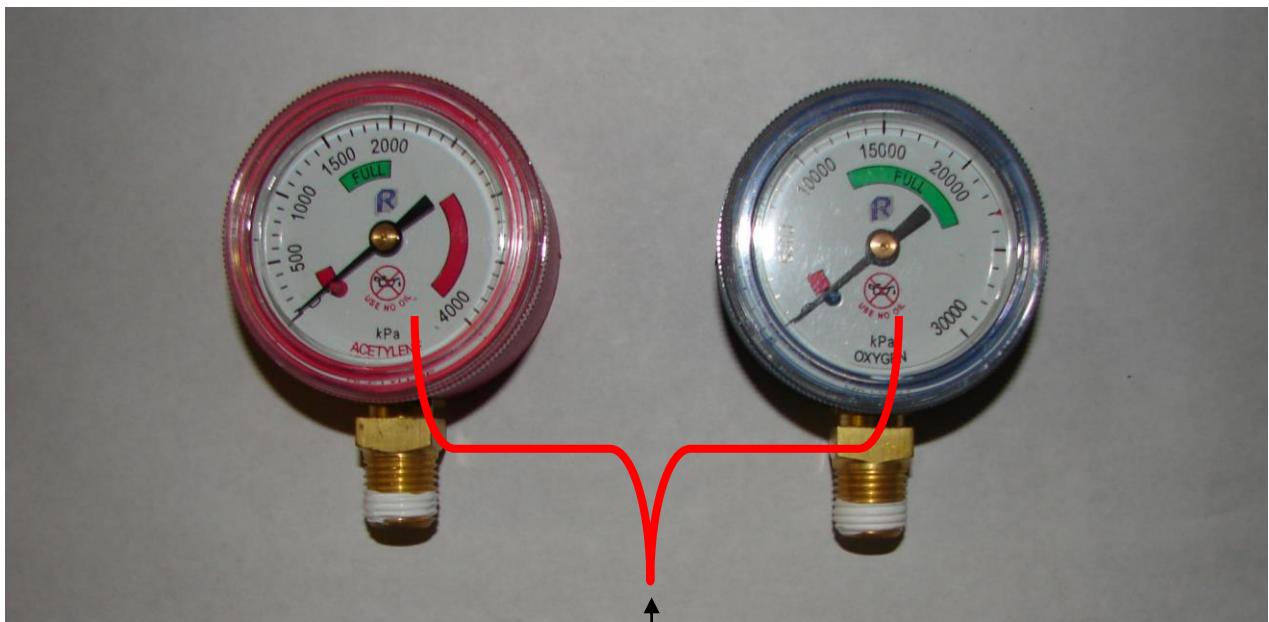
Hose	Colour	Comment
Acetylene	Red	Acetone resistant
Oxygen	Blue	Never use black compressed air hose, because of reaction of Oxygen with Hydro-carbons (Petroleum based products)

15.4 Ignition material / equipment

- 15.4.1 Never use cigarette lighters to ignite the flame, because it can explode in your hand. Cigarette lighters contain Butane gas (LPG) and must be kept at low temperature, the moment heat is applied (like the flame of Oxy-acetylene) it can heat up and explode.
- 15.4.2 Never use matches to ignite the flame. The wood of a match stick contains a chemical that can react with Oxy-acetylene.
- 15.4.3 Use only approved spark lighter (also known as flint lighter) to ignite the flame.



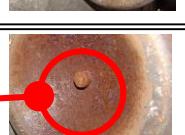
	Hazard : Never use oil or any oil-base product on Oxy-Acetylene gas equipment. It can cause an explosion, oil contains hydro-carbon and has a negative impact on Oxy-Acetylene gas equipment. It causes a chemical reaction and can explode.
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USE NO OIL

16. Checklist procedure for gas cylinders

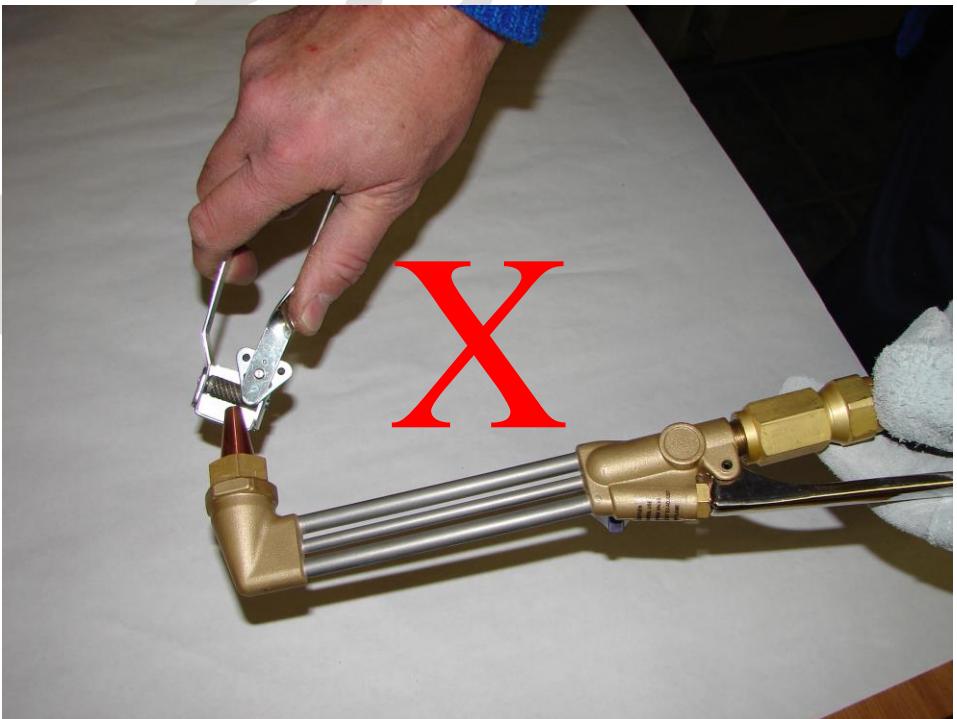
Item / Task	Checkpoints
1. Valve guard	<p>1.1 Valve guard firmly fastened.</p> <p>1.2 Valve guard facing correct direction.</p> <p>1.3 Valve guard must not be bent / damaged.</p> <p>1.4 Not to be used to lift gas cylinder as cylinder may drop and break off valve therefore causing bodily harm as cylinder takes off.</p> 
2. Remove plastic wrapping	<p>2.1 Record reference number on checklist. Conduct inspection as per checklist.</p> <p>2.2 After successful inspection insert red plastic plug into valve, to prevent foreign matter entry.</p> <p>Cylinder must be sealed with a plastic wrapping when received! Have a logbook for each and every cylinder received : (Gas Cylinder Checklist)</p> <p>2.3 A different colour plug will indicate that cylinder has been used previously.</p> 

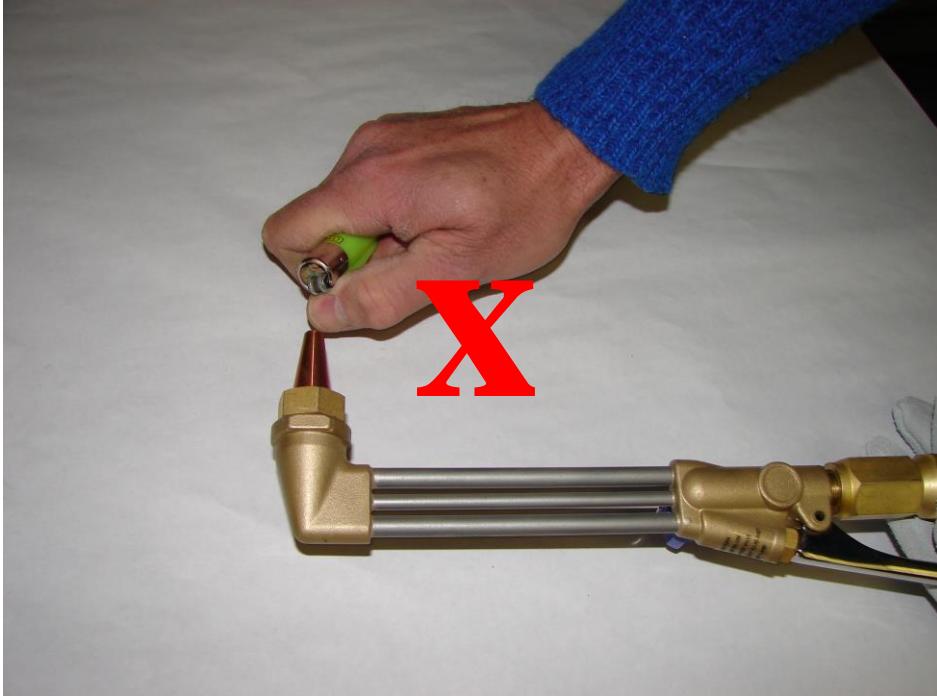
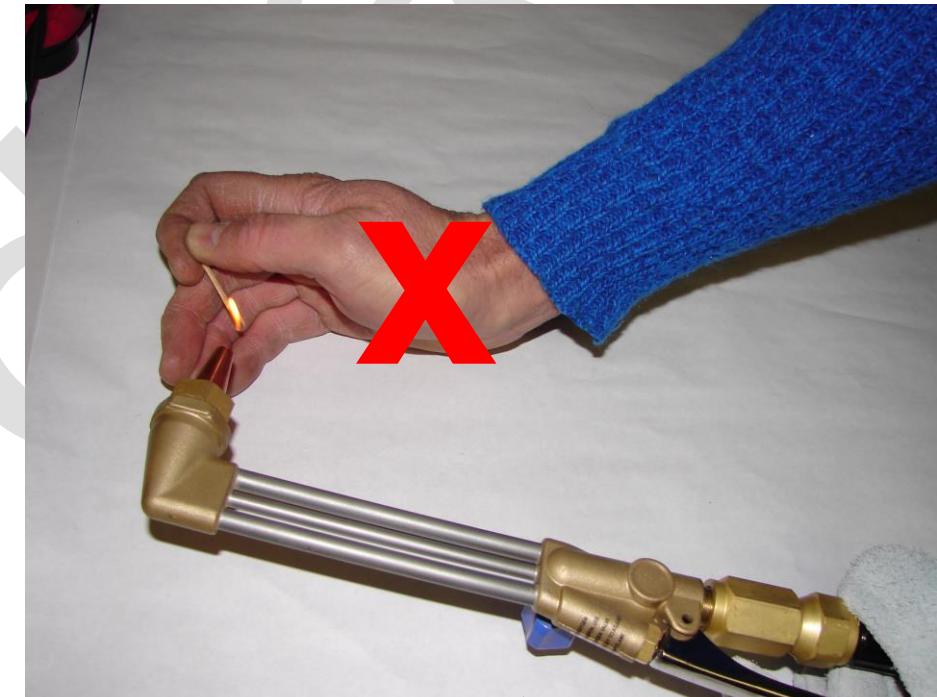
Identification	Requirements	Pass	Fail	Action taken
	Plastic wrapping: - Present - Intact			
	Plastic wrapping: - Reference No: present (Filled contents only)			
	Valve guard : - Tight - Facing right direction			
	Cylinder valve: - No leaks			
	Regulator: - Fit regulator & check pressure on guage (Refer to Cylinder pressure table)			
	Cylinder valve: - Ease of operation Must be able to turn by hand			
	Cylinder valve: - Insert a plug into valve after completion of satisfactory tests. (PSM not AFROX)			
	Sticker: - Present at top of cylinder			
	Cylinder appearance: - Completely covered in paint - No dents deeper than 10mm			
	Cylinder condition: - No rust present anywhere.			
	Fusible plug: Acetylene Only - Not rusted - Check for leaks			

Item / Task	Checkpoints
3. Lighting up procedure	<p>3.1 Following the correct lighting up procedure when using Oxy-acetylene gas cutting equipment is of paramount importance in order to prevent flashbacks and explosions. The use of gas equipment is safe, provided it is controlled and used in accordance to the instructions as stipulated in this module.</p> <p>a) <u>Step 1 :</u></p> <ul style="list-style-type: none"> • Check that the cylinder valves are closed • Check that the torch gas control valves are closed <p>b) <u>Step 2 :</u></p> <ul style="list-style-type: none"> • Open the cylinder valves very slowly by rotating • Sudden opening may cause damage to the pressure regulators • Do not open the valve spindles more than one turn, as this is sufficient to obtain full cylinder pressure <p>c) <u>Step 3 :</u></p> <ul style="list-style-type: none"> • Set the pressures on the pressure regulators in accordance to the gas pressure charts • Clockwise direction increases the outlet pressure (working pressure) • Anti-clockwise direction decreases the outlet pressure (working pressure) <p>d) <u>Step 4 :</u></p> <ul style="list-style-type: none"> • Open the oxygen control valve on the torch for approximately 5 seconds to expel any air and gas mixtures in the system • Close the control valve • Repeat the steps above with the fuel gas control valve <p>e) <u>Step 5 :</u></p> <ul style="list-style-type: none"> • Open the fuel gas control valves on the torch by rotating the valve knob a quarter turn in the anti-clockwise direction • Hold a spark lighter at right angles to the nozzle and ignite the fuel gas • Avoid hesitation prior to lighting the fuel gas, as this may cause highly explosive atmospheric conditions <p>3.2 After igniting the fuel gas, reduce or increase the gas flow by rotating the fuel gas control valve on the torch until the flame has a feathered tail.</p>

Item / Task	Checkpoints
	<p>3.3 Slowly open the Oxygen control valve on the torch and adjust until the flame has a well-defined blue inner cone with a rounded tip. This is called a “neutral flame” which is suitable for cutting applications.</p> <p>3.4 The sketches below show the three different flames used for oxy-fuel gas cutting :</p>
 <p>Too Much Fuel Gas (Correct for Cast Iron)</p> <p>Too Much Oxygen (Pressure too high)</p> <p>Correct (For Steel)</p> <p>Fig. 3. Flame adjusting for cutting.</p>	

Item / Task	Checkpoints
4. The following PPE is compulsory	
 	<p data-bbox="1187 743 1298 772">GOGGLES</p> <p data-bbox="1160 938 1271 968">LEATHER APRON</p> <p data-bbox="1160 1513 1271 1565">LEATHER GLOVES</p> <p data-bbox="1144 1859 1224 1888">SPATS</p>

Item / Task	Checkpoints
5. Positioning of hands during lighting up process	
Correct procedure	
 <p style="color: red; text-align: center;">CORRECT WAY TO IGNITE THE FLAME DIRECTION OF NOZZLE AWAY FROM THE HAND</p>	
THE FOLLOWING POSITIONS ARE INCORRECT AND MUST BE AVOIDED AT ALL TIMES, BECAUSE IT CAN CAUSE SERIOUS INJURIES.	
 <p style="color: red; font-size: 100px; text-align: center;">X</p>	

Item / Task	Checkpoints
	 A photograph showing a person's hand holding a green lighter and attempting to ignite the tip of an oxy-fuel torch. The torch has a red tip and a gold-colored body. A large red 'X' is overlaid on the image, indicating this is a incorrect or unsafe method.
	 A photograph showing a person's hand holding a lit match and attempting to ignite the tip of an oxy-fuel torch. The torch has a red tip and a gold-colored body. A large red 'X' is overlaid on the image, indicating this is a incorrect or unsafe method.

Item / Task	Checkpoints
6. Closing down procedure	<p>6.1 Following the correct closing down procedure when using oxy-acetylene gas cutting equipment is of paramount importance to prevent backflow (back feeding) of gases, which can result in flashbacks and explosions.</p> <p>a) <u>Step 1:</u> To extinguish the flame, first close the fuel gas control valve on the torch and then the Oxygen control valve</p> <p>b) <u>Step 2:</u> Close the fuel gas and oxygen cylinder valves</p> <p>c) <u>Step 3:</u> Open the torch control valves one at a time to release the gas pressure in the pressure regulators and rubber hoses</p> <p>d) <u>Step 4:</u> Adjust the pressure regulators to zero outlet pressure by rotating the pressure adjusting screw in the anti-clockwise direction as far as it will go</p> <p>e) <u>Step 5:</u> Close the gas control valves on the torch.</p> <p>6.2 Store the equipment in a cool, dry, well-ventilated area that is protected from direct sunlight. Be careful not to store Oxy-acetylene gas equipment under crane bulkheads or machinery where a possibility exists of oil or grease dripping on it.</p>

17. Storage of gas cylinders

17.1 Storage of gas cylinders

- a) Storerooms should be well ventilated.
- b) Storerooms must be of fireproof construction and be of such design that in the event of fire the cylinders can be easily removed.
- c) Light fittings as well as all electrical switches, should be of a flame proof design.
- d) Signs indicating "**NO SMOKING - NO NAKEDLIGHTS**" must be displayed.
- e) Full and empty gas cylinders should be stored in separate areas displaying "FULL" and "EMPTY" notices.
- f) The valves of empty cylinders should always be firmly closed. If an empty cylinder is found with the valve open, close the valve immediately and attach a note onto the cylinder stating the following "WARNING - VALVE OF EMPTY CYLINDER LEFT OPEN" This action will ensure that moisture and purity tests are carried out by the supplier before refilling the cylinder.
- g) Oxygen cylinders must be stored separately from combustible gases such as acetylene and LP gas.
- h) Acetylene and LP cylinders must not be stored in a horizontal position, but always in an upright position. Oxygen cylinders may be stored in a horizontal position, provided they are firmly secured to prevent rolling.
- i) If gas cylinders are exposed to heat, the content pressure of the gas will increase dramatically resulting in the cylinder exploding. Therefore all gas cylinders should be stored well away from sources of heat such as furnaces, stoves, boilers, radiators and open fires.
- j) Oil and grease will ignite violently in the presence of oxygen and if the latter is under pressure the result will be an explosion. Gas cylinders and fittings must not be stored in the vicinity of overhead machinery, cranes, hoists or belts.
- k) Cylinders must always be stored securely to prevent them from toppling over. Safety chains or railings can be utilised to secure gas cylinders.



17.2 Transportation and handling of gas cylinders

Gas cylinders are constructed quite robust, but it is of paramount importance that the correct safe transportation and handling procedures are followed in order to prevent accidents and injuries.

The following paragraphs emphasize the incorrect ("DO NOT") and correct ("DO") procedures that are to be followed with regard to the transportation and handling of gas cylinders :

Do not :

- slide or bump cylinders against sharp corners, edges or hard objects
- transport cylinders on vehicles without securing the cylinders in an upright position
- drop cylinders or allow them to come into violent contact with one another
- load or off load cylinders by means of electromagnetic cranes
- transport gas cylinders unless the cylinder valves are adequately protected with cylinder caps
- lift cylinders unless use is made of specially designed lifting cradles
- use cylinders as rollers to move equipment
- use cylinders as job supports
- drag, roll or topple gas cylinders
- tamper with fusible plugs or other safety devices on gas cylinders

Do :

- ensure that cylinders are properly secured during transportation
- remove all pressure regulators and equipment prior to transporting cylinders
- transport cylinders in a vertical position whilst properly secured
- Prevent oil, dirt and other foreign matter from entering cylinder valves



17.3 Leaking gas cylinders

Leaking gas cylinders should immediately be reported to your Learning Practitioner, Supervisor, Foreman.

The following paragraphs stipulate the emergency actions to be taken should your Learning Practitioner not be available :

- If a cylinder valve will not close off completely, sniff gas through the valve by rapidly opening and closing the valve without the regulator fitted. The latter will dislodge and remove any foreign material from the cylinder valve
- If the valve still cannot be completely closed, remove the cylinder to an open space away from people and buildings. Position the cylinder in an upright position and open the cylinder valve to allow the gas to escape into the atmosphere.

	<p>Note : After venting the gas into the atmosphere, close the valve completely and attach a tag onto the cylinder indicating the following :</p> <p></p> <p>CYLINDER VALVE FAULTY, OR : VALVE WILL NOT CLOSE</p>
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	<p>Note : Should the gas leak appear to be around the valve spindle and only be apparent when the valve is opened, the problem may be remedied by tightening the gland nut around the spindle. If tightening of the gland nut does not stop the gas leak, close the valve and attach a tag onto the cylinder indicating the following :</p> <p></p> <p>CYLINDER VALVE FAULTY, OR : VALVE LEAKS WHEN OPENED</p>
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17.4 General precautions to be observed when using gas cylinders

- a) Oil, grease, coal dust and similar organic materials are easily ignited and burn violently in the presence of high Oxygen concentrations. Never allow these substances to come into contact with Oxygen equipment.
- b) Never use gas from a cylinder except via an approved pressure regulator.
- c) Do not apply any lubricants to valves and other gas fittings.
- d) Do not use any joint compounds or tread sealing tape on gas connections.
- e) Although Oxygen is not a combustible gas, it supports and accelerates combustion. Clothes and other material will burn fiercely in the presence of Oxygen and ignition can be caused by a single spark or even hot cigarette ash.
- f) Acetylene and LP gas being highly flammable gases, can be ignited instantly by a spark or a piece of hot metal. In confined spaces a small amount of either gas will create an extremely dangerous explosive atmosphere.
- g) Each fuel gas has its own characteristic odour, which may indicate the presence of a gas leak.
- h) Gas welding and cutting equipment must be inspected for gas leaks on a regular basis by means of leak detection solution.
- i) A room in which welding, cutting or heating is to be done should be well ventilated.
- j) Sparks can travel a distance of up to 10m. It is thus advisable that any combustible substances be removed from the immediate vicinity prior to cutting.
- k) Floors constructed from combustible material such as wood, should be swept clean and then covered with suitable protection such as sheet metal or asbestos mats prior to cutting. Wooden floors should be considered a fire hazard and extreme care must be taken against sparks falling in between the grooves of the floorboards.
- l) Suitable fire-fighting equipment should be readily available when conducting cutting work. The work area must be kept under observation for about half an hour after completion of the work to ensure that no fires have started.

17.5 Safety procedures to be followed with regard to gas cylinders in the event of fire

- a) When a fire breaks, the first priority is to prevent injuries to people and secondly to and prevent it from spreading.
- b) Evacuate all persons from the area not involved in the fire-fighting operation.
- c) If possible remove cylinders, which are not on fire to a safe area.
- d) Cylinders, which cannot be removed, should be cooled with water from a safe distance.
- e) Every effort should be made to keep the cylinders cool and prevent the fusible plugs from melting. These plugs will melt at a temperature of about 100 degree Celsius, resulting in the release of an even greater volume of Acetylene.
- f) Because a fusible plug or rupture disc may be activated at any moment during a fire, fire-fighting personal should keep clear from the path of any gas that might escape from a cylinder.
- g) The velocity of escaping gas from a fusible plug or rupture disc will result in a flame projected some distance from the cylinder. This gas leak cannot be stopped and will prevail until the gas in the cylinder is depleted. In the latter case the escaping gas should be allowed to burn, but hose the cylinder liberally with water and contain the spread of the fire.
- h) Flames emitted from rubber hoses, hose connections, regulator body, regulator stem or valve spindle may be extinguished by closing the cylinder valve.
- i) In case the cylinder valve is obstructed by flames, use a dry powder or carbon dioxide fire extinguisher to contain the flames. In case a suitable fire-extinguisher is not readily available, a leather glove, heavy cloth or garment soaked in water may be draped over the flames.

Then immediately :

- close the cylinder valve
- if possible, remove the cylinder to a safe area
- apply water from a safe distance in order to cool the cylinder
- notify the Learning Practitioner

17.6 Personal protective equipment (PPE)

- a) Welding goggles with lenses of approved colour and shade should be worn to protect your eyes from sparks and eye strain emitted during Oxy-acetylene cutting.
- b) Long sleeve overalls, leather gloves, spats, leather apron and safety shoes must be worn to protect your body against sparks.

17.7 Fumes and gases

During Oxy-acetylene flame cutting, welding and gouging, various fumes and gases are emitted, which may be harmful to the human body. The adverse effects on the human body, caused by the more common fumes and gases are outlined in the following columns :

Origin of source	Hazards	Effects on the human body	Recommended precautions
a) Low carbon steel	None	None	Normal ventilation
b) Manganese steel	Manganese fumes	Irritation to the respiratory system	Use breathing apparatus
c) Stainless steels and Aluminium	O-zone formation	Irritation to the respiratory system	Use breathing apparatus
d) Copper, Zinc, Lead and Cadmium	Fumes are highly toxic and can be fatal	Causes metal fume fever. Symptoms include muscle pains, shivering, and headache and chest tightness	Use breathing apparatus and obtain medical attention if symptoms arise
e) Paints	Toxic fumes that originates from metallic compounds of lead, mercury and zinc	Irritation to the respiratory system	Use protective clothing, safety goggles, gloves and a dust mask when handling this substance
f) Decreasing fluids	Toxic and highly flammable vapours	Irritation to the respiratory system	Remove residue of decreasing fluids from work surfaces prior to welding, cutting, grinding or gouging. Ensure good ventilation.
g) Fuel gases (Acetylene and LPG)	Toxic and highly flammable	Exposure to high concentrations may result in unconsciousness and subsequent asphyxiation	Ensure good ventilation when using these fuel gases. Check all connections for gas leaks.
h) Oxygen gas	Oxygen enrichment induces the hazards for fires and explosion.	None	Use oxygen in well-ventilated areas. Check all connections for gas leaks.

Self-assessment



Instruction :
(To be compiled by Learning Practitioner)

Please provide questions

A small icon of a red heart tied to a purple ribbon.	<p>Note : Refer to your notes to check your answers. If they are not all correct, study the notes again. Ask your Learning Practitioner to check your work and sign below when you have answered all the questions correctly and achieved the required standards, then go on to the next section.</p>		
Learner (name)		Learning Practitioner	
Control number		Control number	
Signature		Signature	
Date		Date	



Glossary of terms

References

- Mines Health and Safety Act
- Manitou MT-X 742 Manual

draft 1

Notes

End of Learner Guide