Vehicle Body Repairing and Painting NTQF Level-II

Learning Guide -16

Unit of Competence: - Carry-out Welding Procedures

Module Title: - Carrying-out Welding Procedures

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LO 01: Prepare for work

Instruction Sheet	Learning Guide #- 16

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Introduction to welding
- Using work instructions
- Observing Workplace Health and Safety
- Reading and interpreting Job specifications
- Selecting and inspecting materials
- Selecting correct hand, power tools and safety equipment
- Determining products
- Identifying and discussing job Procedures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Know welding
- Use work instruction
- observe workplace health and safety
- Read and interpret job specification
- Select and inspect materials
- Identify tools and equipment
- Determine procedures

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 6.
3. Read the information written in the “Information Sheets ”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1,2,3,4,5,6,7” in page 17,19,31,35,39,41,51 respectively-.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work.
6. If you earned a satisfactory evaluation from self check proceed to operation sheet 1,2,3 in page 52,53,54 and lap in page 55”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

1.1 Welding principles and types

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the *weld pool*) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building Welding is used in every industry large or small, as a principle means of fabrication and repairing metal product. The process is efficient, economical and dependable.

Classification of welding process

There are many ways in which the welding processes can be classified. A simple and logical way is to satisfy the welding processes according to the sources of energy used for achieving coalescence. The welding processes can thus be broadly classified as;

A. Pressure welding /plastic welding/

Pressure welding uses friction or explosion to heat the joining section of metal work pieces and join them under pressure. The process is also called solid-state welding. which also a generic term for welding methods that weld work pieces by applying mechanical pressure on the joining section (weld joint).

B. Thermo chemical welding

Thermo chemical welding is a special type fusion welding process. The coalescence is produced of metallic parts with Exothermic Reaction process.

C. Fusion welding /Non pressure welding

Fusion welding is a processes that uses heat to join or fuse two or more materials by heating them to melting point. The process may or may not require the use a filler material. External application of pressure is not required for fusion welding processes, except for resistance welding, which processes can be grouped according to the source of the heat, for example, electric arc, gas, electrical resistance and high energy.

Gas Welding

Gas welding is fusion welding process that joins the metal by using heat of combustion of a strong gas flame. The intense heat raises the temperature of ends, melts and fuses together the edges of the plate to be welded. Filler metal may be added the plate to flowing molten to fill the cavity between the plates. Different oxy-acetylene combinations are used to produce different types heating flames i.e. O2 and C2H2, O2 and H2 with coal gas etc. Oxy –acetylene welding is the most commonly used gas welding process.

Oxy-Acetylene Welding (O2, C2H2)-

Oxyacetylene welding is a gas welding process. In this process coalescence (or bond) is produced by heating with the gas flame obtained from the combustion of acetylene with oxygen. A welding torch is used to mix the gases in the proper proportions and to direct the flame against the parts to be welded. The molten edges of the parts then literally fuse together and after cooling form a strong joint. Usually, it is necessary to add extra material to the joint. The correct material in the rod form of a rod is dipped in a flux powder and is fused with the puddle of and fuses with the puddle of molten metal obtained from the parent metal parts. Acetylene is widely used as the combustible gas because of its high flame temperature when mixed with oxygen. The temperature, which ranges from approximately21000- 35000, is far above the melting point of all commercial metals thus it provides a means for the rapid, localized melting essential in welding.

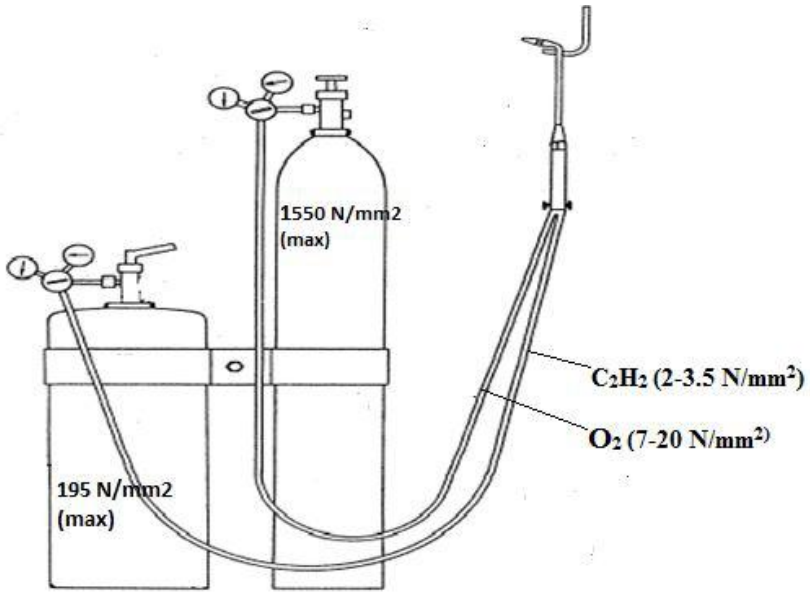
The oxyacetylene flame is also used in cutting ferrous metals. The oxyacetylene welding and cutting methods are widely used by all types of maintenance activities because the flame is easy to regulate, the gases may be produced inexpensively, and the equipment can be transported easily and safely.

Combustion of gas and heat liberated

First stage- $C_2H_2 + O_2 \rightarrow 2\ CO + H_2 + 448$ Kj/mol

Second stage $2\ CO + H_2 + 3O \rightarrow 2\ CO_2 + H_2O + 812$ Kj/mol

Total heat liberated by combustion= 448+812= 1260 Kj/mol of acetylene



Advantages and Disadvantages of Oxy- Acetylene Welding

Advantages of Oxy-Acetylene Welding

- It's easy to learn.
- The equipment is cheaper than most other types of welding rigs (e.g. TIG welding)
- Oxy-acetylene can be used on sites which have no power supply
- The equipment is more portable than most other types of welding rigs (e.g. TIG welding)
- Oxy-acetylene equipment can also be used to "flame-cut" large pieces of material.

Disadvantages of Oxy-Acetylene Welding

- ✓ Oxy-acetylene weld lines are much rougher in appearance than other kinds of welds, and require more finishing if neatness is required.
- ✓ Oxy-acetylene welds have large heat affected zones (areas around the weld line that have had their mechanical properties adversely affected by the welding process)
- ✓ There are safety issues with oxy-acetylene as there is a naked flame present which does not exist with electrical forms of welding.

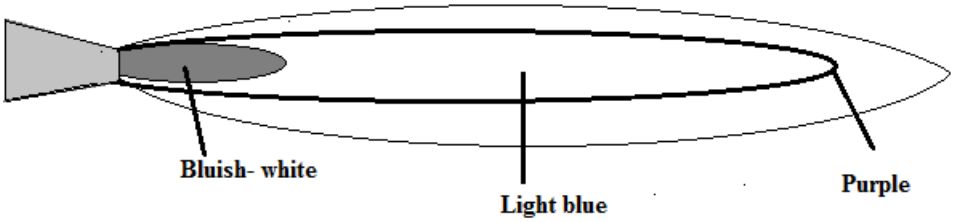
Types of flame

To achieve successful and efficient welding, proper mixing of gas in appropriate proportion is necessary.

Figure - Gas welding flame

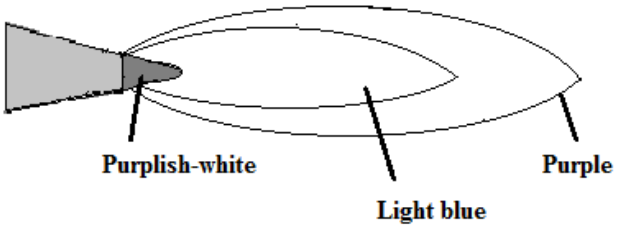
According to the volume of O2 and C2H2 flame can be classified as

1. **Neutral flame-** Neutral Flame is produced when equal volume of O2 and C2H2 are mixed. It has well defined inner cone, which has light blue color. Neutral Flame doesn't create any change in the molten metal and doesn't oxidize or carburize the metal. This flame is used for welding of mild steel, cast iron, aluminum and stainless steel. Temperature of neutral flame is 3232^{O}c.



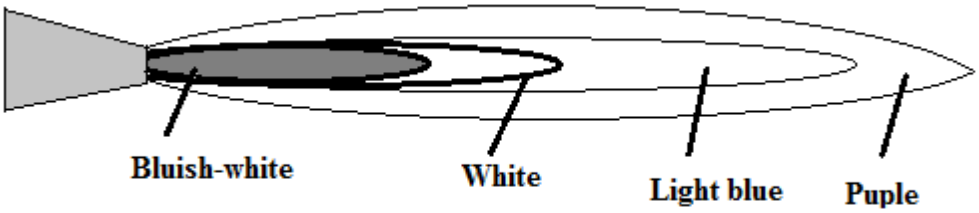
(a) Neutral flame (3232^0 C)

2. **Oxidizing flame-** oxidizing flame is obtained by increasing the supply of oxygen in mixture. It has small white cone which is shorter and more pointed than that of neutral flame. It creates high temperature of 3482° C. It is normally not used except in the case of brass.



(b) Oxidizing flame (3482^0 C)

3. **Reducing/Carburizing/ flame-** it is produced when supply of C2H2 is higher than supply of oxygen and can create an approximate temperature of 3150^{O}C its outer envelope is longer than that of neutral flame. It is used for the welding of lead. In these flames the temperature is maximum at the tip of the inner cone. Feather or brush exists next to the cone and occurs in carburizing flame only.

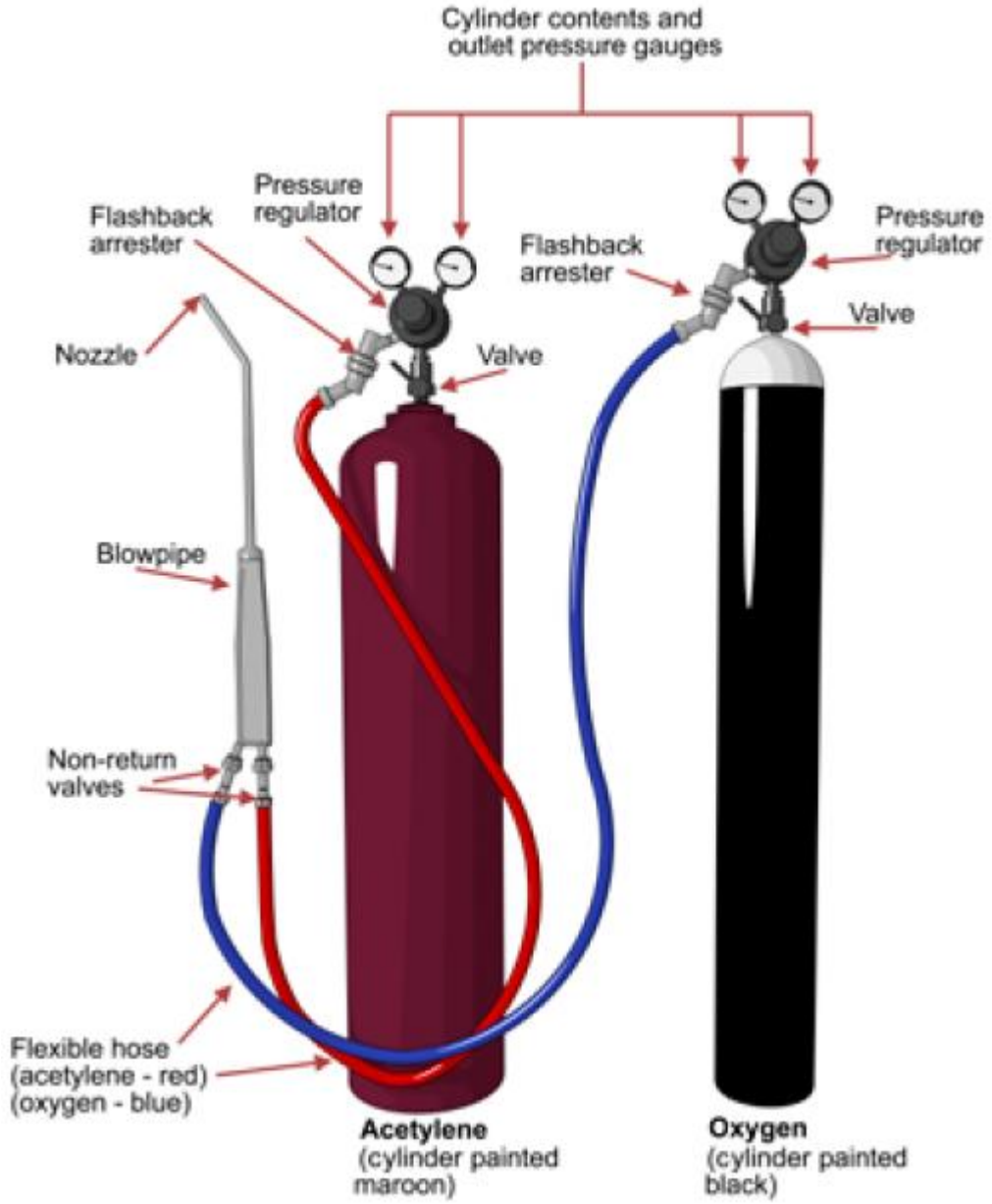


(c) Reducing flame(3150^0 C)

Characteristics of the oxy acetylene welding process include:

1. It uses dual oxygen and acetylene gases stored under pressure in steel cylinders.
2. It has the ability to switch quickly to a cutting process, by changing the welding tip to a cutting tip.
3. The gas mixture attains a high temperature.
4. It uses regulators to control gas flow and reduce pressure on both oxygen and acetylene tanks.
5. It uses double line rubber hoses to conduct the gas from the tanks to the torch.
6. It requires melting the materials to be welded together.
7. It has the ability to regulate temperature by adjusting gas flow.

Oxy-Acetylene Welding Equipment



Video

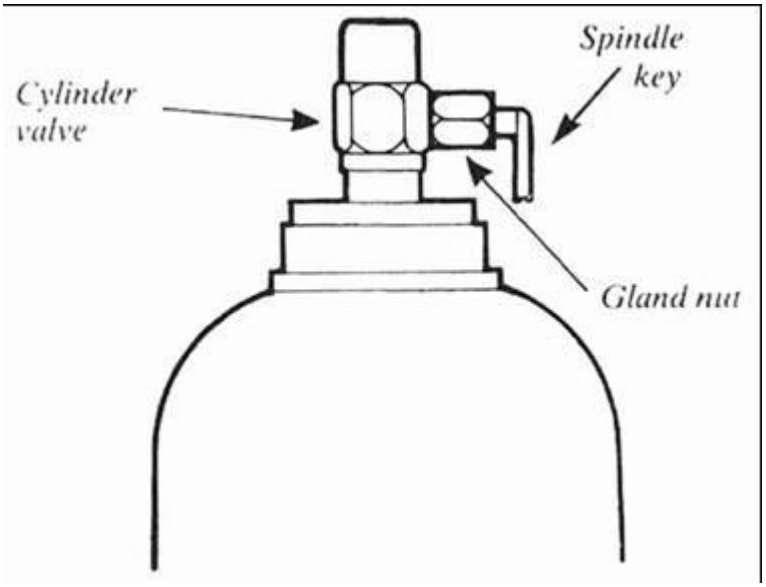
Gas Cylinders

There are two cylinders in a standard gas welding/cutting set namely:

1. An Oxygen cylinder.
2. An Acetylene cylinder.

The cylinders can be identified by their colours, size and by the suppliers' labels. Oxygen cylinders are painted **BLACK** and are taller and narrower than acetylene cylinders. Acetylene cylinders are painted **MAROON** and are shorter and "fatter" than oxygen cylinders. Oxygen cylinders, when full, contain oxygen at a pressure of approximately 15 000 kPa. (1,5 mPa) Acetylene cylinders, when full, contain a vapor pressure of approximately 1800 kPa. Both cylinders should be stored and used in an upright position. If cylinders leaking, do not use and return it. Never use a flame when testing for leaks.

N.B.: This is especially important with acetylene cylinders.



REGULATORS

The pressures contained inside the cylinders are far in excess of the pressure needed to operate a torch. In order to control the pressure leaving a cylinder and entering the welding hoses we need a "pressure-regulator" to prevent the hoses and the torch from "blowing up". In "everyday language" these devices are simply known as "regulators". Regulators are made specifically for the type of gas that they must control and for the degree of pressure that they must withstand. For these reasons regulators are made in such a way that they cannot be fitted to the wrong cylinder.

figure *Two Stage Regulators*

International identification mark

A regulator is connected to a cylinder-valve with a special connector known as a "bull-nose". The threads on the Acetylene regulators' bull-nose are "left-handed" whereas the threads on an Oxygen regulator are "right-handed". This feature makes it "almost impossible" to get things mixed up. As an added precaution, you will find that regulators are "colour coded". Blue is the colour used to denote "oxygen", and red is the colour used to denote acetylene. An oxygen regulator will bear a blue label with the word "oxygen" on it. The acetylene regulator will bear a red label with the word "acetylene" on it.

As if this were not enough to avoid confusion, you will also notice that the connector-nut of the acetylene bull-nose has a groove machined into it. Any threaded fitting that features a groove indicates that the threads are "left-hand".

Regulators most usually have two pressure gauges. One gauge (normally the one nearest to the bull-nose) is a "high-pressure gauge" that registers the pressure within the cylinder. This is known as the "cylinder-gauge". The other gauge, called the "working gauge", registers the pressure that is leaving the regulator and entering the hose and torch. This gauge (working gauge) carries much lower pressure than the cylinder gauge.
A prominent feature of any regulator is the "pressure adjusting-screw". This screw is used to "set" the working pressure into the hose/torch. On all regulators the "Line pressure" (working pressure) is increased by turning the pressure adjusting screw inward, that is, to the right (your right). Pressure is decreased by turning the screw outward, that is, to the left. When you operate the equipment, you must know this! gas leaves the regulator through the outlet port.

Treatment

- Always treat a pressure regulator as a precision instrument. Do not expose it to knocks, jars or sudden pressure surges caused by the rapid opening of the cylinder valve.
- Always open the cylinder valve slowly and smoothly using the special Spindle Key
- Periodically check the bull nose seating on the pressure regulator. If the seating is damaged, it will leak gas. The pressure regulator should be replaced immediately.
- Never use a pressure regulator with other than the gas for which it was designed.
- Release pressure using the pressure adjustment screw when shutting down, after cylinder valves have been closed and pressure in the hose has been released.
- If gauge pointers do not return to zero when the pressure is released, the mechanism is faulty and the regulator should be replaced.
- If the regulator "creeps" (passes gas when the pressure adjustment screw is released, or builds up on the low pressure side when the blowpipe valve is shut) it should be replaced.
- Do not attempt to repair regulators.

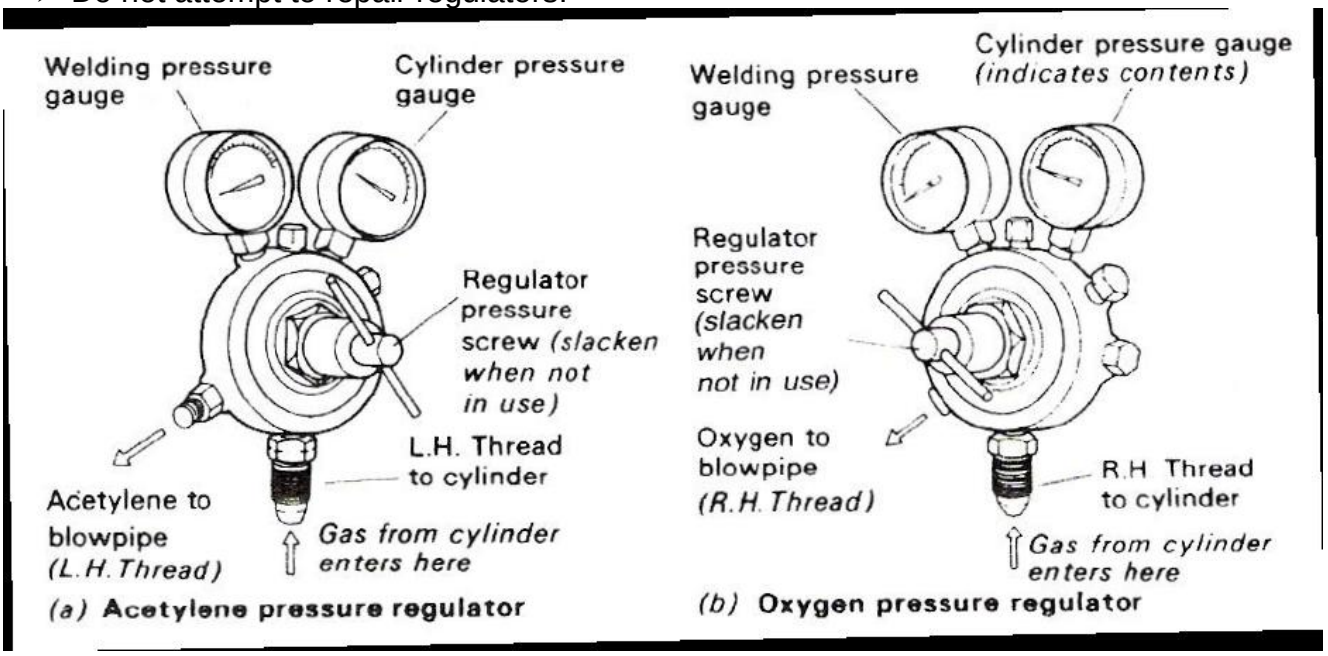


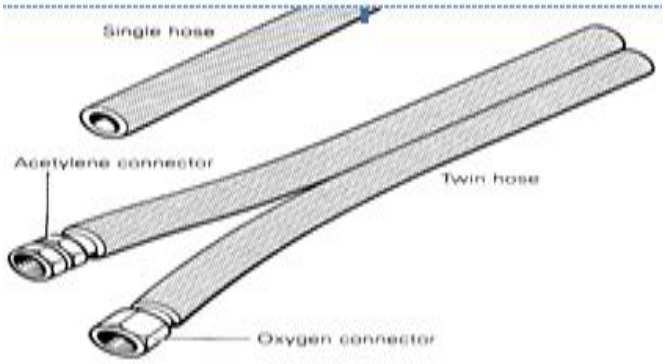
figure:- pressure regulator

WELDING HOSES

Welding hoses carry the gases from the regulator to the torch. These hoses are specially manufactured from materials that can withstand pressure and chemical reactions.
No other hose type may be used!
Hoses are colour coded to avoid accidental switching between gas types. The colours are the same as for regulators, that is, RED for acetylene, and BLUE for oxygen. The hoses connect to the regulator, or to the flashback arrester, and at the other end to the

torch. The Acetylene connectors (at both ends of the red hose) are "Left Handed". Oxygen connectors are "right-handed". This is intended to prevent the "accidental" swapping of hoses.

It is always recommended to buy and use fitted hoses. Hoses should be fitted with the correct end connections attached by permanent clips.



Treatment

- ✓ Do not expose hoses to heat, traffic, slag, sparks, oil, grease, or sharp edges of metal.
- ✓ Test for leakage at working pressure by immersing in water; leaks may be repaired by cutting out a faulty section of hose and inserting an approved coupling.
- ✓ Never use copper couplings with acetylene. Doing so could permit the formation of copper acetylide. Worn ends should be cut back and re-fitted with hose connectors using permanent clips.
- ✓ do not fit more than two or three couplings in a length of hose. Consider replacing the hose entirely as parts are likely to be perished or damaged.
- ✓ Ensure hoses are not wrapped around cylinders when stored or in use. The hose check valve is an automatic safeguard, incorporating a spring-loaded non-return valve. Its purpose is to inhibit oxygen and fuel gases mixing in the hoses. The hose check valve has reduced the incidence of back-feeding in which oxygen contaminates fuel gas hose or vice versa. It is essential to ensure that your welding and cutting equipment is protected, as far as possible, against back-feeding which may cause extensive damage to hoses and regulators in the event of a flashback.

Flame Arrestors

Flame traps are designed to give automatic protection to personnel and equipment against the hazard of mixed gas explosions in gas welding or cutting equipment. The explosion (flashback) can occur when back-feeding of gases has taken place. A mixture of gases is then present in either the oxygen or fuel gas hose and if the operator fails to purge the hoses sufficiently, a flashback can occur when the blowpipe is ignited.

Flashback can be avoided by adhering to recommended operating procedures and the use of flame traps does not enable the operator to ignore good operating practices. It is recommended that approved flame traps are installed in both the oxygen and the fuel gas lines immediately downstream of the pressure regulator

Welding torches

Once the gases having been reduced in pressure by the gas regulators are fed through suitable hoses to the welding torch.

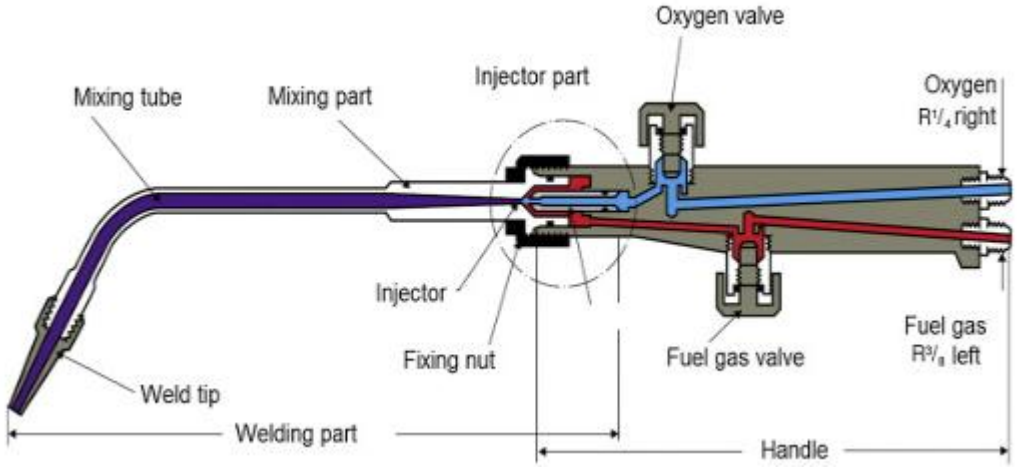


Figure :- Sectional drawing of a torch using the injector.

There are two types of torches normally associated with oxy-acetylene equipment, namely:

1. Welding torches.
2. Cutting torches (flame cutting).

A welding torch is used in the joining of materials, whereas the cutting torch is used in the "separation" of materials. The function of each type however is to "apply heat" to material via a "flame" created at the nozzle or the cutting tip. It is in the torch that acetylene and oxygen are "mixed". The mixture is affected through "control-valves" set into the hose end of the torch handle.

The torch control-valves are manually adjusted by the operator in order to achieve the desired flame. The control valves "control" the volume or flow of gases into the torch. The flow is "shut off' when the hand-wheel is turned fully in (to the right) and "open" when turned out (to the left). On some torches, you will find "non-return valves" fitted to the inlet connections. A "non-return valve" permits gas to flow in one direction only, namely from the hose and into the torch. The purpose of the non-return valve is to prevent the accidental flow of gas, from the torch, into either hose.

NOTE: It must always be kept in mind that when the gases are "mixed" there is an increased chance of combustion taking place. If a welding hose ever contains "mixed gases"

Each gas can be controlled by a valve on the torch. The two gases mix in the torch and after they are ignited they burn at the nozzle. Different size nozzles are used depending on the thickness of material to be welded.

Welding Nozzles and their Uses

The nozzle (tip)* :-** tips are used to supply the flame for gas pass just ignition & burning for welding . the opening is called **orifice**. Nozzles are of various sizes, according to the diameter of the orifice (hole) at the end. The bigger orifice, the greater gas pressure& the higher the gas discharge rate and the greater the intensity of the flame (heat). The nozzles are made of copper, because it is a good conductor of heat. There are **two inlets**. The oxygen inlet has **a *right handed thread, which takes the oxygen hose connecting nut. The acetylene inlet has *a* ***left -handed thread***, which takes the acetylene hose connecting nut. The nut is ***grooved*** around it.

Figure nozzle tip

Nozzle Size

For a given welding torch, the nozzle outlet size has a much greater influence on governing the flame size than changing the gas pressures on adjusting the control valves.

The manufacturers of gas welding equipment have adopted various methods of indicating nozzle sizes, such as:

1. By the approximate consumption of each gas per hour.
2. By the nozzle outlet bore size (orifice diameter).
3. By a reference number corresponding to a metal thickness range which may be welded with a specific nozzle.

Whatever the method employed for indicating nozzle sizes there is a definite relationship between the sizes of welding nozzles and the metal thicknesses. Manufacturer's recommendations should always be followed with regard to nozzle sizes and gas pressures for a particular application.

Nozzle Selection and Working Gas Pressures

As the thickness of the work increases, the flame will be required to supply more heat. This is made possible by increasing the nozzle size and the regulator gas pressures (in accordance with manufacturers' instructions). If you try to weld thick metal with a small nozzle by increasing the gas pressure, there comes a point where the flame leaves the end of the nozzle. This indicates that the pressure is too high, resulting in a very noisy flame. It is much better to work with a 'soft' flame, which is obtained by using the correct nozzle size and pressure settings.

At the other extreme, if you try to weld with a nozzle that is too large for the work, by reducing the supply of gas at the blowpipe valves instead of changing to a smaller nozzle, then small explosions will occur at the nozzle. This is because the gas tends to build up round the nozzle in small bubbles. These small explosions indicate that the gas pressure is too low. The table below lists typical nozzle sizes and gas pressures for oxyacetylene welding. Always consult the manufacturer's information, as this information can vary slightly with different makes of blowpipe.

Mild steel thickness			Nozzle size	Operating pressures				Consumption of gas			
				Acetylene		Oxygen		Acetylene		Oxygen	
(mm)	(in)	(SWG)		(bar)	(lbf/in²)	(bar)	(lbf/in²)	(l/h)	(ft³/h)	(l/h)	(ft³/h)
0.9	–	20	1	0.14	2	0.14	2	85	3	85	3
1.2	–	18	2	0.14	2	0.14	2	110	4	110	4
2	–	14	3	0.21	3	0.21	3	170	6	170	6
2.6	–	12	5	0.21	3	0.21	3	200	7	200	7
3.2	1/8	10	7	0.21	3	0.21	3	250	9	250	9
4	5/32	8	10	0.21	3	0.21	3	280	10	280	10
5	3/16	6	13	0.28	4	0.28	4	400	14	400	14

SWG stands for 'standard wire gauge'

Typical Nozzle Sizes and Gas Pressures for Oxyacetylene Welding

Note: Gas consumption data is merely for rough estimating purposes. It will vary greatly on the material being welded and the particular skill level of the operator.

Economizer

The Economizer is used to save oxygen and fuel gas when the welding or cutting torch is not being used. When the torch is rested on the lever rod of the gas saver the flame is automatically extinguished. To relight, remove torch from the lever rod and pass it over the pilot light which instantly ignites to its pre-determined flame.

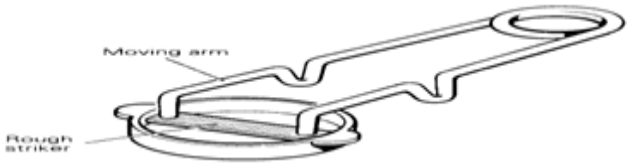
figure:- economizer gas saver

Note: There should be no smoky flame on shut-off. Although a slight snap is normal, a loud bang indicates that the economizer valves need to be adjusted to ensure that the fuel gas stream is shut off before the Oxygen.

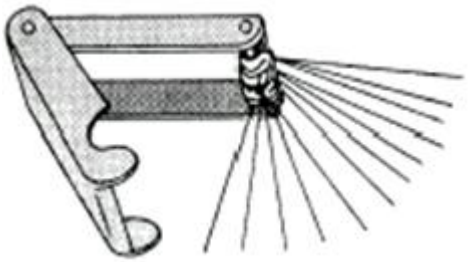
ACCESSORIES

Various accessories can be obtained as aids to welding or cutting processes. Two accessories need special mention, namely:

1. Spark-Lighter -used to light the torch in a "safe" manner.



2. Nozzle Tip cleaners - are small round files used to clear blockages in torch tips and nozzles. They are always supplied in a set of different sizes. When the orifice becomes blocked by dust or particles or molten metal (globules), you need to pass the appropriate size of cleaner into the orifice and then out again as many times as necessary cleaned the tips.



3. ***Welding goggles*: -** You must always wear suitable welding goggles when welding. They protect the eyes from the rays of light emitted by the flame and the pool of molten metal, and also from flying sparks.

4. **Welding flux**: - fluxes are chemical compounds used to remove oxide films & protect oxides on the hot surface & to reduce viscosity of molten metal during welding .It is an available in many forms such as dry powder, paste & thick solution. **Powder flux** is sprinkled on the surface to be welded or the filler rod is dipped in to the powder. **Liquid & paste** fluxes are sprayed on the surface to be welded. Metals & welding rods which require fluxing for good results are bronze, brass, stainless steel & aluminum rods

Defects in welding

The lack of training to the operator or careless application of welding technologies may cause discontinuities in welding. In aluminum joints obtained by fusion welding, the defects such as porosity, slag inclusion, solidification cracks etc., are observed and these defects deteriorates the weld quality and joint properties.

Common weld defects found in welded joints: These defects may result in sudden failures which are unexpected as they give rise to stress intensities. The common weld defects include

i. Porosity
ii. Lack of fusion
iii. Inclusions
iv. Cracking
v. Undercut
vi. Lamellar tearing

i.Porosity

Porosity occurs, when the solidifying weld metal has gases trapped in it. The presence of porosity in most of the welded joints is due to dirt on the surface of the metal to be welded or damp consumables. It is found in the shape of sphere or as elongated pockets. The region of distribution of the porosity is random and sometimes it is more concentrated in a certain region. By storing all the consumables in dry conditions and degreasing and cleaning the surface before welding, porosity can be avoided.

ii. Lack of Fusion

Due to too little input or too slow traverse of the welding torch, lack of fusion arises. By increasing the temperature, by properly cleaning the weld surface before welding and by selecting the appropriate joint design and electrodes, a better weld can be obtained. On extending the fusion zone to the thickness of the joints fully, a good quality joint can be obtained.

iii. Inclusions

Due to the trapping of the oxides, fluxes and electrode coating materials in the weld zone the inclusions are occurred. Inclusions occur while joining thick plates in several runs using flux cored or flux coated rods and the slag covering a run is not totally removed after every run and before the next run starts. By maintaining a clean surface before the run is started, providing sufficient space for the molten weld metal between the pieces to be joined, the inclusions can be prevented.

iv. Cracking

Due to thermal shrinkage, strain at the time of phase change, cracks may occur in various directions and in various locations in the weld area. Due to poor design and

inappropriate procedure of joining high residual stresses, cracking is observed. A stage-wise pre-heating process and stage-wise slow cooling will prevent such type of cracks. This can greatly increase the cost of welded joints. Cracks are classified as hot cracking and hydrogen induced cracking. A schematic diagram of centerline crack is shown below fig. 1.1.

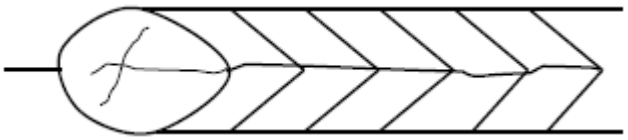


Fig. 1.1 Schematic diagram of centerline crack

The cracking can be minimized by preferring fillers with low carbon and low impurity levels. The solidification cracking can be avoided by reducing the gaps and cleaning the surface before welding.

v. Undercutting

The undercut is caused due to incorrect settings or using improper procedure. Undercutting can be detected by a naked eye and the excess penetration can be visually detected

vi. Lamellar Tearing

Due to non metallic inclusions, the lamellar tearing occurs through the thickness direction. This is more evidently found in rolled plates. As the fusion boundary is parallel to the rolling plane in T and corner joints, the lamellar tearing occur. By redesigning the joint and by buttering the weld area with ductile material, the lamellar tearing can be minimized.

Types of Welding Metals

Steel

Everyone is familiar with the strength of steel. It is an alloy that contains iron and 2% of other elements. Carbon/steel alloy is common and can be found in high, low and medium varieties. Higher carbon content means stronger steel. Steel is versatile and can be used with any welding process. Welding areas need to be cleaned. On the downside it can rust and flake from oxidation.

Stainless Steel

Unlike plain steel, stainless is made to resist corrosion and is hygienic. This is achieved by adding 10% to 30% chromium to other elements such as iron. There is also a nickel alloy available. Stainless is welded using arc welding (tig, mig, stick). The downside is the higher cost.

Aluminum

Similar to stainless steel, aluminum also isn't as corrosive as other metals. It is lighter than stainless steel. In welding pure aluminum and alloys are used. Alloys include:

- copper/aluminum alloy
- manganese alloy
- zinc alloy

Tig welding (GTAW) is the process of choice for aluminum. Other welding methods that are used include GMAW (gas metal arc welding or Mig). Stick aluminum welding is only used for smaller project. The process tarts by selecting a joint design for the base metals (tee, lap, edge, corner or butt).

Tig Welding Guidelines for Aluminum

Thickness	Tungsten Size	Filler Rod Size	Amps	Volts	Gas Cup	Gas Flow (cfh)
1/16"	1/16" – 3/32"	1/16" – 3/32"	70 - 100	15	3/8"	20
3/32"	3/32" – 1/8"	1/8"	90 - 120	15	3/8"	20
1/8"	1/8" – 5/32"	1/8" – 5/32"	125 – 175	15	7/16"	20
3/16"	5/32" – 3/16"	5/32" – 3/16"	170 – 225	15	7/16" – 1/2"	25
1/4"	3/16" – 1/4"	3/16"	220 – 275	15	1/2"	30
3/8"	1/4"	3/16" – 1/4"	330 – 380	15	5/8"	35

Copper

Copper Welding Demonstration Video

Among the welding metals, copper is popular due to its electrical conductivity, heat conductivity, corrosion resistance, appearance and wear resistance. To be called copper it needs to be 99.3% minimum copper content.

Processes used in welding include welding, brazing and soldering. There are multiple types of copper alloys:

- copper-nickel-zinc (called nickel silver)
- copper-nickel
- copper-silicon (called silicon bronze)
- copper-aluminum alloy (aluminum bronze)
- copper-tin
- copper-zinc (also known as brass)
- high copper alloys (up to 5% alloy)

Copper is welded using Gas Tungsten Arc Welding (Tig) and Gas Metal Arc Welding. Some welders will use manual metal arc welding, but it can result in poor quality. When welding copper the joint designs are wider than those recommended for steel. The shielding gas for copper is welding grade argon.

Weld areas are cleaned with a wire bronze brush and then degreased. Oxides that form should be removed after welding. Copper is preheated, however copper alloys do not need to be preheated due to high levels of thermal conductivity.

Weld using copper alloy.

Cast Iron

In terms of welding metals, low carbon steel is easier to weld than cast iron. Cast iron has higher carbon and silicon content, and is not as ductile. When welding with cast iron the surface will need to be cleaned to remove any ingrained grease and oil. All cracks need to be grinded or filed. Cast iron is welded with oxyacetylene welding

Automotive Sheet Metals

- Metals have elastic properties that allow it to be shaped and reshaped with out breaking.
- In repairing sheet metal panels, the auto body technician takes advantages of the properties of metal to restore damaged areas to their pre-collision shape and state.

Types of steels used in vehicles.

1. Mild steel: Steel possessing yield strength of up to 35,000 psi (used until 1980 for auto body construction). It is:
   - Soft and easy to work,
   - Can be safely welded, heat shrunk and cold worked without seriously affecting its strength.
   - But easily deformed and relatively heavy (b/se it is made of large grains that are widely spaced).
2. High strength steel (HSS) (Steel with a yield strength of 40,000 to 150,000 psi)
   - It has far smaller grains that are more densely packed together that give it superb strength

Why Automobile manufacturers are using high-strength steel?

1. High strength steel enables manufacturers to reduce the weight of the vehicle by decreasing the gauge or thickness of its structural members and sheet metal panels without sacrificing strength.
2. Most auto body parts can be made of high strength steel without changing existing dies or tools.
3. Manufacturers have found that using high-strength steel is a cheaper method of reducing the automobile weight than using aluminium or plastics.

There are several different types of high-strength steels that differ in strengthening process (heat treatment, cold rolling, and chemical additives). Three types are often used in automobile structure.

1. High-strength, low-alloy (HSLA) steel, or rephosphorised steel is produced by adding phosphorus to mild steel to upgrade its strength level.
2. High-tensile strength steel or Si-Mn solid solution hardened steel, contains increased amounts silicon, manganese, and carbon to give it a higher tensile strength.
3. Ultra-high-strength steel (UHSS), or dual phase steel, is made by quenching the steel on a continuous annealing line or in a hot strip mill.

NOTE:

Use extreme care when using heat on HSS panels.

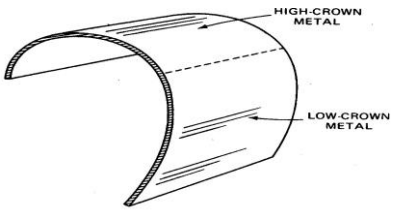
- MIG welding is an acceptable practice for HSS. Most automobile manufacturers do not recommend using oxyacetylene to weld either type.
- Check the appropriate collision or parts manual for the vehicle being repaired to learn exactly what parts are made with, HSLA, UHSS, HTSS, and so on.

How steel panels are strengthened?

- Effect of impact forces: - The sheet metal's resistance to change has three properties.
- *Elastic deformation*: - is the ability of metal to stretch and return to its original shape.
- *Plastic deformation*: -is the ability of the metal to be bent or formed in to different *Shapes.* This is because the grain structure has taken on a new set.
- *Work hardening:* - work hardening is the upper limit of plastic deformation causing the metal to become very hard in the area where it has been bent.

Forming to different shapes can strengthen sheet metals. Some of these are: -

- Crowned surfaces.



Bending metal in the shape of a partial circle strengthens it.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Which of the following welding uses friction or explosion to heat the joining section of metal work pieces and join them under pressure? (1pts)
   A. Pressure welding B. Plastic welding C. Thermo chemical welding D. A & B
2. The following are true for oxygen cylinder except (1pts)
   A. Painted BLACK B. Are taller and narrower than acetylene cylinders
   C. Painted MAROON D. When full a pressure of approximately 15 000 kPa.

Instruction I. Give short answer for the following.

3. Mention at least five types of oxyacetylene welding equipment (5pts)

4. List five common weld defects found in welded joints (5 pts)

Note: **Satisfactory rating - 5 points and above** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Work instructions

1.2 Work instructions

A Work Instruction is a document that provides specific instructions to carry out an Activity. It is also a document describing specific activities and tasks within the organization. It contains the greatest amount of detail.
Work instruction is a step by step guide to perform a single instruction which contains more detail than a Procedure and is only created if detailed step-by-step instructions are needed.

Difference Between Work Instructions and Procedures

Another way of looking at Work Instructions v Procedures is that:
Procedures describe:

- What is the activity is
- Who performs it
- When it is performed

Work instructions describe:

- How the activity is performed.

Purpose of Work Instructions

'A work instruction is a tool provided to help someone to do a job correctly. This simple statement implies that the purpose of the work instruction is quality and that the target user is the worker. Unfortunately, in many workplaces, today's work instructions have little connection with this fundamental focus. Factories have encumbered work instructions with content that has been added to satisfy auditors, lawyers, engineers, accountants and yes, even quality managers. We've piled on so much extraneous material that we've lost sight of the intended purpose of work instructions.'

Steps to Writing Work Instructions

Follow these steps to write your next set of Work Instructions.

1. Know exactly how to perform the task.
2. Plan how to write steps in the correct order.
3. Write the steps in logical order.
4. Start each instructions with a verb.
5. Write each step as a single action.
6. Include warnings as pre-steps.
7. Review and edit instructions carefully.
8. Write in the positive voice.
9. Avoid opinions, preferences, or choices.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List steps to write work instruction (4)

2. Define work instruction (2)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Workplace Health and Safety (WHS)

Safety is a critical consideration for any welding project. Arc and gas welding is a safe occupation when proper precautions are taken. But, if safety measures are ignored, welders face an array of hazards which can be potentially dangerous, including electric shock, fumes and gases, fire and explosions and more.

The workplace or office is a place where productivity is expected and having a pleasant work area certainly adds to a positive environment.

Workstations give you a place to work and organize your tools and equipment more efficiently in your workshop or garage. Employees can do their part in addition to regular cleaning staff housekeeping and custodian maintenance to keep it clean, safe, and healthy for all. Discomfort workstation can have serious health consequences so every technician should be ready the work station to be comfortable for the work activities and the technician who doing the work.

Safety means protecting yourself and others from possible danger and injuring in the shop, you are ' Safe' when you protect your eyes, your fingers, your hands all of yourself from danger as well as others.

1. Work Shop Safety

The preparation of work shop to supply equipment helps to -

- ✓ Keep environment well being
- ✓ Finish with specified our time pre-summing
- ✓ Identify the work and its implementing tools and equipment
- ✓ Decide the work procedure
- ✓ Keep tools, equipment and resource prevent ourselves from injury
- ✓ Done the work with quality

1.1 Hazards in the work shop

a) Faulty work habits
b) Misuse of equipment
c) Misuse of hand tools

A) **Faulty work habits**

i) Smoking around fuel and solvents
ii) Incorrect handling of paint, thinners, solvents, flammable liquids etc..
iii) Blocking exits. A block exit could mean serious injury or even death during an emergency case such as fire.

B) **Misuse of equipments**

i) Incorrect safety guarding of moving machinery
ii) Misuse of flexible electric cords or worn cords. When used through holes the may cause fire
iii) Improperly stored composed gas cylinders
iv) Using hand held electric tools improperly grounded

C) **Misuse of hand tools**

i) Keeping hand tools dirty and in poor conditions
ii) Improper storing of hand tools
iii) Using defective hand tools
iv) Keeping sharp tools in pockets

Fire Prevention

i) Store fuels properly
ii) Keep the shop doors open, will ventilation where fuel vapours can exit
iii) Wipe up the spilled fuel at once and keep the rags in a closed waste containers
iv) Never smoke or light a cigarette around fuels. (Do not smoke in the workshops!)
v) Fix leaking carburetors, fuel pumps fuel lone and fuel tank immediately

vi) Make fine extinguishers available in the workshop and know perfectly well how to use them in case of fire

Environmental condition

- Free from flammable things
- Events around the work campus is closer together
- Climatic condition
- Working area events
- The vehicle should park on the level surface to repair the system
- It should be wide for servicing

Power Tool Safety

- Keep fingers and clothing away from rotating equipment.
- Sanding and buffing wheels must be securely attached.
- Protective guards must be in place.
- Wear safety glasses or a face shield.
- Follow the tool manufacturer's directions.

Hand Tool Safety

- ❖ use tools only designed for the purpose.
- ❖ Use a box end wrench or socket whenever possible.
- ❖ Use only impact sockets with impact wrenches.
- ❖ Never use pliers to loosen or tighten.
- ❖ Never use screwdrivers as chisels.
- ❖ Never strike two hammers together

Personal Safety

Most of the dangers for an auto mechanic involve a running parts, road tests, etc.

Working with chemicals

i) Fire
- Know where the fire extinguishers and fire exits are:-
- Do not get in to confined area with a carbon tetrachloride type extinguishers

ii) Oil and other lubricants
- Make sure that there are no oil leakage on your working area

iii) Battery acid
- Do not smoke around a battery being charged. It gives off hydrogen which is extremely explosive.
- Avoid battery acid from setting in to your eyes or touching your skin.
- When mixing acid always pour slowly the acid in to the water the reverse mixing procedure may cause the mixture to boil and spatter with the force of apparent explosion.

Working on power tools

- The instruction for using any equipment should be studied carefully before the equipment is operated
- Hands and clothes should be kept away from the running machineries
- Disconnect the power source when you stop working on machines
- Clean, lubricate and cover the machine every time you finish working
- Never get under a vehicle which is standing on a jack. Support it with car stands and chock the wheels to keep the car from rolling
- Always use your legs and not and shoes while you are working in the shop

D) First Aid

- Give first aid whenever required using the first aid kit available in the shop
- Depending on the type of accident, call for help (doctor or ambulance).

Observing dangers associated working with welding

Any person involved in welding processes must take every precaution to ensure that the risk of starting a fire is minimized. Your part in minimizing the risk of starting a fire is made when you do the following:

- ✓ Remove, wherever possible, any flammable material from the area. This would include such items as:
  - ➢ Paper.
  - ➢ Oil or fuel drums.
  - ➢ Paint containers and associated products.
  - ➢ Wooden articles.
  - ➢ Fabrics.
  - ➢ Plastics and associated materials.
- ✓ If you have to weld in areas that have "fixed" flammable materials, such as wooden floors then take the time to protect from possible ignition by "wetting down" the area using water.
- ✓ Always make sure that there is a fire extinguisher available nearby.
- ✓ Place a metal tray filled with sand beneath the work area. This is to catch any "slag" that might drop as you work. This practice will be essential if you are "flame cutting".
- ✓ During the working process you will always need to be aware of fire hazards.
- ✓ If there are workers around you ask them to keep an eye on the area. If you are working alone make it a habit to "look around" every few minutes in order to assess the area..
- ✓ Be sure your path is free of parts or tools.
- ✓ Be sure the container is in good condition.
- ✓ Straighten your legs to lift the object.
- ✓ If necessary, turn your whole body, don't twist your body.
- ✓ Bend your legs to lower the object.
- ✓ Place suitable blocks under the object

POTENTIAL HEALTH & SAFETY HAZARDS

HAZARD		TO PROTECT YOURSELF
EXPLOSIVE		Make sure volatile chemicals are stored and handled correctly. Proper grounding must be used for all containers.
HIGH SOUND LEVELS Sound levels exceed 85 dB		**HEARING PROTECTION** is required when working in designated areas.
EXPOSURE		Understand the chemical(s) you are working in the vicinity of. Consult the MSDS and wear the appropriate PPE.
FOOT INJURY		Approved protective footwear is needed when there is the risk of foot injury due to slipping, uneven terrain, abrasion, crushing potential, temperature extremes, corrosive substances, puncture hazards, electrical shock and any other recognizable hazard
COMPRESSED GASES		Do not • drop • keep near heat

FIRE Due to flammable liquids, gases or combustible dusts		Complete a hot work permit work requires it.

1.3.1 protective clothing and equipment

Personal protective equipment (PPE) is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter

What are some tips to know when using protective clothing?

DO

- Wear clothing made from heavyweight, tightly woven, 100% wool or cotton to protect from UV radiation, hot metal, sparks and open flames. Flame retardant treatments become less effective with repeated laundering.
- Keep clothing clean and free of oils, greases and combustible contaminants.
- Wear long-sleeved shirts with buttoned cuffs and a collar to protect the neck. Dark colours prevent light reflection.
- Tape shirt pockets closed to avoid collecting sparks or hot metal or keep them covered with flaps.
- Pant legs must not have cuffs and must cover the tops of the boots. Cuffs can collect sparks.
- Repair all frayed edges, tears or holes in clothing.
- Wear high top boots fully laced to prevent sparks from entering into the boots.
- Use fire-resistant boot protectors or spats strapped around the pant legs and boot tops, to prevent sparks from bouncing in the top of the boots.
- Remove all ignition sources such as matches and butane lighters from pockets. Hot welding sparks may light the matches or ignite leaking lighter fuel.
- Wear gauntlet-type cuff leather gloves or protective sleeves of similar material, to protect wrists and forearms. Leather is a good electrical insulator if kept dry.
- Using a shield can help keep any sparks spray away from your clothing.
- Wear leather aprons to protect your chest and lap from sparks when standing or sitting.
- Wear layers of clothing. To prevent sweating, avoid overdressing in cold weather. Sweaty clothes cause rapid heat loss. Leather welding jackets are not very breathable and can make you sweat if you are overdressed.
- Wear a fire-resistant skull cap or balaclava hood under your helmet to protect your head from burns and UV radiation.
- Wear a welder's face shield to protect your face from radiation and flying particles.

DO NOT

- Do not wear rings or other jewellery.
- Do not wear clothing made from synthetic or synthetic blends. The synthetic fabric can burn vigorously, melt and produce bad skin burns.

Personal protective clothes

	Safety glasses must be worn at all times in work area!
	Respirator with HEPA filters must be worn when working with materials that give off harmful fumes
	Work Boots must be worn at all times when working in an area where there is risk of serious foot injury due materials falling onto the foot.
	Work Gloves should be worn when there is a risk of hand injury during the course of work tasks.
	Hard hats must be worn when working in an environment where there is a risk of objects falling from above or where there is a high risk of striking your head on objects.
	Close fitting clothing or protective clothing must be worn.

Safety procedures when working with oxyacetylene welding equipment.

- Wear personal protective equipment. Wear welding gloves, helmet, leather apron, welding chaps, leather boots, welding goggles, and other personal protective equipment to help prevent weld burns and injury. Make sure the welding goggles or face shield have at least a No. 4 filter lens. Do not wear clothing made of synthetic fibers while welding.
- Fasten cylinders securely. Do not handle cylinders roughly. Chain cylinders in an upright position to a wall or cart. When regulators are not on cylinders, keep safety caps in place. Caps will prevent damage to cylinder valves.
- Never use oil on welding equipment. Oil and grease may ignite spontaneously, when in contact with oxygen.
- Open cylinder valves correctly. Open the valve on the acetylene cylinder no more than three-fourths of a turn so it can be closed quickly in case of emergency. Open the valve on the oxygen tank fully. While welding or cutting, leave the valve wrench in position.
- Keep the tip pointed away from your body. Do not saturate your clothing with oxygen or acetylene. Before and while lighting the flame, keep the tip pointed away from the body.
- Light the flame with an approved lighter. Using matches to light the torch brings your fingers too close to the tip.

- Set the operating pressure carefully. Never use acetylene at a pressure over 15 psi. Follow the manufacturer's recommendations for the correct operating pressures for the metal being welded and for the tip size being used.
- Do not smoke or allow anyone else to smoke near the oxy-fuel gas welder. If fuel gas were to leak from the unit, smoking could provide ignition and cause a fire or an explosion.
- Treat the flame with respect. Keep flame and heat away from the cylinder, hoses, and people. Never lay down a lighted torch. Be sure the flame is out before laying down the torch. Never walk around with a lighted torch.
- Control flashbacks and backfires. Make certain that reverse flow-check valves and flash arrestors are installed on the oxygen and acetylene lines.
- Do not leave the work area until the cylinder valves are closed. Be sure the cylinder valves are closed and pressure is relieved from the hoses before you leave your work area.
- Never stand in front of a regulator while opening a tank valve.
- Do not weld or cut on containers that have held flammable materials.
- Remove regulators and replace protective caps before transporting cylinders.
- Store oxygen cylinders away from acetylene cylinders. A non-combustible wall at least 5 feet high should be used to separate cylinders.
- Handle hot metal with pliers or tongs. Do not leave hot metal on the welding table because unsuspecting persons may touch it and be burned.
- Check connections for leaking gases. To prevent fires or explosions, use soapy water to check connections for leaks.

1.3.2 WHS legislation

Legislation is defined as.

1. the act or process of making a law or laws
2. laws and rules made by the government
3. A proposed or enacted law or group of laws.
4. The act of legislating; preparation and enactment of laws; the laws enacted.
5. Law which has been enacted by legislature or other governing body

Purpose of WHS legislation

The main aim of the WHS Act is to 'secure the health and safety of workers and workplaces through the elimination or minimization of risks, fair and effective representation, consultation, co-operation and issue resolution, encouraging employer organizations and unions to play a constructive role, provision ..

Legislation vs. regulation: What's the difference?

There has been a lot of time and energy spent on updating the legislation around Lone Workers of the world. Legislation is synonymous with constitutional law; the laws that have been enacted by the legislature as well as those still in the process of being enacted. Legislation is both the description of the legal requirements, and of the punishment for violating the law.

Regulations, by comparison, are the ongoing processes of monitoring and enforcing the law: so not just HOW the legislation is being enforced, but also the very act of enforcement. Where the confusion comes in is that a regulation is also the name of the document itself that details the act and description of regulation. It's best to think of it like this: If Legislation is a destination, then Regulation is how we get there.

Regulation comes from a number of sources, but the most common forms are government regulation and self-regulation. Government regulation is a natural extension of legislation, in that it defines and controls some of the ways that a business or individual can operate in order to follow the law. A very straightforward example is food packaging in Canada: it must, at the very least, be packaged with both English and French wording.

Self-regulation is when an individual or a business has control over the particulars of how it meets the minimum legislative requirements.

1.3.3. Material safety management systems

A safety management system (SMS) is a comprehensive management system designed to manage safety elements in the workplace. It includes policy, objectives, plans, procedures, organization, responsibilities and other measures. The SMS is used in industries that manage significant safety risks, including aviation, petroleum, chemical, electricity generation and others.

There are three imperatives for adopting a safety management system for a business – these are ethical, legal and financial.

The safety management basic components are:

1. Policy Establish within policy statements what the requirements are for the organization in terms of resources, defining management commitment and defining occupational safety and health (OSH) targets
2. Organizing How is the organization structured, where are responsibilities and accountabilities defined, who reports to who and who is responsible for what.
3. Planning and Implementation What legislation and standards apply to our organization, what OSH objectives are defined and how are these reviews, hazard prevention and the assessment and management of risk.
4. Evaluation – How is OSH performance measured and assessed, what are the processes for the reporting of accidents and incidents and for the investigation of accidents and what internal and external audit processes are in place to review the system.
5. Action for Improvement – How are preventative and corrective actions managed and what processes are in place to ensure the continual improvement process.

Material safety management is a scientific technique, concerned with Planning, Organizing & Control of flow of materials, from their initial purchase to destination.

Aim of material safety management system

To get

1. The Right quality
2. Right quantity of supplies
3. At the Right time
4. At the Right place
5. For the Right cost

Purpose of material safety management system

- To gain economy in purchasing
- To satisfy the demand during period of replenishment
- To carry reserve stock to avoid stock out
- To stabilize fluctuations in consumption
- To provide reasonable level of client services

Economy in material management

- Containing the costs
- Instilling efficiency in all activities

Four basic needs of Material safety management system

1. To have adequate materials on hand when needed
2. To pay the lowest possible prices, consistent with quality and value requirement for purchases materials
3. To minimize the inventory investment
4. To operate efficiently

Basic principles of material safety management system

1. Effective management & supervision, It depends on managerial functions of
   - Planning, Organizing, Staffing, Directing, Controlling, Reporting and Budgeting
2. Sound purchasing methods

3.Skillful & hard poised negotiations
4.Effective purchase system
5.Should be simple
6.Must not increase other costs
7.Simple inventory control program

Elements of material management

1. Demand estimation
2. Identify the needed items
3. Calculate from the trends in Consumption during last 2 years.

Materials handling

The National Safety Council suggests employers relay the following information to employees to help reduce workplace incidents when handling and moving materials:

- ✓ Avoid lifting materials from the floor or while seated.
- ✓ Make use of available handling aids.
- ✓ Refrain from using sudden or jerky movements.
- ✓ Never lift a load over an obstacle.
- ✓ Perform lifts in areas with adequate footing, space and lighting.
- ✓ Modify objects and redesign jobs to make moving easier.
- ✓ Seek assistance from co-workers.
- ✓ Stay in good physical shape.
- ✓ Begin lifts close to the body.
- ✓ Use containers made of lighter materials.
- ✓ Reduce load sizes when possible.
- ✓ Do not twist or bend while lifting objects.
- ✓ Ensure repetitive, heavy and bulky lifts are not performed.
- ✓ Keep lifts between shoulder and knuckle height.
- ✓ Use conveyors, slides or chutes to eliminate pushing or pulling.

1.3.4 hazardous substances and dangerous goods code

what is hazardous substances in the work place

Exposure to chemicals commonly used in workplaces can lead to a variety of short- and long-term health effects such as poisoning, skin rashes and disorders of the lung, kidney and liver. A quarter of all Victorian employees regularly use hazardous substances such as chemicals, flammable liquids and gases in their work.

how to identify hazardous substances in the work place

To identify if a substance is hazardous, check the product's container label and/or the safety data sheet (SDS) which is available from the supplier. If a product is not classified as a hazardous chemical under the Work Health and Safety Act 2011, a SDS is not required and therefore may not be available.

Dangerous goods vs Hazardous substances

"Hazardous Substances" are classified based only on health effects which have the potential to harm human health. They may be solids, liquids or gases; they may be pure substances or mixtures. When used in the workplace, these substances often produce vapours, fume, dusts and mists. There are many industrial, laboratory and agricultural chemicals which are classified as hazardous. Hazardous substances may cause immediate or long-term health effects. Exposure could result in:

- Poisoning; Irritation; Chemical burns; Sensitization; Cancer; Birth defects; or
- Diseases of certain organs such as the skin, lungs, liver, kidneys and nervous system.

Dangerous goods are classified according to their immediate physical or chemical effects, which may be corrosive, flammable, explosive, spontaneously combustible, toxic, poisoning oxidizing, or water-reactive. These goods can be deadly and can seriously injure or kill people, damage property and the environment.

Hazardous substances and dangerous goods are covered by separate legislation, each focusing on controlling the different risks associated with them. Many hazardous

substances are also classified as dangerous goods, so both pieces of legislation apply to these.

Common hazardous substances

Many industrial, agricultural and medical organizations use hazardous substances. The degree of hazard depends on the concentration of the chemical. Common hazardous substances in the workplace include:

- acids, caustic substances, disinfectants, glues, heavy metals, including mercury, lead, cadmium and aluminium, paint, pesticides, petroleum products, solvents.

Possible side effects of exposure to hazardous substances

Health effects depend on the type of hazardous substance and the level of exposure (concentration and duration). A hazardous substance can be inhaled, splashed onto the skin or eyes, or swallowed. Some of the possible health effects can include:

- poisoning
- nausea and vomiting
- headache
- skin rashes, such as dermatitis
- chemical burns
- birth defects
- disorders of the lung, kidney or liver
- nervous system disorders.

Labels and Safety Data Sheets for hazardous substances

Manufacturers and importers of hazardous substances in Victoria are required by law to provide warning labels and Safety Data Sheets with their products. Employers must ensure that the Safety Data Sheets for each hazardous substance used in the workplace is available to employees, and that a central register of hazardous substances is established. The Safety Data Sheet lists important information on handling the product safely, including:

- potential health effects
- precautions for use
- safe storage suggestions
- emergency first aid instructions
- contact numbers for further information.

Reducing exposure to hazardous substances

Suggestions on reducing exposure to hazardous substances in the workplace include:

- Where possible, perform the task without using hazardous substances
- Where possible, substitute hazardous substances with less hazardous alternatives (for example, use a detergent in place of a chlorinated solvent for cleaning)
- Isolate hazardous substances in separate storage areas
- Purge or ventilate storage areas separately from the rest of the workplace
- Thoroughly train employees in handling and safety procedures
- Provide personal protection equipment such as respirators, gloves and goggles
- Regularly monitor the workplace with appropriate equipment to track the degree of hazardous substance in the air or environment
- Regularly consult with employees to maintain and improve existing safety and handling practices.

Personal safety requirements (e.g. toxic fumes/lead poisoning)

Personal Safety refers to the freedom from physical harm and threat of physical harm, and freedom from hostility, aggression, harassment, and devaluation by members of the academic community. Safety includes worry about being victimized as well as actual incidents. The safety requirements are those requirements that are defined for the purpose of risk reduction. Like any other requirements, they may at first be specified at a high level, for example, simply as the need for the reduction of a given risk.

To be a welding technician, you will need:

- Good practical skills for using welding tools and equipments.
- The ability to work methodically and pay close attention to detail
- Good problem-solving skills
- The ability to read electrical wiring diagrams
- The ability to work alone and as part of a team
- Good communication and customer care skills
- The ability to keep up to date with developments in oxy acetylene welding technology
- An awareness of health and safety.
- Good ventilation in the work place.
- Brightness working area
- Appropriate clothing

General Gas Welding Safety Tips

- Inspect equipment for leaks at all connections using approved leak-test solution.
- Inspect hoses for leaks and worn places.
- Replace bad hoses.
- Protect hoses and cylinders from sparks, flames and hot metal.
- Use a flint lighter to ignite the flame.
- Stand to the side (away from the regulators) when opening cylinder valves.
- Open cylinder valves very slowly to keep sudden high pressures from exploding the regulators.
- Only open the acetylene cylinder valve 1/4 - 3/4 turn; leave wrench in place so the cylinder can be quickly closed in an emergency.
- Open and light acetylene first, then open and adjust oxygen to a neutral flame.
- Close the acetylene torch valve first when shutting off the torch (a "pop" might occur as the oxygen "blows out" the flame, but this eliminates the possibility of the flame burning up the acetylene line).
- When finished, close cylinder valves, bleed the lines to take pressure off regulators, neatly coil hoses and replace equipment.

Oxy-Acetylene Welding Safety

When welding:

1. Always wear protective clothing, i.e. flame retardant overalls.
2. Always wear the correct eye goggles.
3. Always have the spindle key in the acetylene cylinder valve.
4. Always keep cylinders secured in an upright position.
5. Always check for leaks with a soapy solution, NEVER with a naked flame.
6. Never carry out makeshift repairs on welding equipment.
7. Never allow oil or grease to come in contact with oxygen equipment.
8. Never weld an enclosed vessel, i.e. petrol / oil drums until they have been thoroughly cleaned.
9. Never work in an enclosed vessel on your own and always leave the cylinders outside. If working in an enclosure vessel, adequate ventilation should be provided and fire-fighting equipment should be available.
10. In the event of a serious flashback or backfire plunge the blowpipe in a bucket of cold water, leaving the oxygen running to prevent water entering the blowpipe.
11. Should the hoses become damaged, turn off the supply of gas at the cylinder and inform your instructor.
12. Don’t forget, this equipment, if misused or damaged, can be dangerous. If in any doubt seek assistance and clarification from your instructor.

Blowpipes

Gas leaks can be detected by 1% Teepol® or proprietary leak detection solutions or hissing and, in the case of fuel gases, also by smell. Leaks at the head nut or welding nozzle should be cured by cleaning the seat with a soft cloth. If the leak continues, the blowpipe should be replaced. Do not carry out blowpipe repairs.

Backfire

For a variety of reasons e.g. incorrect operating conditions, nozzle blockage etc. the flame may backfire into the blowpipe. Usually the flame can be re-lit immediately.

In a small number of instances the flame may continue to burn inside the blowpipe, a condition called sustained backfire. This can be recognized by a roaring, rushing sound and the body of the blowpipe will become very hot. Rapid action is necessary to prevent permanent damage to the blowpipe, Close the blowpipe oxygen valve, then the blowpipe acetylene valve and allow the blowpipe to cool - it can be plunged into a bucket of water. Check the nozzle for tightness, check gas pressures on the pressure regulators, purge the hoses and if everything looks correct, begin the lighting up procedure,

If sustained backfire recurs, the nozzle or blowpipe or both require replacement.

Fluxes:- Fluxes must only be used in a well ventilated area.

Protective Clothing

Goggles should be worn at all times whilst welding and cutting and should conform to the Protection of Eyes Regulations. Leather or suitable protective clothing should be worn for heavy cutting or welding. The feet should be protected from sparks, slag or falling off-cuts.

Welding, Cutting Drums and Containers

Welding or cutting drums, containers or tanks which have held flammable liquids or gases can be dangerous, even though they are supposed to be clean and free from explosive vapour or liquids. BOC will advise you on suitable precautions.

Do not weld hollow vessels before establishing that confined air is properly vented; hollow metal parts should be drilled to prevent explosions caused by heat.

Ventilation

In a confined space, ensure that there is a suction fan to give adequate ventilation (a fume hood, at the source of fumes, is the best method); do not use oxygen or an air blower and always post a trained helper outside for emergencies. Test all equipment for leaks before entering and remove the equipment outside during periods when it is not in use and on completion of daily work. The welding of brass or galvanized materials should be carried out in well ventilated areas and if the work is likely to be prolonged suitable breathing apparatus should be worn.

When cutting painted or galvanized steel, unless ventilation is very good, fume extraction should be installed at the point of cutting. In some cases it may be necessary to wear a respirator as well.

Fire

Take care that there is no combustible material within reach of sparks; sparks from cutting may travel as far as 10 metres (35 feet) along a floor. Ensure that sparks and falling slag do not fall over the cylinder or hoses. If necessary protect anything in the neighborhoods of the work with sheet metal guards or fiber glass sheets down to the floor - tarpaulins do not give sufficient protection. Where it is necessary to work close to combustible material, keep fire fighting apparatus handy and post a man at the scene of the work for at least half-an-hour after the work has finished. In dusty or gassy atmospheres consult the responsible official in charge before starting work.

Clothing should be free from grease and preferably made of wool which is not so readily flammable. Goggles, collars, combs, buttons, etc., of flammable material should not be worn.

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention at least four personal protective equipment (4 pts)

2. List four categories of WHS (4 pts)

3. Write at least six safety requisition during oxyacetylene welding (6 pts)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Reading and interpreting Job specifications

Definition: Job Specification

A job specification defines the knowledge, skills and abilities that are required to perform a job in an organization. Job specification covers aspects like education, work-experience, managerial experience etc which can help accomplish the goals related to the job. Job specification helps in the recruitment & selection process, evaluating the performance of employees and in their appraisal & promotion. job specification and job description help in giving a overview of the job in terms of its title, position, roles, responsibilities, education, experience, workplace etc.

Importance of Job Specification

1. The importance and purpose of job specification is a thoroughly understand the specific details of a job. Jobs can be of different types and can require a different skill sets to get the maximum output from a particular.
2. Gives important details related to the job like education & skills, prior work experience, managerial experience, personality traits etc which would help an employee accomplish the objectives of a job.
3. For a recruiter, job specification lays down the guidelines basis of which the company can recruit and select the best possible candidate who would be best suited for the job. Apart from actually finding the right candidate or employee,
4. Used for screening of resumes & shortlist only those candidates who are the closest fit to the job.
5. Gives specific details about a job and what kind of skill sets are required to complete the job.

Components of Job Specification

There are many parameters which are considered while giving the job specification for a certain profile.

1. Educational Qualification: This parameter gives an insight on how qualified a certain individual is. It covers their basic school education, graduation, masters degree, other certifications etc

2. Experience: Job specification clearly highlights the experience required in a particular domain for completing a specific job. It includes work experience which can be from a specific industry, position, duration or in a particular domain. Managerial experience in handling and managing a team can also be a job specification criteria required for a particular position

3. Skills & Knowledge: This is an important parameter in job specification especially with knowledge and skill based profiles. The higher the position in a company, the more niche the skills become and more is the knowledge required to perform the job. Skills like leadership, communication management, time management, team management etc are mentioned.

4. Personality traits and characteristics: The way in which a person behaves in a particular situation, handles complex problems, generic behaviour etc are all covered in the characteristics of a job description. It also covers the emotional intelligence of a person i.e how strong or weak a person is emotionally

Job Specification Example

Here is a sample job specification, which is prepared for a marketing manager in a telecom company.

Education	Must be an engineer and MBA in marketing for a reputed MBA institute
Work experience	Must have prior work experience in marketing & sales (preferably telecom or FMCG)
Skills & Knowledge	a. Must be a good communicator and must be able to lead a team. b. Prior experience in handling ATL-BTL activities and managing promotional events. c. Must be able to handle social media like Facebook, Twitter and help build online brand d. Experience in managing PR and media e. Strong analytical skills and problem solving skills f. Must understand business, come up with innovative products and launch them
Personality Traits & Characteristics	1. Must be presentable and a good orator 2. Should be calm in complex situations and show leadership skills in managing multiple teams 3. Should be emotionally strong and should give timely deliverables

The above table is a sample of job specification. More specific details can also be put to give a better understanding about the job.

Advantages of Job Specification

There are several benefits of having a comprehensive job specification. Some advantages are listed below:

1. Job specification highlights all the specific details required to perform the job at its best
2. It gives the HR managers a threshold and a framework on the basis on which they can identify the best prospects
3. Helps in screening of resumes and saves time when there are multiple applications by choosing those who are closest to the job specification
4. HR managers can used job specification as a benchmark to evaluate employees and give them required trainings
5. It also helps companies during performance appraisal and promotions

Disadvantages of Job Specification

As we know, job specification arises from the job description; it also has some related problems. Let us have a look at those limitations:

- Change in technology impacts the requirement of the company, i.e. changing of skills, qualification, experience, knowledge needed to execute the roles and responsibilities properly.
- A job specification is a lengthy process and requires complete knowledge of the job position.

Steps

1. Write up a rough outline. It can be helpful to create a rough outline of your job description before setting down to write the final versions. ...
2. Decide on the job title. ...
3. Include the details of the job. ...
4. Create a summary of the job. ...
5. Include the duties and responsibilities of the job. ...
6. Add job factors to the description

Difference and Comparison of job specification and job description

BASIS	JOB DESCRIPTION	JOB SPECIFICATION
Meaning	Job description is the written document in which all the information regarding a particular job including role, responsibilities and duties is summarized in a systematic manner.	Job specification is the set of specific qualities, knowledge and experience, a person must possess to perform a particular job.
Origin	Originates from Job Analysis	Based on Job Description
Elements	Consist of job title, job location, role, responsibilities, duties, salary, incentives and allowances	Involves personal attributes, skills, knowledge, educational qualification and experience
Objective	Describes the job profile	Specifies the eligibility criteria
What is it?	What the company is offering to the candidate.	What the company is demanding from the candidate.
Application by Human Resource Manager	Used to give the sufficient and relevant information of the job	Used to match the right attributes with the job so described

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain job specification (4)

2. List four components of job specification (4 pts)

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Selecting and inspecting materials for repairing and replacement

Material selection is a step in the process of designing any physical object. In the context of product design, the main goal of material selection is to minimize cost while meeting product performance goals. Systematic selection of the best material for a given application begins with properties and costs of candidate materials. For example, a thermal blanket must have poor thermal_conductivity in order to minimize heat transfer for a given temperature difference. It is essential that a designer should have a thorough knowledge of the properties of the materials and their behavior under working conditions. Some of the important characteristics of materials are : strength, durability, flexibility, weight, resistance to heat and corrosion, ability to cast, welded or hardened, machinability, electrical conductivity, etc.

What kind of materials are used to make cars?

Cars are made of a wide variety of materials, such as steel, aluminum, copper, glass, rubber, and special fibers. First, a raw material production company takes individual raw materials and turns them into materials that can be used to make car parts, and delivers them to parts production companies or to Toyota. These materials are then made into car parts and later installed in car bodies to complete the cars.

Material selection in the automobile industry is an artful balance between market, societal, and corporate demands, and is made during a complex and lengthy product development process. Actual selection of a particular material for a specific application is primarily driven by the trade-off between the material's cost (purchase price and processing costs) and its performance attributes (such as strength and durability, surface finish properties, and flexibility.) The vehicle manufacturers' materials engineer and component-release engineer play the pivotal role in screening, developing, validating, and promoting new materials, although initial consideration of possible material changes may be sparked by numerous players. These selection decisions are made within a material selection process that will continue to evolve. This evolution will largely reflect changes in the vehicle and component development processes to make them more responsive-in terms of accuracy, time, and cost-to market and regulatory demands. The balancing of market, societal, and corporate demands will continue to determine specific automotive material usage in the future.

Surface Finish Material surface finish and the ability to take coatings and paints is an important consideration. Typically, materials may be grouped into two categories, exposed and non-exposed. Exposed materials, such as body panels, are styling sensitive. Exterior body panels require a Class A finish. A Class A finish is a function of the surface finish and surface treatment. Surface finish refers to specific characteristics such as formability and surface smoothness. Surface treatment involves paint and coating treatments. Other considerations such as surface finish and light reflectivity require a material to accept specified primer, base coat, and top coat coatings. Every material has advantages and disadvantages.

Receiving and Inspection of the materials

The receiving department receives the materials supplied by the vendor. The quantity is verified and tallied with the purchase order. The receipt of the materials is recorded on the specially designed receiving slips or forms which also specify the name of the vendor and the purchase order number or into a computer. It also records any discrepancy, damaged condition of the consignment or inferiority of the materials. The purchase department is informed immediately about the receipt of the materials. Usually a copy of the receiving slip is sent to purchase department. In computerized system the Purchase department concerned staff member is supposed to keep a track of all the receipts through the computer.

If the materials require any quality control or inspection, they are sent for such testing. The inspection department tries to verify that the incoming materials comply with the standard quality as specified in the purchase order. It may involve mechanical, electrical, chemical or such types of testing. The accept reject decision may be taken on the basis of either sample testing or testing the entire lot. The inspection may involve in house testing or testing done at the vendor's plant.

The inspection report along with the Test certificate and the recommended acceptance or rejection should be sent to the purchasing department. On the basis of the recommendations made by the inspection department, the purchase department arranges for the segregation of the rejected materials. They are sidetracked from the normal flow towards the stores or production departments. If they involve some further shipments at supplier's end, they are suspended immediately. The concerned departments such as stores department, production department, accounting department, scrap and waste disposal section etc. are immediately informed about the rejections. If the defectives are within the established tolerance limits, they may be accepted as their returning to the vendor may disrupt the production schedule. However, the vendor should be informed about this and if possible, the credit should be claimed from him.

Receiving function is usually of a routine nature and sometimes it is kept independent of purchase department but within Material department usually Stores. However, it is desirable to treat the receiving departments as a subordinate function of purchase department due to following reasons:

1. Before the settlement of the invoices, the purchase department has to verify that the consignment agrees with the purchase order in all respects. This can be verified only with the help of the receiving department.
2. When the shipment is received in damaged condition, the purchase department must have first hand prompt information about this, so that it can initiate immediate legal action against the vendor or the carrier. It can also take necessary action for tapping the substitute sources of the supply for the urgently needed materials.
3. In case of the short shipment from the suppliers, the rush orders can be managed so that the work stoppages caused by the lack of materials can be eliminated.

Payment of the invoice: When the goods are received in satisfactory condition, the invoice is checked before it is approved for the payment. Generally the invoice is checked to see that the goods were duly authorized to purchase, they were properly ordered, they are priced as per the agreed terms, the quantity and quality conform to the order, the calculations are arithmetically correct etc. It is a matter of controversy, whether the invoice should be checked by the purchase department or by the accounting department. The popular argument in favor of purchase department are:

1. It is the purchaser who can accurately verify that the consignment is billed properly.
2. As he is familiar with the routine details and terms and conditions of the order, he can correct and adjust any discrepancy in the execution of the order before an invoice is paid.
3. It allows the purchaser to watch the price of the materials closely increasing his consciousness for the future purchase.

This is now changed and the Stores within the Materials department can take care of receiving as one copy of Purchase order is already marked to them or they can get all the necessary information through the internal computer system

Chemical substances and cleaning materials

Chemicals make your cleaning products work. It is important that you always check the labels to use them in a safe way.

Laundry detergents, all-purpose cleaners, washing-up liquids – they all contain substances called surfactants or surface active materials. They reduce the surface tension between water and grease (liquid oil or solid fat) so that the two can mix, water

can get a hold of the grease and wash it away. That is why we wash dirty clothes with detergent – the detergent can remove dirt in a solid or liquid form.

If you look at the ingredients of a cleaning product, you will see many other chemicals, too. For example, biological detergents contain enzymes. These help to break up and remove grease, but also food and other deposits. Different chemicals are also used to provide scents or colour to a product or to help preserve it.

Cleaning materials /tools/

In order to produce a strong weld joint the surface of the metal must be free from rust, oil &paint. in order to clean these use the following tools.

1. Wire brush:- a steel wire brush is used for cleaning the work & weld
2. Chipping hammer:-is used to remove burrs & slag from the weld deposit.

For the other tools used for holding the work by the hand during welding are:-

1. Tongs:- are used for handling pieces of hot metals
2. Clamps:-are used to hold work piece during welding.
3. Jig& fixtures: - are used to position the work when welding is done.

Tips for safer use

- Check the labels of the products you use and follow the instructions to make sure you handle and store them in a safe way. Hazard pictograms show what kind of damage the product can cause to your health or the environment. Labels also have information on what to do if there is an accident.
- Prefer environmentally-friendly detergents with an official ecolabel – for example, the EU ecolabel or the Nordic ecolabel.
- Always use cleaning products according to the instructions. Some products can cause allergic reactions and irritate the skin and eyes. For example, drain unblockers and toilet cleaners may contain corrosive substances which can cause severe skin burns and damage eyes. Dishwasher detergents, decalcification agents and oven cleaners may also seriously harm your health if not handled properly.
- Remember to store your cleaning products away from the reach of children or pets/domestic animals/. Be also careful to not mix different cleaning products together or to change their container to store content.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is material selection? (2 pts)

2. why welding metal surface clean before welded? (2 pts)

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-6	Selecting correct hand, power tools and safety equipment for safe use

Hand and power tools for welding

Manual tools have fewer moving parts, and their designs are simple in nature. To recap: power tools use a source of power (i.e. battery or electricity) to run, while hand tools rely on human power to operate..

1. Assorted set of hammers just in case you need to strike some metal that gets stuck.
2. Adjustable wrench for tightening the regulator of the gas tank when you are welding with gas.
3. Tape measure for measuring things.
4. Sets squares for better precise markings.
5. A good pair of wire snips for cutting feeding through wires..
6. **A welding table or a workbench** Welding on the ground is impractical, uncomfortable, and may even put your safety at risk. Before you start a welding project, you need to find a solid surface to work on. Whether that's a traditional workbench or a dedicated welding table, that's up to you, but don't skimp on this.
7. Good quality grinders with attachments for cutting, cleaning and smoothening surfaces

Angle Grinders are so versatile that you can't get complete a welding project without using one. Whether you need them for grinding, for smoothing the weld or cutting a piece of metal, you'll definitively feel handicapped if you try to work without one.

8. Welding Clamps:- Welding clamps are essential for keeping your work pieces together so you can weld properly. Once you cut your pieces and fit them together, that's when you use the welding clamps to hold them together so you can tack weld.
9. A couple of C Clamps :- Even when you use a workbench or a welding table, you still need to secure your work-piece down to the table, and that's being done by using C Clamps. Working on an unsecured project, whether that's welding or cutting runs the risk of having your entire project ruined.
10. MIG Pliers

Like most of the tools we recommended so far, they are essential because of their versatility. Whether you need them to remove a hot nozzle, a contact tip, or clip your wire, these cheap and effective tools will save you plenty of frustrating moments.

11. A metal file:- Once your project is finished, after so much cutting and welding you'll see plenty of metal burrs and imperfections that you want to smooth out. While you can use the angle grinder we mentioned before for the big ones, for the small stuff a metal file is a tool you need. A metal file will allow you to work on smaller pieces and smooth the finer details more precisely and they are very cheap, to begin with.

12. Markers, soap stones, sharpies, pen, pencil for marking measurements.
13. Most importantly always have a fire extinguisher next to you while you perform welding

General Requirements for Hand and Power Tools

1. Maintenance. Maintain hand tools, power tools, and jacks in safe operating condition. Immediately remove damaged and defective tools from service and repair or replace them.
2. Proper Use. Use tools only for their designed purpose.
3. Storage. Do not leave tools on scaffolds or elevated work spaces. Provide containers on the jobsite for hand tools.
4. Guarding. If a tool accommodates guards, operate the tool with the guards in place.
5. Point of Operation Guarding. Point of operation is the area on a machine where work is actually performed. Provide guards at the point of operation on machines that expose the operator to injury.
6. Grounding. Double insulate or effectively ground electric tools.
7. Switches. On-off switches controlling the operation of hand-held power tools
8. Personal Protective Equipment. Provide hand tool and power tool operators with personal protective equipment and ensure its use as set forth in the section on "Personal Protective Equipment."
9. Anchoring Fixed Machinery. Securely anchor machines designated for fixed locations to prevent movement.
10. Hazardous Conditions. Use only non sparking or intrinsically safe tools where sources of ignition may cause an explosion or fire.

Welding Safety Equipment

Why is welding safety equipment important?

Molten metal, noxious fumes and scathing ultraviolet and infrared light are just a few of the hazards that welders deal with. Wearing the correct safety equipment can protect you from these dangers, so you can focus on welding.

Welding Helmets

Shielding your face and neck from sparks and radiation, a welding helmet is as essential to welding as a welding machine and torch. Without a helmet (or hood or mask), the powerful radiation emitted by the arc can quickly damage your skin and eyes.

We recommend auto-darkening welding helmets for both new welders and experienced pros. Since you don't need to flip them up and down between welds, auto-darkening helmets make it easier to produce consistent high-quality welds. They also eliminate neck fatigue caused by flipping traditional fixed-shade helmets.

With so many factors to consider when choosing a welding helmet, we devoted an entire post to selecting the right one.

Other Eye and Face Protection

When working in close quarters, it's not always possible to wear a full welding helmet. In these scenarios, options include goggles and hand-held face shields. Usually equipped with #5 lenses and designed for brazing and cutting, welding goggles don't offer enough shade for more powerful welding processes. They also leave your skin completely exposed. A hand-held shield, well, needs a hand to hold.

The Miller Weld-Mask is an innovative solution for close-quarters applications. It features a hood to protect your face and neck, and auto-darkening goggles shade to #13. For a closer look at the features and benefits of the Miller Weld-Mask, read this post from October .

Safety Glasses

Remember that welding helmet manufacturers recommend wearing safety glasses beneath your welding helmet, so find a pair that's comfortable and compliant with national safety standards.

Gloves

Welding is a tactile endeavour. Comfortable, flame-resistant welding gloves go a long way to facilitating a focused and productive welder. Protection is key. Your hands work in close proximity to the arc, exposed to intense heat and radiation. But maintaining dexterity is also important, especially when TIG welding. With so many options available—including women's gloves—it's possible to find the right size and style to suit almost any welder or application.

Stick and heavy-duty MIG welding gloves are made to protect you from heat and spatter. Look for gloves with heavy stitching, flame-resistant construction and multiple layers of insulation. Some heavy-duty welding gloves feature silicone patches for additional protection from heat and spatter.

Standard-duty MIG welding gloves are often made of leather and offer more dexterity and less insulation than their heavy-duty counterparts. Heavier MIG gloves are lined, and light- to medium-duty options are unlined. Have a look at these Miller, Lincoln, and Watson welding gloves if MIG welding is your primary application.

TIG welding gloves combine flexibility and durability. To allow for extra dexterity, TIG gloves are unlined and made of soft, heat-resistant leather, like deer or goat hide. While individual TIG welders maintain their own preferences, most agree that TIG gloves should fit snug, so you can maneuver electrodes without difficulty. KMS has TIG welding gloves in a range of styles and brands.

Body Protection

Like all welding safety equipment, welding jackets are effective when they feature durable flame-resistant materials, fit properly and, most importantly, are actually worn by the welder. Comfort is a key component in wearability, so choose a jacket that is appropriate for the process and application.

Jackets

For light-duty welding applications, cotton jackets are available in both treated flame-resistant cloth and engineered flame-resistant cloth, like these Miller Indura jackets. While either can spare your skin from heat without bogging you down with unnecessary weight, Indura jackets are washable and more durable than classic cotton jackets.

Welders have worn leather jackets for decades. They offer excellent durability and flame resistance in medium- and heavy-duty applications. Trouble is, it gets hot underneath all that heavy pigskin. Still, leather offers the best combination of durability and protection. Some manufacturers offer jackets with leather sections protecting areas that face the most heat and fire-resistant cotton elsewhere.

Jackets made with proprietary flame-resistant fabrics bring together the durability and protection of leather with the lightness of cotton.

Aprons and Sleeves

When worn beneath a jacket, a welding apron can offer additional protection for a welder's legs and chest. Pair it with a flame-resistant shirt and leather sleeves for protection during light-duty welding.

Respirators

Melting metal emits a medley of fumes. Wearing a respirator is a good way to keep all that nasty stuff out of your lungs.

Welding Hats and Beanies

Often made with funky patterns and colourful threads, a welding hat can add a little personality to a welder's personal protective equipment. While some welders like hats with a soft brim they can position over either ear to protect from sparks and slag, others prefer beanies or bandannas to help keep sweat out of their eyes.

Boots

Always wear leather work boots that comply with local safety standards. Welding-specific work boots offer additional protection on the top of your foot, shielding your laces from sparks and protecting your metatarsal from heavy objects.

Self-Check -6	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the difference between hand and power tools? (2 pts)

1. The following are hand tools except (1 pts)
   A. MIG Pliers B. metal file C. grinders D. Adjustable wrench

2. Which of the following is include under General Requirements for Hand and Power Tools ? (1 pts)
   A. Guarding B. Proper Use C. Maintenance D. All

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-7	Determining products to minimize waste materials and task time.

Waste management and disposal

Waste management is the collection, transport, processing or disposal, managing, monitoring and regulation of waste materials. The term usually relates to materials produced by human activity, and the process is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. The management of wastes treats all materials as a single class, whether solid, liquid, gaseous or radioactive substances, and tried to reduce the harmful environmental impacts of each through different methods. Waste types may include

- solid (non-hazardous) e.g. construction and demolition
- liquid (non-hazardous) e.g. chemical and aqueous
- hazardous - regulated, prescribed, quarantined, medical and clinical
- Recoverable resources e.g. recyclable and green waste.

Waste management techniques

It was away of eliminating or utilizing waste in to use able form through the following techniques.

A. Waste reduction (or prevention)

Waste reduction (or prevention) is the preferred approach to waste management because waste that never gets created doesn't have waste management costs. An example of waste reduction is reducing unnecessary packaging from manufactured products and produce. If this excess packaging could be avoided, no one would have to be concerned with the cost and effort of collecting the excess packaging, separating it for recycling, breaking it down, transporting it to manufacturers, and then integrating the recycled materials back into the manufacturing process. Waste reduction also helps conserve resources for future generations and contributes to a cleaner environment

B. Waste reuse

Reuse refers to checking, cleaning or repairing recovery operations, by which products or components of products that would have become waste are prepared so that they can be re-used without any other pre-processing. Preparing for re-use therefore implies changes in practices; both in terms of consumer purchasing habits and in terms of the manufacturing process. Waste can be used as source of fertilizer or alternative energy sources (biogas or fuel wood).The consistency of manure is usually classified as solid, semisolid, slurry or liquid, depending on its fluidity. Animal manure most be handled properly so that odours, dust, flies, rodents, and other nuisances are controlled. The system of waste handling must not allow the waste to be dumped in to streams, rivers, lakes, or reservoirs.

C. Waste audit

Waste audit is referred to as an examination of the amount and type of waste a particular organization receives. There are many types of waste that will be researched during the Waste Audit project such as paper, municipal waste, commercial, industrial, construction, and demolition. Determining the amount and type of waste received by an area will become very useful to any production for future decision making. Knowing what the site is receiving will help us take a stand and work in areas we feel are weak in our Sub regions..

D. Waste minimization

Waste minimization is the application of a systematic approach to reducing waste at source. The basic concept is one of preventing the waste generation rather than having to install end-of-pipe treatment systems to solve the problem. Waste minimization is an activity that relates to all inputs and outputs from an industry, business, site or process. Any raw material input to a process that does not become part of the product, is termed waste. This can be in the form of emissions to air, land and water and rejects. Waste is not simply material excess to requirements, but represents a loss in profits and can reflect as much as between 1% and 4% of a company's turnover. Waste minimization is achieved through the implementation of a number of steps. The first steps include obtaining commitment to the program from senior management, appointing a project champion to manage the program and selecting a project team to assist in data collection. All processes within the factory are then investigated and data collected on all inputs and outputs in terms of quantity and Value.

Below, 9 simple changes you can make to reduce waste in your home.

1. Get to know the rules of recycling. ...
2. Ditch the plastic bags. ...
3. Make a meal plan. ...
4. Start relying on reusable containers. ...
5. Start composting. ...
6. Learn to repair rather than discard. ...
7. Cancel unnecessary mail. ...
8. Stop using disposable plates.

1.5 Identifying and discussing job Procedures

Welding procedures (oxy)

Preparation Assemble all of the materials needed to make the weld. This includes parts, OA equipment, fix turning, tools, safety mask, gloves, and filler rod.

- Clean the parts to be welded.
- Assemble and fixture the parts in place
- Select the nozzle you plan to use for welding. and Clean the nozzle..
- Attach the nozzle to the gas feed line by hand. Don't over-torque -
- Check the pressure levels in the oxygen and acetylene tanks.
- Open the main valve on the acetylene tank approximately 1/2 turn.
- Open the pressure regulator valve on the acetylene tank (turn clockwise to open) and adjust the pressure in the acetylene line to 5 psi. DO NOT pressurize the acetylene over 15 psi - it will explode.
- Open the acetylene pin valve on the handle of the welding tool, letting acetylene escape. weak the pressure regulator valve until the regulator pressure is constant at 5 psi. Close the acetylene pin valve.
- Open the main valve on the oxygen tank. Turn the valve until it is fully open (until it stops turning).
- Open the pressure regulator valve on the oxygen tank (turn clockwise to open) and adjust the pressure in the oxygen line to 10 psi.
- Open the oxygen pin valve on the handle of the welding tool, letting oxygen escape. weak the pressure regulator valve until the regulator pressure is constant at 10 psi. Close the oxygen pin valve.
- Slightly open the acetylene valve (approx. 1/8 turn), until you can just barely hear acetylene escaping.

- Make sure there is no person or anything flammable in the path of the nozzle. Use the striker to ignite the acetylene. The flame should be yellow and will give off a lot of soot.

Adjusting the flame:

- Open the acetylene valve further and watch the flame near the nozzle tip. Add more acetylene until the flame is just about to separate from the tip. (The flame will separate from the tip of the nozzle if you add too much acetylene.) If so, reduce the flow until the flame reattaches to the tip, and then open the valve again to the near-separation point.
- Slightly open the oxygen pin valve. If the flame goes out, turn off the gases and try again. DO NOT try and ignite the flame with both oxygen and acetylene pin valves open. As the oxygen is added the flame will turn bluish in color.
- The blue flame will be divided into 3 different color regions - a long yellowish tip, a blue middle section, and a whitish-blue intense inner section. There are three types of flames as described below :

1. Neutral - This type of flame is the one you will use most often in the shop.
2. Reducing - This “reducing” flame will remove oxygen from iron oxides in steel.
3. Oxidizing flame : This flame burns hotter. A slightly oxidizing flame is used in brazing, and a more strongly oxidizing flame is used in welding certain brasses and bronzes.

Welding

- Put on a dark face-shield, at least shade 5, to protect your eyes from the light of the flame. Make sure you have on long sleeves and all natural fibers. You can wear a leather welding jacket and/or gloves if it makes you feel more comfortable.
- Apply the flame to the parts to begin heating. Use the region of the flame near the tip of the bluish inner region.
- The metal will begin to glow. Continue heating both parts being welded until a small pool of welded metal appears near the edge of each of the parts. You must get molten pools on both parts simultaneously to create the weld. They may require adding more heat to one side than the other, and takes some practice.
- After the molten pools have formed on both sides of the weld, use the flame to gently stir the two pools together to form the weld. This also takes a little practice.
- After the two pools have joined, slowly move the flame along the weld line, lengthening the pool using metal from both parts. A gentle, circular, swirling motion will help mix the molten metal from both sides as the puddle is lengthened. This process is highly dependent on the materials and part geometries being welded. Practice, practice, practice to get better control. Welding sample parts is a good idea..
- Continue this process until the entire weld line is complete.
- Once you're done, close the oxygen valve first, and then the acetylene valve.

Note: Welded parts can remain hot for a long time.

Shutting Down and Cleaning Up

- With the flame extinguished and the pin valves closed, close the main valve on the oxygen tank. It should be firmly seated at the bottom.
- Open the oxygen pin valve to bleed off all of the oxygen in the regulator and feed line. Close the pin valve once the feed line pressure has gone to zero.
- Fully back out the oxygen regulator valve so there is no pressure in the line. DO NOT close the valve, as this will pressurize the line once the tank is open again. In the case of the acetylene, if it is pressurized over 15 psi, it may explode! If you are not sure about doing this properly, find a TA to help you.
- Repeat above steps for the acetylene line.
- Return all of the tools to their proper storage places and coil the feed lines around the handle on the gas cylinder cart. Note: Do not remove the nozzle from the feed

line. The feed lines should always have a nozzle attached to prevent accidental damage to the threads used to attach the nozzle.

- Clean up any debris on the table or floor, and sweep floor around your work area.

1.8.1 thermal cutting procedures

Thermal cutting processes separate materials by applying heat, with or without a stream of cutting oxygen. The three dominant processes are oxy-fuel, plasma and laser cutting.

1. **Oxy-fuel cutting** is widely used for cutting steel of all shapes and sizes. This method is often described as 'burning' or 'flame cutting' because in this method an oxy-fuel torch is used to burn steel and cut it. In scientific terms, an exothermic reaction takes place between oxygen and steel which leads to the melting of the metal and eventual break down. This method is predominantly used to cut carbon steel because it is most effective with metals with lower melting point than the base metal. This method is used mainly in repair work for welding pipes and tubes. It is used in some metal art work also. Its main advantage is that it can be used where electricity is not available and it is portable, economical and almost maintenance free.

2. **Plasma cutting** is a method wherein a high speed jet of hot plasma is directed through a constrictive nozzle to cut metal. This method is commonly used to cut steel, **aluminum**, brass and copper. It is widely used in metal fabrication workshops, garages and in industries. This is one of the most preferred methods of thermal cutting because it is cost effective, cuts precisely and faster and does not warp the surrounding area. The advantages of **plasma cutting** are that it requires minimal training, can be used to cut through a wide range of thickness, is economical, precise and fast.

3. Laser Cutting:- This is by far the most popular of the three thermal cutting methods. It yields very accurate and precise cuts on steel, **aluminum** and stainless steel. Because of a small kerfs and controlled heat, laser cutting is best suited for intricate design cutting and minute holes. Laser cutting requires a little skill because you should be able to focus the laser beam on the exact spot. The laser beam when it falls on the metal leads to rapid melting and complete vaporization of the metal while the gas blows the molten metal away.

1.8.2 Thermal heating procedures

Process heating is heating, usually from steam, which is used to increase the temperature in a process vessel. ... If the generated steam is used for energy generation or process heating, then the thermal efficiency of the overall system is increased.

1.8.3 Types of flux, rod and their applications

Weld flux is a chemical purifying agent, flowing agent or cleaning agent. which is a combination of carbonate and silicate materials used in welding processes to shield the weld from atmospheric gases. It is commonly used in metal joining and metallurgy. It is a material used to promote the fusion of metals and is employed in welding. Which used to Prevent the formation of oxides and the other unwanted contaminations, or to dissolve them and facilitate removal. During welding the flux melts and becomes a liquid slag, Covering the operation and protecting the molten weld metal. the slag hardens upon cooling and must be removed later by Chipping or brushing.

Types of Fluxes

1. Halide Fluxes (CaF2-NaF)
2. Oxide Fluxes (MnO-SiO2 , FeO-MnO-SiO2)
3. Halide -Oxide Fluxes (CaF2-CaO-Al2O3)

Functions of Flux in welding.

1. Provide protective atmosphere for welding.
2. Stabilize the arc and control arc resistivity
3. Reduce spattering.
4. Permit Use of different types of current and polarity.
5. Promote slag detachability.

Comparison between Flux shielding and Gas shielding For flux shielding

1. Sustenance of shield cover is more
2. Control of heat transfer is good.
3. Reactivity with metal is more
4. Used for Ferrous materials.
5. Size of Heat affected zone **(HAZ)** is more.
6. Arc stability is less.
7. Arc initiation is difficult.
8. Chances of Slag entrapment is High.
9. Cost is less.

1.8.4 Equipment maintenance procedures

Clean-up and regular maintenance is important for keeping equipment in good working order. Staff shall keep specific maintenance logs for all equipment used. Refer to manufacturer's operation manual for recommended equipment scheduled maintenance, repair, and/or adjustments. Keep equipment maintenance records indefinitely.

General requirements for equipment maintenance include:

- Obtaining a copy of the maintenance schedule recommended by the manufacturer.
- Ensuring that maintenance is performed as required.
- Ensuring that the person(s) performing the maintenance are competent (e.g. licensed mechanic).
- Retaining records of maintenance/service conducted.
- Specifying who is responsible for overseeing equipment maintenance and where the records are kept.
- Set up a system for removal and tagging of damaged or defective tools and equipment.

The method of development for the standard maintenance procedures (SMP) on a larger, more complicated task has several steps but the principles of concise documentation and absolute accountability are the same as with those of the routine SMP. The following steps are important when it comes to developing SMPs for larger jobs:

- **Have a pre-plan.** Before you begin the large job, have the maintenance planner sit down with all of the personnel who were members of the work team the last time the job was done, or at least as many of them as are available. The planner should write out the steps the way they are remembered. This plan—sketchy though it may be—will form the outline of the upcoming job.
- **Photograph the job.** The importance of this step is paramount. Even a well-written job plan can be misread or misunderstood. A photograph, however, speaks for itself. If you have the equipment and personnel, videotaping the procedure is even better. The supervisor is not a good choice for this role, because he/she needs to be supervising. If the reliability engineer is not available, perhaps the scheduler or the clerk can pitch in. Another idea is to enlist the aid of an employee who has been assigned to restricted duty.

- **Write it down.** The maintenance planner should be the one to write down the action step-by-step, beginning with the safe lockout of the machine. This individual should assume that he/she is writing the procedure for someone who is a total stranger to the plant and the machines—and that the written procedure will ensure that this imaginary person can successfully complete the job. The planner should be looking not only at what currently is being done, but also for ways to improve on the procedure (including ways the job can go more smoothly in the future). He/she also should be sure to record the number of man hours associated with each step, from kitting the job right on down to cleanup.
- **Write out a complete parts list.** This list should be as comprehensive as possible, down to the numbers and grades of the nuts, bolts and washers that are needed. Lead times for special-order or fabricated parts should be noted.
- **Write out a complete supplies, tools and experts list.** If special jigs or stands are made for the job, they should be noted on the SMP, including where they are stored. Have there been shortages of special welding rods or bottled gas? Jacks, cranes and special tools also should be noted. What about consultants or factory reps? If they were present last time, chances are they will be needed next time. Does an operator need to be present? Will it be desirable to have predictive maintenance personnel available to take readings for baselines after the job is completed?
- **Include drawings and diagrams.** Any tool, document or image that can help the technician as he/she is performing the job should be available.

Self-Check -7	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is waste management ? (2)

2. List down waste management techniques (4)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation sheet 1

OPERATION TITLE:- Assembling oxyacetylene equipments

PURPOSE:- reducing hazard and improve safety

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- Safe and comfort working environment
- Hazard free/ well sorted work shop
- Well equipped tools/equipments,
- Well ventilated& have bright light

EQUIPMENT **TOOLS AND MATERIALS :**

Oxyacetylene equipment, wrench , wire brush

PROCEDURE

- Clean the parts to be welded.
- Assemble and fixture the parts in place
- Select the nozzle you plan to use for welding.
- Clean the nozzle..
- Attach the nozzle to the gas feed line by hand. Don't over-torque -
- Check the pressure levels in the oxygen and acetylene tanks.
- Open the main valve on the acetylene tank approximately 1/2 turn.
- Open the pressure regulator valve on the acetylene tank
- Open the acetylene pin valve on the handle of the welding tool,
- Open the main valve on the oxygen tank.
- Open the pressure regulator valve on the oxygen tank
- Open the oxygen pin valve on the handle of the welding tool,
- Slightly open the acetylene valve (approx. 1/8 turn),
- Make sure there is no person or anything flammable in the path of the nozzle. Use the striker to ignite the acetylene.

PRECAUTIONS:-

- ✓ Wear working clothes properly which fit with your body
- ✓ Use proper tools/equipments the purpose designed for.
- ✓ Keep yourself from electric shock

QUALITY CRITERIA: -

Assured the Performing of all the activities listed to assemble all equipments on a good condition with the specific manual

Operation sheet 2

OPERATION TITLE:- Adjusting oxyacetylene flame

PURPOSE:- to use correct flame for the work to be weld

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- Safe and comfort working environment
- Hazard free/ well sorted work shop
- Well equipped tools/equipments,
- Well ventilated& have bright light

EQUIPMENT **TOOLS AND MATERIALS :**

Assembled Oxyacetylene, wrench , wire brush, igniter

PROCEDURE

- Open the acetylene valve further and watch the flame near the nozzle tip.
- Add more acetylene until the flame is just about to separate from the tip. (The flame will separate from the tip of the nozzle if you add too much acetylene.) If so, reduce the flow until the flame reattaches to the tip, and then open the valve again to the near-separation point.
- Slightly open the oxygen pin valve. If the flame goes out, turn off the gases and try again.
- DO NOT try and ignite the flame with both oxygen and acetylene pin valves open. As the oxygen is added the flame will turn bluish in color.
  The blue flame will be divided into 3 different color regions - a long yellowish tip, a blue middle section, and a whitish-blue intense inner section.

1. **Neutral** - equal oxygen and acetylene, use most often in the shop.
2. **Reducing** more acetylene less oxygen, to remove oxygen from iron oxides in steel.
3. **Oxidizing flame** : more oxygen less acetylene, burns hotter. A slightly oxidizing flame is used in brazing, and a more strongly oxidizing flame is used in welding certain brasses and bronzes.

PRECAUTIONS:-

- ✓ Wear working clothes properly which fit with your body
- ✓ Use proper tools/equipments the purpose designed for.
- ✓ Keep yourself from electric shock

QUALITY CRITERIA: -

Assured the Performing of all the activities listed to adjust all types of flame on a good condition with the specific manual

Operation sheet 3

OPERATION TITLE:- Shutting Down and Cleaning Up

PURPOSE:- prevent fire hazard and safe equipments

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- Safe and comfort working environment
- Hazard free/ well sorted work shop
- Well equipped tools/equipments,
- Well ventilated& have bright light

EQUIPMENT **TOOLS AND MATERIALS :**

Assembled Oxyacetylene, wrench , wire brush,

PROCEDURE

- With the flame extinguished and the pin valves closed, close the main valve on the oxygen tank..
- Open the oxygen pin valve to bleed off all of the oxygen in the regulator and feed line. Close the pin valve once the feed line pressure has gone to zero.
- Fully back out the oxygen regulator valve so there is no pressure in the line.
- Repeat above steps for the acetylene line.
- Return all of the tools to their proper storage places and coil the feed lines around the handle on the gas cylinder cart. Note.
- Clean up any debris on the table or floor, and sweep floor around your work area

PRECAUTIONS:-

- ✓ Wear working clothes properly which fit with your body
- ✓ Use proper tools/equipments the purpose designed for.
- ✓ Keep yourself from electric shock

QUALITY CRITERIA: -

Assured the Performing of all the activities listed to shutting down oxyacetylene flame on a good condition with the specific manual

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LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8 hour.

Task 1. Use work instructions to determine job requirements, including job sheets, quality and quantity of materials.
Task 2. Observe Workplace Health and Safety (WHS) requirements, including personal protection needs
Task 3. Read and interpret Job specifications
Task 4. Select and inspect materials for repairing and replacement
Task 5. Select correct hand, power tools and safety equipment for safe use.
Task 6. Determine products to minimize waste materials and task time.
Task 7. Identify and discuss job Procedures

List of Reference Materials

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Vehicle Body Repairing and Painting NTQF Level-II

Learning Guide -17

Unit of Competence: - Carry-out Welding Procedures

Module Title: - Carrying-out Welding Procedures

LG Code: EIS VRP2 M06 LO02-LG-17

TTLM Code: EIS VRP2 TTLM 0919v1

LO 02: Carry out oxy acetylene welding procedures

Instruction Sheet	Learning Guide #- 17

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Accessing **Information**
- Carrying out welding according to a standard
- Completing Welding procedures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Access **Information**
- Carry out welding according to a standard
- Complete Welding procedures without causing damage to any component or system

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written in the “Information Sheets ”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1,2,3 ” **in page 65,69,72 respectively-.**
5. Ask from your teacher the key to correction
6. If you earned a satisfactory evaluation from self check proceed to operation sheet1 in page 73 and lap in page 74”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet 1	Accessing Information

1.1. Workplace procedures relating to the use of tools and equipment

GAS WELDING TOOLS AND EQUIPMENTS

Equipment for gas welding as well as for gas cutting are almost similar. It consists of two large steel cylinders one containing oxygen at high pressure and other dissolved acetylene also at high pressure. In addition to tools and equipments some consumables are also used in gas welding. Major tools and equipment and consumables are listed below followed by their brief description.

Tools and Equipment

A. Gas cylinders (two)
B. Hose pipes and valves
C. Cylinder pressure gauge
D. Outlet pressure gauge
E. Pressure regulators
F. Blow pipe or torch and spark lights
G. Welding screens
H. Goggles, screens, gloves and apron
I. Wire brush, trolley, chipping hammer.

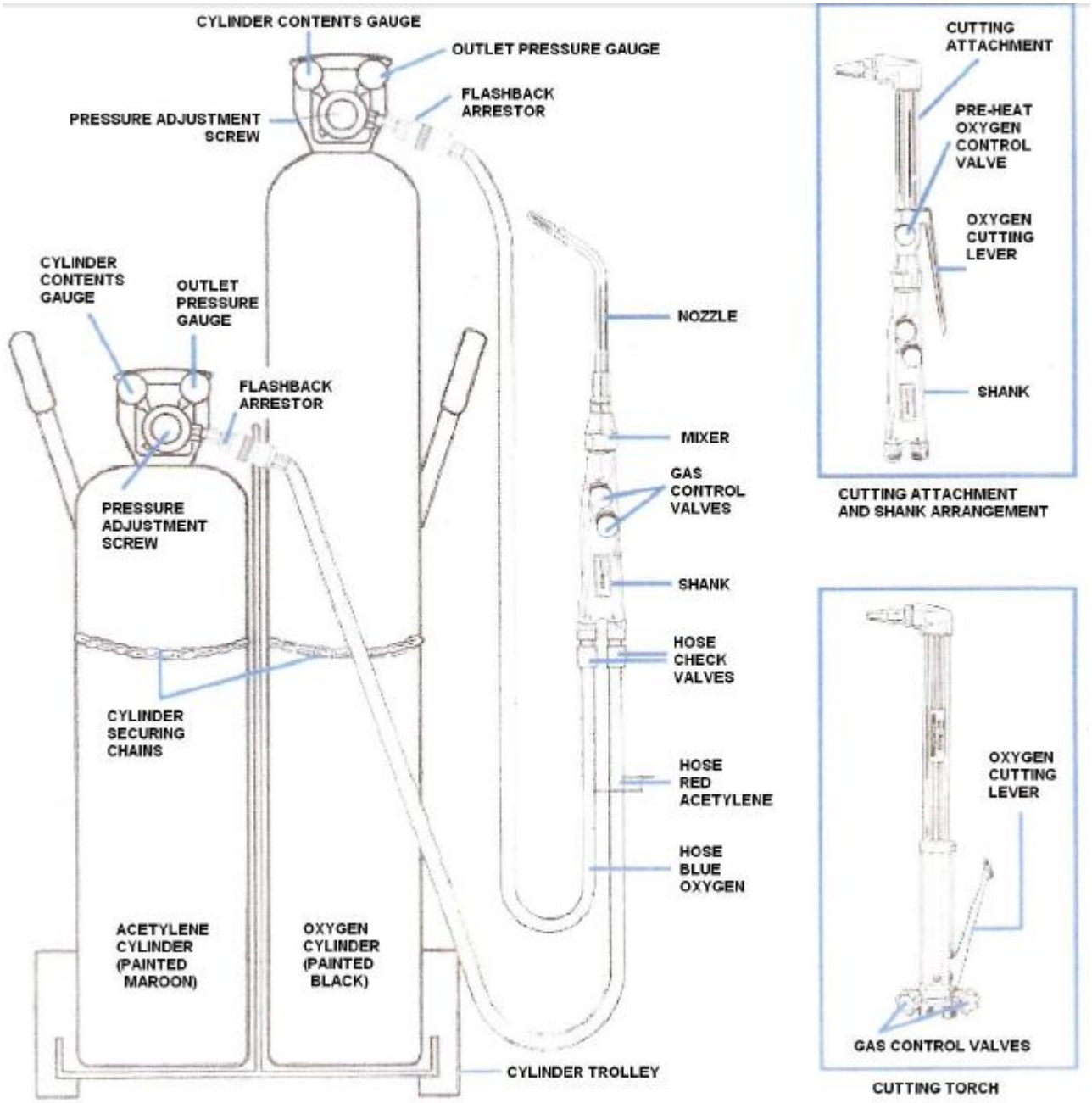
Consumables

a. Oxygen gas
b. Acetylene gas
c. Filler metal (rod or wire)
d. Fluxes.
e. *Metal to be Welded*
f. Iron rich steels
g. Stainless steel
h. Copper
i. Aluminum and its alloy

Composition of Welding Rod

a. More ‘C’ Si, Mn less ‘P’ and ‘S’
b. should have ‘Cr’ and ‘V’.
c. Copper rods with phosphorus.
d. Rods of same metal containing some silicon.

Oxy-Acetylene Welding and Cutting Equipment Assembly step by step instruction



1. Equipment assembly: Ensure that the equipment is assembled correctly
2. Check equipment: First, make sure that the gas flow from both the oxygen and the acetylene cylinders is turned off tightly. The two cylinders are secured in an upright position. This is usually on a wheeled trolley. Look at the hose pressure and cylinder pressure gauges on top of each cylinder. Both gauges on each cylinder should read zero. If both gauges do not read zero, turn the main cylinder valve on the top of the cylinder clockwise, to close it completely. Then you must purge the system of any gas.
3. Purge the system: To purge the system, make sure the main cylinder valve is closed tightly. Pick up the torch handle and note that it has two hoses attached. One hose supplies acetylene, the other oxygen. Turn the oxygen regulator under the gauges clockwise, and open the oxygen valve on the handle. This will purge any gas that may still be in the system and the gauges should both drop back to zero. Repeat this procedure with the acetylene cylinder.

4. Install the torch handle: The torch handle is the connection between the hoses and the working tips. It consists of a body and two taps. It's used for both welding, Brazing and heating. Different attachments are connected to the handle to enable cutting. Examine the connections. One connection is marked "OX", and is for the oxygen hose. The other is marked "AC", and is for the acetylene hose.
5. Connect the hoses: As a further safety precaution, you'll find the oxygen connector is right hand thread and the acetylene connector is a left hand thread.
6. Install the correct tip: Welding tips come in sizes that are stamped with a number. Number one is the smallest tip. The larger the number, the larger the tip and the greater the heat that it will provide. Select the tip size suitable for the task and screw it onto the end of the torch handle. Hold the torch handle in your hand, so that you can comfortably adjust the oxygen and acetylene taps. Position the tip so that it faces away from you. Gently tighten the tip-securing fitting.
7. Adjust the pressure of the gas flow: You are now ready to adjust the gas pressure for heating. Look at the two valves on the torch handle. The valve next to the oxygen hose controls the flow of oxygen to the tip. Close it tightly clockwise. The valve next to the acetylene hose controls the flow of acetylene to the tip. Also, close it tightly clockwise.
8. Turn on the gases: Now that you're ready to use the torch, turn the main valve on the top of each cylinder counter-clockwise half a turn to open the valve. The needle on the cylinder pressure gauge will rise to show you the pressure in the cylinder. Turn the oxygen regulator handle clockwise until the needle in the gauge registers 2-5 PSI. Turn the acetylene regulator handle clockwise until the needle in the gauge registers 2-5 PSI. This is your working pressure for welding light plate.
9. Check the area: Before you light the torch, check the area you're working in to make sure there are no flammable materials or fluids nearby. Workmates should also be clear of the area. The welding flame is not only extremely hot; it also produces dangerous ultra violet rays, which will damage your eyes. It is absolutely vital that you are wearing the right safety gear: gloves and tinted goggles or face mask. So put them on and adjust them comfortably.
10. Ignite the torch: Now you are ready to ignite the torch with the striker. The tip of the torch must be pointing downwards away from your body and away from the gas cylinders. Turn the acetylene valve on the torch handle slightly towards the 'ON' position. You should hear the gas hissing. Hold the striker against the tip of the torch with the lighter cup between the torch and you. Flick the striker to create the spark that will ignite the gas at the tip of the torch. Open the acetylene valve slowly until the sooty smoke produced by the torch disappears. Then slowly open the oxygen valve on the torch handle.
11. Adjust the flame: As you open the oxygen valve, you will see the color of the flame change. The pure acetylene flame is yellow, and it will change to blue as you add the oxygen. Continue to open the oxygen valve until you can observe a small, sharp blue cone in the center of the torch flame. This is the "neutral", you can now adjust to the desired flame, for the task you are doing. (Welding, brazing)

1.2. Component manufacture specifications

Component manufacturing references the individual manufacturing services utilized to produce individual components of a system. Component manufacturing refers to metal and plastic manufacturing services including simple weldments, manifolds and tube assemblies. Some manufacturing service providers are able to manufacture components with metals and plastics, and many can also build products to meet specifications.

The Manufacturing Specification is an alternative to producing separate sheets for the manufacturing flow chart, sequence drawing and final 3D drawing. It is a concise sheet, which summaries each of these design sheets. When creating this sheet, check

everything you write and draw against the specification you wrote earlier in the project, after the research section.

A manufacturing specification contains all the information that is needed to make the product. It describes the stages of manufacture and the materials needed, using flowcharts, diagrams, notes and samples. A manufacturing specification is done once the final product has been developed

1.3. Customer requirements

A customer requirement is a specification that originates with customers as opposed to internal stakeholders. This can include both functional and non functional requirements for products, services and experiences.

There can be two types of customer requirements:

1. Service Requirement
2. Output Requirement

Service Requirements: Intangible aspects of purchasing a product that a customer expects to be fulfilled. It consists of elements like on-time delivery, service with a smile, easy-payment etc. It encompasses all aspects of how a customer expects to be treated while purchasing a product and how smooth his buying process goes.

Output Requirements: These are mostly the tangible characteristics, features or specifications that a consumer expects to be fulfilled in the product. If a consumer is availing a service as a product, then various service requirements can take the form of output requirements. For example, if the consumer is hailing a metro cab, then on-time arrival becomes an output requirement. For other products such as gadgets, the product specifications like the loudness and clarity of a pair of speakers becomes its output requirements.

1.4. Industry/workplace codes of practice

The purpose of an industry code is to ensure industry compliance with an agreed upon set of objectives that benefit workers, employers and consumers. These objectives usually concern the promotion of best industry practice, improving safety standards and enhancing consumer confidence.

A code of practice provides practical guidance for people who have work health and safety duties. These codes give guidance on:

- How to achieve the standards required under the Act
- Effective ways to identify and manage risks.

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the Act, in relation to the subject matter of the code.

Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Benefits of an industry code of practice?

An industry code of practice provides a range of benefits to both industry and consumers such as:

- The creation and enforcement of appropriate industry practices formulated by industry experts.
- The flexibility of an industry code allows businesses to respond to recurring market issues and adapt to changing consumer needs.
- A business-friendly alternative to legislation that can result in reduced costs for industry and government.

- Providing safeguards and protection for consumers.

An industry code of practice will set out a framework for compliance through provisions such as:

- Specific measures for compliance, relevant guidelines, standards and practices;
- Risk management strategies;
- Complaint handling schemes and sanctions for non-compliance; and
- An outlined process for periodic review of the code.

1.5. Material safety data sheets

A Material Safety Data Sheet (MSDS) is a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product. It is an essential starting point for the development of a complete health and safety program. It also contains information on the use, storage, handling and emergency procedures all related to the hazards of the material. The MSDS contains much more information about the material than the label. MSDSs are prepared by the supplier or manufacturer of the material. It is intended to tell what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, what to do if accidents occur, how to recognize symptoms of overexposure, and what to do if such incidents occur.

There are nine (9) categories of information that must be present on an MSDS in Canada. These categories are specified in the Controlled Products Regulations and include:

1. Product Information: product identifier (name), manufacturer and suppliers names, addresses, and emergency phone numbers
2. Hazardous Ingredients
3. Physical Data
4. Fire or Explosion Hazard Data
5. Reactivity Data: information on the chemical instability of a product and the substances it may react with
6. Toxicological Properties: health effects
7. Preventive Measures
8. First Aid Measures
9. Preparation Information: who is responsible for preparation and date of preparation of MSDS

The Controlled Products Regulations prescribes what information must be present in more detail.

What is a Material Safety Data Sheet (MSDS)? A material safety data sheet is a technical document which provides detailed and comprehensive information on a controlled product related to:

- Health effects of exposure to the product
- Hazard evaluation related to the product's handling, storage or use
- Measure to protect workers at risk of exposure
- Emergency procedures.

Key Takeaways: Material Safety Data Sheet (MSDS)

- A Material Safety Data Sheet or is a summary of the key properties of a substance and the hazards associated with its use.
- Material Safety Data sheets are not standardized, so it's important to consult one provided by a respected source.
- Two chemicals that have the same name may have very different MSDS sheets because the particle size of the product and its purity may significantly affect its properties.

- MSDS sheets should be kept in an easy-to-find location and made accessible to all persons dealing with chemicals.

1.6. Workplace procedures relating to reporting and communication

Workplace procedures communicates an organisation's values and the organisation's expectations of employee behaviours and performance. Workplace policies often reinforce and clarify standard operating procedure in a workplace. Many routine matters can be dealt with through simple workplace procedures and processes being put in place. Employers often provide employees with handbooks, policies and procedures which regulate workplace matters such as:

- Work health and safety.
- Anti-discrimination and equal employment opportunity.
- Occupational Health and Safety.
- Use of company property.
- Use of social media.
- Drug and alcohol use.
- Employee performance management and discipline.

All organizations who employ staff should have well documented policies and procedures, at the very least, for the following reasons:

- Policies and procedures can fulfill employers' obligations and responsibilities under certain legislation such as work health and safety and discrimination legislation.
- Policies and procedures provide employees with a clear understanding of what is expected of them.
- Policies and procedures provide a fair, predictable and consistent approach to managing the workplace and workplace issues. Avoiding the need make it up as you go which in almost all cases will result in a problem.
- Being able to refer to a set of policies and procedures can save time when inducting new employees and for training purposes.
- Policies and procedures and a written employment agreement are valuable reference tools in managing workplace issues arising from employee misconduct or inappropriate behavior.

1.7. Manufacturer specifications and operational procedures

Manufacturer's specifications means

- ✓ the written specifications, instructions or recommendations provided by the manufacturer of equipment or supplies that describe how the equipment or supplies are to be constructed, erected, installed, assembled, examined, inspected, started, operated, used, handled, stored, stopped, calibrated, adjusted, maintained, repaired or dismantled,
- ✓ an instruction, maintenance or operating manual provided by the manufacturer of equipment or supplies; (directives du fabricant)
- ✓ written guide lines established by a manufacturer for the installation and operation of the manufacturer's equipment.

Standard operating procedures (SOPs) are written instructions intended to document how to perform a routine activity. Many companies rely on standard operating procedures to help ensure consistency and quality in their products.

A standard operating procedure (SOP) is a set of step-by-step instructions compiled by an organization to help workers carry out complex routine operations. SOPs aim to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. The following are consumable materials during welding except
   A. Copper B. Oxygen gas C. Fluxes. D. Apron
2. ---------- is a document that contains information on the potential hazards.
   A. Manufacturing Specification B. Customer requirements
   C. workplace codes of practice
3. What is Standard operating procedures?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 2	Carrying out welding according to a standard

Welding Techniques

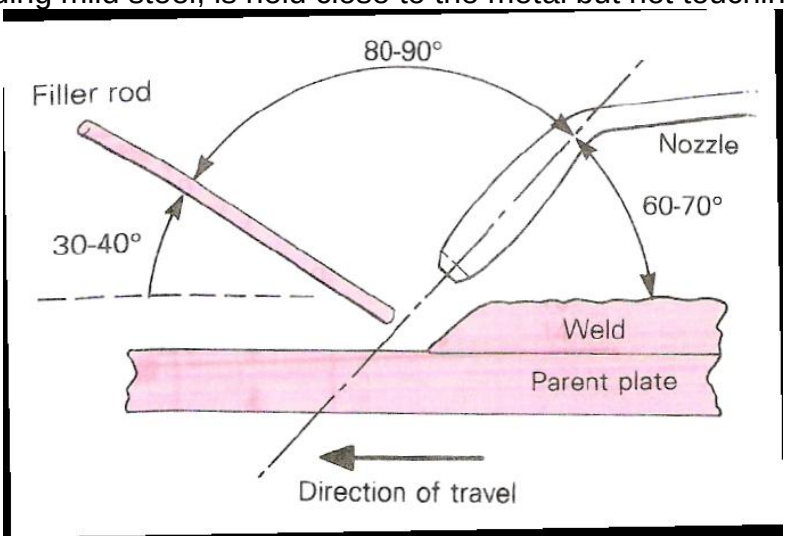
When you have mastered the technique of lighting the blowpipe and adjusting the neutral flame correctly, you will be ready to practice the different techniques of gas welding. This will usually involve some practice, under supervision, on scrap pieces of material.

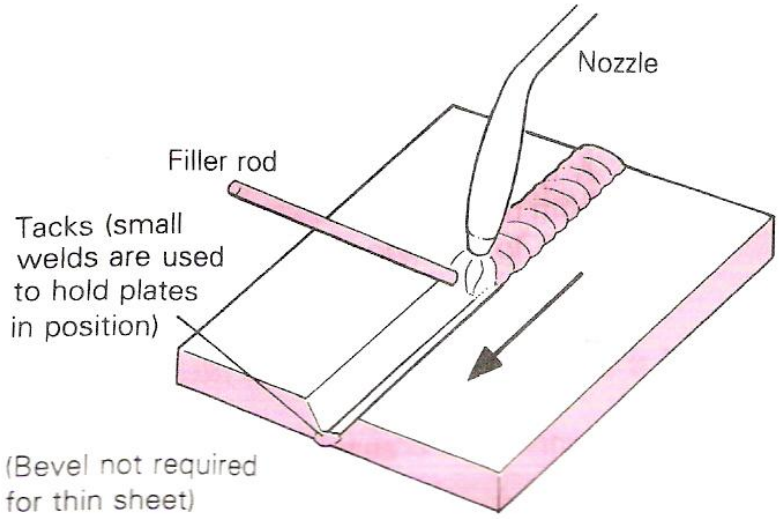
The Leftward Technique of Gas Welding

The first stage is to deposit a straight bead of weld on a single piece of material and then, when you have perfected this, to practice joining two pieces. The ultimate aim is to achieve a standard of weld quality that will enable you to produce the required test pieces, if you want to become a qualified welder.

The leftward method of gas welding is used for welding steel plate up to 5 mm in thickness. It can also be used for welding non-ferrous metals.

When the blowpipe is held in the right hand, the weld travels from right to left, with the filler rod in front of the nozzle. The inner cone of the flame, which should be in the neutral condition for welding mild steel, is held close to the metal but not touching it.





The Leftward Technique of Gas Welding

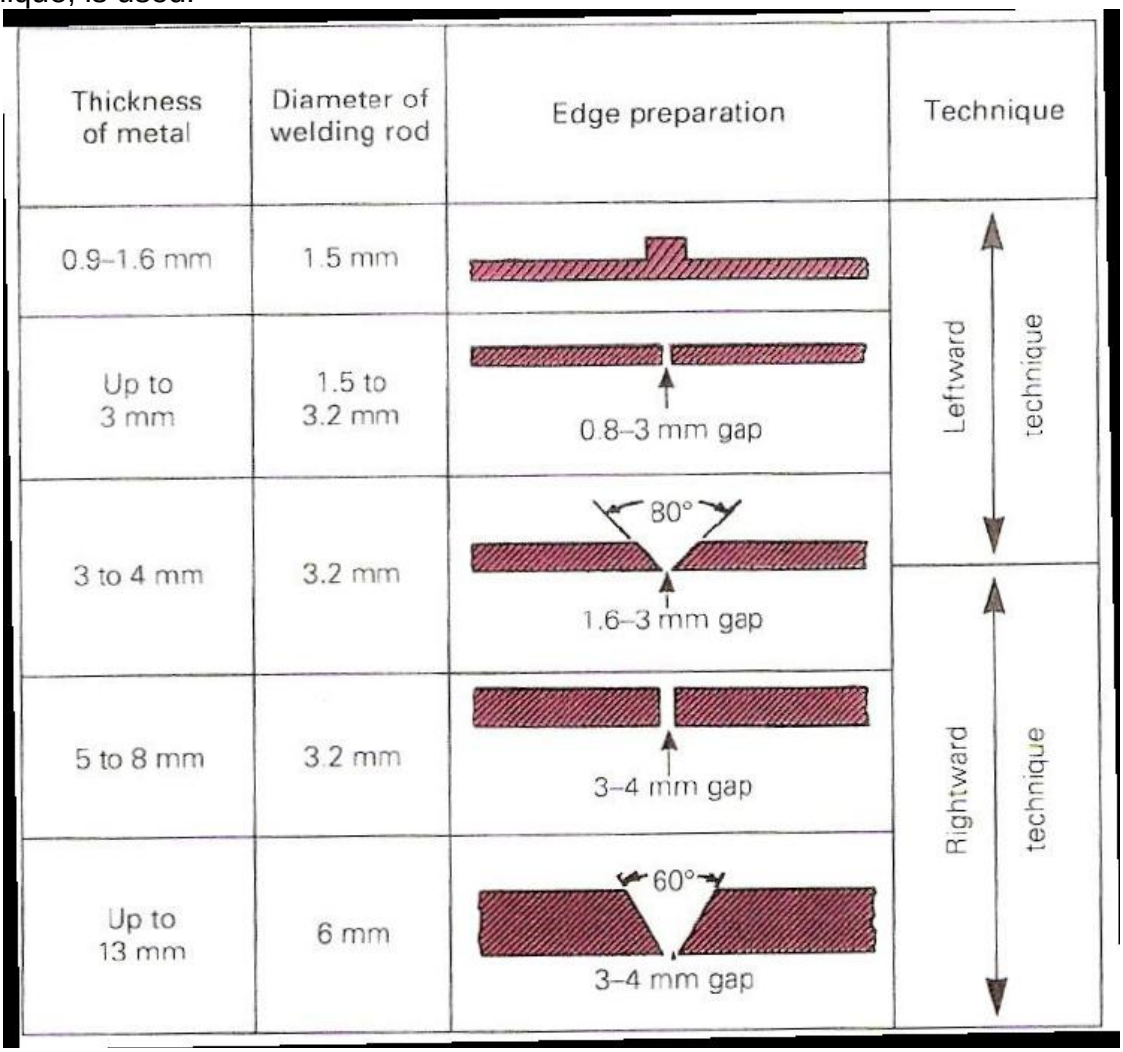
For the best welding conditions, the blowpipe and filler rod should be held at approximately the angles shown in **the figure.** The nozzle is given either circular or slight side-to-side movements in order to obtain good and even fusion at the sides of the weld.

To commence welding by this technique, play the flame on the start of the joint until a molten pool is formed. Welding then proceeds by filler rod being fed or dipped into the molten pool. The rod is melted by this dipping action and not by the flame itself.

Do not hold the filler rod continuously in the molten pool, as this could prevent the heat of the flame and thus the molten pool from reaching the lower parts of the weld joint, resulting in possible lack of fusion.

The Rightward Technique of Gas Welding

As the plates get thicker, different edge preparations are employed. These different edge preparations are shown in **Error! Reference source not found.**. Notice that as the plate gets more than 4 mm thick, it is recommended that another technique, the rightward technique, is used.



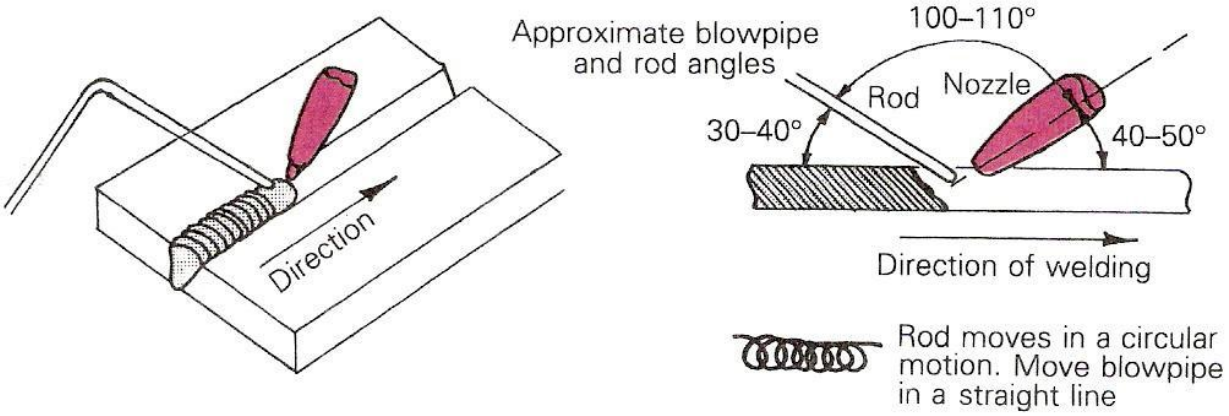
Edge Preparations for Different Thicknesses of Plate. Above 13mm thickness, plate can be beveled and welded from both sides.

These days it is more usual to use one of the arc welding processes on materials above 4 mm thickness, but the rightward method is handy to know. Some welding courses include it, and a brief description is given here.

The rightward technique is shown in **Error! Reference source not found.**. Some of the advantages of this method on thicker plate are as follows:

1. It is faster and uses less filler rod, so it is less expensive.
2. There is less expansion and therefore less contraction.
3. The flame remains over the deposited metal, giving an annealing action.
4. A better view of the molten pool is obtained, allowing for greater control of the welding operation.

Gas welding can be used for positional welding (welding in the vertical and overhead positions). These notes cover the flat position only, as you will need to perfect this technique thoroughly before you can learn positional welding.



The Rightward Technique of Gas Welding

Video

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Which off the following is not true during welding ?

2. Write four advantages of the rightward technique of gas welding method on thicker plate

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 3	Completing Welding procedures

Making final inspection to ensure protective guards and safety features

Final inspection is identifying whether work done/repaired parts normal operation, work tool/equipments and working area can be operated, adjusted and maintained safely. final inspection is necessary for any working activity work area, tools/ equipments where significant risks to health and safety may arise from incorrect repairing/maintaining, installation, reinstallation, deterioration or any other circumstances. The need for final inspection and inspection frequencies should be determined through risk assessment.

Importance of inspection

As an essential part of a health and safety program, the work done,/and workplaces should be inspected. Inspections are important as they allow you to:

- listen to the concerns of workers and supervisors
- gain further understanding of jobs and tasks
- identify existing and potential hazards
- determine underlying causes of hazards
- monitor hazard controls (personal protective equipment, engineering controls, policies, procedures)
- recommend corrective action

Some common poor work practices include:

- using machinery or tools without authority
- operating at unsafe speeds or in other violation of safe work practice
- removing guards or other safety devices, or rendering them ineffective
- using defective tools or equipment or using tools or equipment in unsafe ways
- using hands or body instead of tools or push sticks
- overloading, crowding, or failing to balance materials or handling materials in other unsafe ways, including improper lifting
- repairing or adjusting equipment that is in motion, under pressure, or electrically charged
- failing to use or maintain, or improperly using, personal protective equipment or safety devices
- creating unsafe, unsanitary, or unhealthy conditions by improper personal hygiene, by using compressed air for cleaning clothes, by poor housekeeping, or by smoking in unauthorized areas
- standing or working under suspended loads, scaffolds, shafts, or open hatches

Inspection Procedures

When conducting inspections, follow these basic procedures:

- Draw attention to the presence of any immediate danger--other items can await the final report.
- Shut down and "lock out" any hazardous items that cannot be brought to a safe operating standard until repaired.

- Do not operate equipment. Ask the operator for a demonstration. If the operator of any piece of equipment does not know what dangers may be present, this is cause for concern. Never ignore any item because you do not have knowledge to make an accurate judgment of safety.
- Look up, down, around and inside. Be methodical and thorough. Do not spoil the inspection with a "once-over-lightly" approach.
- Clearly describe each hazard and its exact location in your rough notes. Allow "on-the-spot" recording of all findings before they are forgotten. Record what you have or have not examined in case the inspection is interrupted.
- Ask questions, but do not unnecessarily disrupt work activities. This may interfere with efficient assessment of the job function and may also create a potentially hazardous situation.
- Consider the static (stop position) and dynamic (in motion) conditions of the item you are inspecting. If a machine is shut down, consider postponing the inspection until it is functioning again.
- Discuss as a group, "Can any problem, hazard or accident generate from this situation when looking at the equipment, the process or the environment?" Determine what corrections or controls are appropriate.
- Do not try to detect all hazards simply by relying on your senses or by looking at them during the inspection. You may have to monitor equipment to measure the levels of exposure to chemicals, noise, radiation or biological agents.
- Take a photograph if you are unable to clearly describe or sketch a particular situation

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List four importance of inspection (4 Pts)

2. Mention at least six common poor work practice in the workplace (6 pts)

Note: **Satisfactory rating - 5 points & above** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation sheet 1

OPERATION TITLE:- apply oxyacetylene welding
PURPOSE:- to weld or attach two or more metals together

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- Safe and comfort working environment
- Hazard free/ well sorted work shop
- Well equipped tools/equipments,
- Well ventilated& have bright light

EQUIPMENT **TOOLS AND MATERIALS :**

Assembled Oxyacetylene, wrench , wire brush, igniter, filler metal (rod or wire), fluxes, metal to be welded, chipping hammer, protective cloth,

PROCEDURE

1. Assemble all of the materials needed to make the weld.
2. Clean the parts to be welded.
3. Adjusting the flame (neutral, reducing or oxidizing)
4. Put on a dark face-shield, at least shade 5, to protect your eyes from the light of the flame.
5. Make sure you have on long sleeves and all natural fibers. You can wear a leather welding jacket and/or gloves if it makes you feel more comfortable.
6. Apply the flame to the parts to begin heating. Use the region of the flame near the tip of the bluish inner region.
7. The metal will begin to glow. Continue heating both parts being welded until a small pool of welded metal appears near the edge of each of the parts. You must get molten pools on both parts simultaneously to create the weld. They may require adding more heat to one side than the other, and takes some practice.
8. After the molten pools have formed on both sides of the weld, use the flame to gently stir the two pools together to form the weld. This also takes a little practice.
9. After the two pools have joined, slowly move the flame along the weld line, lengthening the pool using metal from both parts. A gentle, circular, swirling motion will help mix the molten metal from both sides as the puddle is lengthened. This process is highly dependent on the materials and part geometries being welded. Practice, practice, practice to get better control. Welding sample parts is a good idea..
10. Continue this process until the entire weld line is complete.
11. Once you're done, close the oxygen valve first, and then the acetylene valve
12. Shutting Down and Cleaning Up

PRECAUTIONS:-

- ✓ Wear working clothes properly which fit with your body
- ✓ Use proper tools/equipments the purpose designed for.
- ✓ Keep yourself from electric shock

QUALITY CRITERIA: -

Assured the Performing of all the activities listed to adjust all types of flame on a good condition with the specific manual

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8 hour.

Task 1. Access information from appropriate sources to enable welding to be performed in accordance with vehicle and equipment manufacturer procedures.
Task 2. Carry out welding according to a standard
Task 3. Complete Welding procedures without causing damage to any component or system.

List of reference materials

1. https://www.mbaskool.com/business-concepts/marketing-and-strategy-terms/11884-customer-requirements.html
2. https://www.bizmanualz.com/increase-customer-satisfaction/what-are-the-customers-requirements.html
3. https://axenics.com/blog/contract-manufacturing-vs-component-manufacturing-whats-the-difference
4. http://www.technologystudent.com/despro_flsh/manspec1.html
5. https://lawpath.com.au/blog/what-is-an-industry-code-of-practice
6. https://www.worksafe.qld.gov.au/laws-and-compliance/codes-of-practice
7. https://www.codea.com.au/publication/workplace-policies-and-procedures/
8. https://www.thoughtco.com/using-material-safety-data-sheets-602279
9. https://www.uregina.ca/hr/hsw/assets/docs/pdf/Laboratory-Safety/Material-Safety-Data-Sheet.pdf
10. https://www.ccohs.ca/oshanswers/legisl/msdss.html
11. http://www.acastronovo.com/ClassHtms/Weld01.htm
12. https://www.sciencedirect.com/topics/engineering/gas-welding
13. http://ignou.ac.in/upload/Unit-5.pdf
14. https://en.wikipedia.org/wiki/Standard_operating_procedure
15. https://www.lawinsider.com/dictionary/manufacturers-specifications

Vehicle Body Repairing and Painting NTQF Level-II

Learning Guide -18

Unit of Competence: - Carry-out Welding Procedures

Module Title: - Carrying-out Welding Procedures

LG Code: EIS VRP2 M06 LO3-LG-18

TTLM Code: EIS VRP2 TTLM 0919v1

LO 03: Cleanup work area and maintain equipment

Instruction Sheet	Learning Guide #- 18

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Collecting and storing material that can be reused
- Removing waste and scrap following workplace procedures
- Cleaning and inspecting equipment and work area for serviceable conditions in accordance with workplace procedures.
- Tagging unserviceable equipment and identifying faults in accordance with workplace requirements
- Completing operator maintenance in accordance with manufacturer's specifications and site procedures
- Maintaining tooling in accordance with workplace procedures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Collect and store material that can be reused
- Remove waste and scrap
- Clean and inspect equipment and work area for serviceable conditions
- Tag unserviceable equipment and identifying faults
- Complete operator maintenance
- Maintain tools and equipments

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written in the “Information Sheets ”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1,2,3,4,5,6” **in page 80,82,86,88,90,92 respectively-.**
5. Ask from your teacher the key to correction
6. If you earned a satisfactory evaluation from self check proceed to operation sheet 1,2,3 in page 92,93,94 and lap in page 95”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet 1	Collecting and storing material that can be reused

Housekeeping Signs

The workplace or office is a place where productivity is expected and having a pleasant work area certainly adds to a positive environment. Employees can do their part in addition to regular cleaning staff housekeeping and caretaker maintenance to keep it clean, safe, and healthy for all.

Collecting and storing material that can be reused

The proper care and storage of materials, tools and equipments are not only the concern of the management but of the workers who use the equipment.

A major responsibility of the technician is to ensure that materials, tools and equipment are maintained in a good condition and are readily available when required for the various work activities. Faulty tools and equipments are a common reason for delays on technical activities.

Good organization of stored materials is essential for overcoming material storage problems whether on a temporary or permanent basis. There will also be fewer strain injuries if the amount of handling is reduced, especially if less manual materials handling is required. The location of the stockpiles should not interfere with work but they should still be readily available when required. Stored materials should allow at least one meter (or about three feet) of clear space under sprinkler heads.

figures. proper storage of tools, materials and equipments

Importance of proper storage of tools and equipments

- It is important factor for safety and health as well as good business.
- Improves appearance of general-shop and construction areas.
- Reduce overall tool cost through maintenance.
- This also ensures that tools are in good repair at hand.

- ❖ Teaches workers principles of tool accountability.

Pointers to follow in storing tools and equipments

- ➢ Have a designated place for each kind of tools.
- ➢ Label the storage cabinet or place correctly.
- ➢ Store them near the point of use.
- ➢ Wash and dry properly before storing.
- ➢ store sharp edge materials properly when not in use with sharp edge down.
- ➢ Put frequently used items in conveniently accessible conditions.
- ➢ Gather and secure electrical chord to prevent entanglement or snagging.
- ➢ Cutting boards should be stored vertically to avoid moisture collection
- ➢ Metal equipments can be stacked on one another after drying.
- ➢ Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define workplace (2)

2. List four importance of proper storage of tools and equipments (8 pts)

Note: **Satisfactory rating - 5 points & above** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 2	Removing waste and scrap following workplace procedures

Waste Disposal Practices

There are eight major groups of waste management methods, each of them divided into numerous categories. Those groups include source reduction and reuse, animal feeding, recycling, composting, fermentation, landfills, incineration and land application. You can start using many techniques right at home, like reduction and reuse, which works to reduce the amount of disposable material used.

Methods of Waste Disposal

1. Landfill:- which is the most popularly used method of waste disposal used today. This process of waste disposal focuses attention on burying the waste in the land

2. Incineration/Combustion:- which is a type disposal method in which municipal solid wastes are burned at high temperatures so as to convert them into residue and gaseous products. .

3. Recovery and Recycling:- It is the process of taking useful discarded items for a specific next use. These discarded items are then processed to extract or recover materials and resources or convert them to energy in the form of useable heat, electricity or fuel.

4. Recycling is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. Recycling is the third component of Reduce, Reuse and Recycle waste hierarchy. The idea behind recycling is to reduce energy usage, reduce volume of landfills, reduce air and water pollution, reduce greenhouse gas emissions and preserve natural resources for future use.

5. Plasma gasification:- It is another form of waste management. Plasma is a primarily an electrically charged or a highly ionized gas. Lighting is one type of plasma which produces temperatures that exceed 12,600 °F . With this method of waste disposal, a vessel uses characteristic plasma torches operating at +10,000 °F which is creating a gasification zone till 3,000 °F for the conversion of solid or liquid wastes into a gas.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List five waste disposal methods (10 pts)

Note: **Satisfactory rating - 5 points & above** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 3	Cleaning and inspecting equipment and work area

Cleaning up is not just a measure of respect for the workspace, it also removes hazards. Cleaning is so important because when we clean an area, we are also doing some inspection or checking of machinery, equipment, and work conditions. An operator cleaning a machine can find many mal-functions. When a machine is covered with oil, soot, and dust, it is difficult to identify any problems that may be developing. While cleaning the machine, however, one can easily spot oil leakage, a crack developing on the cover, or loose nuts and bolts. Once these problems are recognized, they are easily fixed. It is said that most machines breakdowns begin with vibration (due to lose nuts and bolts), with introduction of foreign particles such as dust (due to the crack on the cover, for instance), or with inadequate oiling and greasing. For this reason cleaning is useful to make discoveries while cleaning machines.

Kinds of Cleaning Solvents

Solutions are homogeneous mixture of two or more components. They can be gaseous, liquid or solid. When we speak of a solution, we usually think of a solid dissolved in water. While water is the most common solvent, other liquids are frequently employed as solvents for certain substances for example wax maybe dissolved in gasoline. The dissolved material in a solution is termed as solute (e.g. wax) while the dissolving medium is called solvent (e.g. gasoline). However, the term can be interchanged depending on which substance is of greater amount.

Solvent is a component of a solution that dissolves solute and is usually present in large proportion or amount. It can be classified as polar or non polar. Polar solvents are solvents which dissolve/are soluble in water; while non polar solvents are solvents which do not dissolve/are insoluble in water.

Solvents usually used for cleaning in automotive shops are: water, gasoline, kerosene, thinner and detergent soap.

The table below shows the kinds of cleaning solvents based on their solubility in water.

Cleaning Solvents	Solubility in Water	Polar	Nonpolar
a. water	soluble	x	
b. gasoline	insoluble		x
c. kerosene	insoluble		x
d. thinner	insoluble		x
e. detergent soap	soluble	x	

Properties of Cleaning Solvents

A useful generalization much quoted is that “Like dissolves like”. More specifically, high solubility occurs when the molecules of the solute are similar in structure and electrical properties to the molecules of the solvent.

When there is a similarity of electrical properties; e.g. high dipole element between solute and solvent, the solute-solvent attractions are particularly strong. When there is dissimilarity, solute-solvent attractions are weak. For this reason, a polar substance such as H2O usually is a good solvent for a polar substance such as detergent soap but a poor solvent for a non polar substance such as gasoline.

Uses of Cleaning Solvents

Cleaning Solvents	Uses
1. Gasoline	- It is used to wash oil/greasy tools/equipment.
2. Diesoline	- It is used to wash oil engine, transmission and other parts of the vehicle.
3. Kerosene	- It is used to remove dust, grease oil, paint, etc.
4. Thinner	-It is used to remove spilled paint on the floor, walls and tools.
5. Soap and water	- It is used to wash/clean upholstered furniture such as seats, tables, cabinets, etc.

Occupational Health and Safety Practices in Handling Cleaning Solvents

A great percentage of eye injury and cuts results from a disregard for the simplest of rules in handling cleaning solvents. You should never use compressed air to clean your clothes, hands or body. The pressure could cause the cleaning solvents and dirt particles to penetrate your skin, resulting in infection and /or blood poisoning. Do not use compressed air to clean an object immediately after it has been removed from a hot cleaning tank. First, rinse the cleaning solvents away with water. Do not use carbon tetrachloride as a cleaning solution. The fumes, when inhaled can cause serious internal injury and possibly result in death. When steam-cleaning, place the object to be cleaned on a pallet and wear a face shield and rubber gloves for protection against loose debris.

If a job or cleaning task requires the use of gloves, use the appropriate gloves. Do not for instance use welding gloves when removing an object from a hot tank, or rubber gloves when welding. If you have cut, nicked, or burned yourself, or something has got into your eyes, report immediately to the first-aid person. Keep all inflammable cleaning solvents in closed tin containers and whenever possible, store them in a separate area.

Clean up procedures

- ✓ Clean up every time whenever you leave an area, including sweeping the floor.
- ✓ Clean and return all tools to where you got them.
- ✓ Use compressed air sparingly; never aim it at another person or use it to clean hair or clothes.
- ✓ Shut off and unplug machines when cleaning, repairing, or oiling.
- ✓ Never use a rag near moving machinery.
- ✓ Use a brush, hook, or a special tool to remove chips, shavings, scraps etc. from the work area. Never use the hands.
- ✓ Keep fingers clear of the point of operation of machines by using special tools or devices, such as, push sticks, hooks, pliers, etc.
- ✓ Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.
- ✓ Mop up spills immediately and put a chair or cone over them if they are wet enough to cause someone to slip.

Inspection of work tools/equipment

The purpose of inspection is to identify whether work tool/equipments and working area can be operated, adjusted and maintained safely. Not all work area, tools/equipments needs formal inspection to ensure safety and in many cases a quick visual check before use will be sufficient. However inspection is necessary for any work area, tools/ equipments where significant risks to health and safety may arise from incorrect installation, reinstallation, deterioration or any other circumstances. The need for inspection and inspection frequencies should be determined through risk assessment.

Importance of inspection

As an essential part of a health and safety program, workplaces should be inspected. Inspections are important as they allow you to:

- listen to the concerns of workers and supervisors
- gain further understanding of jobs and tasks
- identify existing and potential hazards
- determine underlying causes of hazards
- monitor hazard controls (personal protective equipment, engineering controls, policies, procedures)
- recommend corrective action

Inspection Procedures

When conducting inspections, follow these basic procedures:

- Draw attention to the presence of any immediate danger--other items can await the final report.
- Shut down and "lock out" any hazardous items that cannot be brought to a safe operating standard until repaired.
- Do not operate equipment. Ask the operator for a demonstration. If the operator of any piece of equipment does not know what dangers may be present, this is cause for concern. Never ignore any item because you do not have knowledge to make an accurate judgment of safety.
- Look up, down, around and inside. Be methodical and thorough. Do not spoil the inspection with a "once-over-lightly" approach.
- Clearly describe each hazard and its exact location in your rough notes. Allow "on-the-spot" recording of all findings before they are forgotten. Record what you have or have not examined in case the inspection is interrupted.
- Ask questions, but do not unnecessarily disrupt work activities. This may interfere with efficient assessment of the job function and may also create a potentially hazardous situation.
- Consider the static (stop position) and dynamic (in motion) conditions of the item you are inspecting. If a machine is shut down, consider postponing the inspection until it is functioning again.
- Discuss as a group, "Can any problem, hazard or accident generate from this situation when looking at the equipment, the process or the environment?" Determine what corrections or controls are appropriate.
- Do not try to detect all hazards simply by relying on your senses or by looking at them during the inspection. You may have to monitor equipment to measure the levels of exposure to chemicals, noise, radiation or biological agents.
- Take a photograph if you are unable to clearly describe or sketch a particular situation

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. The following are importance of inspection except (2)
   A. listen to the concerns of workers and supervisors
   B. determine underlying causes of hazards
   C. recommend corrective action
   D. increase cause of hazards

Instruction II : match column "A" with "B" (10points)

"A"	"B"
-----1. kerosene	A. used to wash oil/greasy tools/equipments
-----2. Gasoline	B. used to wash oil engine, transmission and other parts of the vehicle
-----3. Diesoline	C. used to remove dust, grease oil, paint, etc
-----4. Thinner	D. used to wash/clean upholstered furniture such as seats, tables, cabinets, etc
-----5. Soap and water	E. used to remove spilled paint on the floor, walls and tools.

Note: **Satisfactory rating - 6 points & above** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 4	Tagging unserviceable equipment and identifying faults in accordance with workplace requirements

TAGS

The use of tags is considered an administrative control and as such only provides limited protection to people and plant; therefore in all cases a physical isolation must be used in conjunction with a tag to prevent the accidental activation of an isolation point.

Attaching the Tag

The person attaching the tag must completely fill the tag with the following information:

- Name & company of person placing tag
- The classification/department the person works for
- The date that the tag was placed
- The equipment / plant the tag was placed on
- Contact number
- Work order / job number if applicable
- Signature

It is important to clearly identify the exact piece of equipment that the tag and lock was placed on to allow identification of those personnel working on the plant.

Depends on what you need it for. You can include a stub to give to your customers, or feature numbering so you can easily track each defective part. Choose materials with a bit more durability if you'll be working outside, replace old tags, or fasten your tags to something new.

- We specialize in Repair Tags and we stock several different options for whatever suits your space. Check out our repair tag material guide to compare.
- All tags feature smudge-proof surface. Write your information with a pen, pencil, or marker.
- Bright colored repair and inspection tags with bold, legible prints display and highlight vital information.
- Order tags with our handy Tag-in-a-Box® for convenient storage and dispensing of tags. Just pull and tear!
- Looking for the right fit? Get a custom design. Our customer service staff is happy to help you find what you need.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Mention six information must completely fill the tag during a person attaching the tag (6 pts)

Note: **Satisfactory rating - 3 points & above** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 5	Completing operator maintenance in accordance with manufacturer's specifications and site procedures

Tools and Equipment Maintenance

All tools, equipment and vehicles must be properly maintained so that workers are not endangered. Construction regulations require inspections of vehicles, tools, machines and equipment before use.

components of maintenance program

A maintenance strategy includes procedures as well as corrective and preventive maintenance

- Inspections ensure that tools and equipments are operating correctly. Safety inspections ensure the tools/equipments are safe for both patients and operators.
- Corrective maintenance (cm) restores the function of a failed device and allows it to be put back in to service.
- Preventive maintenance (pm) aims to extend the life of the tools/equipment and reduce failure rates.

  Preventive maintenance is the systematic care and protection of tools, equipment, machines and vehicles in order to keep them in a safe, usable condition, limit downtime and extend productivity. We must always be aware that maintenance tasks themselves are potentially hazardous and can result in injury. The successful maintenance program is:
  - well organized and scheduled,
  - controls hazards,
  - defines operational procedures, and
  - trains key personnel.

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List four successful maintenance program (4 pts)

2. Write 3 components of maintenance program (6 pts)

Note: **Satisfactory rating - 5 points & above** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet 6	Maintaining tooling in accordance with workplace procedures.

Tools need to have enough space to be operated safely and not endanger the operator or other people in the space. People need to concentrate when trying new tools, especially ones that can injure. Make sure there is enough real estate to use a tool safely. Work areas need to be well lit and clean. Ventilation and/or air filtering is required for many tools.

The equipment itself needs to be as safe as possible. Tools should be well maintained and not have safety features removed or defeated. This is especially important when using second-hand tools that might not have a perfectly safe heritage. When acquiring new tools consider spending the extra money on models with advanced safety features, such as a Saw Stop table saw.

Make well-stocked first-aid kits visible and easily accessible throughout your space. Post clear and visible warning signs on all equipment and where necessary.

Provide personal safety equipment such as goggles, earplugs, gloves, etc. to those who don't have their own.

Accidents may happen. They probably will, and let's hope they are all minor. Nonetheless, do make sure that there is a legal entity that owns the space so that the effects of a serious injury don't extend the horror with legal ramifications

Self-Check -6	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Which of the following are false during maintaining tooling

   A. tools not endanger the operator or other people in the space.
   B. The tools itself not needs to be as safe as possible
   C. Tools should be well maintained and not have safety features removed or defeated
   D. Tools need to have enough space to be operated safely

Note: **Satisfactory rating - 1 points & above** **Unsatisfactory - below 1 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation sheet 1

OPERATION TITLE:-Storing/arranging tools and shop equipments

PURPOSE:- For safety and health as well as good business. and for Reducing overall tool cost through maintenance.

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- ✓ Safe working area
- ✓ Properly operated tools and equipments
- ✓ Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALS :

- ✓ Hand tools -screw driver, wrenches, hammers etc
- ✓ Equipments - floor jack, hydraulic crane etc
- ✓ special tools - torque wrench etc
- ✓ Reused materials

PROCEDURE:-

- ➢ Design place for each kind of tools.
- ➢ Label the storage cabinet or place correctly.
- ➢ Store them near the point of use.
- ➢ Wash and dry properly before storing.
- ➢ Store sharp edge materials properly when not in use with sharp edge down.
- ➢ Put frequently used items in conveniently accessible conditions.
- ➢ Gather and secure electrical chord to prevent entanglement or snagging.
- ➢ Cutting boards should be stored vertically to avoid moisture collection
- ➢ Metal equipments can be stacked on one another after drying.
- ➢ Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.

PRECAUTIONS:-

- ➢ Wear working cloths which properly fit with your body
- ➢ Make working area hazard free
- ➢ Read and interpret manual which guide you how to use tools and equipments

QUALITY CRITERIA:

Assured performing of the activities correctly accordance with the given procedure mentioned above.

Operation sheet 2

OPERATION TITLE:- Cleaning work shop area

PURPOSE:- For safety and health as well as good business.

CONDITIONS OR SITUATIONS FOR THE OPERATIONS:-

- ✓properly sorted working area
- ✓Properly operated tools and equipments
- ✓Appropriate working cloths fit with the body.

EQUIPMENT TOOLS AND MATERIALS :

- ✓ Hand tools -brush / ascopa etc
- ✓ Equipments - air compressor etc
- ✓ water, solvent, etc

PROCEDURE:-

1. Clean up every time whenever you leave an area, including sweeping the floor.
2. Clean and return all tools to where you got them.
3. Use compressed air sparingly; never aim it at another person or use it to clean hair or clothes.
4. Shut off and unplug machines when cleaning, repairing, or oiling.
5. Never use a rag near moving machinery.
6. Use a brush, hook, or a special tool to remove chips, shavings, etc. from the work area. Never use the hands.
7. Keep fingers clear of the point of operation of machines by using special tools or devices, such as, push sticks, hooks, pliers, etc.
8. Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.
9. clean up and dry spills immediately and put a chair or cone over them if they are wet enough to cause someone to slip.

PRECAUTIONS:-

- ➢ Wear working cloths which properly fit with your body
- ➢ Make working area hazard free
- ➢ Read and interpret manual which guide you how to use tools and equipments

QUALITY CRITERIA:

Assured performing of the activities correctly accordance with the given procedure mentioned above.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8 hour.

Task 1. Collect and store material that can be reused
Task 2. Remove waste and scrap following workplace procedures
Task 3. Clean and inspect equipment and work area for serviceable conditions in accordance with workplace procedures.
Task 4. Tag unserviceable equipment and identifying faults in accordance with workplace requirements
Task 5. complete operator maintenance in accordance with manufacturer's specifications and site procedures
Task 6. maintain tooling in accordance with workplace procedures.
Task 7. Perform the 5S in the assigned workshop:

List of reference materials

https://www.omicsonline.org/conferences-list/waste-disposal-practices