



Republic of the Philippines  
**DEPARTMENT OF EDUCATION**



# **K to 12 Basic Education Curriculum Technology and Livelihood Education Learning Module**



## **SHIELDED METAL ARC WELDING (SMAW)**

*EXPLORATORY COURSE*

*Grade 7 and Grade 8*

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## What Is This Module About?

Welcome to the course of **Shielded Metal Arc Work (SMAW)**!

This Module is an exploratory and introductory course which leads you to Shielded Metal Arc Work National Certificate Level II (NC II)<sup>1</sup>. It covers 4 common competencies in which a Grade 7/Grade 8 Technology and Livelihood Education (TLE) student like you ought to possess, namely:

- 1) Use Basic Hand Tools and Equipment;
- 2) Mensuration and Calculation;
- 3) Applying Safety and Practices;
- 4) Interpret Plans and Drawings.

These **4** common competencies are covered separately in 4 Lessons. As shown below, each Lesson is directed to the attainment of one or two learning outcomes:

### Lesson 1 – Use Basic Hand Tools and Equipments

- LO 1 - Select and classify hand tools and equipment.
- LO 2 - Use hand tools and equipment; and
- LO 3 - Maintain hand tools.

### Lesson 2 – Perform Mensuration and Calculations

- LO 1 - Perform four fundamental operations
- LO 2 - Convert English units of measurement to Metric System
- LO 3 - Perform basic ratio and proportion, area and volume calculation

### Lesson 3 – Apply Safety Practices

- LO 1 - Identify Hazardous Area
- LO 2 - Use personal protective clothing and devices
- LO 3 - Occupational safety and health requirements and policy

### Lesson 4 – Interpret Plans and Drawings

- LO 1 - Identify Standard Alphabet of lines
- LO 2 - Interpret Standard Drawing Symbol

Your success in this exploratory course on **Shielded Metal Arc Work (SMAW)** is shown in your ability to perform the performance standards found in each lesson.

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<sup>1</sup>**NATIONAL CERTIFICATE (NC)** is a certification issued to individuals who achieved all the required units of competency for a national qualification as defined under the Training Regulations. NCs are aligned to specific levels within the PTQF. (TESDA Board Resolution No. 2004-13, Training Regulations Framework)

**NATIONAL CERTIFICATE LEVEL** refers to the four (4) qualification levels defined in the Philippine TVET Qualifications Framework (PTQF) where the worker with:

- a. **NC I** performs a routine and predictable tasks; has little judgment; and, works under supervision;
- b. **NC II** performs prescribed range of functions involving known routines and procedures; has limited choice and complexity of functions, and has little accountability;



## How Do You Use This Module?

This Module has 4 Lessons. Each Lesson has the following parts:

- Learning Outcomes
- Performance Standards
- Materials/Resources
- Definition of Terms
- What Do You Already Know?
- What Do You Need to Know?
- How Much Have You Learned?
- How Do You Apply What You Learned?
- How Well Did You Perform?
- What is your Score?
- References

To get the most from this Module, you need to do the following:

1. Begin by reading and understanding the Learning Outcome/s and Performance Standards. These would tell you what you should know and be able to do at the end of this Module.
2. Find out what you already know by taking the Pretest then check your answers against the Answer Key. If you get 99 to 100% of the items correctly, you may proceed to the next Lesson. This means that you need not go through the Lesson because you already know what it is about. If you failed to get 99 to 100% correctly, go through the Lesson again and review especially those items which you failed to get.
3. Do the required Learning Activities. They begin with one or more Information Sheets. An Information Sheet contains important notes or basic information that you need to know.

After reading the Information Sheet, test yourself on how much you learned by means of the Self-Check. Refer to the Answer Key for correction. Do not hesitate to go back to the Information Sheet when you do not get all test items correctly. This will ensure your mastery of basic information.

4. It is not enough that you acquire content or information. You must be able to demonstrate what you learned by doing what the Activity / Operation /Job Sheet directs you to do. In other words, you must be able to apply what you have learned in real life.

5. How well did you perform? Accomplish the Scoring Rubrics.

Each Lesson also provides you with references and definition of key terms for your guide. They can be of great help. Use them fully.



If you have questions, ask your teacher for assistance.

## LESSON 1

### Use Basic Hand Tools and Equipment



#### LEARNING OUTCOMES:

At the end of this Lesson, you are expected to do the following:

- LO 1. select and classify hand tools and equipment ;
- LO 2. use hand tools and equipment; and
- LO 3. maintain hand tools.



## Definition of Terms

**Adjustable wrench-** a tool with movable jaw which makes it adjustable to various sizes of nuts

**Ball peen hammer-** a tool for straightening bending and deforming metals

**Chipping hammer-** used for removing slag on weld and with two faces, the tapered from one side and round pointed on the other side

**Cold chisel-** a wedge-shaped tool used to shear, cut and chip metal

**Files-** made of high grade steel hardened and tempered. A file has rows of teeth that form, shape and finish metal by removing small chips and smoothing rough edges of the metal surface

**Hacksaw** - a tooth- cutting tool usually with a solid and adjustable frame

**Lubricating-** a process of maintenance wherein oil is put in between moving parts of a tool or equipment to prevent the tool from rust or damage

**Maintenance-** following routine procedures to keep the tools or equipment at its most efficient condition

**Measuring tools-** tools used to measure the dimension of an object or metal

**Micrometer caliper-** a precision measuring instrument used to measure dimensions in thousandths of an inch

**Pliers-** a tool for holding, cutting and twisting wires

**Punches-tools-** used for permanent marking on surface of metal

**Scraper-** a tool for removing points, burrs, and sharp edges from metal surface and similar parts

**Screw driver-** a hand tool that is designed to turn screws. The blade is made of steel, attached to one end of which a wooden or plastic handle

**Tightening/ loosening-** a process where tools and equipment are adjusted based on standard procedure

**Try square-** an instrument used to measure the squareness of an object

**Vernier caliper-** a precision measuring instrument used to measure the inside, outside diameter, as well as depth of hole and slot

**Wrench-** used for loosening and tightening light and heavy nuts and bolts

## LEARNING OUTCOME 1

### Select and classify hand tools and equipment

#### PERFORMANCE STANDARDS

- Hand tools selected are appropriate to the requirements of the task.
- Unsafe or defective tools are identified and marked for repair according to procedure.



### What Do You Already Know?

Let us determine how much you already know about selecting and classifying tools and equipment. Take this test.

#### Pretest LO 1

- I. **Directions:** Match Column A with Column B. Write only the letter of the correct answer on a separate sheet of paper.

#### Column A

1. A measuring tool used to measure squareness of an object.
2. Tools used for measuring or setting of distances, and to lay out arcs and circles.
3. Rectangular in shape and tapered slightly in width and thickness. It is the most commonly used files for general work.
4. It is used for chipping flat surfaces, cutting of rivets or metal fasteners, thin sheets, small bars; and for general purposes.
5. The most common tool used in tool room. It is made of tapered steel about 1/8 inch thick and 3/4 inch wide and 6 to 12 inches long.

#### Column B

- a. Hacksaw
- b. Cold chisel
- c. Try Square
- d. Flat file
- e. Divider

**Multiple Choice** - Directions: Choose the letter of the correct answer Use separate sheet of paper.

1. A tooth cutting tool usually with the solid and adjustable frame.  
A. Hacksaw  
B. Hammer  
C. Screw driver  
D. Wrench
2. Tool used for loosening and tightening light and heavy nuts and bolts.  
A. Hacksaw  
B. Screw driver  
C. Hammer  
D. Wrench
3. This tool is used to tighten and loosen screws by pushing or pulling screws in a rotating manner.  
A. Hacksaw  
B. Screw driver  
C. Hammer  
D. Wrench

## Multiple Choice

Directions: Choose the letter of the correct answer Use separate sheet of paper.

1. A tooth cutting tool usually with the solid and adjustable frame.
  - A. Hacksaw
  - B. Screw driver
  - C. Hammer
  - D. Wrench
2. Tool used for loosening and tightening light and heavy nuts and bolts.
  - A. Hacksaw
  - B. Screw driver
  - C. Hammer
  - D. Wrench
3. This tool is used to tighten and loosen screws by pushing or pulling screws in a rotating manner.
  - A. Hacksaw
  - B. Screw driver
  - C. Hammer
  - D. Wrench



## What Do You Need To Know?

**Read Information Sheet 1.1 very well then find out how much you can remember and how much you learned by doing Self-Check 1.1.**

### Information Sheet 1.1

A list of common hand tools and their uses are provided with picture illustration for your better comprehension.

Hand tools are classified into four:

1. Measuring tools
2. Cutting tools
3. Driving tools and
4. Holding tools

Each classification has different types and uses.

### 1. MEASURING TOOLS



- **Pull-push rule.** This flexible rule when extended will support itself, but may also be used to measure curved, irregular surfaces. Steel tape rule blade is usually  $\frac{1}{2}$  inch wide and 72 inches long. The graduation is sixteenths, except for the first 6 inches which are graduated in thirty-seconds of an inch.



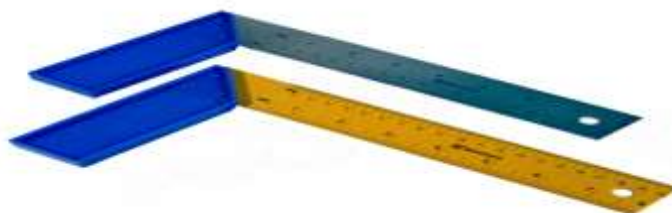
- **Steel tape is** similar to a steel tape rule except for its flexible number of feet that are marked on the tape. The tape is  $\frac{3}{8}$  inch wide and available in lengths from 25 to 100 feet.



- **Steel rule.** This is the most common tool used in tool room. It is made of tempered steel about  $\frac{1}{8}$  inch thick and  $\frac{3}{4}$  inch wide and 6 to 12 inches long. The same style maybe obtained in length from 1 to 48 inches.



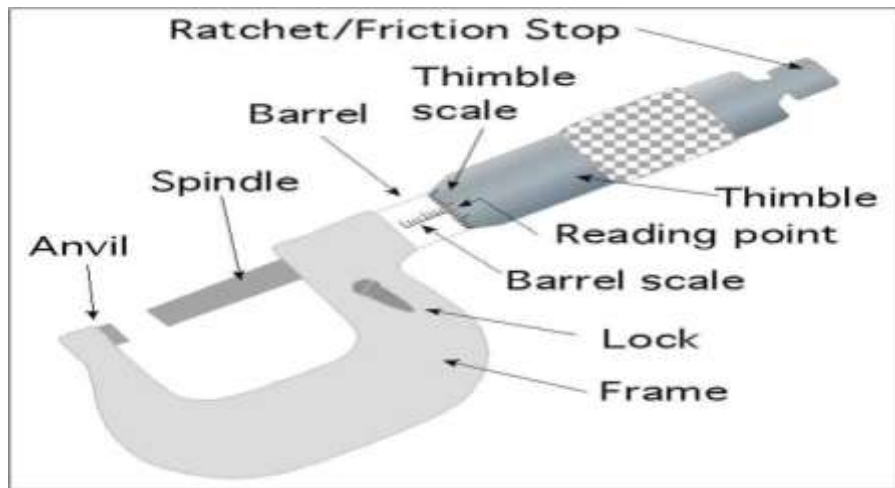
- **Try square** is an instrument used to measure the square of an object.



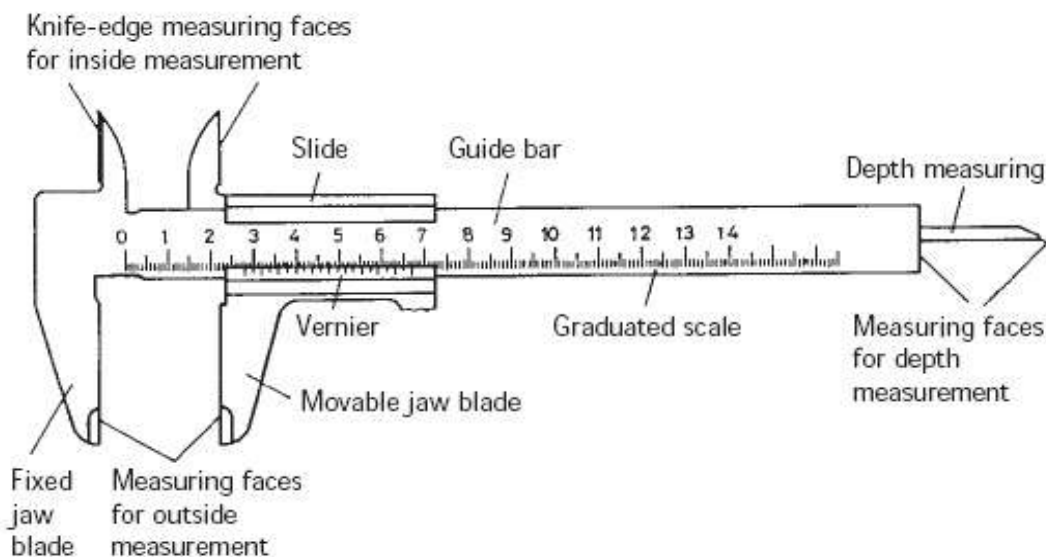
- **Combination square.** It is an instrument combined with  $45^\circ$ ,  $90^\circ$  and a protractor.



□ **Micrometer caliper.** Is a precision measuring instrument used to measure dimensions in thousandths of an inch.



□ **Vernier caliper is** a precision measuring instrument used to measure the inside, outside diameter, as well as depth of hole and slot.



□ **Dividers.** These are used for measuring or setting of distances, and to lay out arcs and circles.



## 2. CUTTING TOOLS

1. **Hacksaw** is a tooth-cutting tool usually with a solid and adjustable frame. The main parts are handles, blade, tightening screw and nuts. The tool is mainly used in cutting metals like plates, pipes, rods, bars, angular, etc. but of minimal thickness, width and length. Sometimes this tool is used for cutting plastic pipes and other materials to suit to its purpose.

- Frame. It is the main body of the hacksaw which holds the blade. The different types of frames are the following:

*a. Fixed or solid frames* are intended to hold only one size of blade about 10 inches long



*b. Adjustable frame* is frame that can be adjusted to hold blades of different sizes such as 10, 12 and 14 inches in length.



- Blade. It is made of thin, high grade steel usually 1.27 mm thick and 30.48cm long with an inclined row of teeth serving as cutter.



The two types of blades are:

- All hard.* In this type, the entire blade is hardened and tempered, making it very brittle. Use this type in cutting steel and cast iron.
- Flexible back.* In this type, only the teeth portion is hardened and tempered, making the blade springy and less likely to break.

The following are the recommended teeth-per-inch of blades for different kinds of stocks to be cut:

- 14 teeth-per-inch. It is used for brass, aluminum, cast iron and soft iron.
- 18 teeth-per-inch. It is used for drill rod, mild steel, tool steel and general work
- 24 teeth-per-inch. It is recommended for thin tubing and pipe.



- Files are made of high grade steel which are hardened and tempered. Each file has rows of teeth that form, shape and finish metal by removing small chips and smoothing rough edges of the metal surface. They differ in length, shape, cut and coarseness.

Kinds of files:

1. Mill file a single-cut file used for filing and finishing brass and bronze.



2. Flat file is usually rectangular in shape and tapered slightly in width and thickness. It is one of the most commonly used files for general work.



3. Square file is intended for filing square or rectangular holes.



4. Round file is used primarily for enlarging holes.



5. Half-round file is used for filing curved or concave surfaces.



A triangular file is used for filing surfaces that meet at least 90°. It is exclusively used for sharpening wood saws and for smoothing rectangular opening. It is also known as three-square file.



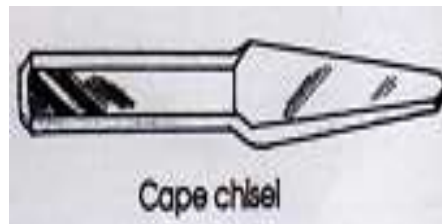
- **Cold chisel.** A wedge-shaped tool used to shear, cut, and chip metal

Types of cold chisel and their particular functions:

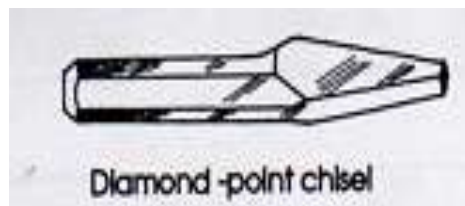
1. *Flat chisel* is used for chipping flat surfaces, cutting off rivets or metal fasteners, thin sheets, and small bars, and for general purposes. Its cutting edge ranges from 13 to 25mm.



2. *Cape chisel* has a narrow edge suited for cutting narrow grooves or slots.



3. *Diamond-point chisel* has a diamond-shaped cutting edge intended to cut V-grooves.



3. *Round-nose chisel* has a round nose cutting edge for cutting round and semi-circular grooves.



- **Scraper** is used in removing points, burrs and sharp edges from metal surface and similar parts. This tool is made of hardened steel of various shapes that fit according to each

purpose. There are bearing scrapes, flat, sharper, three-connected scraper. Below are types of scrapers and their uses:



1. For the removal of the high spots on metal surface.

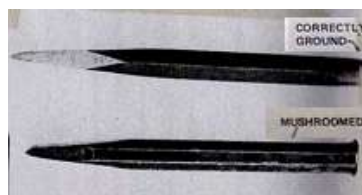


2. For scraping the surface of cylindrical bearing when fitting shafts into place.



3. For the removal of burrs and sharp internal edges from soft brushing and similar parts

- **Punches** are used for permanent marking on the surface of metal.



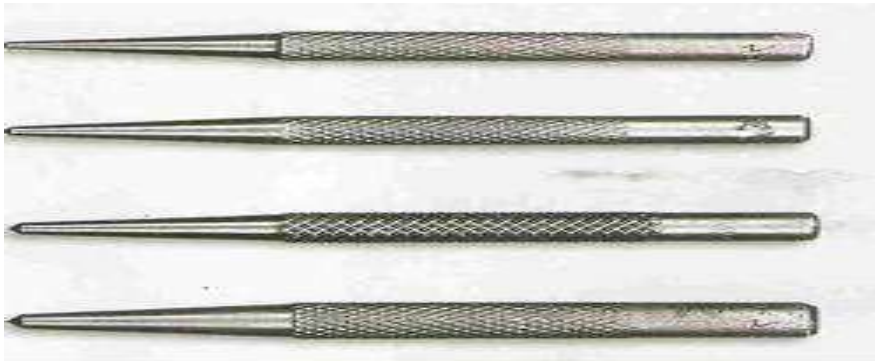
### KINDS AND USES OF PUNCHES

- **Prick punch** has a small center punch which is also known as a layout puncher. Its point is placed at an angle of 30 degrees.





- **Center punch** has one end-guard to a 90 degrees conical point.



### 3. DRIVING TOOLS

- **Hammers**

1. Ball peen hammer is used for straightening bending and deforming metals. It has two faces. One is flat in striking cold chisels and punches. The other side the “peen” is rounded for bending and shaping metals. Ball peen hammer generally has a wood or fiberglass handle measuring 10-16 inches long. Head weight ranges from 2-48 oz. A 20oz hammer is good for general purpose.



2. Chipping hammer is used for removing slag on weld and with two faces, the tapered from one side and round pointed on the other side.



- **Wrench** is used for loosening and tightening light and heavy nuts and bolts. There are different kinds and sizes of wrenches designed according to uses and functions.
1. An adjustable wrench has a movable jaw which makes it adjustable to various sizes of nuts. A heavy type of adjustable wrench is the monkey/pipe wrench.



Adjustable Wrench



Pipe Wrench

1. Oxy acetylene wrench- A type of wrench used for tightening hose and fitting connection on oxy-acetylene unit.



Oxy- Acetylene Wrench

2. An open-ended wrench is one that is made to fit one size of nut or bolt. This is the most inexpensive type of wrench that is quite efficient in ordinary situations.



Single-ended



Double-ended

3. A closed-end wrench is similar to a single-ended wrench, but as it entirely encloses a nut, there is a little danger of the wrench slipping off the nut or the jaws spreading apart.



Single-ended

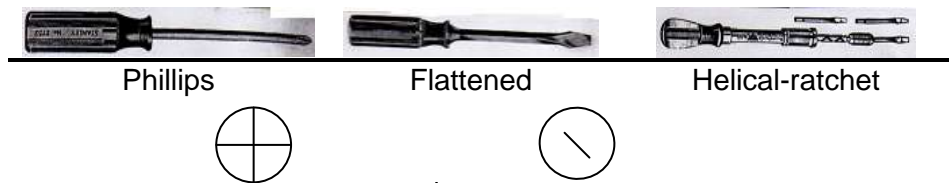


Double-ended

4. Socket wrench is a tool with usually interchangeable socket to fit over a nut or bolt.



- **Screwdriver** is hand tool that is designed to turn screws. The blade is made of steel, attached to one end of a wooden or plastic handle. The other end is flattened to fit slots in the heads of screws on bolts. The other kinds of screw drivers are called a Phillips screw driver and helical-ratchet screw driver.

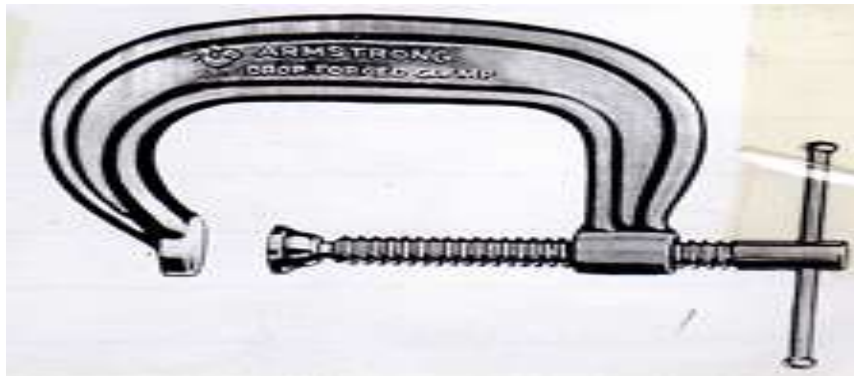


#### 4. HOLDING TOOLS

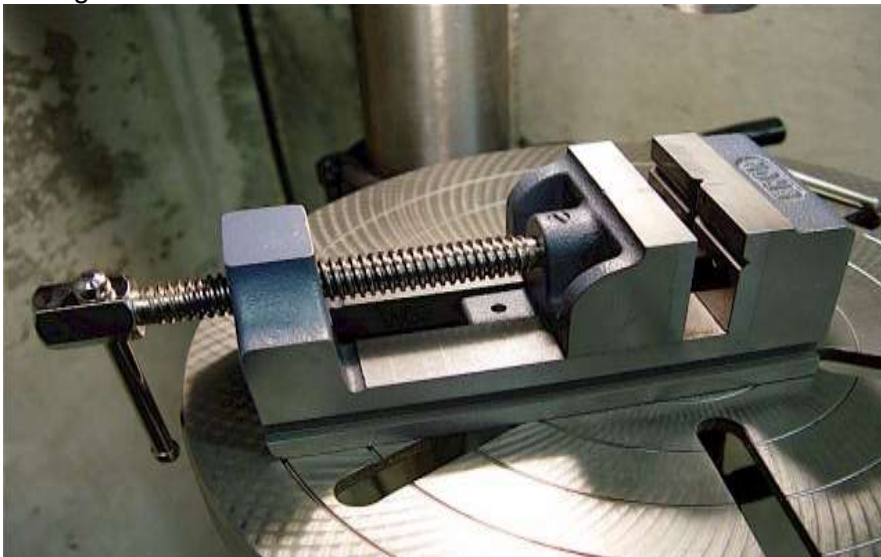
- **Clamps** are made of different sizes and appearance that are fitted for its purpose. These devices have been designed to hold work securely while performing skills such as grinding, bending, fitting, and cutting of metals. Some types of clamps and metal vises are:
  1. Tool-maker clamp is used for holding small parts both at the bench and at the machine. This tool is also known as a parallel clamp.



2. C-Clamp is an all-purpose clamp that is generally used for all kinds of work.



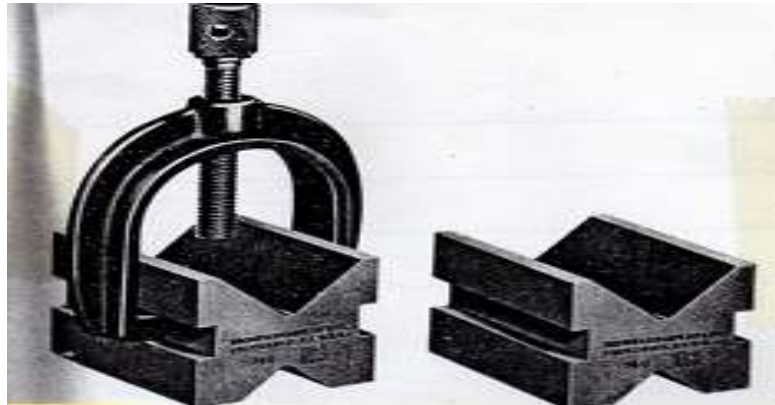
3. Drill vise is a sturdy steel vise with movable jaw that easily goes back or forth by raising the handle.



4. Machinist vise is a work holding tool for machining activity.



5. Hand vise V block with clamp is used to hold metal stocks for small machining operation.



6. Vise Grip is a tool used to grip the stock tight enough to hold the object.



7. Tong is used to hold the metal to be forged and must be held securely while working.



8. Pliers are used for holding, cutting and twisting wires.



Combination pliers



Side cutting pliers



Long nose pliers



Slip joint pliers/Mechanical pliers



# How Much Have You Learned?

## Self-Check 1.1

**Directions:** Match the name of the hand tools with the correct pictures. Write the letter of your answer on a separate sheet of paper.

A		B	
1. Phillips screw	<p>A. </p> <p>B. </p> <p>C. </p> <p>D. </p> <p>E. </p> <p>F. </p> <p>G. </p> <p>H. </p>	I. 	<p>J. </p> <p>K. </p> <p>L. </p> <p>M. </p> <p>N. </p> <p>O. </p> <p>P. </p>
2. Box wrench			
3. Scraper			
4. Square file			
5. C-clamp			
6. Steel tape			
7. Cold chisel			
8. Machinist vise			
9. Ball peen hammer			
10. Hand vise			
11. Open- ended wrench			
12. Hack saw			
13. Steel rule			
14. Helical-ratchet screw driver			
15. Chipping hammer			



Refer to the Answer Key. What is your score? If you didn't get a perfect score, help yourself by mastering what you failed to get. Go back to Information Sheet 1.

Read Information Sheet 1.2 very well then find out how much you can remember and how much you learned by doing Self-Check 1.2.

Information Sheet 1.2

## Defective and Non-Defective Hand tools

### Introduction:

There are many ways of identifying hand tools. One of these is to identify them according to their function. However, awareness of defective and non-defective hand tools is a primordial concern of workers/welders to be effective in their jobs.

Below are the recommended practices to identify defective and non-defective hand tools.

### 1. Visual inspection

Defective tools can easily be distinguished from the functional ones through visual inspection. The physical appearance of tools will describe such characteristics as dullness, sharpness, dismantled parts, and unevenness of the teeth of the cutting tools.

### 2. Functionality

Another way is to check the quality of the manufactured tools. Is it already susceptible to wear and tear? Has it already exceeded its service life? Has it passed the manufacturer's quality control test?

A few pieces of hand tools issued in the shop can be subjected for condemnation if they are no longer serviceable.

### 3. Performance

Performance of hand tools is determined not only during the actual use but also after use to find out whether the hand tools are still worth using.

### 4. Service span

Hand tools are issued to shop teachers at one time. However, this must be recorded to determine when it was received and how long the tools have been kept in the shop. A hand tool which is too old is unsafe for both the students and workers. Such tool should be marked defective and segregated from the good ones.



## How Much Have You Learned?

### Self-Check 1.2

**Directions:** Choose the letter of the correct answer.

1. Defective hand tools are kept and \_\_\_\_\_.
  - A) marked as defective.
  - B) mixed together with non-defective tools.
  - C) put anywhere in the shop.
  - D) sold in the junk shop
  
2. One way of checking whether hand tools are defective or non-defective is the\_\_\_\_\_.
  1. length of service
  11. trade mark of the manufacturer
  111. physical appearance

A. 1 only	C. 111 only
B. 11 only	D. 1, 11, and 111
  
3. Which is determined after the operation of a hand tool is tested ?
  - A. Service span
  - B. Performance
  - C. Physical appearance
  - D. Repair Maintenance
  
4. All defective hand tools with major defects are subjected to \_\_\_\_\_.
  1. Repair
  11. Condemnation
  111. Display/sample

A. 1 only	C. 111 only
B. 11 only	D. 1, 11, and 111
  
5. Service span of a tool pertains to \_\_\_\_\_.
  - A) maintenance schedule
  - B) determining when the tool is acquired
  - C) functionality of a tool
  - D) defectiveness of a tool

**Refer to the Answer Key. What is your score? If you did not get all the items, go back to the items which you failed to get. Refer to your note then correct your answer.**

## LEARNING OUTCOME 2

### Use hand tools and equipment

## PERFORMANCE STANDARDS

- Task is performed in accordance with company or industry safety procedures.



## What Do You Already Know?

Let us determine how much you already know about using hand tools and equipment. Take this test.

Pretest LO 2

**Directions:** Your teacher will demonstrate an improper way of using a tool. Observe your teacher then tell why his/ her demonstration on the use of the tool is wrong. Identify the proper way of using each tool.

Teacher will demonstrate at least way of using the

1. hacksaw
2. bench vise
3. ball peen hammer
4. chisel
5. wrench
6. screw driver

## Multiple Choice

Directions: Choose the letter of the correct answer. Use separate sheet of paper.

1. A tooth cutting tool usually with the solid and adjustable frame.
  - E. Hacksaw
  - F. Screw driver
  - G. Hammer
  - H. Wrench
  
2. Tool used for loosening and tightening light and heavy nuts and bolts.
  - E. Hacksaw
  - F. Screw driver
  - G. Hammer
  - H. Wrench
  
3. This tool is used to tighten and loosen screws by pushing or pulling screws in a rotating manner.
  - E. Hacksaw
  - F. Screw driver
  - G. Hammer
  - H. Wrench



## What Do You Need To Know?

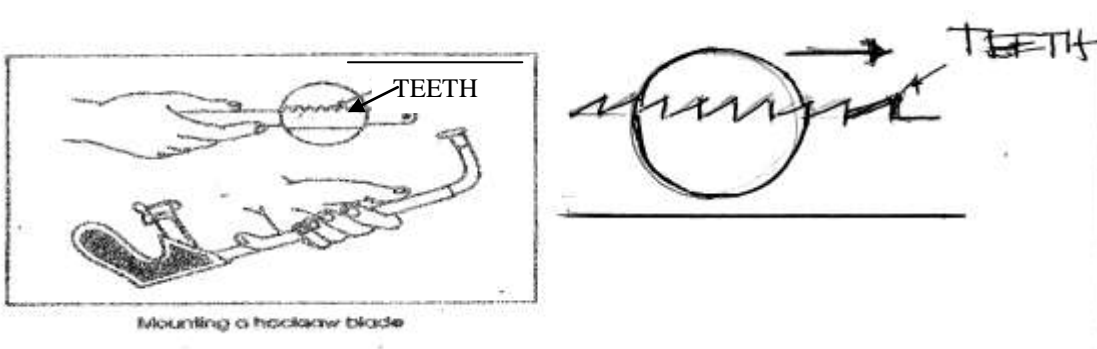
Read the Information Sheet 2.1 very well then find out how much you can remember and how much you learned by doing Self-check 2.1.

### Information Sheet 2.1

## Procedures on using different hand tools and equipment

### Hacksaw

#### Steps in Mounting Blade to the Metal Frame



1. Select the correct type of blade.
2. Attach the blade to the frame by pointing the teeth away from the handle.
3. Tighten the wing nut of the handle until the blade is tight enough.

#### **Safety Measures:**

Tighten the wing nut securely enough to prevent from buckling and breaking.

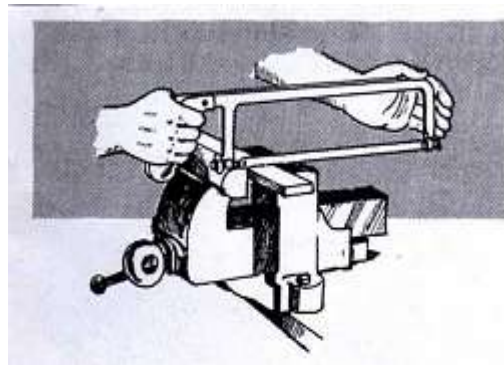


### Steps in Fixing Stock In Metal Vise and Operation Position

25-30 cm

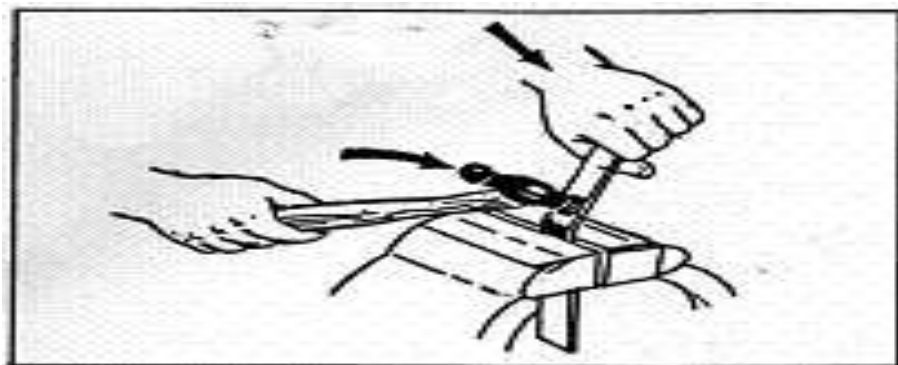
1. Fasten the stock in vise with lay-out line as close as possible to the end of the used vise jaws.
2. Stand with your feet 25 to 30 centimeters apart and one foot forward.
3. Lean the body a little forward as shown in the drawing

### Steps in Sawing the Stock



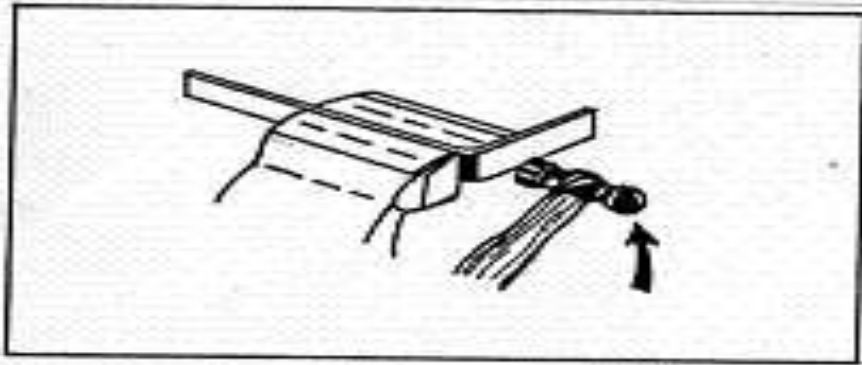
1. Start the saw by guiding the blade with the thumb of your left hand while taking one or two light strokes with your right hand.
2. Move the saw with a light, steady, and even motion of about 40 to 50 strokes per minute.
3. Apply pressure during the forward stroke and release during the return strokes.
4. Hold the stock with your left hand to avoid cuts upon sawing with your right hand

### Steps in Bending 90° with Ball Peen Hammer



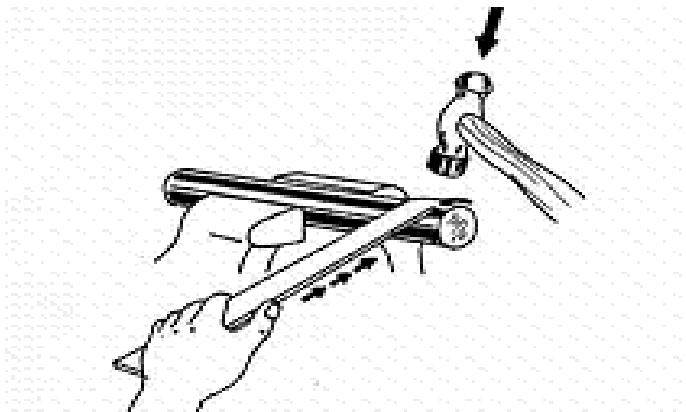
1. Force the metal over the vise jaws using left-hand.
2. Strike it several times near the hand with flat head of a hammer.

### Steps in Squaring off a 90° Bend



3. Place the metal in the bench vise and tighten strongly.
4. Strike the metal with the flat head of a hammer in the direction of the arrow indicated.

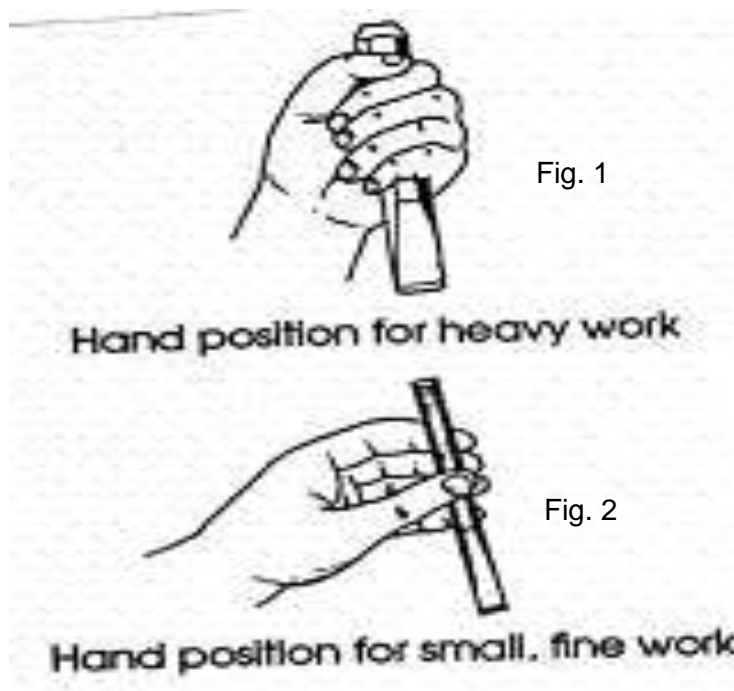
### Circular Bend



1. Place the metal over a pipe or round bar and clamp in a bench vise.
2. Strike the metal with a glancing blow using the flat head of a hammer until the desired curve is obtained.

## Cold Chisel

Cold Chisel is used for cutting and chipping cold metals.



The illustration above presents the Two-Hands Positioning in cold chiseling which shows the proper grip in using the tool. For heavy work, hand gripping of tool should be strong and tight; for fine and small work, hold the tool lightly.

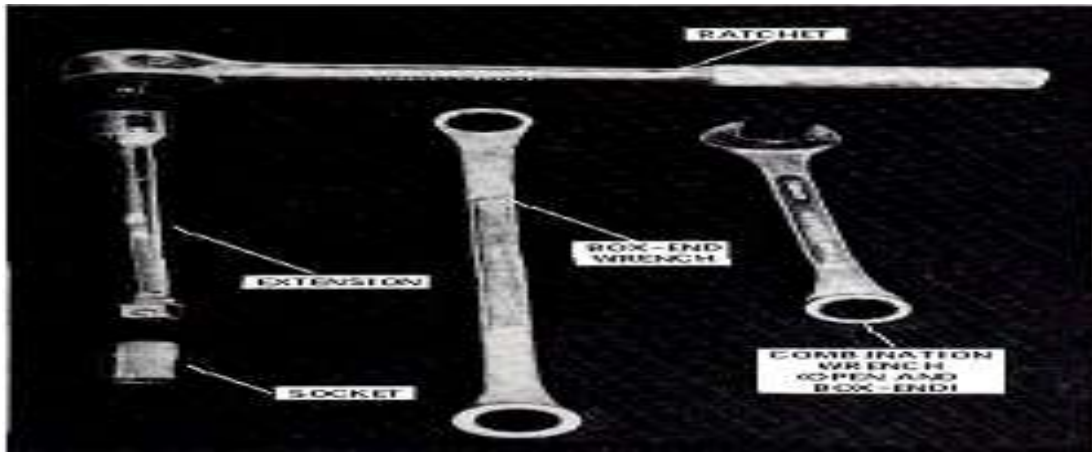


Look at the person work with the ball peen hammer and the chisel, as shown in the illustration above. A cold chisel will cut metals only if you strike it with the flat head of a ball peen hammer. The complete safety protection device and the body position when performing the task (chiseling) are evidently done.

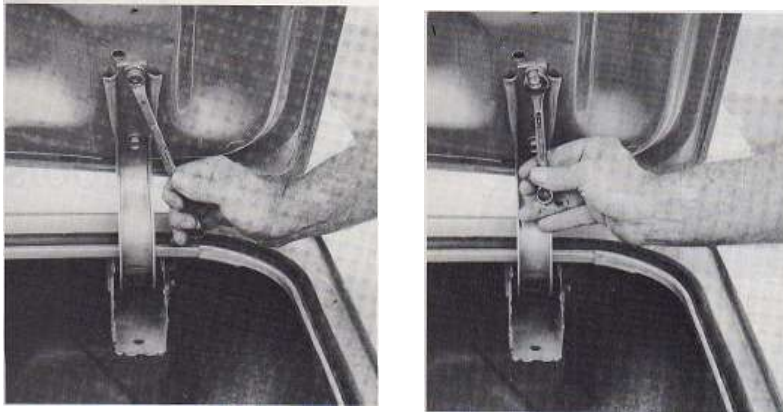


## Wrench

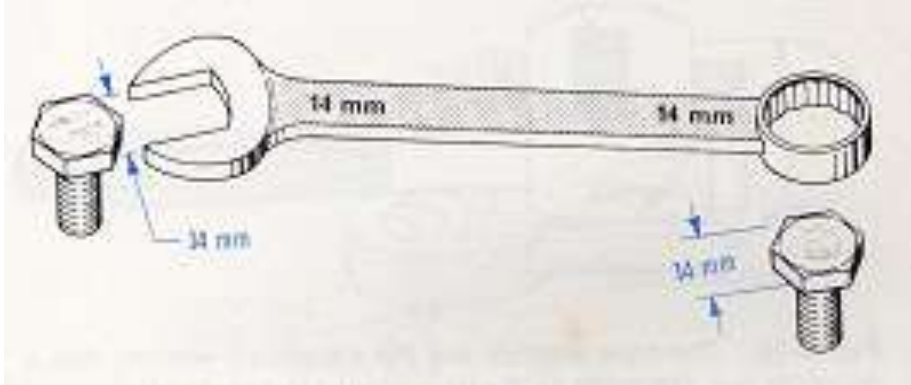
Wrench is used for loosening and tightening light and heavy nuts and bolts. There are various kinds and sizes of wrenches designed according to use and function. It is tool steel on movable jaws.



A repair worker often uses tools to remove and replace damaged parts. The wrenches are used to tighten and loosen the nut and bolts that hold the parts in place. Other tools are used to hold parts for cutting, welding and other works.



Wash type of wrench is usually used for only one or two different jobs. Figure above shows a repair worker using a box-end wrench and an open-end wrench to remove a deck lid bolt in an automobile. The ends of the wrench are offset (the hand is lower than the handle). In this way, the worker's hand is above the surface of any object as the nut or bolt is turned.



A combination wrench of open-end and a box-end will tell the advantage of box-end over open lid. Box-end wrench has complete contact with six points on the bolt head. This completely surrounds the grip of the bolt head or nut allowing less chances of wrench slippage.

## Screw Drivers

**Fig. 4-40.** Phillips® screwdrivers are a necessary part of the body worker's tool kit. Phillips-head screws are often used to fasten interior trim parts. (Courtesy of Snap-On Tools)



**Fig. 4-41.** The Phillips® screwdriver has four "teeth" that fit into the recess in the head of the Phillips screw.

**Fig. 4-38.** The body repair worker needs a good selection of standard (straight) tip screwdrivers. These have a round shank. (Courtesy of Snap-On Tools)



Screw drivers are usually made in different sets. This tool is used to tighten and loosen screws by pushing or pulling screws in a rotating manner. In the above illustration, a set of standard and Phillips tips of different sizes are shown.

Screwdriver is driven by fully turning the blade in clockwise motion until the entire screw is removed from the wood and metal. The purpose is to hold or fix two pieces and by no chances to space apart even opposing force occurs.



## How Much Have You Learned?

### Self-Check 2.1

- I. List two (2) **don'ts** in the use of :
  - a. hacksaw
  - b. bench vise
  - c. ball pen hammer
  - d. Chisel
  - e. Wrench
  - f. Screw drivers



## How Do You Apply What You Have Learned?

### (Demonstration)

<b>Direction:</b> Demonstrate the use of the tools in Self-Check 2.1 then use the checklist below as basis for judging whether you meet the required competency. Write yes or no on separate answer sheet.		
	Yes	No
1. Can select correct type of blade of a hacksaw.		
2. Can move the body a little forward while sawing the metal.		
3. Can apply pressure during forward stroke and release in return while sawing.		
4. Can strike the metal with flat head of a hammer.		
5. Can use wrench in loosening and tightening nuts and bolts.		
6. Can use types of screw drivers correctly.		
7. Can perform actual operations of hand tools by following safety practices.		
8. Can hold cold chisel properly while hammering with a hammer.		
9. Can follow steps in rounding stock with the use of a hammer.		
10. Can assemble and disassemble properly some movable hand tools.		
Overall: Did the student meet the standard requirements?		

## LEARNING OUTCOME 3

### Maintain hand tools

#### PERFORMANCE STANDARDS

- Routine maintenance of hand tools is undertaken according to standard operating procedures, principles and techniques.
- Hand tools are stored in designated location in accordance with manufacturer's instruction or standard operating procedure.



### What Do You Already Know?

**Let us determine how much you already know about maintaining hand tools. Take this test.**

#### Pretest LO 3

Here are simple maintenance activities for hand tools.

1. lubricating
2. tightening/ loosening
3. sharpening
4. simple repair
5. cleaning

Identify the tools where each of the above 5 activities apply.

#### Multiple Choice.

**Directions:** Choose the letter of the correct answer Use separate sheet of paper.

1 Process applied to hand tool to extend its life span.

A. Cleaning.

- B. Simple repair
- C. Lubricating
- D. Overhauling

2 Which process refers to the application of a substance to the identified items in parts like barrels, rollers, springs, bearing, bolts and nuts, and other automotive parts to lessen friction?

- A. Cleaning.
- B. Simple repair
- C. Lubricating
- D. Overhauling

3. A bench vise is resting. How could have been prevented?

- A. Cleaning
- B. Simple repair
- C. Lubricating
- D. Overhauling

4. A worker handle of a ball peen hammer is broken. What is the remedy?

- A. Cleaning
- B. Simple repair
- C. Lubricating
- D. Overhauling

5. Your hacksaw is dull? What maintenance activity should you do?

- A. Cleaning
- B. Simple repair
- C. Lubricating
- D. Overhauling



## What Do You Need To Know?

Read the Information Sheet 3.1 very well then find out how much you can remember and how much you learned by doing Self-Check 3.1.

### Information Sheet 3.1

#### 1. ROUTINE MAINTENANCE



Maintenance of hand tools and machines are both primordial concerns of a repair technician in the welding shops and/or in the welding production. The activities should be on schedule and with proper coordination with the production people. The term “repair” and “maintenance” works mean differently. Repair, unusually focuses on the program of works done in the operation of power plants in machines that are in trouble of stopping its function. While the term “maintenance” means a scheduled or a planned visit of tools or equipments for inspection and from there, reports and recommendation developed and the next tasks to be decided such as cleaning, application of lubricants, dismantling and etc.

Some of the simple maintenance activities for hand tools, and the maintenance schedule should be posted in a visible corner of the shop where everybody can read it.

- **Lubricating.** A task performed in the shop/production through the application of lubricant substance to the identified items in parts like barrels, rollers, springs, bearing, bolts and nuts, and other automotive parts.
- **Tightening/Loosening.** In an assembly of structures, we have tools for fittings that need to be tightened and loosened in as much as they pose high risk to safety. Tightening bolts and nuts and other fittings requires procedures that should be carried out for compliance.

- **Tool for Hand Sharpening.** Some tools need to be sharpened such as blades of knife, cold chisel, punches and many others. To do hand sharpening for hand tools requires techniques and application. In some multi knives cutter, manufacturers produce knife sharpening system to hold or clamp the blade for ensuring strong blade to stone contact during sharpening and also provides with course to fine honing stones. For cold chisel and punches, the right file-size and grades are used for repairing the defective anvil curve.
- **Simple Repair.** Repair practices of hand tools are still available anytime. But, to some extent, tools are checked yearly and many of the hand tools are eligible for condemnation and the whole items are to be replaced by new units. However, there are instances when minor repair can be performed, like replacement of wooden handle of a hammer and mushroomed head of a cold chisel.
- **Cleaning.** Simple process applied to hand tools. The cleaning approach may differ from one another. For example, cleaning of the rack corners of hand tools by using air vacuum or by a piece of cloth. Similar process may be applied to identical cleaning situations.



By piece of cloth



By air vacuum

## 2. PROPER STORAGE OF HAND TOOLS/EQUIPMENT

### (5S Implementation)

- ✓ Clearly label machinery, equipment, part, jigs, tools, and their locations, so that everything is understandable and visible to everyone at a glance.
- ✓ Don't pile up jigs, tools, and materials without separators (shelves). They should be picked up easily.
- ✓ Rearrange machinery and equipment to make smooth production flow, when necessary.
- ✓ Maintain the space around the fire extinguishers and evacuation passages free.



## How Much Have You Learned?

### Self-Check 3.1

**Directions:** Choose the letter of the correct answer. Use a separate answer sheet.

1. A maintenance process of moving assembled parts and hand tools through the use of oil and greases.
  - A) Simple Repair
  - B) Lubricating
  - C) Hand Sharpening
  - D) Tightening
2. What is considered a minor repair?
  - A) The task not too long to perform
  - B) Whole item to be replaced
  - C) Motor overhauling
  - D) Cleaning
3. Proper storage of hand tools entails:
  - A) Placing hand tools together in one place.
  - B) Labeling hand tools properly in the tool cabinet.
  - C) Keeping hand tools in anyplace in the tool room.
  - D) Lubricating tools
4. "Urgent repair" is similar to:
  - A) maintenance schedule
  - B) maintenance Inspection
  - C) an ordinary routine
  - D) an immediate repair
5. Don't pile up jigs, tools and materials without:
  - A) label
  - B) separator
  - C) identification
  - D). stamping

**Refer to the Answer Key. What is your score?**





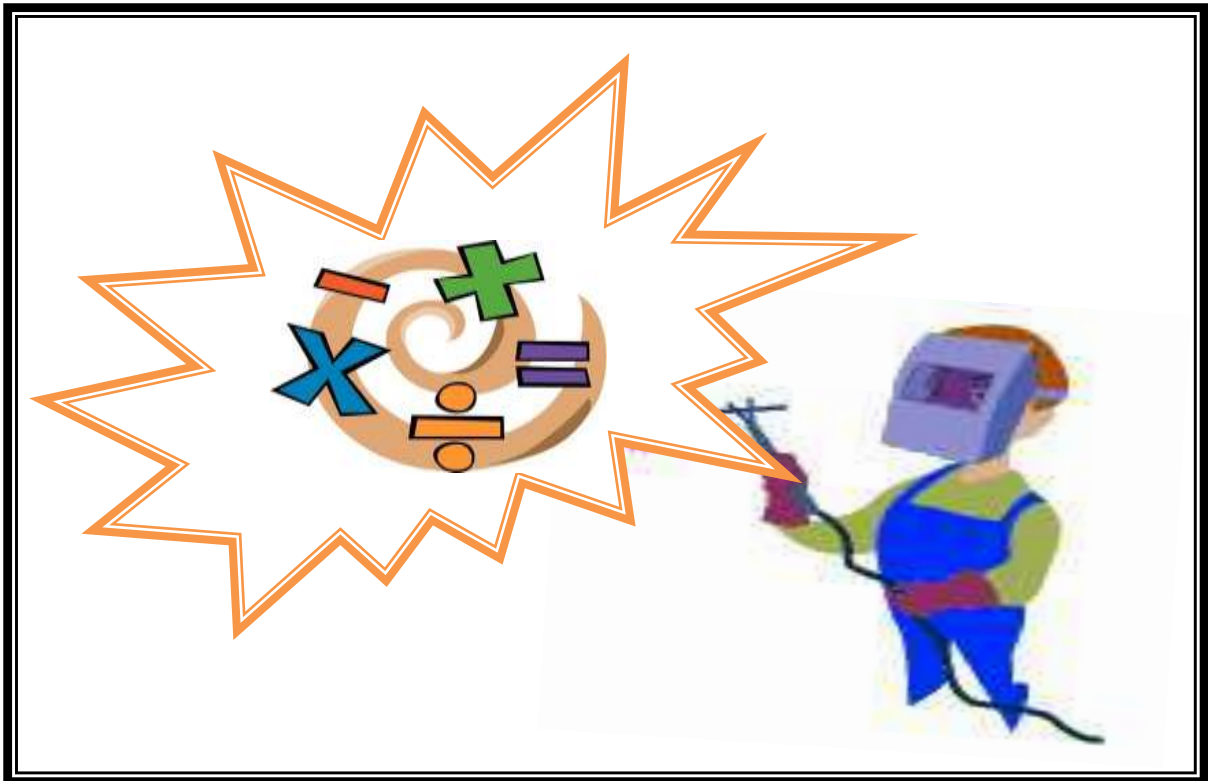
**Congratulations! You did a great job!  
Rest and relax a while then move on  
to the next lesson. Good luck!**

## REFERENCES

- Welding Technology, Second Edition by Gower A. Kennedy
- Welding Inspection Technology, Education Department, American welding Society
- Welding Principles and Application by Larry Jeffus and Harold V. Johnson

## LESSON 2

### Perform Mensuration and Calculation



#### LEARNING OUTCOMES:

At the end of this Lesson, you are expected to do the following:

- LO 1. perform four fundamental operations;
- LO 2. convert English units of measurement to metric system; and
- LO 3. perform basic ratio and proportion, area and volume calculation.



## Definition of Terms

**Addition** – the process of uniting two or more numbers to make it one

**Decimal point** – the period in a decimal number

**Denominator** – part the whole number has been divided

**Dividend** – the number to be divided

**Division** – the process of finding how many times one number contains the other number

**Divisor** – the number by which division is done

**English system** – the system that uses inch, foot, and pound as units of measurement

**Even numbers** – any number that can be divided by two

**Fraction** – one part of a whole number

**Lowest common denominator** – highest number that will divide equally numerator and denominator

**Metric system** – system that uses millimeter, centimeter and meter as units of measure

**Minuend** – the number from which subtraction is made

**Multiplicand** – the number which is multiplied

**Multiplication** – the process of adding one number as many times by another number

**Multiplier** – the number by which multiplication is done

**Numerator** – the number of parts in the fraction

**Odd number** – any number that cannot be divided by two

**Plus sign** – the sign indicating addition

**Prime number** – number that can be divided on exact

**Product** – the result of multiplication

**Proportion** - the equality of two ratios

**Quotient** – the result of division

**Ratio** – a comparison of two quantities

**Remainder** – the difference between two numbers

**Subtraction** – the process of taking one number away from another

**Subtrahend** – the number to be subtracted

**Sum** – the result obtained from adding two or more numbers

**Whole number** – number that have no fractional or decimal number

**Zero** – the number having no value

## LEARNING OUTCOME 1

**Perform four fundamental operations**

## PERFORMANCE STANDARDS

- Simple calculations involving whole numbers, mixed numbers, fraction and decimal are performed using the four fundamental operations.



## What Do You Already Know?

**Let us determine how much you already know about performing the four fundamental operations. Take this test.**

Pretest LO 1

### I. TRUE – FALSE

**Directions:** Encircle T if the statement is correct and F if it is incorrect.

- |   |   |  |
|---|---|--|
| T | F | 1. Odd numbers cannot be divided by two.                   |
| T | F | 2. A mixed number has a numerator larger than denominator. |
| T | F | 3. An improper fraction can be changed to mixed number.    |
| T | F | 4. Fractions are divided horizontally.                     |
| T | F | 5. Any number multiplied by zero equals that number.       |

### II. COMPLETION

**Directions:** Complete the sentences by filling the blank with the correct word.

6. Any number that has no fractional or decimal parts is called \_\_\_\_\_.
7. A number that can be divided by 2 is \_\_\_\_\_.
8. The system of measurement most commonly used worldwide is \_\_\_\_\_.
9. The process of uniting two or more numbers to make it one is called \_\_\_\_\_.
10. The opposite of addition is \_\_\_\_\_.



## What Do You Need To Know?

### INTRODUCTION:

The four fundamental operation (addition, subtraction, multiplication and division) skills should be developed in Shielded Metal Arc Work (SMAW) doing jobs. Inaccurate operation would mean waste of time, effort, materials and the quality of the finish product. The skill in measuring starts with the ability to add, subtract, multiply and divide.

**Read the Information Sheet 1.1 very well then find out how much you can remember and how much you learned by doing Self-Check 1.1.**

Information Sheet 1.1

### WHOLE NUMBERS

Whole numbers are numbers that have no decimal or fractional parts. It can be ODD or EVEN numbers. ODD numbers are those that cannot be divided by two (2). EVEN numbers are numbers that can be divided by 2 with an exact number of times.

Examples:

Whole Numbers - 1 , 3 , 15 , 20 , 45 , 64 , 75 , 102 , etc.

Odd Numbers - 3 , 5 , 7 , 9 , 25 , 51 , 79 , 101 , etc.

Even Numbers - 2 , 4 , 6 , 8 , 12 , 20 , 24 , 50 , etc.

### ADDITION

Addition is the process of combining two or more arithmetical or algebraic quantities in one sum. It is the most common operation in mathematics indicated by a plus (+) sign. It is also used when numbers are added horizontally or vertically. When more than two numbers are added vertically, no sign is required. The sum is the result obtained from adding two or more numbers.

To add whole numbers horizontally is more difficult than adding them, vertically. Example,  $20 + 15 + 30 + 25 = 90$ , this method is not commonly used because mistakes can occur more easily.

## THE NUMBER PLACE VALUE

We can find the value of a digit based on its place in the number.

Example: 3,452

- Digit 2 is in the Ones place
- Digit 5 is in the Tens place
- Digit 4 is in the Hundreds place
- Digit 3 is in the Thousands place

## STEPS IN ADDING WITHOUT REGROUPING

- Always add the digits in the ones place first.
- Add the digits in the tens place next.
- Add the digits in the hundreds place.
- Add the digits in the thousands place and so on

Examples:

$$\begin{array}{r} 241 \\ + 356 \\ \hline 597 \end{array}$$

$$\begin{array}{r} 315 \\ + 482 \\ \hline 797 \end{array}$$



## How Much Have You Learned?

### Self-Check 1.1

- I. **Directions:** Fill in the place value of a digit based on its place in the number. Use a separate sheet of paper as your answer sheet.

1. In 725 \_\_\_\_\_ is in hundreds \_\_\_\_\_ tens \_\_\_\_\_ ones
2. In 450 the digit 5 is in the \_\_\_\_\_ place
3. In 2,615 the digit 2 is in the \_\_\_\_\_ place
4. In 150 \_\_\_\_\_ is in the hundreds place
5. In 685 \_\_\_\_\_ is in the tens place

- II. **Directions:** Add the following numbers with or without regrouping

6.	742	7.	562	8.	735	9.	478	10.	857
	+		+		+		+		+
	236		317		179		125		964
	_____		_____		_____		_____		_____

Refer to the Answer Key. What is your score?

Read the Information Sheet 1.2 very well then find out how much you can remember and how much you learned by doing Self-check 1.2

## Information Sheet 1.2

### **SUBTRACTION**

It is the process of taking one number away from another number. It is the opposite of addition. The minus (-) sign indicates subtraction. The Minuend is the number from which the subtraction is made. The Subtrahend is the number which is subtracted. The Remainder is the difference between the two numbers.

#### **Subtracting Whole Numbers**

Procedure:

- Subtract the subtrahend from the minuend to get the remainder.

To Check:

- Add remainder to subtrahend to get the minuend.

Example:

$$\begin{array}{r} 568 \\ - 43 \\ \hline 525 \end{array}$$

- 568 – is the minuend
- 43 – is the subtrahend
- 525 – is the remainder
- 8 – is in the ones place
- 6 – is in the tens place
- 5 – is in the hundreds place

To Check: Add remainder 525 and 43 the subtrahend to get the minuend 568

#### **Steps in Subtracting Without Regrouping**

- Subtract the digits in the ones place first
- Subtract the digits in the tens place
- Subtract the digits in the hundreds place and so on

Example:

$$\begin{array}{r} 578 \\ - 231 \\ \hline 347 \end{array} \qquad \begin{array}{r} 965 \\ - 732 \\ \hline 233 \end{array} \qquad \begin{array}{r} 879 \\ - 546 \\ \hline 333 \end{array}$$



## How Much Have You Learned?

### Self-Check 1.2

I. **Directions:** Subtract the following with or without regrouping. Use a separate sheet of paper as your answer sheet.

$$\begin{array}{r} 1. \quad 854 \\ - 731 \\ \hline \end{array}$$

$$\begin{array}{r} 2. \quad 976 \\ - 352 \\ \hline \end{array}$$

$$\begin{array}{r} 3. \quad 685 \\ - 523 \\ \hline \end{array}$$

$$\begin{array}{r} 4. \quad 851 \\ - 673 \\ \hline \end{array}$$

$$\begin{array}{r} 5. \quad 513 \\ - 256 \\ \hline \end{array}$$

Refer to the Answer Key. What is your score?

Read the Information Sheet 1.3 very well then find out how much you can remember and how much you learned by doing Self-check 1.3.

### Information Sheet 1.3

## MULTIPLICATION

Is the process of adding one number as many times as there are units in the other number, for example  $2 \times 3 = 6$ . It can also produce the same result as adding  $3 + 3 = 6$ . The sign times or multiplied by (X) indicates multiplication. The Multiplicand is the number which is multiplied. Multiplier is the number by which multiplication is done. Product is the result of multiplication.



## Multiplying Whole Numbers

Procedure:

- Multiply the multiplicand by the multiplier to get the product.

To Check:

- Reverse multiplicand and multiplier the multiply again to get the product or divide the product by the multiplier to get the multiplicand.

Example:

$$\begin{array}{r} 150 \text{ - Multiplicand} \\ \times \quad 7 \text{ - Multiplier} \\ \hline 750 \text{ - Product} \end{array}$$

## Multiplying Fractions

Procedure:

- Multiply the numerator of one fraction by the numerator of the other fraction.
- Do the same with the denominators.
- Reduce the answer to the lowest term as required.

Example:  $3/5 \times 1/5 = 3/25$  - Multiply the numerators ( $3 \times 1 = 3$ ) to get 3 then

- Multiply denominators ( $5 \times 5 = 25$ ) to get 25, thus
- $3/5 \times 1/5 = 3/25$



## How Much Have You Learned?

Self-Check 1.3

**Directions:** Multiply the following whole, fractions and decimal numbers or the information asked for below. Use a separate sheet of paper as your answer sheet.

1.  $\begin{array}{r} 245 \\ \times \quad 13 \\ \hline \end{array}$

2.  $\begin{array}{r} 152 \\ \times \quad 126 \\ \hline \end{array}$

3.  $3/8 \times 5/8 =$

4.  $2/5 \times 3/5 =$

5.  $\begin{array}{r} 8.25 \\ \times \quad .5 \\ \hline \end{array}$

Read the Information Sheet 1.4 very well then find out how much you can remember and how much you learned by doing Self-Check 1.4.

Information Sheet 1.4

## DIVISION

Is the process of finding how many times one number contains the other number. It is the reverse of multiplication. The sign divided by  $\div$  indicates division. Dividend is the number to be divided. Divisor is the number by which division is done. Quotient is the result of division and Remainder is part of the quotient left whenever a quotient is not a whole number. Example:  $25 \div 4 = 6 \frac{1}{4}$  ( $25 \div 4 = 6$  remainder 1)

### Dividing Whole Numbers

Procedure:

- Divide dividend by divisor to get the quotient

To Check:

- Multiply the divisor by the quotient or vice versa to get the dividend

$$\begin{array}{r} 54 \text{ - Quotient} \\ 5 \overline{) 270} \text{ - Dividend} \\ \underline{25} \text{ - 5 Divisor} \\ 20 \\ \underline{20} \\ 0 \end{array}$$
$$\begin{array}{r} 54 \text{ - Quotient} \\ \times 5 \text{ - Divisor} \\ \hline 270 \text{ - Dividend} \end{array}$$



## How Much Have You Learned?

Self-Check 1.4

**Directions:** Divide the following whole, decimal numbers and fractions. Use a separate sheet of paper as your answer sheet.

1.  $7 \overline{) 392}$

2.  $25 \overline{) 225}$

3.  $150 \overline{) 1050}$

4.  $15 \overline{) 375}$

5.  $\frac{2}{3} \div 4 =$

Refer to the Answer Key. What is your score?



## How Do You Apply What You Have Learned?

Show that you learned something by doing this activity

Activity Sheet Sheet 1.1

I. **Directions:** Fill in each empty box with plus, minus or equals sign ( + ) ( - ) or ( = )

70		50		120
50		20		30
20		70		90

II. **Directions:** Match column A with column B. Write the letter of the correct answer on the blanks provided for.

<b>A</b>	<b>B</b>
_____ 1. Minuend	215
_____ 2. Remainder	+ 10
_____ 3. Multiplicand	_____
_____ 4. Divisor	225 – (A)
_____ 5. Dividend	320- (B)
_____ 6. Sum	- 150- (C)
_____ 7. Quotient	_____
_____ 8. Subtrahend	170- (D)
_____ 9. Product	15- (E) X 5 – (F)
_____ 10. Multiplier	_____
	75 – (G)
	50 – (H)
	$3 \sqrt{150} - (I)$
	$\frac{15}{0} \#- 3 \text{ is } (J)$
	$\frac{0}{0}$
	$\frac{0}{x}$

**Refer to the Answer Key. What is your score?**

## LEARNING OUTCOME 2

### Convert English Units of measurement to Metric System

#### PERFORMANCE STANDARDS

- Units are converted to the required figure using the given formulae.
- English measurements are converted to metric measurements according to procedure.



### What Do You Already Know?

Let us determine how much you already know about converting units of measurement from English System to Metric System and vice versa. Take this test.

#### Pretest LO 2

I. **Directions:** Convert the following units of measurement. Use a separate sheet of paper for your answer.

1. 5 Meters = \_\_\_\_\_ Inches
2. 35 Centimeters = \_\_\_\_\_ Feet
3. 18 Feet = \_\_\_\_\_ Meter
4. 20 Inches = \_\_\_\_\_ Millimeter
5. 180 Centimeters = \_\_\_\_\_ Yard

II. **Directions:** Identify the equivalent unit of the following prefixes.

6. Milli -
7. Centi-
8. Deci-
9. Micro-
10. Deka-

Check your answer against the answer key.



## What Do You Need To Know?

**Read the Information Sheet 2.1 very well then find out how much you can remember and how much you learned by doing Self-check 2.1.**

Information Sheet 2.1

### INTRODUCTION:

The Metric System is known as the most common measurement system used in most places of the world. There are common prefixes used to represent as multipliers. For example, in a distance of 2,000 meters can also be expressed as 2 Kilometers.

The English System on the other hand is also known as the British (US) System likewise commonly used anywhere in the world. This system uses the Inch, Foot and Pound as the basic units of measurement. Decimal inch based on tenths and hundredths to simplify measurements. It is commonly used by Engineers, Architects, Surveyors, Draftsmen etc. For better understanding of the systems one must be familiar with the conversion of the English units of measurement to the metric system and vice versa by applying the appropriate conversion factors and procedures.

### Measurement Systems

The basic measurement in the English system is the Yard divided into Feet and Inches abbreviated as follows: Yard – Yd. , Feet – Ft. , and Inches as In. The Metric System or the Systems International (SI) use Meter as the basic unit of measure divided into Decimeters, Centimeters, and Millimeters with the following abbreviations when used.

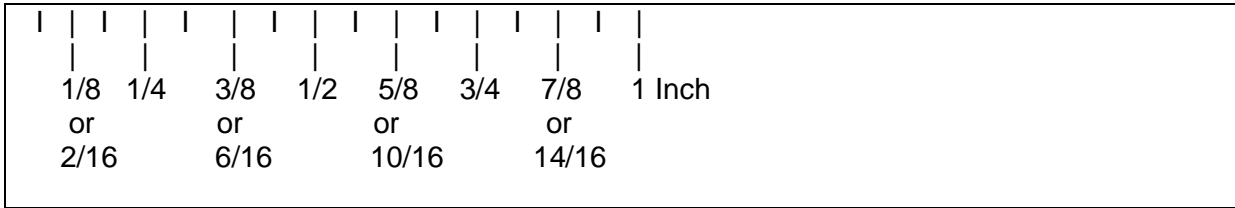
Meter	_	m	Centimeter	_	cm
Decimeter	_	dm	Millimeter	_	mm

Measuring accurately is skill that should be developed. Inaccurate measurements would mean waste of time, effort, materials and the quality of the finish product. The skill in measuring starts with the ability to read and interpret the systems of measurement.

The measuring tool available in the workshop contains English System in one side and Metric System on the other. In the English System, the inch is divided into 16 graduations. The first graduation reads 1/16, the second 2/16 or 1/8, the third as 3/16 and so on.

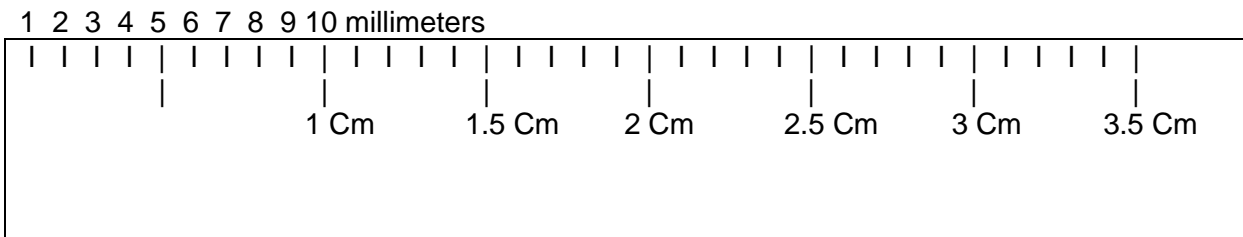
### A- English System

1/16      5/16      9/16      13/16



### B- Metric System

The Metric System (Systems International-SI) Centimeters is divided into ten (10) Graduations where the first graduation reads 1 millimeter, the second 2 millimeters, the fifth 5 millimeters or .5 centimeter and so on.



### BASE UNITS OF MEASURE

Unit	Metric Symbol	Quantity
Meter	m	Length
Gram	g	Mass
Second	s	Time
Ampere	A	Current

### COMMON UNIT PREFIXES

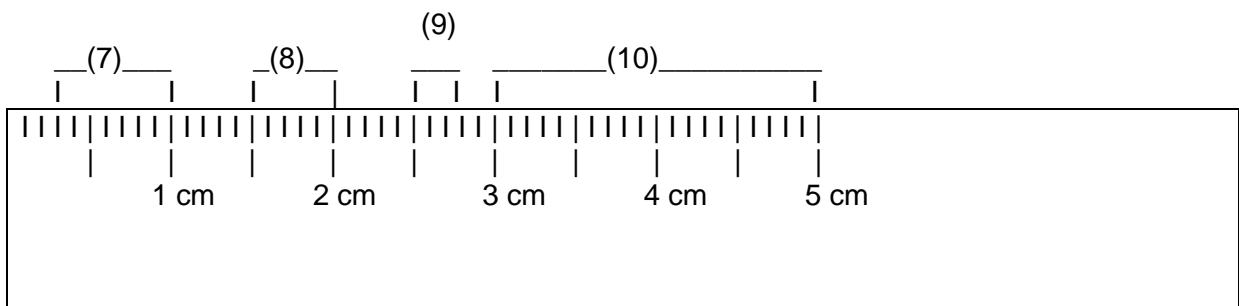
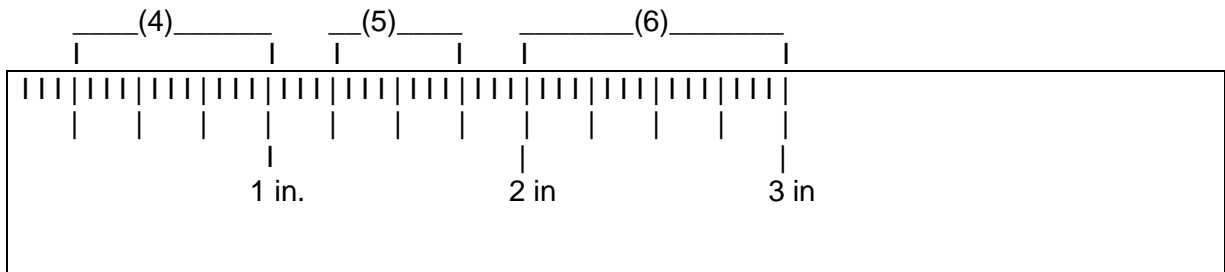
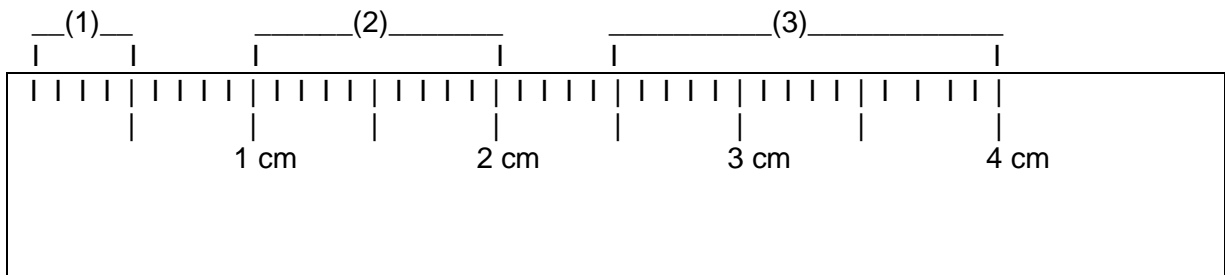
Prefix	Unit	Number
Micro	Millionth	.000001
Milli	Thousandth	.001
Centi	Hundredth	.01
Deci	Tenth	.1
Deka	Ten	10
Hecto	Hundred	100
Kilo	Thousand	1,000



## How Much Have You Learned?

### Self-Check 2.1

**Directions:** Write the correct measurements from the bench rule indicated by numbers below. Use a separate sheet of paper as your answer sheet.



**Refer to the Answer Key. What is your score? If you don't have a perfect score, go back to Information Sheet 2.1 then answer the question again.**



**Read Information Sheet 2.2 very well then find out how much you can remember and how much you learned by doing Self-Check 2.2.**

Information Sheet 2.2

A- Metric to English Equivalentents

Metric System or Systems International (SI) \_ English System or British (US) System

1 Meter	=	39.37 Inches
		3.28 Feet
0.30 Meter/ 30 Centimeters	=	1 Foot
1 Centimeter	=	0 .3937 Inch
2.54 Centimeters	=	1 Inch
1 Millimeter	=	0.03 Inch
25 Millimeters	=	1 Inch
1 Kilometer	=	1093.6 Yards

B – English to Metric Equivalentents

1 Inch	=	2.54 Centimeters
.5 Foot	=	150 Millimeters
		15 Centimeters
1 Foot	=	30.5 Centimeters
1 Yard	=	91.5 Centimeters

Sample Computations:

**Metric to English Conversion**

- To convert meters to feet, divide the length in meters by .30

a- 12 meters to = \_\_\_\_\_ feet = 12/.30

$$= 40$$

40	
.30	1200
	120
	0
	0
	X

- To convert meter to inches, multiply the length in meters by 39.37

b- 2 meters to = \_\_\_\_\_ inches =  $2 \times 39.37$   
 $= 78.74$

$$\begin{array}{r} 11 \\ 39.37 \\ \times \quad 2 \\ \hline 78.74 \end{array}$$

**English to Metric Conversion**

- To convert feet to meter, divide the length in feet by 3.28

c- 82 feet to = \_\_\_\_\_ meters =  $82/3.28$   
 $= 25$

$$\begin{array}{r} 25 \\ 3.28 \overline{) 82.00} \\ \underline{656} \\ 1640 \\ \underline{1640} \\ X \end{array}$$

- To convert inches to centimeters, multiply the length in inches by 2.54

d- 50 inches to = \_\_\_\_\_ centimeters =  $2.54 \times 50 = 127 \text{ cm}$

$$\begin{array}{r} 2.54 \\ \times \quad 50 \\ \hline 127.00 \end{array}$$

e- 15 inches to = \_\_\_\_\_ millimeters =  $15 \times 25 = 375 \text{ mm}$

f- 5 yards to = \_\_\_\_\_ centimeters =  $5 \times 91.5 = 457.5 \text{ cm}$



## How Much Have You Learned?

### Self-Check 2.2

**Directions:** Convert the following English measurements to metric (vice-versa). Use a separate sheet of paper as your answer sheet.

#### I. English to Metric

1. 5 Inches - \_\_\_\_\_ Centimeters
2. 3 Feet - \_\_\_\_\_ Millimeters
3. 10 Yards - \_\_\_\_\_ Centimeters
4. 6 Feet - \_\_\_\_\_ Meters
5. 8 Inches - \_\_\_\_\_ Millimeters

#### II. Metric to English

6. 32 Millimeters - \_\_\_\_\_ Inches
7. 15 Centimeters - \_\_\_\_\_ Foot
8. 4 Meters - \_\_\_\_\_ Feet
9. 7 Centimeters - \_\_\_\_\_ Yards
10. 9 Meters - \_\_\_\_\_ Inches

**Refer to the Answer Key. What is your score?**

## LEARNING OUTCOME 3

**Perform basic ratio and proportion, area and volume calculations**

## PERFORMANCE STANDARDS

- Percentages are computed using appropriate formula.
- Precise and accurate formulas for computing area needed in metal trade are used.



## What Do You Already Know?

**Let us determine how much you already know about the use farm tools and equipment. Take this test.**

Pretest LO 3

- I. Directions: Fill in the blanks with the correct answers. Use a separate sheet of paper for your answers.
  1. \_\_\_\_\_ is a comparison of two numbers or quantities usually separated by a colon.
  2. The equality of two ratios is called \_\_\_\_\_.
  3. The principle of proportion states that the product of the means is equal to the product of the \_\_\_\_\_.
  4. \_\_\_\_\_ is the number of unit squares equal to the surface of an object.
  5. The three dimensional size of an object measured in cubic unit is called \_\_\_\_\_.

II. Identify the formula used for finding area and volume of different geometrical figures from the word pool below.

6.  $L \times W$

7.  $\frac{1}{2} bh$

8.  $2 \pi r$

9.  $L \times W \times H$

10.  $.7854 \times D^2 \times h$

Cylinder	Square	Triangle
Rectangle	Circle	



## What Do You Need To Know?

Read the Information Sheet 3.1 very well then find out how much you can remember and how much you learned by doing Self-check 3.1.

Information Sheet 3.1

### Ratio and Proportion

#### Ratio

The ratio of two numbers is a comparison of two quantities. It is expressed as the indicated quotient of two numbers called TERMS of the ratio. The ratio of C to D maybe expressed as C : D, read as C is to D, C/D or  $C \div D$ . The numbers 4/6, 6 : 9, 8 : 12 or 14 : 21 have the same value as the ratio is 2 : 3.

When the ratios are between measurements, the term of the ratio must be expressed in the same units. The three angles of a triangle are usually expressed as 1 : 2 : 3, read as 1 is to 2 is to 3. If the sum of the angles of a triangle is 180 degrees, the measurement of each angle can be determined using the following procedure.

Examples:

- I. Find the measurement of each angle of a triangle, if the ratio of the angles of a triangle is 1 : 2 : 3 and the sum of the is 180 degrees.

Solution:

Let X = measurement of the first angle  
2X = measurement of the second angle  
3X = measurement of the third angle

$$\begin{aligned} X + 2X + 3X &= 180 \text{ degrees} - \text{sum of the 3 angles of a triangle} \\ 6X &= 180 \text{ degrees} - \text{sum of X's} \\ X &= 30 \text{ degrees} - \text{measurement of the first angle} \\ 2X &= 2 (30) = 60 \text{ degrees} - \text{measurement of the second angle} \\ 3X &= 3 (30) = 90 \text{ degrees} - \text{measurement of the third angle} \end{aligned}$$

- II. Find the ratio of 4 hours to 2 days.  
= 4 hours to 2 days  
= 4 hours to 48 hours  
= 1:12 (dividing 4 and 48 by 4)



Proportion is an equation with a ratio on each side. It is a statement that two ratios are equal .

Example:  $3/8 = 6/16$

When one of the four numbers in a proportion is unknown, cross product maybe used to find the unknown number. Question marks or letter  $x$  and  $n$  are frequently used in place of the un-known number.

Example:

Solve for n:  $1/2 = n/4$  Using cross product, we multiply  $2 \times n$   
 $= 4$ , so  $2 \times n = 4$   
 $= 2n = 4$  ( $4 \div 2 = 2$ )  
 $n = 2$



## How Much Have You Learned?

### Self-Check 3.1

- I. Find the ratio of the following measurements given below. Use a separate sheet of paper for your answer.
  1. 6 inches to 3 feet
  2. 15 centimeters to 1 meter
  3. 3 feet to 5 yards
  4. 150 millimeters to 50 centimeters
  5. 30 centimeters to 2 meters
  
- II. Find the unknown term of proportions given below.
  6.  $5 : 10 = 6 : x$
  7.  $4 : x = 2/8$
  8.  $6 : 3 = 12 : x$
  9.  $2/3 = x : 6$
  10.  $3 : 9 = 4 : x$

**Read the Information Sheet 3.2 very well then find out how much you can remember and how much you learned by doing Self-check 3.2.**

### Information Sheet 3.2



## COMPUTING FOR AREA AND VOLUME

In the metal trades, common formulas related to plane and solid figures are used for laying-out jobs. For example, a welder maybe required to lay-out and build a cylindrical tank to hold specified number of gallons of liquid. By applying the volume formula for cylinders, the welder can determine the size of cylindrical tank.

### AREA

Area is the number of unit squares equal to the surface of an object. For example, a standard size of a piece of plywood contains 32 square foot (sq. ft.). Because it measures 4 feet by 8 feet so,  $4 \times 8 = 32$  square feet.

Area is expressed in square inches, square feet and other units of measure. A square inch measure  $1'' \times 1''$  or each equivalent. A square foot contains 144 square inches by multiplying  $12'' \times 12'' = 144$  sq. inches. The area of any plane figure can be determine by applying the proper formula.

### CIRCLE

When the diameter of a circle is known, the circumference is found by using the following formula.

$$C = \pi D \quad \text{Where:} \quad \begin{array}{l} C = \text{Circumference} \\ \pi = 3.1416 \\ D = \text{Diameter} \end{array}$$

Example:

1. What is the circumference of a 20" diameter circle?

Solution:  $C = \pi D$

$$C = 3.1415 \times 20$$

$$C = 62.832 \text{ inches}$$

### Finding the circumference of circle (Diameter)

When the diameter is known, the circumference of a circle is found by applying the following formula.

$$C = 2 \pi r \quad \text{Where:} \quad \begin{array}{l} C = \text{Circumference} \\ 2 = \text{Constant} \\ \pi = 3.1416 \\ r = \text{Radius} \end{array}$$

Example:

2. What is the circumference of a 10" radius circle?

Solution:  $C = 2 \pi r$   
 $C = 2 \times 3.1416 \times 10$   
 $C = 62.832$  Inches

### **Finding the area of a circle (Diameter)**

When the diameter of a circle is known, area of a circle is found by applying the following formula.

$$A = \pi \frac{d^2}{4} \text{ or}$$

$$A = 0.7854 \times D^2$$

Where A = Area

0.7854 = Constant

$D^2$  = Diameter Squared

Example:

3. What is the area of a 28" diameter circle?

Solution:  $A = 0.7854 \times D^2$   
 $A = 0.7854 \times (28 \times 28)$   
 $A = 0.7854 \times 784$   
 $A = 615.75$  Square Inches

### **Finding the area of a circle (Radius)**

When the radius is known, the area of a circle is found by applying the following formula.

$$A = \pi r^2$$

Where A = Area

$\pi = 3.1416$

$r^2$  = radius squared

Example:

4. What is the area of a 14" radius circle?

Solution:  $A = \pi r^2$   
 $A = 3.1416 \times (14 \times 14)$   
 $A = 3.1416 \times 196$   
 $A = 615.754$  sq. inches

## Finding the area of square or a rectangle

The area of square or a rectangle can be found by applying this formula.

$$A = L \times W \quad \text{Where} \quad \begin{array}{l} A = \text{Area} \\ L = \text{Length} \\ W = \text{Width} \end{array}$$

Example:

5. What is the area of a 22' x 16' storage room?

Solution:

$$\begin{array}{l} A = L \times W \\ A = 22 \times 16 \\ A = 352 \text{ sq. ft.} \end{array}$$

## Finding Area of a Triangle

The area of a triangle can be found by using this formula.

$$A = \frac{1}{2} b h \quad \text{Where} \quad \begin{array}{l} A = \text{Area} \\ \frac{1}{2} = \text{Constant} \\ b = \text{base} \\ h = \text{height} \end{array}$$

Example:

6. What is the area of a triangle with a 10" base and 12" height?

Solution:

$$\begin{array}{l} A = \frac{1}{2} b h \\ A = \frac{1}{2} \times (10 \times 12) \\ A = \frac{1}{2} \times 120 \\ A = 60 \text{ sq. inches} \end{array}$$

## VOLUME

Is the three- dimensional size of an object measured in cubic units. For example, the volume of a standard size of concrete block is 1,024 cubic inches, because  $8 \times 8 \times 16$  is equals to 1,024 cu. In.

Volume is expressed in cubic inches, cubic feet, cubic yards and other units of measure. A cubic inch measures  $1'' \times 1'' \times 1''$  or its equivalent. A cubic foot contains 1,728 cubic inches because  $12'' \times 12'' \times 12'' = 1,728$  cu. In. A cubic Yard contains 27 cu. Ft. because  $3' \times 3' \times 3' = 27$  cu. Ft. The Volume of a solid figure can be determined by applying the proper formula.

### Finding the volume of a rectangular solid

The volume of a rectangular solid can be found by applying the following formula.

$$V = L \times W \times H$$

Where V = Volume  
L = Length  
W = Width  
H = Height

Example:

7. What is the volume of a 24" x 12" x 8" rectangular solid?

Solution:  $V = L \times W \times H$

$$V = 24 \times 12 \times 8$$

$$V = 2,304 \text{ cu. Inches}$$

### Finding the volume of a cylinder

When the diameter of a cylinder is known, the volume can be found by applying the following formula.

$$V = 0.7854 \times D^2 \times h$$

Where V = Volume

0.7854 = Constant

D<sup>2</sup> = Diameter squared

h = Height

Example:

What is the volume of a tank that is 4ft. in diameter and 12 feet in length?

Solution:  $V = .7854 \times D^2 \times h$

$$V = .7854 \times (4 \times 4) \times 12$$

$$V = .7854 \times 16 \times 12$$

$$V = 150.79 \text{ cubic feet (cu.ft.)}$$

<b>Formulas for Computing Area and Volume of Plane and Geometric Figures</b>	
Square	4 x side
Rectangle	2 x (length + width)
Parallelogram	2 x (side1 + side2)
Triangle	side1 + side2 + side3
Regular n-polygon	n x side
Trapezoid	height x (base1 + base2) / 2

Trapezoid	base1 + base2 + height x [csc(theta1) + csc(theta2)]	
Circle	2 x pi x radius	
Ellipse	4 x radius1 x E(k,pi/2) E(k,pi/2) is the Complete Elliptic Integral of the Second Kind k = (1/radius1) x sqrt(radius1 <sup>2</sup> - radius2 <sup>2</sup> )	
<b>Area formula</b>		
Square	side <sup>2</sup>	or S <sup>2</sup>
Rectangle	length x width	or LW
Parallelogram	base x height	or bh
Triangle	base x height / 2	or bh/2 or 1/2bh
Regular n-polygon	(1/4) x n x side <sup>2</sup> x cot(pi/n)	
Trapezoid	height x (base1 + base2) / 2	
Circle	pi x radius <sup>2</sup>	or 6S <sup>2</sup>
Ellipse	pi x radius1 x radius2	
Cube (surface)	6 x side <sup>2</sup>	
Sphere (surface)	4 x pi x radius <sup>2</sup>	or 4Πr <sup>2</sup>
Cylinder (surface of side)	perimeter of circle x height	
	2 x pi x radius x height	
Cylinder (whole surface)	Areas of top and bottom circles + Area of the side	
	2(pi x radius <sup>2</sup> ) + 2 x pi x radius x height	
Cone (surface)	pi x radius x side	
Torus (surface)	pi <sup>2</sup> x (radius2 <sup>2</sup> - radius1 <sup>2</sup> )	
<b>Volume formula</b>		
Cube	side <sup>3</sup>	or S <sup>3</sup>
Rectangular Prism	side1 x side2 x side3	
Sphere	(4/3) x pi x radius <sup>3</sup>	or 4/3Πr <sup>3</sup>
Ellipsoid	(4/3) x pi x radius1 x radius2 x radius3	
Cylinder	pi x radius <sup>2</sup> * height	or Πr <sup>2</sup> h
Cone	(1/3) x pi x radius <sup>2</sup> x height	or 1/3 Πr <sup>2</sup> h
Pyramid	(1/3) x (base area) x height	
Torus	(1/4) x pi <sup>2</sup> x (r1 + r2) x (r1 - r2) <sup>2</sup>	



## How Much Have You Learned?

### Self-Check 3.2

- I. Directions: Find the Area of the following geometrical figures. Use a separate sheet of paper for your answers.
  1. What is the area of a 25" diameter circle?
  2. What is the area of a 20' x 15' feet tool room?
  3. What is the area of a triangle with a 12" base and a 15" height?
  
- II. Directions: Find the volume of the following.
  4. What is the volume of a water tank that is 6' in diameter and 14' long?
  5. What is the volume of a 22" x 10" x 8" rectangular solid?

**Refer to the Answer Key. What is your score?**



**Congratulations! You did a great job!  
Rest and relax a while then move on  
to the next lesson. Good luck!**

### REFERENCES

- Austin, John Benjamin. Electric Arc Welding. Chicago: American Welding Society, 1952
- Boyd, Gardner T. Metalworking. Illinois: Willcox Co. 1982
- Feirer, John L. Modern Metalcraft . Illinois: A. Bennet Co. 1946
- IMCS-DEPED, Industrial Technology Metalworks I, SEDP Series
- Proctor E. Thomas. Print Reading for Welders. American Technical Publishing, Illinois, 60430

## LESSON 3

### Apply safety practices



#### LEARNING OUTCOMES:

At the end of this Lesson, you are expected to do the following:

- LO 1. identify hazardous area.;
- LO 2. use personal protective clothing and devices; and
- LO 3. perform safe handling of tools, equipment and materials



## Definition of Terms

**Bacteria** – simple, one-celled organisms that may or may not be harmful..

**Biological hazards-** hazards caused by living organisms which include insects, molds, fungi, viruses, and bacterial contamination.

**Ergonomic hazards-** hazards are commonly seen in the workplaces which are improperly designed tools or work areas

**Fuel** - any substance, which will combine in the presence of heat-that is, a fuel is “something that will burn”.

**Initial triage and tagging-** sorting patients into categories of priority for care and transport based on the severity of injuries and medical emergency.

**Leather jacket-**is made of chrome leather and prevents the entry of sparks between the clothes and body.

**Mandatory signs-** regulatory signs which indicate that an instruction must be carried out.

**Materials handling-** a technique which include the art of lifting, placing, storing or movement of materials through the use of appropriate handling equipment and men.

**Physical Hazards-** hazard due to the transfer of energy between an object and a worker.

**Prohibition signs-** are regulatory signs which indicate that an action or activity is not allowed.

**Protective sleeves** are made from leather to protect the arms.

**Regulatory Signs-** signs contain instructions that need to be complied with them constitutes an offense under law, standing orders, company policy.

**Safety inspection-** the process of locating and reporting existing and potential condition that may cause accidents.

**Safety Shoes-** safety shoes have heat-resistant soles and impact-resistant toes.

**Warning Signs-** signs which warn of hazard or hazardous condition that is likely to be life-threatening.

**Welding gloves/gauntlet-** made of chrome leather and protects the hands from heat, spatter, and radiations.

**Welding shield/helmet-** used to protect our face and eyes from the arc rays and heat, and the spatter from the molten metal.

**Welding spats-** made of chrome leather and protects the feet from spatter.

## Acronyms

**OSHS-** Occupational Safety and Health Standards

**PPE-** Personal Protective Equipment



## LEARNING OUTCOME 1

### Identify hazardous area

## PERFORMANCE STANDARDS

- Hazards are identified correctly in accordance with OHS (occupational health and safety) procedures.
- Safety signs and symbols are identified and adhered to in accordance with workplace safety procedure.



## What Do You Already Know?

Let us determine how much you already know about identifying hazardous area. Take this test.

Pretest LO 1

**Directions:** Identify the term that is described:

### *Column A*

### *Column B*

\_\_\_\_\_ 1. The most common and painful injuries that occur in the welding shop.

\_\_\_\_\_ 2. An immediate care given to a person who has been injured or suddenly taken illness.

\_\_\_\_\_ 3. A symbol used to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury.

\_\_\_\_\_ 4. Mandatory rules and standards set and enforced to eliminate or reduce hazards in the workplace.

\_\_\_\_\_ 5. It is used to protect our face and eyes from the arc rays and heat and the spatter from the molten metal.

- Welding shields/helmet
- Occupational safety health standard
- Burn
- First aid
- Caution
- Hazard



## What Do You Need To Know?

**Read the Information Sheet 1.1 very well then find out how much you can remember and how much you learned by doing Self-Check 1.1.**

Information Sheet 1.1

### Environmental Hazards

1. **Physical Hazards.** Hazards due to the transfer of energy between an object and a worker.
  - Excessive noise
  - Inadequate illumination
  - Extreme temperature
  - Extreme pressure
  - Vibration
  - Radiation
  - Inadequate ventilation
  - Cluttered area
  - Ignorance or carelessness of the worker
2. **Chemical Hazards.** These hazards arise from inhaling chemical agents in the form of vapor gases, dust, fumes, mist, or by skin contact with these materials.
  - Mist Fine particles of a liquid float in air
  - Gases- substances in gaseous state but are always airborne at room temperature.
  - Vapor- results when substances that are liquid at room temperature evaporate.
  - Dust- solid harmful substances are ground, cut or crushed by mechanical actions.
  - Fumes- gas is condensed in air, chemically changed and becomes fine solid particles which float in air.

#### Four Possible Routes of Entry of Chemical Hazards

1. Inhalation- breathing in toxics is the most common and dangerous route.
  2. Ingestion- toxics enter through the gastrointestinal tract.
  3. Absorption- toxics pass through skin into the bloodstream.
  4. Injection- toxics may be injected into the body (needles, ect.)- the least common, yet most direct route of entry
3. **Biological Hazards.** Hazards caused by living organisms which include insects, molds, fungi, viruses, and bacterial contamination; from defects in sanitation and housekeeping procedures, such as in the provision of potable water, removal of industrial wastes and sewage, food handling , and personal cleanliness.

### **Agents of Biological Hazards**

- Bacteria – simple, one-celled organisms that may or may not be harmful.
- Viruses – organisms that depend on a host cell for development or reproduction
- Fungi – may be small or large parasitic organisms growing in a living or dead plant or animal
- Rickettsia – rod-shaped microorganisms that are smaller than bacteria and depend on a host for development or reproduction. Microorganisms transmitted by fleas, ticks, and lice

#### *Common Health Problems from Biological Hazards*

- a. Tuberculosis (TB)
- b. Tetanus
- c. Viral Hepatitis
- d. HIV/AIDS

#### *Diseases caused by virus*

- a. Upper Respiratory Tract Infection
- b. Hepatitis B Infection
- c. Acquired Immunodeficiency Syndrome (AIDS)
- d. Rabies

4. **Ergonomic Hazards.** Hazards commonly seen in the workplace, which are improperly designed tools or work areas, improper lifting or reaching, poor visual conditions or repeated motions in an awkward position that may be responsible for fatigue, stress and strain and may lead to accidents in the occupational environment.

Ergonomics is si the study of designing equipment and devices that fit the workers

### **Effects of Ergonomic Hazards**

- a. low productivity
- b. high rate of errors
- c. material wastage and equipment

### **Health Problems caused by Ergonomics**

- a. musculoskeletal problems
- b. vascular problems
- c. visual problems
- d. hearing problems
- e. skin problem
- f. psychological problems

## Welding Safety

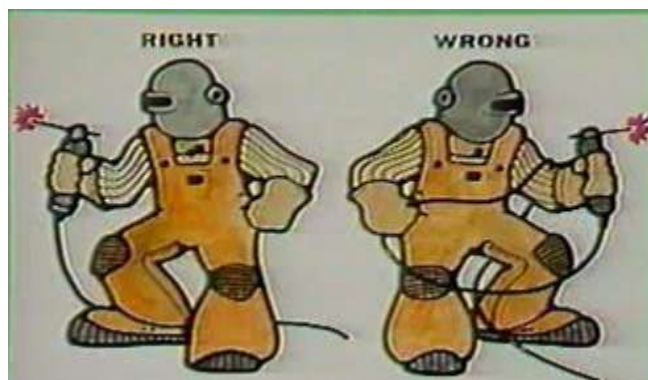
1. **Electric shock** – maybe caused by open and not properly insulated cable. Workers are advised to regularly check electrical wiring connection.



**Check primary circuit wiring connection**

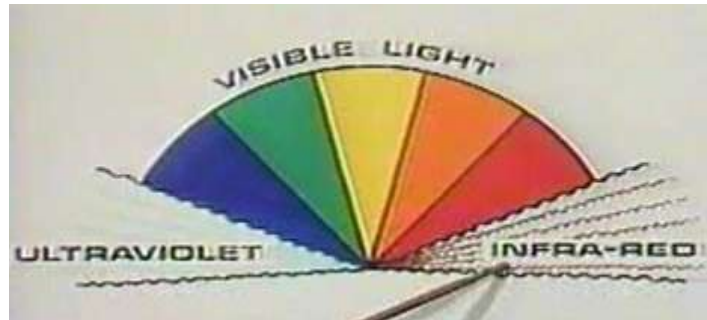


**Check welding cable for crack or cut insulation**



**Do not put welding cable around the part of your body.**

2. **Arc rays** can damage both eyes and skin, so wear proper protective clothing and filter lenses.



### BURN CAUSED BY LIGHT

- Ultra violet light- can cause first degree or second degree burn to the eyes and skin
  - Infrared – wave that is felt as heat
  - Visible light- light that we see
    - producer of varying quantities and color
3. **Fumes and Gases**- Use proper ventilation and position yourself out of the fume flow.

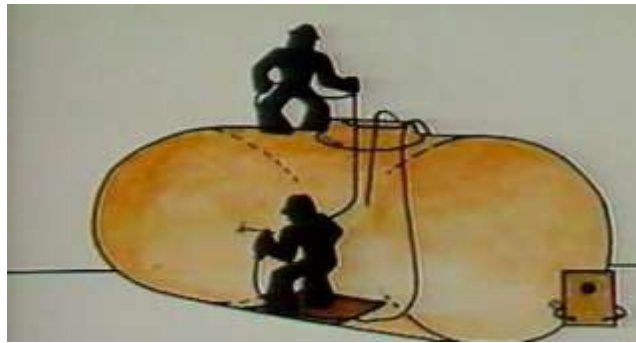
Electrode Diameter IN.	Ventilation Required CFM
3/16 or less	2000
1/4	3500
3/8	4500
1/8 Flux cored	4500

The bigger diameter of the electrode, the more ventilation is required.



Dangerous powder dust comes from weld fumes filtered during welding

4. **Fire and explosion-** may result from faulty welding operation .Always understand the environment where your are welding and never take anything for granted.



**Proper procedure for welding in a tank**

5. **Compressed gas-** must be handled in such a way as to prevent personal or equipment damage.
6. **Face and eye protection** - must be worn at all times in the workplace. This includes safety goggles and full -faced mask.



**Protection Clothing against sparks and hot metals**

Source: [http://nasdonline.org/static\\_content/documents/1087/as230f3.gif](http://nasdonline.org/static_content/documents/1087/as230f3.gif)

**7. Wear correct eye, ear, and body protection.**



**Wear proper body, face, and eye protection**



## How Much Have You Learned?

### Self-Check 1.1

**Direction:** Read and analyze the statement carefully. Choose the best answer and write the letter only in your answer sheet.

1. Which hazards are due to transfer of energy between an object and a worker?
  - A. Chemical hazards
  - B. Physical hazards
  - C. Biological hazards
  - D. Ergonomics hazards
2. Which kind of hazard causes deadening of a welder's hand because of unadvisable position during welding?
  - A. Chemical hazards
  - B. Physical hazards
  - C. Biological hazards
  - D. Ergonomics hazards
3. Impact resulting from being struck by and struck against objects may cause serious accidents which one is referred to?
  - A. Chemical hazards
  - B. Physical hazards
  - C. Biological hazards
  - D. Ergonomics hazards

4. Which process do toxics pass through gastrointestinal organ?
  - A. Ingestion
  - B. Inhalation
  - C. Absorption
  - D. Injection
  
5. People who work with animals, animal products or animal wastes have a greater risk of infection because of\_\_\_\_\_.
  - A. Chemical hazards
  - B. Physical hazards
  - C. Biological hazards
  - D. Ergonomics hazards

**Refer to the Answer Key. What is your score?**



Read Information Sheet 1.2 very well then find out how much you can remember and how much you learned by doing Self-Check 1.2.

## Information Sheet 1.2

### Safety Signs and Symbols

#### Introduction

Safety symbols are pictures sometimes called safety pictographs, pictograms, or pictorials. They are used in place of, or as a supplement to written words. These symbols provide warnings or alerts about a possible hazard.

Because pictures may convey information better than words, graphic symbols are added to precautionary labels to show major workplace dangers like welding or cutting hazards.

The use of symbols on precautionary labels is optional, and is recommended for the following reasons:

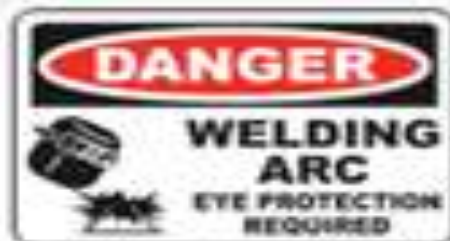
- Symbols may show and help to explain the hazards quickly.
- Symbols can be understood by both readers and non-readers.
- Symbols may be multilingual and usually translate directly into all languages.

Welding and cutting industry has adopted standardized symbols and uniform methods of use to avoid user confusion and to supplement and reinforce the written message.

#### Words

The large word at the top of the label is called the signal word. It is used in combination with a specific colored background and combined with the safety alert symbol to indicate the degree of seriousness of a potential hazard. Because of its colored background, the signal word is usually the first element that you notice when looking at a safety label. According to International Standard Organization (ISO), there are three (3) choices for a signal word:

1. **DANGER.** Used to indicate an imminently hazardous situation which, if avoided, will result in death or serious injury. The use of this signal word should be limited to the most extreme situations.
- 2.



3. **WARNING.** This indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



4. **CAUTION.** Used to indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. CAUTION may also be used without the safety color symbol (the triangle with exclamation mark) to indicate property-damage-only.



### Color

Since color is typically the first thing that draws the attention of the viewer, the color-coded surrounding shapes act as a first level of meaning and, as you draw closer to the sign, you are able to distinguish the specific information conveyed by the graphic symbol.

Example A is an ISO "Warning Safety Sign". This type of label is meant to tell what the hazard is (e.g. "fire hazard").

Example B is an ISO "Prohibition Safety Sign". This label tells about an action not to take in order to avoid a hazard (e.g. "no open flame").

Example C is an ISO "Mandatory Action Safety Sign". This label defines an action that needs to be taken to avoid the hazard (e.g. "read manual").

## Classification of Safety Signs

**1. Regulatory Signs-** signs contain instructions. Failure to comply with them constitutes an offense under law, standing orders, company policy, etc.

- a. **Mandatory signs** are regulatory signs which indicate that an instruction must be carried out. When symbols are used they are white on a blue disc. Text-only mandatory signs are black on white in a portrait format.



- 2. Prohibition signs** are regulatory signs which indicate that an action or activity is not allowed. The symbolic shape used on prohibition signs is the red circle and slash over a black symbol. Prohibition signs may contain only the red circle and text with no symbol.



- 3. Warning Signs-** signs which warn of a hazard or hazardous condition that is not likely to be life-threatening. The symbolic shape used on warning signs is black triangle with yellow interior and black symbol. The word warning is not required to print on the sign, although it is often used for added impact.



**4. Danger Signs-** signs which warn of a hazard or hazardous condition is likely life-threatening. It is recommended that symbols not be used on danger signs.



**5. Fire Signs-** advise the location of fire alarms and firefighting equipment. Fire signs contain a white symbol and/or text on a red background.



**6. Emergency Information Signs-** indicate the location of, or direction to, emergency-related facilities (exits, first aid, safety equipment, etc.). These signs feature a white symbol and/or text on a green background.



**7. General Information Signs-** communicate information of a general nature in order to avoid misunderstanding or confusion. These signs often refer to housekeeping, company practices and logistics.





## How Much Have You Learned?

### Self-Check 1.2

**Direction:** Read and analyze each statement carefully. Choose the best answer and write the letter only on your answer sheet.

1. Pictures that are used to inform workers on safety practices are\_\_\_\_\_.
  - A. Cautions
  - B. Warnings
  - C. Prohibitions
  - D. Safety signs
2. Signs which indicate that an action is not allowed are\_\_\_\_\_.
  - A. regulatory signs
  - B. mandatory signs
  - C. prohibition signs
  - D. warning signs
3. Which are used to indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury?
  - A. Danger
  - B. Caution
  - C. Warning
  - D. Emergency
4. Signs indicate that an instruction must be carried out\_\_\_\_\_.
  - A. regulatory signs
  - B. mandatory signs
  - C. prohibition signs
  - D. warning signs
5. Which used to indicate an imminently hazardous situation which, if avoided, may result in death or serious injury?
  - A. Danger
  - B. Warning
  - C. Caution
  - D. Emergency

**Refer to the Answer Key. What is your score?**

**Read the Information Sheet 1.3 very well then find out how much you can remember and how much you learned by doing Self-Check 1.3.**

### Information Sheet 1.3

## Occupational Safety and Health Standards

### Introduction

Occupational Safety and Health Standards (OSHS) are mandatory rules and standards set and enforced to eliminate or reduce occupational safety and health hazards in the workplace.

OSH Standards aim to provide at least the minimum acceptable degree of protection that must be granted to every worker in relation to dangers of injury, sickness, or death that may arise by reason of his or her occupation. The provision of OSHS by the government is an exercise of police power, with the intention of promoting the welfare and well-being of workers.

### Coverage and Scope of OSHS

All establishments, workplaces, and undertakings are covered, including agricultural enterprises whether operating for profit or not, except:

1. Residential places exclusively devoted to dwelling purposes.
2. Those directly engaged in land, sea and air transportation (however, their dry docks, garages, hangers and maintenance, and repair shops and offices are covered).
3. The activities of a lessee regarding the safety of a mining claim or lease, including mines safety, mineral conservation, and pollution in establishments or work places falling under the mining industry.

### Minimum Standards on Safety and Health in the Workplace

The OSHS require every company to keep and maintain its workplace free from work hazards that are likely to cause physical harm to the workers or damage to property.

The following must be provided by the employer;

- Appropriate seats, lighting, and ventilation.
- Adequate passageways, exits, and firefighting equipment
- Separate toilet facilities and lockers for men and women.
- Appropriate safety clothing like protective gear, masks, helmets, safety boots, coats, or goggles.
- Medicines, medical supplies, or first-aid kits.
- Free medical and dental services and facilities.

## **Safety Measures to be Observed within the Premises of Establishments**

- Building premises shall have adequate fire, emergency or danger signs and safety instructions of standard colors and sizes visible at all times.
- Other visible signs that may be needed to direct the drivers of motorized vehicle such as STOP, YIELD, and DO NOT ENTER, properly positioned within the compound of the establishment to increase safety especially during the night.
- Handicapped employees shall be restricted only to designated workplaces. For as practicable and feasible reasons, they shall be provided with facilities for safe and convenient movement within the establishment.
- Good housekeeping shall be maintained at all times through cleanliness of buildings, yards, machines, equipment, regular waste disposal, and the orderly arrangement of process operations, storage and filing materials.
- Adequate dressing rooms, lockers rooms, comfort rooms and lavatories separate for male and female workers shall be provided.

## **Responsibilities of Employers and Employees under OSHS**

### **Duties of Employers**

- Adopt administrative policies on safety in accordance with the provisions of the standards.
- Report to the Regional Director or his/her duly authorized representative the policies adopted and the safety organization established.
- Submit to the Regional Director or his/her duly authorized representative once every three months a report on the safety performance, safety committee meetings and its recommendations and measures taken to implement the recommendation.
- Act on recommended safety measures and provide access to appropriate authorities.

### **Duties of Employees**

- Follow safety policies.
- Report unsafe conditions and practices to the supervisor.
- Serve as member of the Health and Safety Committee, when called upon to do so.
- Cooperate with the Health and Safety Committee.
- Assist government agencies in the conduct of safety and health inspection.

## **Rule 1100: Gas and Electric Arc Welding and Cutting Operations**

### **1100.01: General Provisions:**

1. Welding or cutting operations shall not be permitted in rooms or areas containing combustible materials or in proximity to explosives or flammable liquids, dusts, gases, or vapors, until all fire and explosion hazards are eliminated.
2. Welding or cutting operations on containers filled with explosives or flammable substance is prohibited. Welding closed containers that have held explosive or flammable substance shall only be undertaken after the containers have been thoroughly cleaned and found completely free of combustible gases or vapors of the containers are filled with inert gas or with water.

3. Welding and cutting operations carried out or done in places where persons other than the welders work or pass shall be enclosed by means of suitable stationary or portable screens. Screens shall be opaque, of sturdy construction to withstand rough usage of a material which will not readily be set on fire by sparks or hot metal at least 2 meters (6.5 feet) high, and preferably painted with light flat paint.
4. A portable fire extinguisher shall be provided at the place where welding and cutting operations are being undertaken.
5. Before welding and cutting operations are allowed in large establishments, the area shall be inspected by the safety man. He shall issue a written permit or authorization for welding and cutting, indicating there in the precautions to be followed to avoid fire or accidents.

1100.02: Personal Protective Equipment:

1. All workers or persons directly engaged in welding or cutting operations shall be provided with the following personal protective equipment:
  - a. goggles, helmet, or head shields fitted with suitable filter lenses and hand shields, and
  - b. suitable aprons
2. All personnel directly assisting in welding or cutting operations shall be provided with goggles or other protective clothing, as may be necessary.

1100.03: Welding or Cutting in Confined Spaces:

Inherent of any fumes, gases, or dusts by persons welding or cutting in confined spaces shall be prevented by the provision of:

1. Local exhaust and general ventilation system to keep fumes, gases, or dusts within allowable concentrations or threshold limit values.
2. Approved types of respiratory protective equipment





## How Much Have You Learned?

### Self-Check 1.1

**Directions:** Read and analyze each statement carefully. Choose the best answer and write the letter only on your answer sheet.

1. Safety standards are mandatory rules set and enforced to eliminate or reduce,
  - A. welding defects
  - B. welding injuries
  - C. welding problems
  - D. hazards in the workplace
2. The governments purpose of creating Occupational Safety and Health Standards is to\_\_\_\_\_.
  - A. produce quality output
  - B. produce safety personnel
  - C. promote welfare and well-being of workers
  - D. protect the rights of the workers against abusive employers
3. Under Rule 1100.01 of the gas and electric arc welding operations, welders are\_\_\_\_\_.
  - A. provided with PPE by employers
  - B. provided with exhaust and ventilated system
  - C. protected from any violations against their rights
  - D. prohibited from working in areas prone to combustible materials
4. Rule 1100.02 states that workers must be
  - A. provided with PPE by employers
  - B. provided with exhaust and ventilated system
  - C. protected from any violations against their rights
  - D. prohibited from working in areas prone to combustible materials
5. Concerning welding or cutting in confined spaces under Rule 1100.03, welders are
  - A. provided with PPE by employers
  - B. provided with exhaust and ventilated system
  - C. protected from any violations against their rights
  - D. prohibited from working in areas prone to combustible materials

**Refer to the Answer Key. What is your score?**

## LEARNING OUTCOME 2

**Use personal protective clothing and devices.**

### PERFORMANCE STANDARDS

- Personal protective clothing/equipment (PPE) as per job requirements are identified.
- Proper wearing of PPE is properly observed in accordance with workplace safety policies.



## What Do You Already Know?

**Let us determine how much you already know about the use of personal protective clothing and devices. Take this test.**

Pretest LO 2

**Directions:** Read each sentence carefully and select the best answer.

1. Which are made from light asbestos coated with aluminium protect all of the body during welding?
  - a. Safety shoes
  - b. Protective Cover all
  - c. Welding spats
  - d. Leggings
  - e. Safety goggles
  
2. Which ones are made from leather to protect the legs and feet.
  - a. Safety shoes
  - b. Protective Cover all
  - c. Welding spats
  - d. Leggings
  - e. Safety goggles

3. Which are heat resistant shoes?

- a. Safety shoes
- b. Protective Cover all
- c. Welding spats
- d. Leggings
- e. Safety goggles

4. Which are made of chrome leather and protect our feet from spatter?

- a. Safety shoes
- b. Protective Cover all
- c. Welding spats
- d. Leggings
- e. Safety goggles

5. Which are used where grinding and chipping off slags?

- a. Safety shoes
- b. Protective Cover all
- c. Welding spats
- d. Leggings
- e. Safety goggles



## What Do You Need To Know?

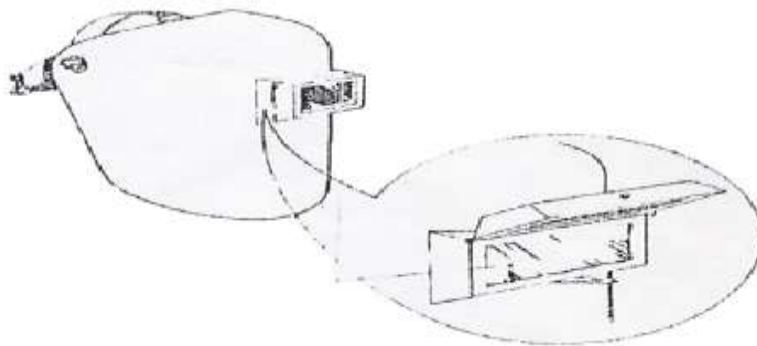
Read the Information Sheet 2.1 very well then find out how much you can remember and how much you learned by doing Self-Check 2.1.

### Information Sheet 2.1

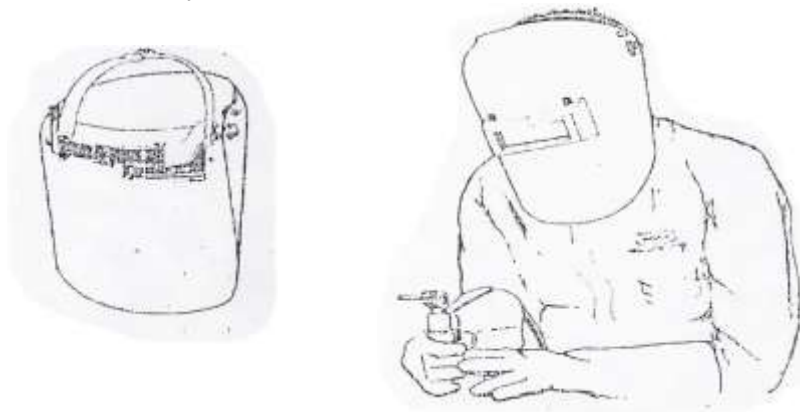
#### Personal Protective Equipment (PPE)

The observation of health and safety precautions in welding operation is of greatest importance. Your life and that of the others are more important than the job you are doing.

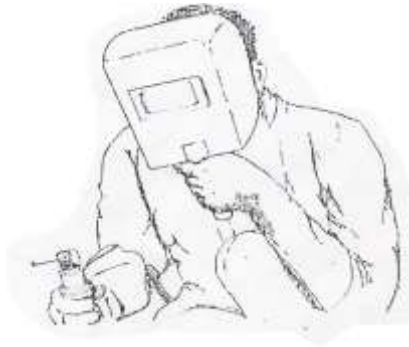
1. **Welding shield/helmet** is used to protect our face and eyes from the arc rays and heat, and the spatter from molten metal. The arc is viewed through a filter which reduces the intensity of radiation but allows a safe amount of light to pass for viewing the weld pool and end of the electrode.



- 1.1 **Helmet type** welding shield is more convenient to use because it allows both hands to work freely.



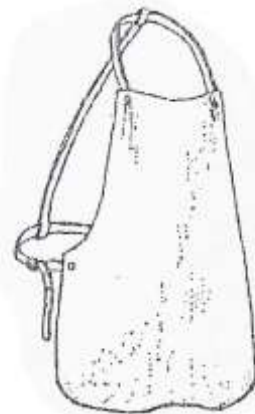
**1.2 Hand-held shield** allows only one hand to work freely.



2. **Leather jacket** is made of chrome leather and prevents the entry of sparks between our clothes and body.



3. **Leather apron** is made of chrome leather and provides a welder with complete protection of his chest to mid calf from sparks and hot metal.



4. **Welding gloves/gauntlet** is made of chrome leather and protects our hands from heat, spatter, and radiations.

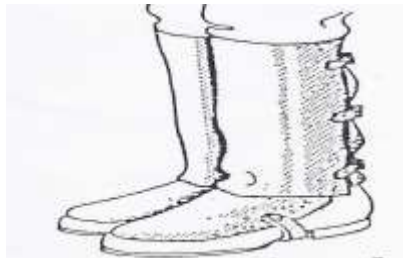


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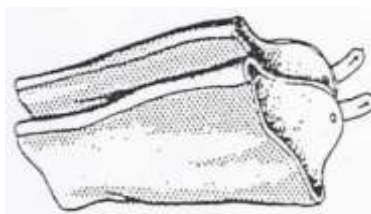
5. **Face shield** is best for general protection because it can be worn under an arc welding helmet



6. **Leggings** are made from leather to protect the legs and feet.



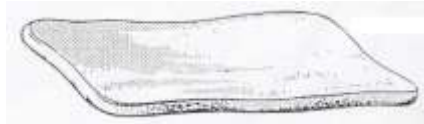
7. **Protective sleeves** are made from leather to protect the arms.



8. **Protective cover all** are made from light asbestos coated with aluminum to protect the whole body during welding.



9. **Welding cushions** are made from leather for sitting and kneeling beside the work piece as protection against cold.



10. **Welding spats** are made of chrome leather and protects our feet from spatter.



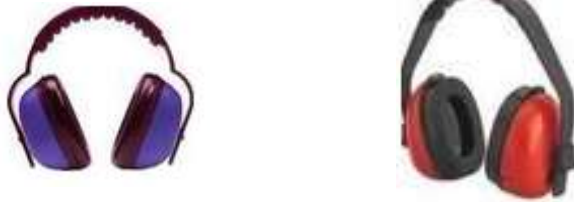
11. **Safety Shoes-** have heat resistant soles and impact resistant toes. Some safety shoes have metal in soles, while others protect workers from different types of electrical hazards.



12. **Safety goggles-** are used when grinding and chipping off slag.



13. **Earmuffs**- are used for ear coverings and are connected by a flexible band and worn as protection against extreme noise.



14. **Earplugs**- is a pair of device that is meant to be inserted in the ear canal to protect the wearer's ears from loud noise or intrusion



15. **Respirator**- is an apparatus worn over the mouth and nose or the entire face to prevent the inhalation of dust, smoke, or other noxious substances.



**Full face respirator**

Source:

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## How Much Have You Learned?

### Self-Check 1.1

**Identification:**

**Directions:** Observe carefully the illustration below. Name the different safety equipment worn by the worker.



Refer to the Answer Key. What is your score?

**Read the Information Sheet 2.2 very well then find out how much you can remember and how much you learned by doing Self-Check 2.2.**

## Information Sheet 2.2

### **Proper Use of Personal Protective Equipment**

The primary approach in any safety effort is to maintain or change the physical environment so that accidents would not occur. However, it is necessary for economic reasons or in temporary or changing conditions to safeguard personnel by equipping them individually with specialized personal protective equipment (PPE). Although the use of PPE is an important consideration in the development of a safety and health program, it should not be used permanently for maintaining a safe and healthy work environment. In general, government regulations list the use of PPE as a case of last resort. Analyzing accident situations is done to determine whether PPE can prevent a recurrence. When work conditions cannot be made more safely clearly PPE is necessary.

### **Proper Training**

To obtain the worker's complete compliance with the requirements to wear the PPE, the following factors must be considered:

1. the extent to which the personnel who must wear the equipment understand its necessity
2. the ease and comfort with which it can be worn with a minimum of interference with normal procedures
3. the available economic, social, and disciplinary sanctions which can be used to influence the attitudes of the workers

### **Head Protection**

Safety hats should be inspected prior to their use.

- Inspect suspension systems that show evidence of materials cracking, tearing, fraying or other signs of deterioration. Suspension should provide a minimum clearance of 1 to 1.25 inch between the top of the worker's head and the inside crown of the hat.
- Check any signs of cracks or perforations of brim or shell, deformation of shell, or evidence or exposure to excessive heat, chemicals or radiation.
- Remove any accumulation of conductive material on or inside the shell that cannot be removed prior to use.

Objects should not be placed inside the safety hat between the shell and the suspension device. This space is designed so an impact will not transmit to the head of the worker.

Safety hats should be kept free of abrasions, scrapes, and nicks and should not be deliberately dropped, thrown, or otherwise abused because they will lose their protective qualities.

Ventilation should not be drilled in safety hats.

## Eye and Face Protection

Eye protectors must meet the minimum requirements:

- Provide adequate protection against the particular hazards for which they are designed
- Be reasonably comfortable when worn under the designated conditions
- Fit snugly without interfering with the movements or vision of the wearer
- Be durable.
- Be capable of being disinfected.
- Be kept clean and in good repair
- Design, construction, testing, and use of eye and face protection must be in accordance with ANZI Z8.1-1989. The fitting of goggles and safety spectacles should be performed by someone skilled in the procedure. Prescribed safety spectacles should be fitted only by a qualified optical person. Safety spectacles require special frames. Combinations of normal street wear frames with safety lenses are not in compliance with the required standards for eye protectors.



## Ear Protection

The prevention of excessive noise exposure is the only way to avoid hearing damage. Engineering and administrative control must be used if the sound levels are exceeded. If such controls fail to reduce the sound levels within the level specified, personal hearing protection must be used. Molded earplugs should be individually fitted by a professional.

Some earplugs are disposable, to be used one time and then thrown away. The non-disposable type should be cleaned after each use for proper protection.

Earmuffs must make a perfect seal around the ear to be effective. Glasses, long sideburns, long hair and facial movements, such as chewing, may reduce protection. Special equipment is available for use with glasses or beards.

## Foot and Leg Protection

For protection of feet and legs from falling or rolling objects, sharp objects, molten metal, hot surfaces, and wet slippery surfaces, workers should use appropriate foot guards, safety shoes, boots and leggings.

Never wear open-toed footwear while working with hot metal or welding apparatus.

## Safety Belts, Lifelines and Lanyards

Lifelines, safety belts, and lanyards are used only for safeguarding employees. Any lifeline, safety belt, or lanyard are actually subjected to in-serving loading, as distinguished from static load testing shall be immediately removed from service and shall not be used again for employee safeguarding.





## How Much Have You Learned?

### Self-Check 2.2

#### Multiple Choices:

**Directions:** Read each statement carefully. Choose the answer that will best complete the statement.

1. Safety belts were designed to safeguard workers \_\_\_\_\_.
  - A. by carrying heavy load
  - B. by holding hot metals
  - C. from noise exposure
  - D. from falling
2. Safety hats should be free from abrasions, cracks, or frayings and should not be deliberately dropped or thrown because \_\_\_\_\_.
  - A. a space should be designed to protect.
  - B. ventilation should be drilled in them.
  - C. they will lose their protective quality.
  - D. their appearance and style should be modern.
3. Earmuffs and earplugs are effectively used \_\_\_\_\_.
  - A. for engineering and administrative control.
  - B. for workers to look fashionable.
  - C. to match the glasses and hair style of workers.
  - D. to avoid hearing damage.
4. The main purpose of wearing eye and face protection is to \_\_\_\_\_.
  - A. keep clean and be in good condition.
  - B. be capable of being disinfected.
  - C. fit snugly without interference of eye movement.
  - D. provide adequate protection against hazards.
5. A responsible worker shows awareness about safety except
  - A. Awareness to the limited application of PPE
  - B. Awareness to the unlimited application of PPE
  - C. Person who wears PPE understands its necessity
  - D. Influence the attitudes of the workers about safety

**Refer to the Answer Key. What is your score?**



## LEARNING OUTCOME 3

**Identify safety and health requirements and policy**

## PERFORMANCE STANDARDS

- Safe handling of tools, equipment and materials is properly observed in accordance with OHS requirements and industry/company policies.
- Safety label and tag of tools and equipment are strictly followed.



## What Do You Need To Know?

**Read the Information Sheet 3.1 very well then find out how much you can remember and how much you learned by doing Self-Check 3.1.**

Information Sheet 3.1

## Pre-use Inspection and Checking Procedures

### INTRODUCTION

Safety and health inspection is a central part of most safety, health and environmental protection programs, such practices a reliable way for identifying and eliminating conditions that could contribute to accidents, illnesses, or environmental damages.

Safety inspection is a tool in the prevention of accident. If regular inspection of existing potentially unsafe conditions is not done, accidents in the workplace are likely to happen.

### *Elements of Effective Safety and Health Inspection Programs*

An effective safety and health inspection program requires the following:

1. Sound knowledge of the facility. Familiarity with the facilities of the establishment is an effective tool in determining things are to be inspected and how often these things should be inspected.

2. Knowledge of relevant standards, regulations and codes. The reference of all safety and health rules and regulations of the company should always be the established local legislations and codes. These standard regulations will be our guide in assessing whether our workplace is safe or not.
3. Systematic inspection system. In occupational safety and health, time is very important. An established inspection system will facilitate inspection activities and will allow the designated safety inspector to improve the workplace based on identified hazards as early as possible.
4. Method of reporting, evaluating and using the data. Evaluation of effectiveness of the program is a must to determine whether a program is a success or a failure. Inspection should be documented. Reports prepared and submitted and other safety and health data are vital in evaluating the program.

## **Safety and Health Inspection Cycle**

### **1. Purpose**

The primary purpose of inspection is to detect potential hazards so they can be corrected before an accident occurs. Inspection should be conducted in an organization to locate and report existing and potential unsafe conditions or activities. It is important that every potential hazard found in workplaces must be corrected to ensure that no one will be injured, or one will be exposed to any diseases and that working environment will not be contaminated by hazardous chemicals emitted in the process.

### **2. Inspection Priorities**

Who will conduct the inspection?

- a. Safety professionals. They spearhead the inspection activity.
- b. Company or facility management. They demonstrates commitment to maintain a safe working environment.
- c. First – line Supervisors or Foreman. They continually monitor the workplace.
- d. Employees. They inspect the workplace and any tools, equipment, and machinery that will be used. Any defects that the employee is not authorized to correct should be reported immediately to the supervisor.
- e. Maintenance personnel. He is responsible for locating and correcting hazards.
- f. Joint Safety and Health Committee. It conducts regular inspection as part of its functions.

Items to be inspected are as follows;

- a. Environmental factors
- b. Hazardous supplies and materials
- c. Production and related equipments
- d. Power source equipment
- e. Electrical equipment
- f. Hand tools
- g. Personal Protective Equipment
- h. Personal service and first aid facilities
- i. Fire protection and emergency response equipment
- j. Walkways and roadways
- k. Elevators, electric stairways and manlifts
- l. Working surfaces
- m. Materials handling equipment



- n. Transport equipment
- o. Warning and signaling devices
- p. Containers
- q. Storage facilities and area both indoor and outdoor
- r. Structural openings
- s. Building and structures
- t. Miscellaneous

Conditions need to be inspected:

Unsafe conditions inspected should be described specifically and clearly. Usually, conditions to look for can be indicated by such words as “jagged”, “exposed”, “broken”, “frayed”, “leaking”, “rusted”, “corroded”, “missing”, “vibrating”, “loose”, or “slipping”. Sometimes exact figures are needed, for example, the maximum pressure in a boiler or the percent spread of a sling hook.

### 3. Schedule of Evaluation

Inspection can be classified as one of two types – continuous or interval inspection, which should be discussed each using the key points such as the following:

#### a. Continuous Inspection

It involves noting an apparently or potentially hazardous conditions or unsafe procedure that needs to be corrected it immediately or reported at once to initiate corrective action. It is sometimes called informal inspection because it does not conform to a set of schedule, plan, or checklist.

#### b. Interval Inspection

Planned inspections at specific intervals are what most people regard as “real” safety and health inspections. They are deliberate and follow a systematic procedure that permits examination of specific items or conditions. The interval inspections may be periodic, intermittent, or general.

### 4. Conducting Inspection

In conducting an inspection, some of the general considerations are the following;

- Must not interrupt normal operations
- Review all accidents and previous inspection report made.
- Awareness of any potential hazards
- Wearing of Personal Protective Equipment
- Formulation of checklist

#### Reporting and Recording

Checklists serve as reminders of what to look for and as records of what have been covered. They can be used to structure and guide inspection. They also allow on-the-spot recording of all findings and comments before they are forgotten. In case an inspection is interrupted, checklists provide a record of what has and what has not been inspected. Otherwise, an inspection may miss items or conditions that should be

examined. Good checklists also help in follow-up work to make sure hazards have been corrected or eliminated.

The format of a checklist should include columns to indicate either compliance or date is taken, action, date. Space should also be provided to cite the specific violation, a way to correct it, and a recommendation that the condition receives more or less frequent attention. Whatever the format of the checklist, space should be provided for the inspector's signature and the inspection date.

Inspection Report – Every inspection must be documented in a clearly written inspection report furnished by the inspector. Without a complete and accurate report, the inspection would be a little more than an interesting sightseeing tour. Inspection reports are usually of three types:

1. Emergency – made without delay when a critical or catastrophic hazard is probable.
2. Periodic – covers those unsatisfactory non-emergency conditions observed during the planned periodic inspection. This report should be made within 24 hours of the inspection.
3. Summary – lists of all items of previous periodic reports for a given time.

Generally, inspection reports are sent to the head of the department or area where the inspection was made. Copies are also given to executive management and the manager to whom the department head reports.

## **5. Implementation**

Upon implementation of the inspection report, make sure that recommendations proposed by the inspector will be given priority depending on the hazards found in the area.

In making recommendations, inspectors should be guided by four (4) rules:

1. Correct the cause whenever possible. If all the resources needed to correct the cause are already available, improve the working condition.
2. Immediately correct everything possible. All possible causes of accident should be corrected at once to prevent their recurrence. This will definitely be done if all measures are in place.
3. Report conditions beyond one's authority and suggest solutions. Safety is everybody's job. Anyone should be involved in the prevention of accident. If you identify hazards in your place or work, report them at once to your supervisor. Give recommendation to correct the situation.
4. Take intermediate action as needed. Time is an essence as far as safety is concern. If unsafe condition was identified and corrective measure is at hand. Improve it at once.

## **6. Monitoring**

Monitoring is a management prerogative. Management must realize that employees are keenly interested in the attention paid to correcting faulty conditions and hazardous procedures. Recommendations approved and supported by management should become part of the organization's philosophy and program. At regular intervals, supervisors should report progress in complying with the recommendations to the safety department, the company safety and health committee, or the person designated by management to receive such information. Inspectors should periodically check to see what progress

toward corrective actions is being made. Unsafe conditions left uncorrected indicate a breakdown in management communications and program applications.

Sometimes management will have to decide among the several courses of action. Often these decisions will be based on cost effectiveness. For example, it may be cost-effective as well as practical to substitute a less toxic material that works as well to the highly toxic substance presently in use. On the other hand, replacing a costly but hazardous machine may have to wait until funds can be allocated. In this case, the immediate alternative taken or proposed must be communicated to all persons involved.



## How Much Have You Learned?

### Self-Check 3.1

#### Multiple Choice:

**Directions:** Read and analyze the statement carefully. Choose the best answer and write the letter only in your answer sheet.

1. A tool in the prevention of accident to locate and report existing and potential unsafe conditions that, if left uncontrolled, have the capacity to cause accident in the workplace
  - a. Safety tools
  - b. Safety inspection
  - c. Safety procedures
  - d. Safety equipments
2. Evaluation of effectiveness of the program is a must to determine whether a program is a success or a failure.
  - a. Systematic inspection system
  - b. Sound knowledge of the facility
  - c. Method of reporting, evaluating, and using the data
  - d. Knowledge of relevant standards, regulations and codes
3. When to inspect tool rooms?
  - a. General inspection
  - b. Periodic inspection
  - c. Intermittent inspection
  - d. Continuous inspection
4. When conducting safety and health inspection, general consideration must be observed except
  - a. Duration of inspection
  - b. Awareness of potential hazards
  - c. Review of previous inspection report
  - d. Must not interrupt normal operation
5. An employee is authorized to practiced safety except
  - a. Repair defective tools
  - b. Report unsafe conditions

- c. Identify and repair defective tools
- d. Guards and warning signs are in place

Refer to the Answer Key. What is your score?



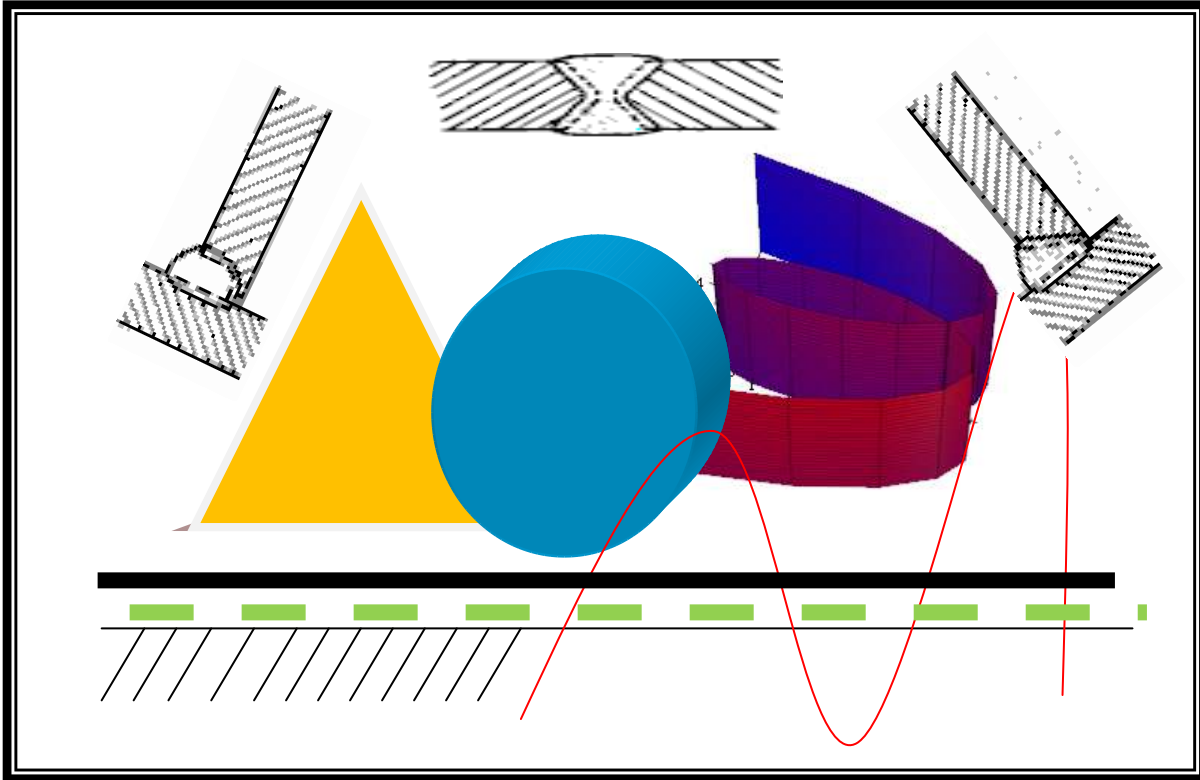
**Congratulations! You did a great job!  
Rest and relax a while then move on  
to the next lesson. Good luck!**

## REFERENCES

- Welding Technology, Second Edition by Gower A. Kennedy
- Welding Inspection Technology, Education Department, American Welding Society
- Welding Principles and Application by Larry Jeffus and Harold V. Johnson

## LESSON 4

### Interpret Drawings and Symbols



#### LEARNING OUTCOMES:

At the end of this Lesson, you are expected to do the following:

- LO 1. identify standard alphabet of lines; and
- LO 2. interpret standard drawing symbols.



## Definition of Terms

**Arrow side-** a weld symbol that is written above the reference line.

**Both side-** a weld symbol that is written above and below the reference line.

**Concave-** a curve inward (see contour symbol)

**Convex-** a curve outward (see contour symbol)

**Drawing** - illustrating objects using drawing instruments

**Other side-** a weld symbol that is written above the reference line

**Reference Line-** written horizontally forming an obtuse angle

**Sketching-** freehand drawing

**Symbol** - a figure or character used in place of a word or group of words.

**Tail-** is a part of an arrow symbol on a welding blue

**Tolerance-** the total amount of variation permitted for the design size of a part

**Weld joints-** refer to how the parts to be welded are assembled prior to welding

**Weld symbol-** indicates a require type of weld and supplemental implementation

**Weld symbols-**miniature drawing of the metal edge preparation prior to welding

- provide the means of placing complete welding information on drawing

## LEARNING OUTCOME 1

Identify standard alphabet of lines

## PERFORMANCE STANDARDS

- Alphabet of lines are identified according to ISO (International Standard Organization).



## What Do You Already Know?

Let us determine how much you already know about identifying standard alphabet of lines. Take this test.

Pretest LO 1

**Directions:** Read each sentence carefully then identify the word referred to in each number.

1. Which is a thick solid line used to show the visible shape of the object.
  - a. Hidden line
  - b. Center line
  - c. Extension line
  - d. Object line
  - e. Short break line
2. Which is a heavy irregular line drawn freehand that is used to show a short break to conserve space on a drawing?
  - a. Hidden line
  - b. Center line
  - c. Extension line
  - d. Object line
  - e. Short break line

3. Which broken line is made up of a series of short and long dashes or alternately spaced, to show the center of circles, arcs, and symmetrical objects?
- Hidden line
  - Center line
  - Extension line
  - Object line
  - Short break line
4. Which broken line of medium thickness is used to show the edges and outline not visible to the eye.
- Hidden line
  - Center line
  - Extension line
  - Object line
  - Short break line
5. Which fine lines extend from the object with a slight break between and is used to show dimensioning points.
- Hidden line
  - Center line
  - Extension line
  - Object line
  - Short break line





## What Do You Need To Know?

Read the Information Sheet 1.1 very well then find out how much you can remember and how much you learned by doing Self-Check 1.1.

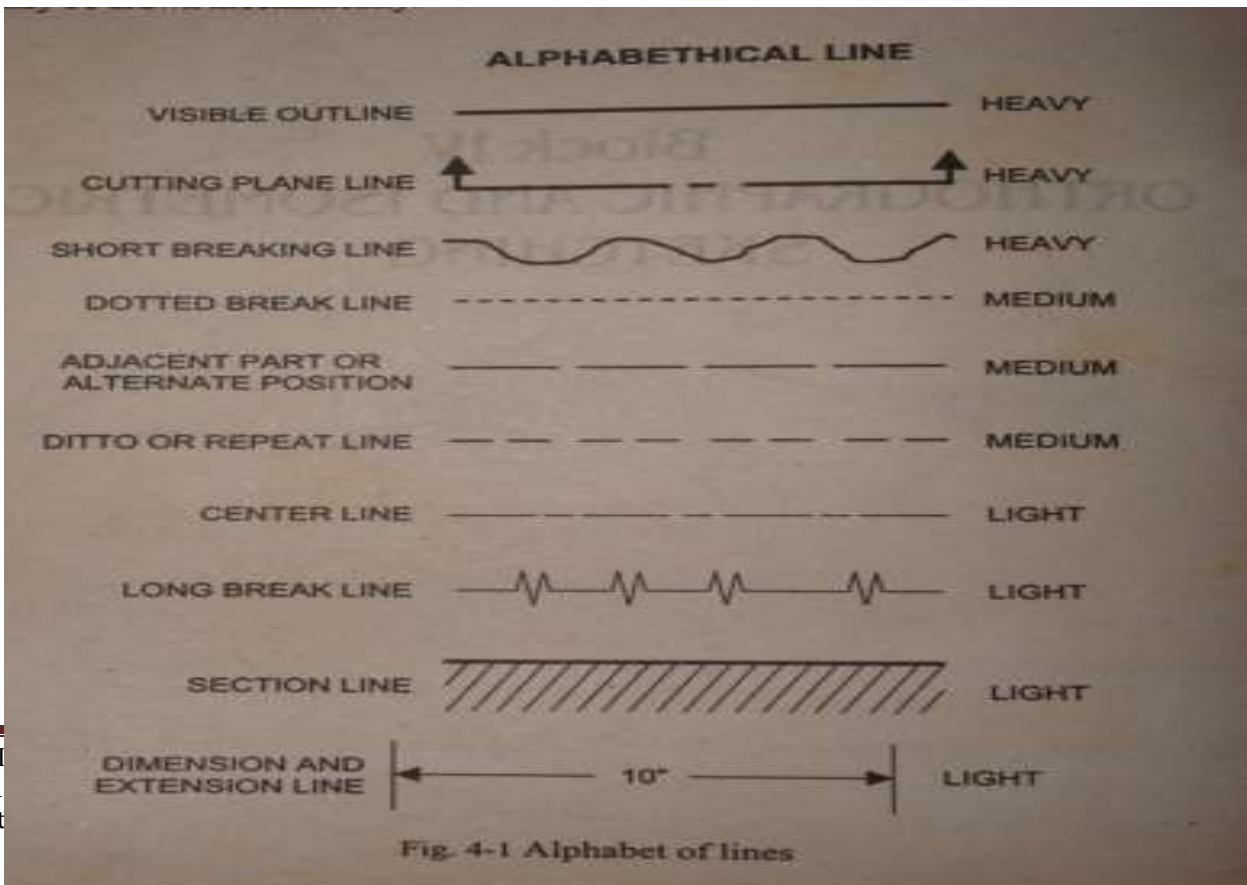
Information Sheet 1.1

### Alphabet of Lines

Lines are the bases of all drawings. They are used even from simple drawings to the difficult ones. Practice, exercise and correct use of techniques in the making of lines will give student experience in technical sketching. Moreover, constant practice will help students develop skills in making lines and use of pencils. It should be remembered that the basic requirement for line construction is clarity of line produced.

In practice, the kind of line produced depends on the hardness of the pencil. For drawing using pencil, the medium and light lines are more prepared.

There are conventional lines used in drawing. These lines are called alphabet of line and each line serves a particular purpose. These lines may either be drawn freehand or they may be drawn mechanically.



There are several different types of lines used on a print and each has different meaning. To be able to interpret a print, the reader should have knowledge of these lines. These lines are called **alphabet of lines**.

1. **Object Line.** Thick solid line used to show the visible shape of the object.



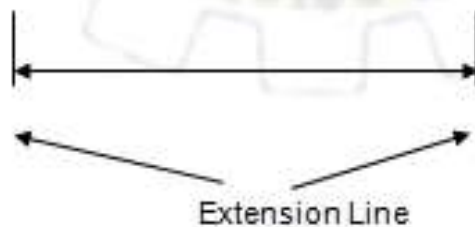
2. **Hidden Line.** Broken line of medium thickness and used to show the edges and outlines not visible to the eye.



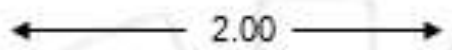
3. **Center Line.** Fine, broken line made up of a series of short and long dashes alternately spaced. To show the center of circles, arcs, and symmetrical objects and to aid in dimensioning the parts of the object.



4. **Extension Line.** Fine lines that extend from the object with a slight break between and it is used to show dimensioning points.



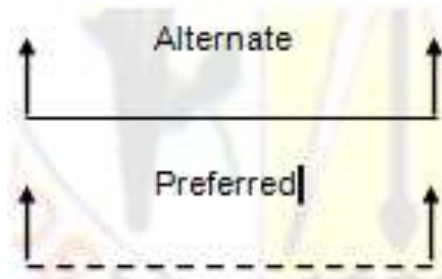
5. **Dimension Line.** Lines used to indicate the measurement of objects. It consists of three parts: arrowheads, fine line, and number or measurement. The fine lines have the same thickness or weight as the projection line. The arrowheads are short heavy strokes (called flares) placed at the extremities of this fine line. The shape of an arrowhead is like the point of an ordinary pen. The number or figure is usually positioned at the middle of the fine line and its axis is perpendicular to it.



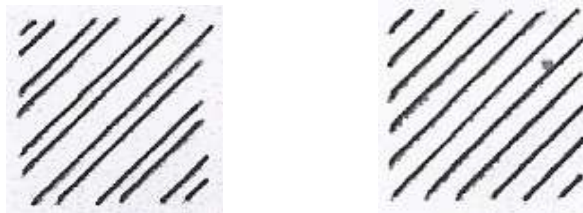
6. **Leader Line.** Fine, straight line with an arrowhead or round solid dot at one end and usually drawn at an angle. Points directly to a surface for the purpose of dimensioning or adding a note. A dot may be used at the end of the straight line where reference is made to a surface area.



**Cutting Plane Line.** A thick broken line made up of a series of one long and two short dashes alternately spaced. The arrowheads are placed at right angles to the cutting plane line. The purpose of this line is to indicate where an imaginary cut is made through the object. The arrow points in the direction in which the section should be viewed. Letters next to the arrowheads identify the section in cases where more than one section is shown on the drawing. These lines are oriented vertically, horizontally, or at the actual angle at which the part is drawn.



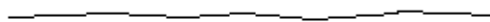
7. **Section Lines.** Series of fine lines-solid or solid and broken-arranged in specific patterns. They may be shown either straight or curved. When shown straight, they are usually drawn at a 45° angle. It is used to indicate the imaginary cut surface referred to by the cutting plane line. To represent various kinds of materials.



8. **Chain Line.** Heavy, broken line made up of a series of long and short dashes alternately spaced. It is used to indicate the location and extent of a surface.



9. **Short Break Line.** Heavy, irregular line drawn freehand used to show a short break to conserve space on a drawing.



10. **Long Break Line.** Ruled, light line with freehand zigzags used to show a long break to conserve space on a drawing.



11. **Phantom Line.** Light, broken line made up of a series of long and two short dashes used to show alternate positions of a part; to show relationship of existing part to new part; and to show machined surfaces.





## How Much Have You Learned?

### Self-Check 1.1

#### Multiple Choice:

**Direction:** Identify what is referred to in the statement, then write only the letter of your answer on a separate sheet.

1. Fine lines with arrowheads usually touch the extension lines and show distance given by the dimensions.
  - a. Hidden Lines
  - b. Dimension Lines
  - c. Extension Lines
  - d. Cutting Plane Lines
  
2. The purpose of this line is to indicate where an imaginary cut is made through the object.
  - a. Hidden Lines
  - b. Dimension Lines
  - c. Extension Lines
  - d. Cutting Plane Lines
  
3. Series of fine lines-solid or solid and broken arranged in specific patterns used to represent various kinds of materials.
  - a. Chain Line
  - b. Break Line
  - c. Section Line
  - d. Phantom line
  
4. Fine lines that extend from the object with a slight break between and it is used to show dimensioning points.
  - a. Chain Line
  - b. Object Line
  - c. Section Line
  - d. Extension Line
  
5. Used to show the visible shape of the object.
  - a. Chain Line
  - b. Object Line
  - c. Section Line
  - d. Extension Line

**Refer to the Answer Key. What is your score?**

## LEARNING OUTCOME 2

Interpret standard drawings and symbols

## PERFORMANCE STANDARDS

- Welding joints and symbols are interpreted according to drawing standard.








## What Do You Already Know?

Let us determine how much you already know about interpreting standard drawings and symbols. Take this test.

Pretest LO 2

**Directions:** Match column A with column B then write the letter of your answer.

	Column A	Column B
_____ 1.		A- Weld all Round
_____ 2.		B- Single V Butt
_____ 3.		C- Fillet
_____ 4.		D- Double V Butt

\_\_\_\_\_ 5. 

E- Bead



## What Do You Need To Know?

Read the Information Sheet 2.1 very well then find out how much you can remember and how much you learned by doing Self-Check 2.1.

Information Sheet 2.1

### Welding Symbol

**Location of Elements:** The elements of a welding symbol have standard locations with respect to each other.

**Location Significance of Arrow:** The arrow element in a welding symbol in conjunction with the reference line determines the arrow side and other side of a weld.

The symbol depicting an arrow side weld is always placed below the reference line. The arrow side is always closest to the reader when viewed from the bottom of the drawing. The weld symbol depicting other side weld is placed above the reference line, away from the reader. Welds on both sides of a joint are shown by placing weld symbols on both sides of the reference line.

Some weld symbols have no arrow or other side significance. However, supplementary symbols used in conjunction with these weld symbols may have such significance. For example, welding symbols for resistance spot and seam welding have no side significance, but GTAW, EBW, or other spot and seam welds may have arrow and other side.

**References:** When a specification, process, test, or other references are needed to clarify a welding symbol, the reference is placed in a tail on the welding symbol. The letters complete joint penetration (CJP) may be used in the tail of the arrow to indicate that a complete joint penetration groove weld is required, regardless of the type of weld or joint preparation. The tail may be omitted when no specification, process, or other reference is required with a welding symbol.

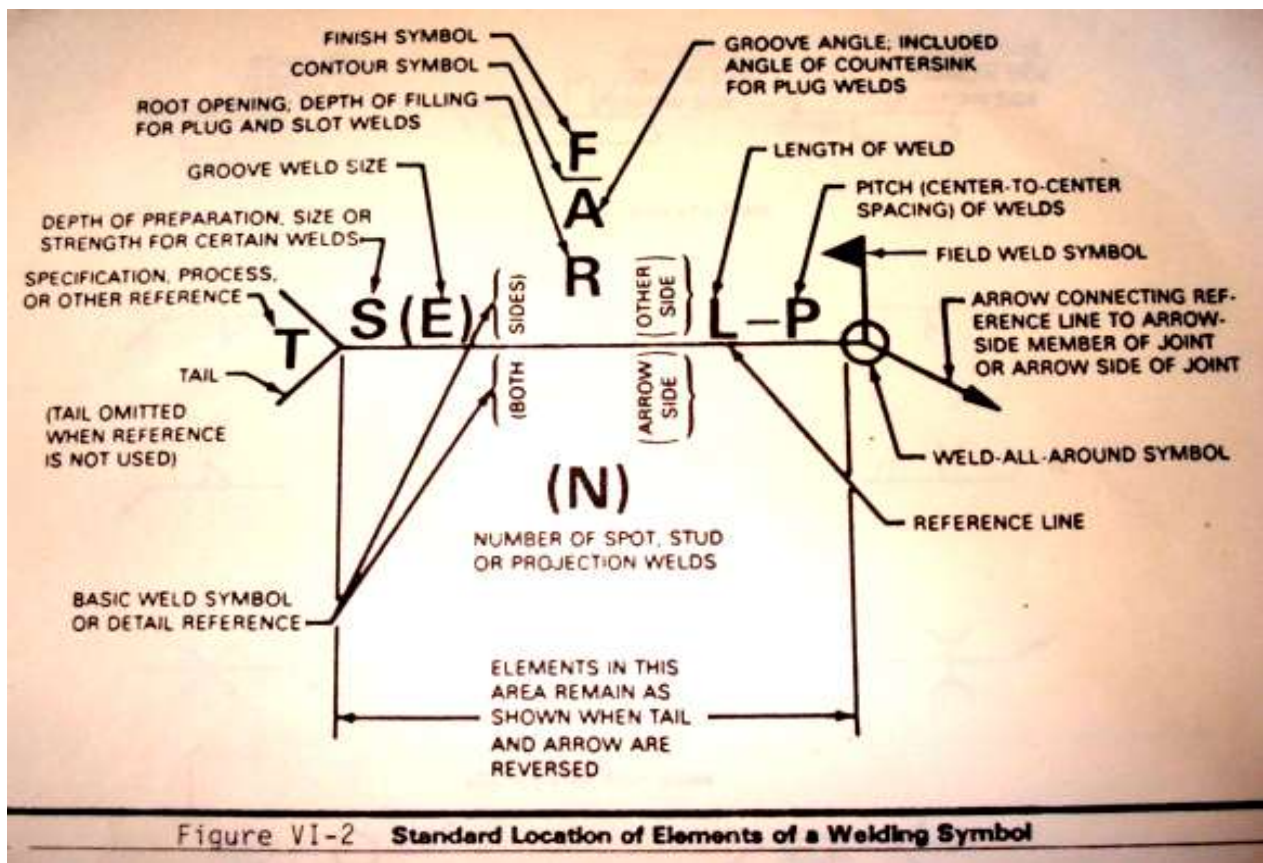
**Dimensions:** Dimensions of a weld are shown on the same side of the reference line as the weld symbol. The size of the weld is shown to the left of the weld symbol, and the length of the weld is placed on the right. If a length is not given, the weld symbol applies to that portion of the joint between abrupt changes in the direction of welding or between specified dimension lines. If a weld symbol is shown on each side of the reference line, dimensions are required to be given for each weld even though both welds are identical.

Either US Customary or SI units may be used when specifying dimensions. However, only one of the two should be used for a product or project.

If a weld in a joint is to be intermittent, the length of the increments and the pitch (center-to-center spacing) are placed to the right of the weld symbol.

The term weld symbol and welding symbol have different meanings. A weld symbol indicates the required type of weld. The welding symbol includes the weld symbol and supplementary information. A complete welding symbol consists of the following elements:

- Reference line
- Arrow
- Basic weld symbol
- Dimensions and other data
- Supplementary symbol
- Finish symbol
- Tail
- Specification, process and other references



F – Finish Symbol

A – Groove Angle: included angle of countersink for plug welds

R – Root Opening; depth of filling for plug and slot welds.

S – Depth of Bevel: size or strength for certain welds

E – Groove Weld Size

L – Length of Weld

P – Pitch of Weld: center-to-center spacing

T – Tail of Weld: specification, process of other reference (omitted when reference is not used)

N – Number of Spot, Stud, or Projection Welds

 - Field Weld

 - Weld All Around



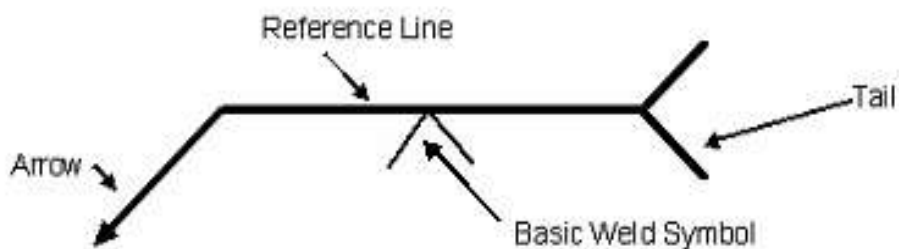
**—** - Contour Symbol

In your welding work, you may be required to work from these drawings; therefore, you should understand the use and meaning of these symbols.

## MEANING & USE OF SYMBOLS

An arc welding symbol consists of the main four parts

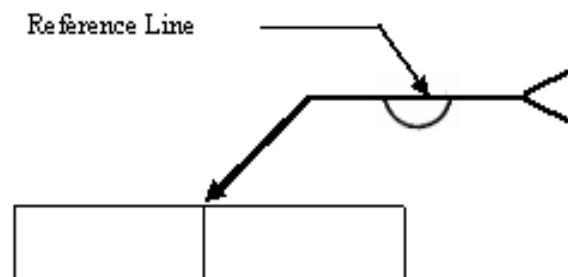
1. A reference line
2. An arrow.
3. A basic welding symbol
4. A tail



The basic symbol indicates the type of weld.

(Butt, fillet, etc.)

1. The **reference line** is a line connected to the arrow. The position of the basic symbol above or beneath this line determines the location of the weld. The reference line is always drawn parallel to the bottom edge of the drawing, or to the base line of a particular view.

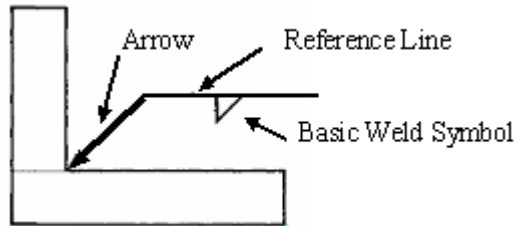


2. The **arrow** indicates the position of the weld; it is drawn at an angle from the end of the reference line to one side of the joint. This side is called the 'arrow side of the joint'. The opposite side is called the other side of the joint.



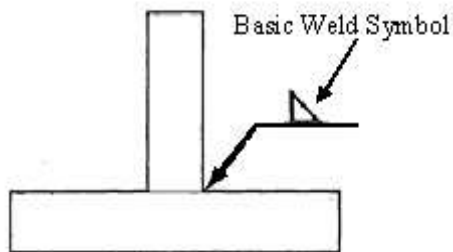
## Arrow Location

Welds on the 'arrow side of the joint' are shown by inverting the weld symbol and placing it beneath the reference line.



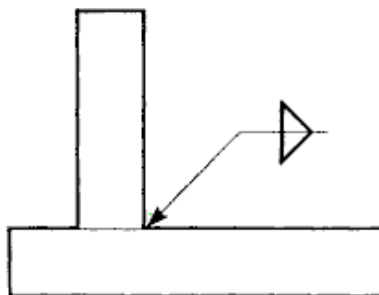
## Symbol Indicating Fillet Weld At Arrow Side of Joint

1. Welds on the 'other side of the joint' are shown by placing the symbols above the reference line.






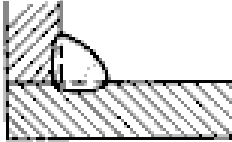









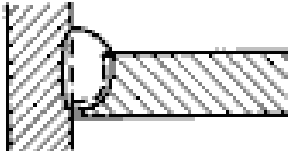


## Symbol indicating fillet welds on the other side of joint.

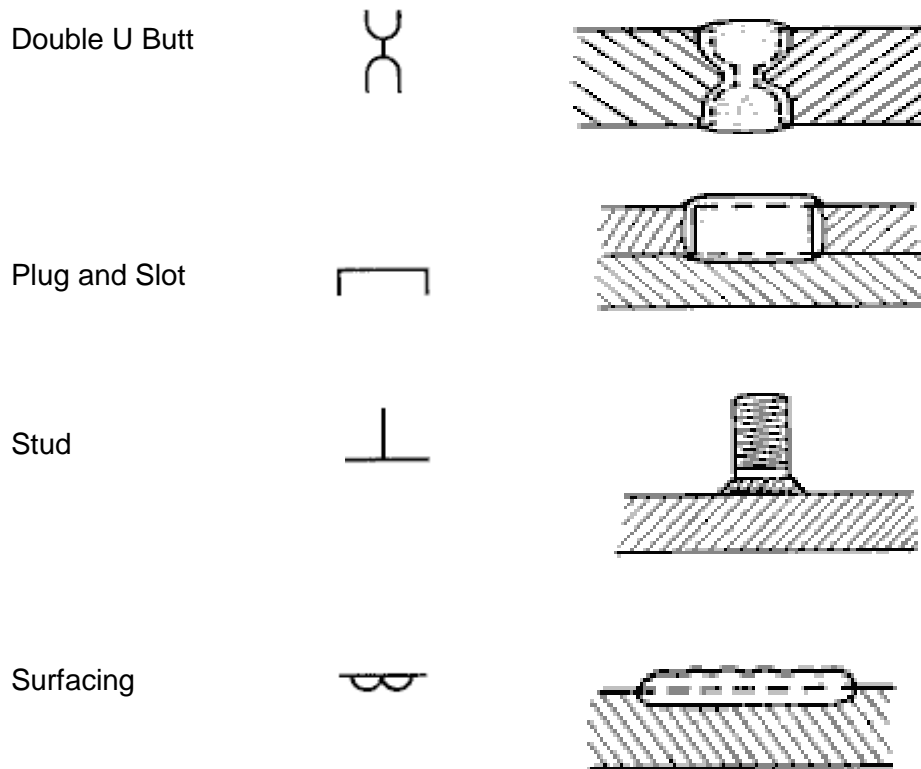
2. Welds on both sides of the joint are shown by placing the weld symbol above and below the reference line.



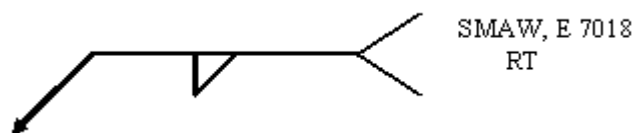
## Fillet weld both sides of the joint

3. **Basic weld symbols** describe the type of weld to be made. This symbol is a miniature drawing of the metal's edge preparation prior to welding. The basic weld symbol is only part of the entire AWS welding symbol.

Form of Weld	Weld Symbol	Sectional Representation
Bead		
Fillet		
Square Butt		
Single V Butt		
Single Bevel Butt		
Single U Butt		
Single J Butt		
Double V Butt		



4. The **tail** is added to the symbol only when special notes are required. A number or letter code used inside the tail direct the welder to special notes located elsewhere on the drawing. These notes may specify the heat treatment, welding process used, or other information not given on the welding symbol.





## How Much Have You Learned?

### Self-Check 2.1

#### I. Multiple Choice:

**Directions:** Read and analyze the statement carefully. Choose the best answer and write the letter only in your answer sheet.

1. This is information used as a guide by the welder in constructing or assembling metal products.

- a. Drawings
- b. Sketches
- c. Weld Symbols
- d. Welding Symbols

2. Parts of the welding symbol used to indicate position of the weld.

- a. Reference Line
- b. Weld Symbol
- c. Arrow
- d. Tail

3. The symbol triangle attached to the reference line indicates the type of weld.

- a. Bead
- b. Fillet
- c. Square Butt Weld
- d. Single V Butt Weld

4. When special notes are required for the welder to be informed, part of the welding symbol is indicated.

- a. Reference Line
- b. Weld Symbol
- c. Arrow
- d. Tail

5. This symbol is a miniature drawing of the metal's edge preparation prior to welding.

- a. Reference Line
- b. Weld Symbol
- c. Arrow
- d. T

**Refer to the Answer Key. What is your score?**

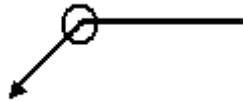
Read the Information Sheet 2.2 very well then find out how much you can remember and how much you learned by doing Self-Check 2.2.

## Information Sheet 2.2

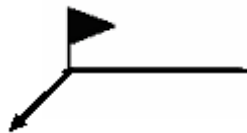
### Supplementary Symbols

**Supplementary symbols** can be placed above or below the basic symbol, or at the intersection of the reference line and the arrow. Dimensions and reference to specifications, or welding procedures may also be added.

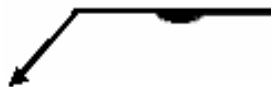
1. **Weld all around** is a circle drawn on the welding symbol, indicating that the described weld is to be made all around the part.



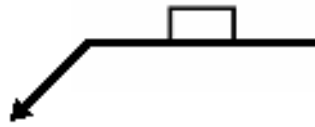
2. **Field weld symbol** is a symbol added to the basic AWS welding symbol to indicate that a weld is to be made at the job site ("in the field"), rather than in a fabricating shop.



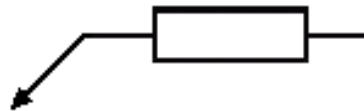
3. **Melt through** is a complete joint penetration for a joint welded from one side and visible root reinforcement is produced.



4. **Backing symbol** is an open rectangular box used in combination with a groove weld symbol located on the reference line indicating that locating materials is required on the opposite side control penetration.

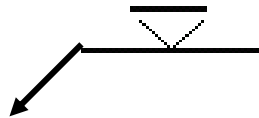


5. **Spacer symbol** is an open box that intersects the reference line, indicating that a spacer is placed between joint.

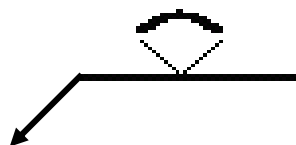


### Contour and Finish Symbol

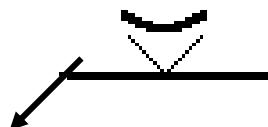
1. **Flush contour symbol** is located on the same side as the symbol and indicates the weld should be approximately a flat plane with the surface.



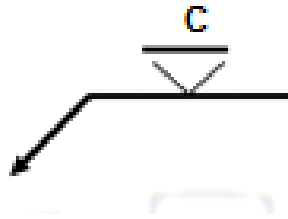
2. **Convex contour symbol** is located on the side as the symbol and indicates that the weld should be raised or convex shape.



3. **Concave contour symbol** is located on the same side as the symbol indicates that the weld should be concave shape.



4. If the contour requires finishing, a **finishing symbol** will be used in conjunction with the contour symbol, a letter G indicate grinding, C indicate shipping, M indicate machining, and U indicate unspecified which local method should be used.







## How Much Have You Learned?

### Self-Check 2.2

#### Multiple Choice:

**Directions:** Read and analyze the statement carefully. Choose the best answer and write the letter only in your answer sheet.

1. This symbol indicating that the joint/welds cannot be made in the shop but rather it will be made on site.

- a. Weld all around
- b. Field weld symbol
- c. melt through
- d. spacer

2. Weld all around symbol is mostly applied on welded joints like

- a. Pipe welded to similar diameter of pipe
- b. Plate welded to plate with the same thickness
- c. Pipe welded to plate
- d. All of the above

3. This symbol is required to control the penetration on the opposite side of the joint.

- a. Melt through
- b. Finish symbol
- c. Backing symbol
- d. Spacer

4. What finish symbol should be included when it requires 2-3 mm weld reinforcement above the surface of the base metal?

- a. finishing symbol
- b. flush contour symbol
- c. convex contour symbol
- d. concave contour symbol

5. What should be included in the welding symbol when the welded joint requires grinding?

- a. finishing symbol
- b. flush contour symbol
- c. convex contour symbol
- d. concave contour symbol

**Refer to the Answer Key. What is your score?**



**Congratulations! You did a great job!  
Rest and relax a while then move on  
to the next lesson. Good luck!**

## REFERENCES

- Welding Technology, Second Edition by Gower A. Kennedy
- Welding Inspection Technology, Education Department, American welding Society
- Welding Principles and Applications : Larry Jeffus and Harold V. Johnson



# Answer Keys

## **LESSON 1**

### Pretest LO 1

- |      |      |
|------|------|
| 1. C | 6. A |
| 2. F | 7. D |
| 3. D | 8. B |
| 4. B |      |
| 5. E |      |

### Self-Check 1.1

- |      |       |
|------|-------|
| 1. F | 9. D  |
| 2. N | 10. M |
| 3. G | 11. I |
| 4. L | 12. E |
| 5. C | 13. B |
| 6. O | 14. A |
| 7. K | 15. J |
| 8. H |       |

### Self-Check 1.2

1. A
2. C
3. C
4. B
5. B

### Self-Check 2.1

1. Yes
2. Yes
3. Yes
4. Yes
5. Yes
6. Yes
7. Yes
8. Yes
9. Yes

10. Yes

Pretest LO 3

1. A      3. C      5. B  
2. C      4. B

Self-Check 3.1

1. B
2. A
3. B
4. D
5. B
6. B
7. C

## **LESSON 2**

Pretest LO 1

1. T
2. F
3. F
4. T
5. F

Self-Check 1.1

- I.
  1. 7, 2, 5
  2. Tens
  3. Thousands
  4. 5
  5. 8
- II.
  6. 978
  7. 879
  8. 914
  9. 603

Self-Check 1.2

1. 122
2. 624
3. 162
4. 178
5. 257

Self-Check 1.3

1. 3,185
2. 19,252
3. 15/64
4. 6/5 or 1 & 1/5
5. 4.125

Self-Check 1.4

1. 56
2. 9
3. 7
4. 25
5. 2/12 or 1/6

Activity Sheet Sheet 1.1

A.

70	+	50	=	120
-		+		-
50	-	20	=	30
=		=		=
20	+	70	=	90

B.

- |      |       |
|------|-------|
| 1. B | 6. A  |
| 2. D | 7. H  |
| 3. E | 8. C  |
| 4. J | 9. G  |
| 5. I | 10. F |

Pretest LO 2

- |                    |               |
|--------------------|---------------|
| 1. 196.85 Inches   | 6. Thousandth |
| 2. 1.14 Feet       | 7. Hundredth  |
| 3. 5.49 Meters     | 8. Tenth      |
| 4. 508 Millimeters | 9. Millionth  |
| 5. 2 Yards         | 10. Ten       |

Self-Check 2.1

1. 4 cm
2. 1 cm
3. 1  $\frac{1}{2}$  cm
4.  $\frac{3}{4}$  in
5.  $\frac{1}{2}$  in
6. 1 in
7. 7 mm
8. 5 mm
9. 3 mm
10. 2 cm

Self-Check 2.2

- I.
  - 1.25 cm
  - 2.900 mm
  - 3.900 cm
  - 4.1.82 m
  - 5.150 mm
- II.
  - 6.1.28 in
  - 7..5 ft.
  - 8.13.12 ft
  - 9..07 yds
  - 10.358.33 in

Pretest LO 3

1. Ratio
2. Proportion
3. Extremes
4. Area
5. Volume
6. Square or Rectangle (Area)
7. Triangle
8. Circle
9. Square or Rectangle (Volume)
10. Cylinder

Self-Check 3.1

I.

1. 1 : 6
2. 3 : 20
3. 1 : 5
4. 3 : 10
5. 3 : 20

II.

6.  $x = 12$
7.  $x = 5$
8.  $x = 6$
9.  $x = 4$
10.  $x = 12$

Self-Check 3.2

1. 490.87 Sq. Inches
2. 320 Sq. Feet
3. 90 Sq. Inches
4. 395 Cubic Feet
5. 1,760 Sq. Feet

### **LESSON 3**

Pretest LO 1

Self-Check 1.1

1. B
2. D
3. A
4. B
5. C

Self-Check 1.2

1. A
2. C
3. B
4. B
5. A

Self-Check 1.2

1. D
2. C
3. D
4. A
5. B

Pretest LO 2

Self-Check 1.1

1. Helmet
2. Leather jacket
3. Welding gloves
4. Leader apron
5. Leggings



Self-Check 2.2

1. D
2. B
3. A
4. D
5. A

Self-Check 3.1

1. A
2. B
3. C
4. A
5. D

**LESSON 4**

Pretest LO 1

1. D
2. E
3. B
4. A
5. C

Self-Check 1.1

1. B
2. A
3. C
4. D
5. B

Pretest LO 2

1. D
2. A

3. E
4. B
5. C

Self-Check 2.1

1. A
2. C
3. B
4. D
5. B

Self-Check 2.2

1. B
2. A
3. C
4. C
5. A

## *Acknowledgement*

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