Department of Education
Region X - Northern Mindanao
DIVISION OF CAGAYAN DE ORO
Fr. William F. Masterson, SJ Avenue, Upper Balulang, Cagayan de Oro City

Learning Activity Sheets in Shielded Metalic Arc Welding (SMAW)

SHARED OPTIONS

Senior High Alternative Responsive Education Delivery

Competence.Dedication.Optimism

Preface

It has been elaborated in research and literature that the highest performing education systems are those that combine quality with equity. Quality education in the Department of Education (DepEd) is ensured by the learning standards in content and performance laid in the curriculum guide. Equity in education means that personal or social circumstances such as gender, ethnic origin or family background, are not obstacles to achieving educational potential and that inclusively, all individuals reach at least a basic minimum level of skills.

In these education systems, the vast majority of learners have the opportunity to attain high-level skills, regardless of their own personal and socio-economic circumstances. This corresponds to the aim of DepEd Cagayan de Oro City that no learner is left in the progression of learning. Through DepEd's flexible learning options (FLO), learners who have sought to continue their learning can still pursue in the Open High School Program (OHSP) or in the Alternative Learning System (ALS).

One of the most efficient educational strategies carried out by DepEd Cagayan de Oro City at the present is the investment in FLO all the way up to senior high school. Hence, Senior High School Alternative Responsive Education Delivery (SHARED) Options is

operationalized as a brainchild of the Schools Division Superintendent, Jonathan S. Dela Peña, PhD.

Two secondary schools, Bulua National High School and Lapasan National High School, and two government facilities, Bureau of Jail Management and Penology-Cagayan de Oro City Jail and Department of Health-Treatment and Rehabilitation Center-Cagayan de Oro City, are implementing the SHARED Options.

To keep up with the student-centeredness of the K to 12 Basic Education Curriculum, SHARED Options facilitators are adopting the tenets of Dynamic Learning Program (DLP) that encourages responsible and accountable learning.

This compilation of DLP learning activity sheets is an instrument to achieve quality and equity in educating our learners in the second wind. This is a green light for SHARED Options and the DLP learning activity sheets will continually improve over the years.

Ray Butch D. Mahinay, PhD
Jean S. Macasero, PhD

Acknowledgment

The operation of the Senior High School Alternative Responsive Education Delivery (SHARED) Options took off with confidence that learners with limited opportunities to senior high school education can still pursue and complete it. With a pool of competent, dedicated, and optimistic Dynamic Learning Program (DLP) writers, validators, and consultants, the SHARED Options is in full swing.

Gratitude is due to the following:

- Schools Division Superintendent, Jonathan S. Dela Peña, PhD, Assistant Schools Division Superintendent Alicia E. Anghay, PhD, for authoring and buoying up this initiative to the fullest;
- CID Chief Lorebina C. Carrasco, and SGOD Chief Rosalio R. Vitorillo, for the consistent support to all activities in the SHARED Options;
- School principals and senior high school teachers from Bulua NHS, Lapasan NHS, Puerto NHS and Lumbia NHS, for the legwork that SHARED Options is always in vigor;
- Stakeholders who partnered in the launching and operation of SHARED Options, specifically to the Bureau of Jail Management and Penology-Cagayan de Oro City Jail and the Department of Health-Treatment and Rehabilitation Center-Cagayan de Oro City;

- Writers and validators of the DLP learning activity sheets, to which this compilation is heavily attributable to, for their expertise and time spent in the workshops;
- Alternative Learning System implementers, for the technical assistance given to the sessions; and
- To all who in one way or another have contributed to the undertakings of SHARED Options.

Mabuhay ang mga mag-aaral! Ito ay para sa kanila, para sa bayan!

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MONITORING OF ACCOMPLISHED LEARNING ACTIVITY SHEETS

SHIELDED METAL ARC WELDING NC-II

ACTIVITY NUMBER	LEARNING ACTIVITY TITLE	DATE	SCORE	ITEM
1	Safe Welding Practices - Shock Hazards			5
2	Safe Welding Practices - Radiation			5
3	Safe Welding Practices - Fumes			9
4	Safe Welding Practices – Proper Ventilation			5
5	Safe Welding Practices – Fire Hazards			5
6	Safe Welding Practices – Explosion Hazards			5
7	Essentials in Welding – Angle of Electrode			5
8	Essentials in Welding –Electrode Selection			5
9	Essentials in Welding – Current Setting			5
10	Essentials in Welding – Angle of Electrode			5
11	Essentials in Welding – Length of Arc			5
12	Essentials in Welding – Travel Speed			3
13	Acceptable Weld Profiles			5
14	Weld Defects - Overlap			1
15	Weld Defects - Porosity			1
16	Weld Defects - Spatter			1
17	Weld Defects - Undercut			1
18	Weld Defects – Weld Crack			1
19	Welding Specifications			5
20	Welding Procedure Specifications			4
21	Pre-welding Familiarization			5
22	Safety			5
23	Set-up			3
24	Strike an Arc and Position Rod			2
25	Welding the Bead			2
26	Remove Slug and Examine the Bead			2

Name:	Date:	Score:
Subject : SAFE WELDING PRACTICES		
Lesson Title : SHOCK HAZARDS		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://www.controleng.com/single-article/safe-welding-practices.html		LAS No.: 1

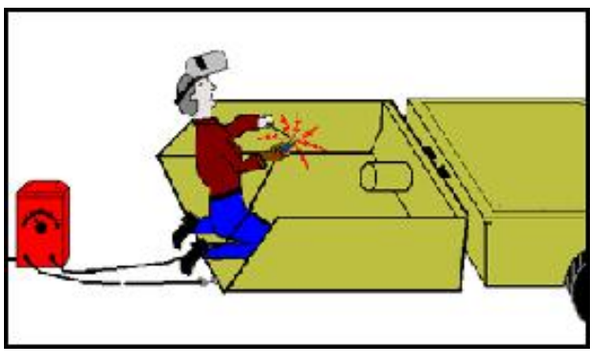
CONCEPT NOTES:

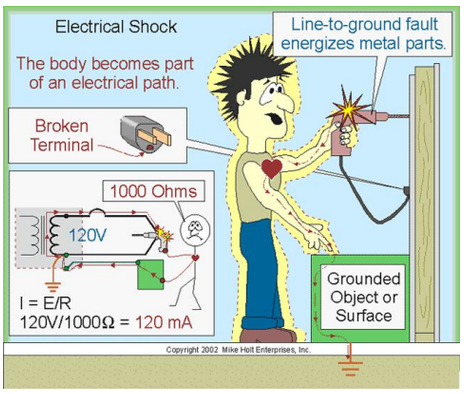
A shock can be received from primary (input) voltage by touching a lead inside the welder with the power to the welder "on" while having your body or hand on the welder case or other grounded metal. The input power cord must be unplugged or the power disconnect switch turned off.

A secondary voltage shock can occur when touching a part of the electrode circuit, such as a bare spot on the electrode cable, at the same time a part of the body is touching another side of the welding circuit, the work, or welding ground.

The conditions that increase the likelihood of a severe shock are wet conditions and welding in or on a metal workpiece.

Use plywood, rubber mats, or other dry insulation to stand or lie on. Keep gloves dry, even if this means keeping an extra pair. Don't rest body, arms, or legs on the workpiece, especially if clothing is wet or bare skin is exposed.





EXERCISE: Check the appropriate box.

No.	Condition/Material	Electric Shock	Safe
1.	Touching a Lead		
2.	Rubber Mats		
3.	Plywood		
4.	Wet working Area		
5.	Electrode Bare Spot		

Name:	Date:	Score:
Subject : SAFE WELDING PRACTICES		
Lesson Title : RADIATION		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://www.controleng.com/single-article/safe-welding-practices.html		LAS No.: 2

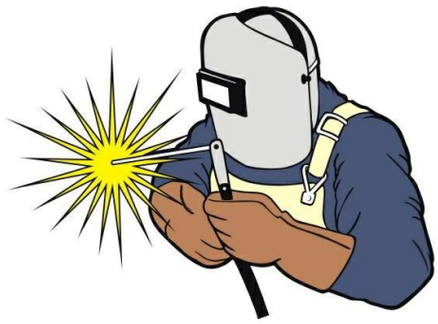
CONCEPT NOTES:

Eyes should be protected from radiation exposure. Even a brief exposure to UV radiation can cause eye burn known as "welder's flash." While this condition is not always apparent until several hours after exposure, it causes extreme discomfort and can result in swelling, fluid excretion, and temporary blindness. Normally, welder's flash is temporary, but repeated or prolonged exposure can lead to permanent eye injury.

Besides not looking at an arc, the only other preventive measure is the use of proper eye-shading filters. The general rule is to choose a filter too dark to see the weld, then move to lighter shades without dropping below the minimum protective rating.

Helmet-type shields and handheld face shields offer the most complete shading against arc radiation. The shields protect the head, face, ears, and neck from heat, sparks, and flames.

While infrared radiation can usually be felt as heat, there is no real way to tell if you're being exposed to UV radiation. Don't take any chances and always wear eye protection.



EXERCISE: Check the appropriate box

No.	Condition	Exposed	Safe
1.	Staring at an Arc without protection		
2.	Shades below the minimum protective rating		
3.	Helmet-type shields		
4.	Temporary blindness		
5.	Handheld face shields		

Name:	Date:	Score:
Subject : SAFE WELDING PRACTICES		
Lesson Title : FUMES		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://www.controleng.com/single-article/safe-welding-practices.html		LAS No.: 3

CONCEPT NOTES:

Fume plumes contain solid particles from consumables, base metals, and base-metal coatings. Depending on the length of exposure, most acute effects are temporary, and include symptoms of burning eyes and skin, dizziness, nausea, and fever.

Zinc fumes can cause metal fume fever, a temporary illness that is similar to the flu. Chronic long-term exposure to welding fumes can lead to siderosis (iron deposits in the lungs) and may affect pulmonary function.

Cadmium is a toxic metal found on steel as a coating or in silver solders. Cadmium fumes can be fatal even under brief exposure, with symptoms much like those of metal fume fever. Twenty minutes of welding in the presence of cadmium can be enough to cause fatalities. Symptoms appear within an hour, and death may occur five days later.

The gases that result from an arc welding process also present a potential hazard. Most of the shielding gases (argon, helium, and carbon dioxide) are non-toxic, but as they are released, they displace oxygen in the breathing air, causing dizziness, unconsciousness, and death if the brain is denied its needed oxygen long enough.

EXERCISE: Check the appropriate box

No.	Check if the statement is true	√	No.	Health Symptoms	√
1.	Zinc fumes can cause metal fume fever		5.	burning eyes and skin	
2.	Siderosis are iron deposits in the lungs		6.	dizziness	
3.	Argon, helium, and carbon dioxide fumes are non-toxic.		7.	nausea	
			8.	fever	
4.	Lack of oxygen can cause dizziness.		9.	itchiness	

Name:	Date:	Score:
Subject : SAFE WELDING PRACTICES		
Lesson Title : PROPER VENTILATION		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://www.controleng.com/single-article/safe-welding-practices.html		LAS No.: 4

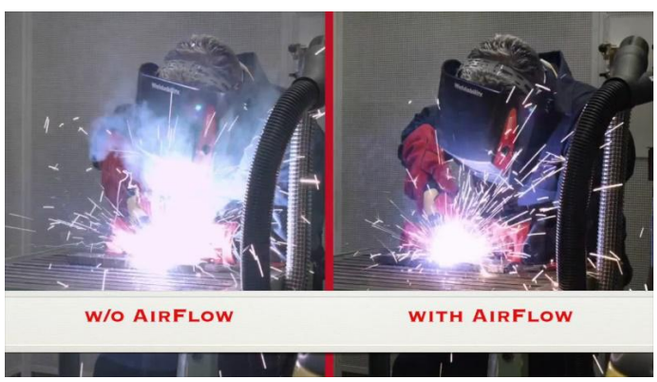
CONCEPT NOTES:

Adjustable hoods, fixed enclosures, or booths can provide local exhaust of welding fumes. Individual movable hoods are particularly suitable for bench welding, but they can be used for any welding or cutting job, provided the hood is always close to the area being welded.

When arc welding in a confined area, all the hazards associated with welding are amplified. There is great danger that enough flammable gases or vapors may be present to cause an explosion.

Welding fumes can accumulate rapidly, with high concentration, and can force out breathable air, suffocating the welder in the process.

For work in any kind of enclosed area, ensure adequate ventilation or use an air-supplied respirator. Have someone trained to handle emergencies positioned outside the enclosure and able to pull you out if danger arises.



EXERCISE: Check the appropriate box

No.	Check if the statement is true	Answer
1.	Enough flammable gases or vapors may cause an explosion.	
2.	High concentration fumes can force out breathable air.	
3.	Welding in a confined area is a good practice.	
4.	Movable hoods are suitable for bench welding.	
5.	Lack of breathable air can cause suffocation.	

Name:	Date:	Score:
Subject : SAFE WELDING PRACTICES		
Lesson Title : FIRE HAZARDS		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://www.controleng.com/single-article/safe-welding-practices.html		LAS No.: 5

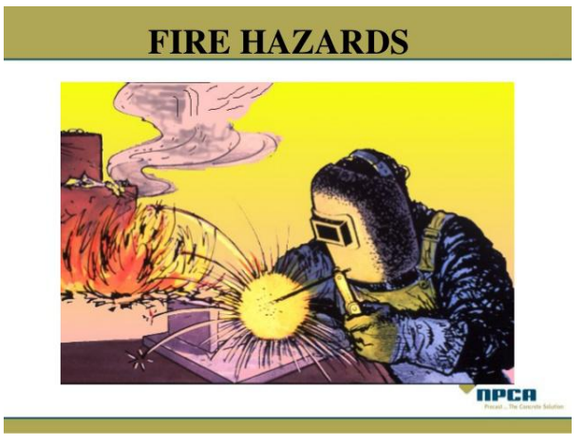
CONCEPT NOTES:

Because of the extreme temperatures associated with any arc welding process, always be aware of fire hazards. The welding arc can reach temperatures of 10,000° F, but this heat in itself is **not** generally a fire hazard.

The danger of fire results from the effects of this intense heat upon the work and in the form of sparks and molten metals. Because these can spray up to 35 ft. from the work, recognize and distance yourself from combustible materials. It is also important to be sure the work is not in contact with any combustible, which it may ignite when heated.

Observe where sparks and metals are falling. If there are flammable materials, including fuel or hydraulic lines, in the work area, and they or the work can't be moved, put a fire-resistant shield in place.

Know where fire alarms and fire extinguishers are located. If there are none in the area, be sure there is access to fire hoses, sand buckets, fire-resistant blankets, and other firefighting equipment.



EXERCISE: Check the appropriate box

No.	Check if the statement is true	Answer
1.	Arc welding is associated with extreme temperatures	
2.	The welding arc can reach temperatures of 20,000° F.	
3.	Welding arc temperatures are generally a fire hazard.	
4.	Dangers of fire are from the effects of arc's intense heat.	
5.	Sand bucket is an example of a firefighting equipment.	

Name:	Date:	Score:
Subject : SAFE WELDING PRACTICES		
Lesson Title : EXPLOSION HAZARDS		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://www.controleng.com/single-article/safe-welding-practices.html		LAS No.: 6

CONCEPT NOTES:

Because of the explosive nature of welding gas cylinders, pay particularly close attention to their storage and use. Examine the cylinder and check the label to ensure it is the correct shielding gas for the process. Check that regulators, hoses, and fittings are the right ones for that gas and pressure and are in good condition.

Cylinders must be stored in an upright position, with the valve caps in place, in an area away from combustibles and fuels, and safeguarded from damage, heat, and flames. When they are in use, keep them out of traffic routes and away from flying sparks, with all hoses run neatly to the welding area. Never allow the electrode or other "electrically hot" parts of the welder to touch a cylinder. Never move cylinders without the valve cap in place.

EXERCISE: Check the appropriate box

No.	Check if the statement is true	Answer
1.	Welding gas cylinders are explosive in nature.	
2.	Cylinders must be stored in an upright position.	
3.	There is no need to keep valve caps in place.	
4.	Cylinders must be stored away from combustibles and fuels.	
5.	Cylinders should be safeguarded from damage, heat, and flames.	

Name:	Date:	Score:
Subject : Shielded Metal Arc Welding (SMAW)		
Lesson Title : Essentials in Welding – Angle of Electrode		
Learning Competency: LO1. Weld Carbon Steel Plates in Vertical Position (3F)		
References : https://www.aws.org/store/page/free-downloads		LAS No.: 7

Concept Notes:

International welding codes and standards

The purpose of each of the welding codes is to have a uniform way to approach welding that reflects the best practices developed and proven to work over time.

Standard Number	Description
AWS A02.4	Standard symbols for welding, brazing, and non-destructive examination
AWS A03.0	Standard welding terms and definitions
AWS A05.1	Specification for carbon steel electrodes for shielded metal arc welding
AWS A05.18	Specification for carbon steel electrodes and rods for gas shielded arc welding
AWS B01.10	Guide for the nondestructive examination of welds
AWS B02.1	Specification for Welding Procedure and Performance Qualification
AWS D10.11	Root pass welding for pipe
AWS D10.12	Pipe welding (mild steel)
AWS D11.2	Welding (cast iron)

Exercise:

No.	Give the appropriate code	Code
1.	What is the code for root pass welding	
2.	Standard welding terms and definitions	
3.	Pipe welding (mild steel)	
4.	Welding (cast iron)	
5.	Standard symbols for welding, brazing, and non-destructive examination	

Name:	Date:	Score:
Subject : Shielded Metal Arc Welding (SMAW)		
Lesson Title : Essentials in Welding –Electrode Selection		
Learning Competency: LO1. Weld Carbon Steel Plates in Vertical Position (3F)		
References : http://summbearsmanufacturing.weebly.com/a-welding-resources.html		LAS No.: 8

Concept Notes

Selection of Electrode

The correct choice of electrode size involves consideration of the type, position, preparation of the joint. The electrode for a given application must be selected carefully to provide the strength and characteristics required for the weld joint.

ELECTRODE SELECTION CHART

ELECTRODE	AC	DC*	POSITION	PENETRATION	USAGE
6010	NO	EP	ALL	DEEP	MIN. PREP, ROUGH, HIGH SPATTER
6011	YES	EP	ALL	DEEP	
6013	YES	EP, EN	ALL	LOW	GENERAL, EASY
7014	YES	EP, EN	ALL	MED	SMOOTH, EASY, FAST
7018	YES	EP	ALL	LOW	LOW HYDROGEN, STRONG
7018AC	YES	EP	ALL	LOW	
7024	YES	EP, EN	FLAT HORIZ FILLET	LOW	SMOOTH, EASY, FASTER
Ni-CI	YES	EP	ALL	LOW	CAST IRON
308L	YES	EP	ALL	LOW	STAINLESS

*EP = ELECTRODE POSITIVE (REVERSE POLARITY)
*EN = ELECTRODE NEGATIVE (STRAIGHT POLARITY)

Exercise:

No.	Give the appropriate kind electrode	Electrode
1.	Weld bead on 3/4" steel plate	
2.	Use in welding cast iron	
3.	Use for penetration and rough surface	
4.	Use in general purposes	
5.	Weld bead on the surface of a steel plate	

Name:	Date:	Score:
Subject: Shielded Metal Arc Welding		
Lesson Title: Essentials in Welding – Current Setting		
Learning Competency: LO1. Weld Carbon Steel Plates in Vertical Position (3F)		
References: http://www.weldingtipsandtricks.com/shielded-metal-arc-welding-rods.html		LAS No.: 9

Concept Notes:

Current Setting

The welding current or amperage is essential to producing welds with good appearance and the required strength characteristics.

Correct current, amperes, must be based on the specific size of electrodes, welding position and base metal or materials

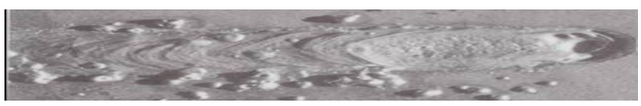
ROD	Size	Amperage range
6010	1/8"	Suggested Amperage Range: 75-125
7018	3/32"	Suggested Amperage Range: 65-100
6013	1/8"	Suggested Amperage Range: 80-130
6011	5/32"	Suggested Amperage Range: 110-165
7024	1/8"	Suggested Amperage Range: 140-190

(A) 

Correct amperage

(B) 

Low Amperage

(C) 

High Amperage

Exercise: Give the rod size

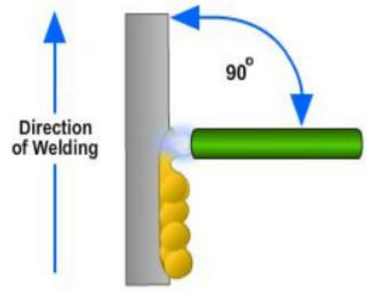
No.	ROD Size	Range of amperage
1.		Suggested Amperage Range 75-125
2.		Suggested Amperage Range 65-100
3.		Suggested Amperage Range 80-130
4.		Suggested Amperage Range 110-165
5.		Suggested Amperage Range 140-190

Name:	Date:	Score:
Subject : Shielded Metal Arc Welding (SMAW)		
Lesson Title : Angle of Electrode		
Learning Competency: LO1. Weld Carbon Steel Plates in Vertical Position (3F)		
References : http://www.weldingtipsandtricks.com/arc-welding.html		LAS No.: 10

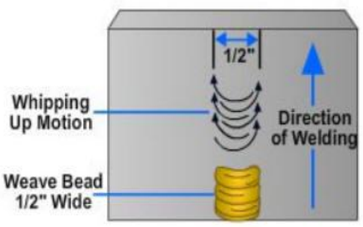
Concept Notes:

Angle of Electrode

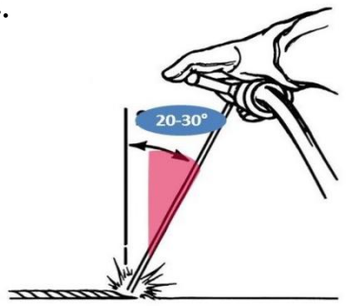
The angle at which you hold the electrode affects the shape of the weld bead which is very important in fillet and deep groove welding. The electrode angle consists of two positions: work angle and travel angle.



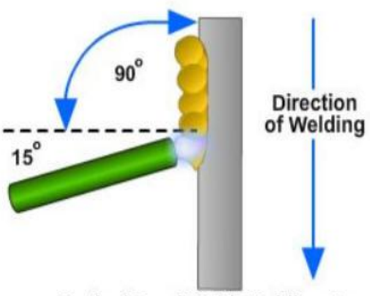
Vertical Bead Weld, Welding Up
A



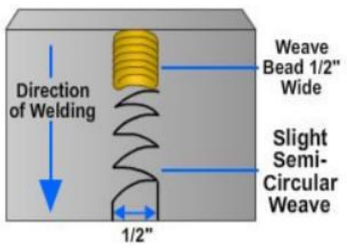
Vertical Weave Bead Weld, Welding Up
B



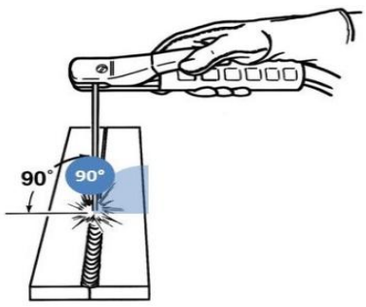
TRAVEL ANGLE



Vertical Bead Weld, Welding Down
C



Vertical Weave Bead Weld, Welding Down
D



WORK ANGLE

Exercise:

Check the appropriate box for the right angle.

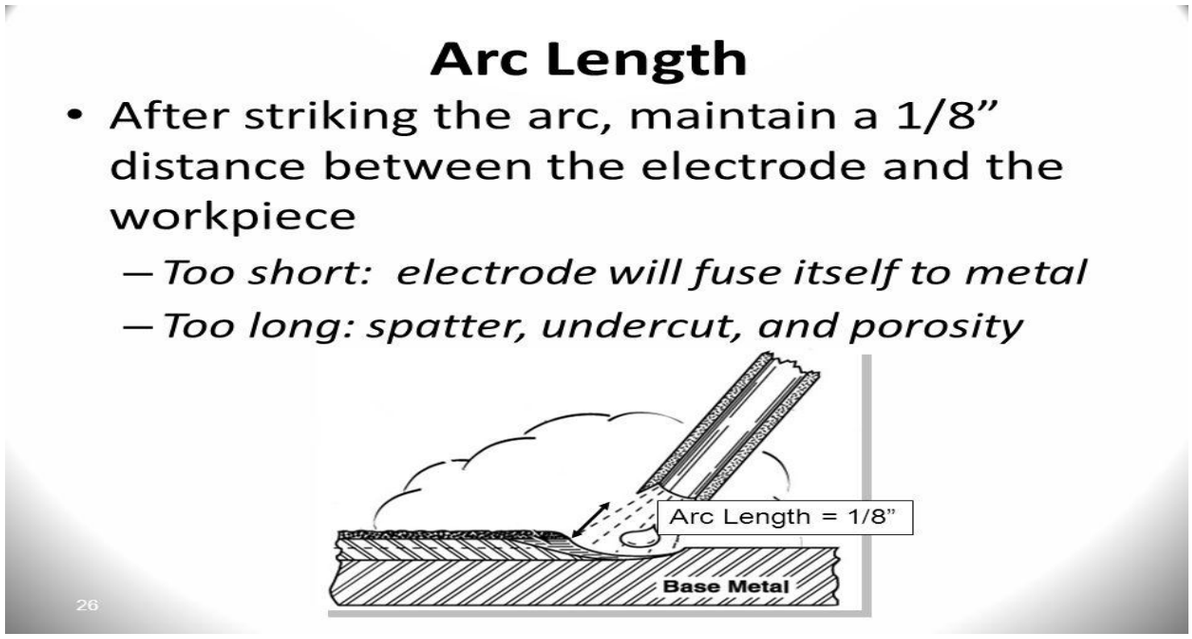
No.	Questions	Answer
1.	Welding downward 1° in vertical position	
2.	Welding downward 50° in vertical position	
3.	Welding downward 15° in vertical position	
4.	Welding upward 90° in vertical position	
5.	Welding upward 180° in vertical position	

Name:	Date:	Score:
Subject : Shielded Metal Arc Welding (SMAW)		
Lesson Title : Essentials in Welding – Length of Arc		
Learning Competency : LO1. Weld Carbon Steel Plates in Vertical Position (3F)		
References : http://www.weldingtipsandtricks.com/arc-welding.html		LAS No.: 11

Concept Notes:

Length of Arc

The arcing effect creates the intense heat required for melting the electrode and the base metal together. It is the distance from the tip of the electrode to the base metal



Exercise:

Check the appropriate box for the right answer.

No.	The fitting arc length in welding would be?	Answer
1.	1/8"	
2.	1/4"	
3.	3/4"	
4.	1"	
5.	1/32"	

Name:	Date:	Score:
Subject : Shielded Metal Arc Welding (SMAW)		
Lesson Title : Essentials in Welding – Travel Speed		
Learning Competency: LO1. Weld Carbon Steel Plates in Vertical Position (3F)		
References : https://www.mig-welding.co.uk/arc-welding-faults.htm		LAS No.: 12

Concept Notes:

Travel Speed

Travel speed is the rate at which the electrode moves along the workpiece. The key to correct travel speed is "reading" the weld puddle, because the weld puddle is a liquid version of the weld bead.

Exercise:

Identify the speed travel of the weld bead in picture below

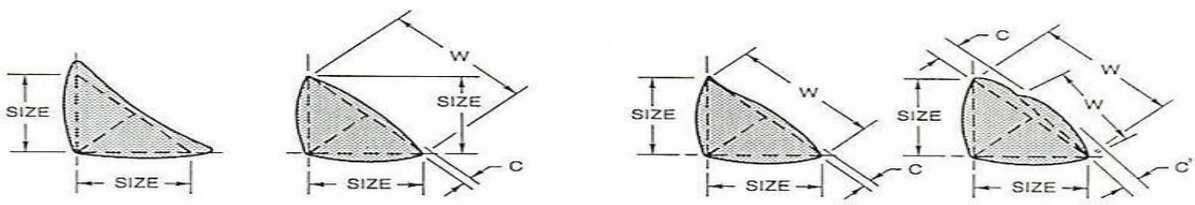
1. 2. 3.

Name:	Date:	Score:
Subject : Shielded Metal Arc Welding (SMAW)		
Lesson Title : Acceptable Weld Profiles		
Learning Competency: LO1. Weld Carbon Steel Plates in Vertical Position (3F)		
References : LANL Engineering Standards Manual		LAS No.: 13

Concept Notes:

Acceptable weld profiles

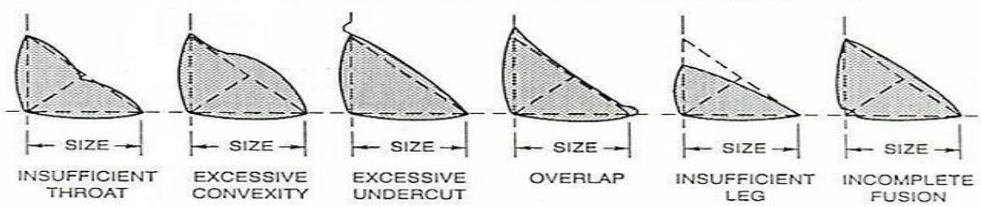
This section is contains information of what is acceptable and unacceptable weld profiles.



(A) DESIRABLE FILLET WELD PROFILES (B) ACCEPTABLE FILLET WELD PROFILES

NOTE: CONVEXITY, C, OF A WELD OR INDIVIDUAL SURFACE BEAD WITH DIMENSION W SHALL NOT EXCEED THE VALUE OF THE FOLLOWING TABLE:

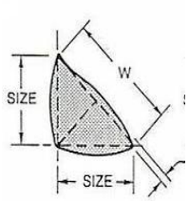
WIDTH OF WELD FACE OR INDIVIDUAL SURFACE BEAD, W	MAX CONVEXITY, C
W ≤ 5/16 in. (8 mm)	1/16 in. (1.6 mm)
W > 5/16 in. TO W < 1 in. (25 mm)	1/8 in. (3 mm)
W ≥ 1 in.	3/16 in. (5 mm)

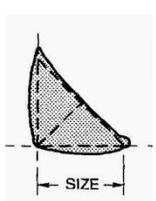


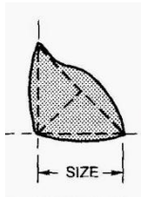
(C) UNACCEPTABLE FILLET WELD PROFILES

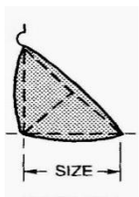
Exercise:

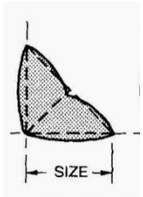
Determine if the picture presented is acceptable or unacceptable for fillet and groove weld profile. Write your answer in the box provided.

1. 

2. 

3. 

4. 

5. 

Name:	Date:	Score:
Subject:		
1. Lesson Title: WELDING DEFECTS CAUSES AND REMEDIES (OVERLAP)		
Learning Competency: LO 1. WELD CARBON STEEL PLATES IN VERTICAL POSITION (3F)		
References : WELDING ON CARBON STEEL PIPES USING SMAW MODULE		LAS No.: 14

CONCEPT NOTES:

WELDING DEFECTS CAUSES AND REMEDIES (OVERLAP)

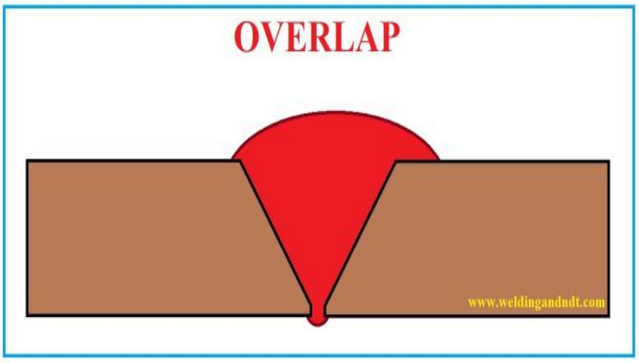
Causes of Overlap:

1. Improper welding technique.
2. By using large electrodes this defect may occur.
3. High welding current

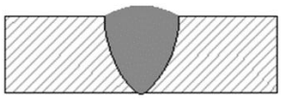
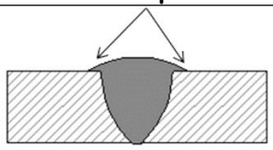
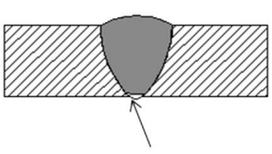
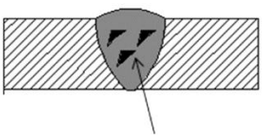
Remedies for Overlap:

1. Using a proper technique for welding.
2. Use small electrode.
3. Less welding current.

. **Example/ Illustration**



EXERCISE: Identify the Overlap Weld Defect. Encircle the letter

			
A.	B.	C.	D.

Name:	Date:	Score:
Subject :		
Lesson Title: WELDING *DEFECTS CAUSES AND REMEDIES (POROSITY)*		
Learning Competency: LO 1. WELD CARBON STEEL PLATES IN VERTICAL POSITION (3F)		
References : WELDING ON CARBON STEEL PIPES USING SMAW MODULE	LAS No.: 15	

CONCEPT NOTES:

WELDING DEFECTS CAUSES AND REMEDIES (POROSITY)

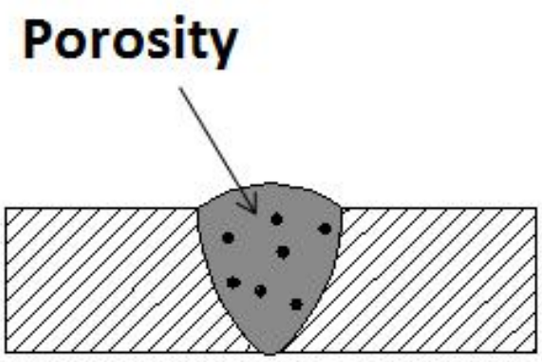
CAUSES:

1.Short arc with exception of low hydrogen
2. Insufficient paddling
3. Impaired base metal
4. Poor Electrode
5. Improper Shield Coverage

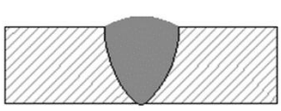
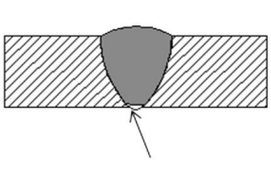
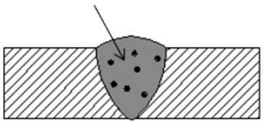
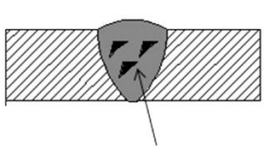
REMEDIES:

1. Check Impurities in base metal
2. Allow sufficient paddling
3. Use proper current

. **Example/ Illustration**



EXERCISE: Identify the Porosity Weld Defect. Encircle the letter.

			
A.	B.	C.	D.

Name:	Date:	Score:
Subject :SHIELDED METAL ARC WELDING (SMAW)		
Lesson Title: WELDING *DEFECTS CAUSES AND REMEDIES (SPATTER)*		
Learning Competency : LO 1. WELD CARBON STEEL PLATES IN VERTICAL POSITION (3F)		
References : WELDING ON CARBON STEEL PIPES USING SMAW MODULE	LAS No.: 16	

CONCEPT NOTES

WELDING DEFECTS CAUSES AND REMEDIES (SPATTER)

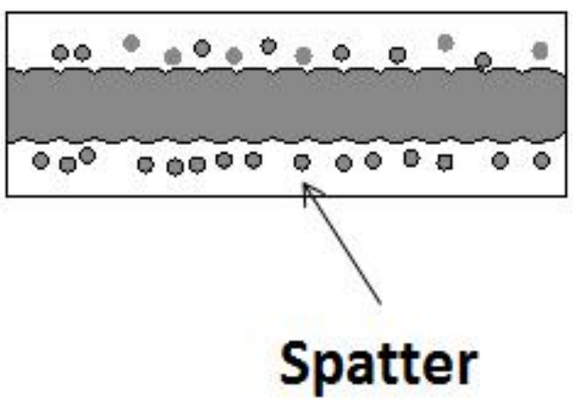
Causes of Spatter:

1. High Welding current can cause this defect.
2. The longer the arc the more chances of getting this defect.
3. Incorrect polarity.
4. Improper gas shielded may also cause this defect.

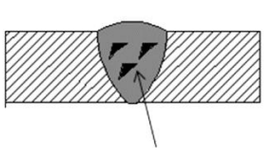
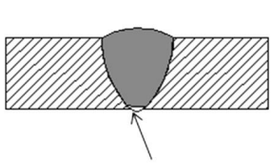
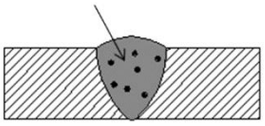
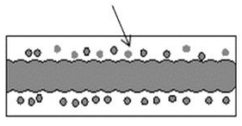
Remedies for Spatter:

1. Reducing the arc length and welding current
2. Using the right polarity and according to the conditions of the welding.
3. Increasing the plate angle and using proper gas shielding.

. **Example/ Illustration**



EXERCISE: Identify the Spatter Weld Defect. Encircle the letter.

			
A.	B.	C.	D.

Name:	Date:	Score:
Subject :SHIELDED METAL ARC WELDING (SMAW)		
Lesson Title :*WELDING DEFECTS CAUSES AND REMEDIES (UNDERCUT)*		
Learning Competency: LO 1. WELD CARBON STEEL PLATES IN VERTICAL POSITION (3F)		
References : WELDING ON CARBON STEEL PIPES USING SMAW MODULE	LAS No.: 17	

CONCEPT NOTES

WELDING DEFECTS CAUSES AND REMEDIES (UNDERCUT)

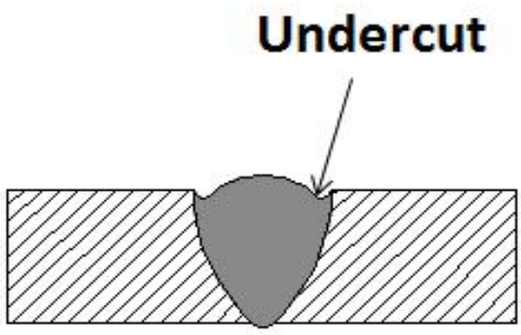
CAUSES:

1. Faulty Electrode or poor manipulation
2. Faulty Electrode use
3. Correct to high

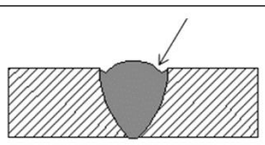
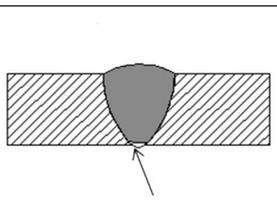
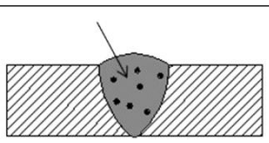
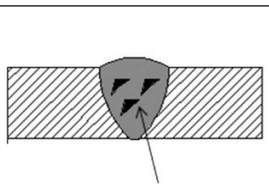
REMEDIES;

1. Use a uniform weave in butt welding
2. Avoid using an overly large electrode
3. Avoid excessive weaving
4. Use moderate current weld slowly

. **Example/ Illustration**



EXERCISE: Identify the Undercut Weld Defect. Encircle the letter.

			
A.	B.	C.	D.

Name:	Date:	Score:
Subject :SHIELDED METAL ARC WELDING (SMAW)		
Lesson Title: *WELDING DEFECTS CAUSES AND REMEDIES (WELD CRACK)*		
Learning Competency: LO 1. WELD CARBON STEEL PLATES IN VERTICAL POSITION (3F)		
References : WELDING ON CARBON STEEL PIPES USING SMAW MODULE	LAS No.: 18	

CONCEPT NOTES

WELDING DEFECTS CAUSES AND REMEDIES (WELD CRACK)

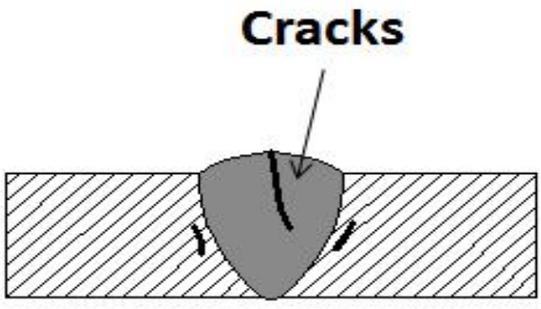
Causes of Weld Crack:

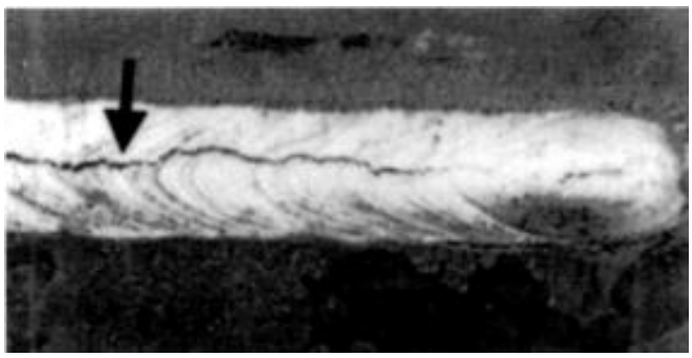
1.Poor ductility of the given base metal.
2. The presence of residual stress can cause a crack on the weld metal.
3. The rigidity of the joint which makes it difficult to expand or contract the metal

Remedies for Weld crack:

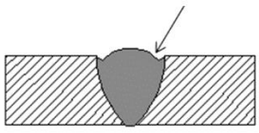
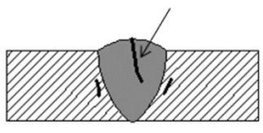
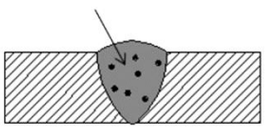
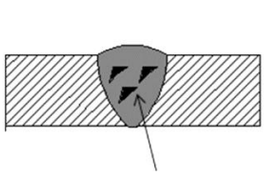
1. Using appropriate materials may decrease the chances of crack.
2. Preheating the weld and reducing the cooling speed joint helps in reducing crack.
3. Reduce the gap between the weld joints by using reasonable weld joints.

. **Example/ Illustration**





EXERCISE: Identify the Weld Crack Defect. Encircle the letter.

			
A.	B.	C.	D.

Name:	Date:	Score:
Subject: SHIELDED METAL ARC WELDING (SMAW)		
Lesson Title: Welding Specifications		
Learning Competency: LO 1 WELD CARBON STEEL PLATES IN VERTICAL POSITION (3F)		
References: WELDING ON CARBON STEEL PIPES USING SMAW MODULE		LAS No.: 19

CONCEPT NOTES:

Welding Specifications:

a) G – GROOVE

b) F – FILLET

PLATE

a) 1 – FLAT POSITION

b) 2 – HORIZONTAL POSITION

c) 3 – VERTICAL POSTION

d) 4 – OVER – HEAD POSITION

PIPE

a) 1 – MOVABLE PIPE POSITION

b) 2 – FIXED / MOVABLE VERTICAL PIPE POSITION

c) 5 – FIXED HORIZONTAL PIPE POSITION

d) 6 – FIXED 45 DEGREE PIPE POSITION

e) 2G – PIPE GROOVE, FIXED / MOVABLE VERTICAL POSITION

f) 5G - PIPE GROOVE, FIXED HORIZONTAL POSITION

g) 6G - PIPE GROOVE FIXED 45 DEGREE POSITION

. **Example/ Illustration**

EXERCISE:

No.	Give the appropriate code/specification:	Code
1.	Movable pipe position (Pipe)	
2.	Horizontal position (Plate)	
3.	Fillet	
4.	Groove	
5.	Pipe groove fixed 45-degree position	

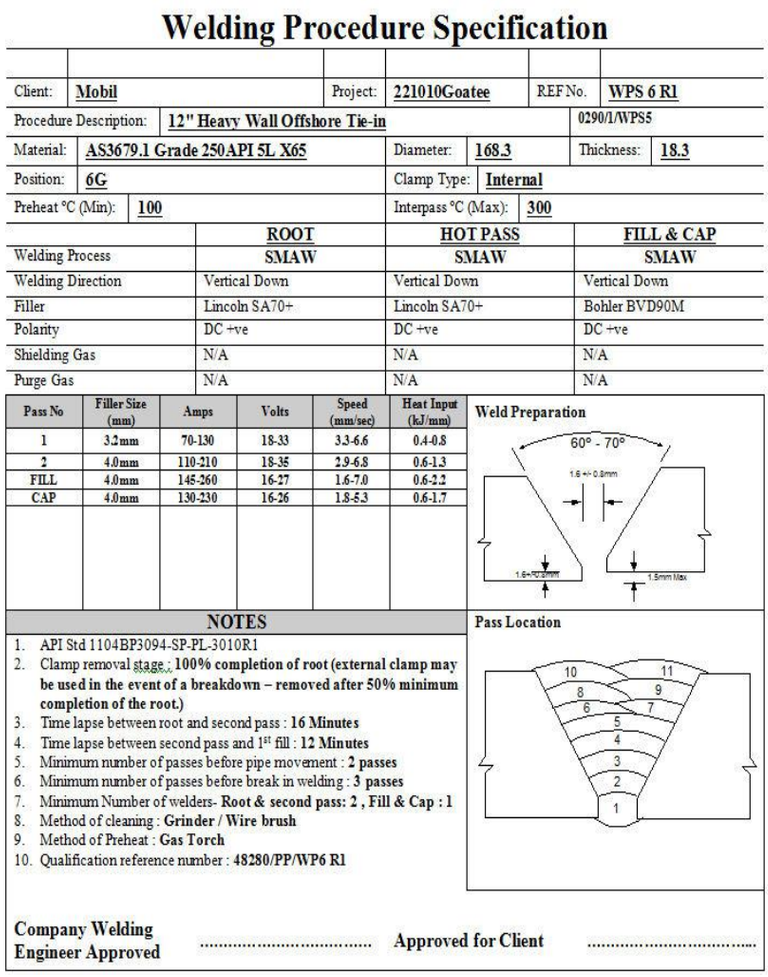
Name:	Date:	Score:
Subject: SHIELDED METAL ARC WELDING (SMAW)		
Lesson Title: Welding Procedure Specification		
Learning Competency: LO 1. WELD CARBON STEEL PLATES IN VERTICAL POSITION (3F)		
References : WELDING ON CARBON STEEL PIPES USING SMAW MODULE	LAS No.: 20	

CONCEPT NOTES

A **Welding Procedure Specification** (WPS) is a formal document describing welding procedures. The purpose of the document is to guide welders to the accepted procedures so that repeatable and trusted welding techniques are used.

According to the **American Welding Society** (AWS), a WPS provides in detail the required welding variables for specific application to assure repeatability by properly trained welders.

The **American Society of Mechanical Engineers** (ASME similarly defines a WPS as a written document that provides direction to the welder or welding operator for making production welds in accordance with Code requirements.



Welding Procedure Specification

Client:	Mobil	Project:	221010Goatee	REF No.	WPS 6 R1
Procedure Description:	12" Heavy Wall Offshore Tie-in				0290/1/WPS5
Material:	AS3679.1 Grade 250API 5L X65	Diameter:	168.3	Thickness:	18.3
Position:	6G	Clamp Type:	Internal		
Preheat °C (Min):	100	Interpass °C (Max):	300		

	ROOT	HOT PASS	FILL & CAP
Welding Process	SMAW	SMAW	SMAW
Welding Direction	Vertical Down	Vertical Down	Vertical Down
Filler	Lincoln SA70+	Lincoln SA70+	Bohler BVD90M
Polarity	DC +ve	DC +ve	DC +ve
Shielding Gas	N/A	N/A	N/A
Purge Gas	N/A	N/A	N/A

Pass No	Filler Size (mm)	Amps	Volts	Speed (mm/sec)	Heat Input (kJ/mm)
1	3.2mm	70-130	18-33	3.3-6.6	0.4-0.8
2	4.0mm	110-210	18-35	2.9-6.8	0.6-1.3
FILL	4.0mm	145-260	16-27	1.6-7.0	0.6-2.2
CAP	4.0mm	130-230	16-26	1.8-5.3	0.6-1.7

Weld Preparation

NOTES

1. API Std 1104BP3094-SP-PL-3010R1
2. Clamp removal stage : **100% completion of root (external clamp may be used in the event of a breakdown – removed after 50% minimum completion of the root.)**
3. Time lapse between root and second pass : **16 Minutes**
4. Time lapse between second pass and 1st fill : **12 Minutes**
5. Minimum number of passes before pipe movement : **2 passes**
6. Minimum number of passes before break in welding : **3 passes**
7. Minimum Number of welders- **Root & second pass: 2 , Fill & Cap : 1**
8. Method of cleaning : **Grinder / Wire brush**
9. Method of Preheat : **Gas Torch**
10. Qualification reference number : **48280/PP/WP6 R1**

Pass Location

Company Welding Engineer Approved ..... Approved for Client .....

In the oil and gas pipeline sector, the American Petroleum Institute **API 1104** standard is used almost exclusively worldwide. **API 1104** accepts the definitions of the American Welding Society code **AWS A3.**

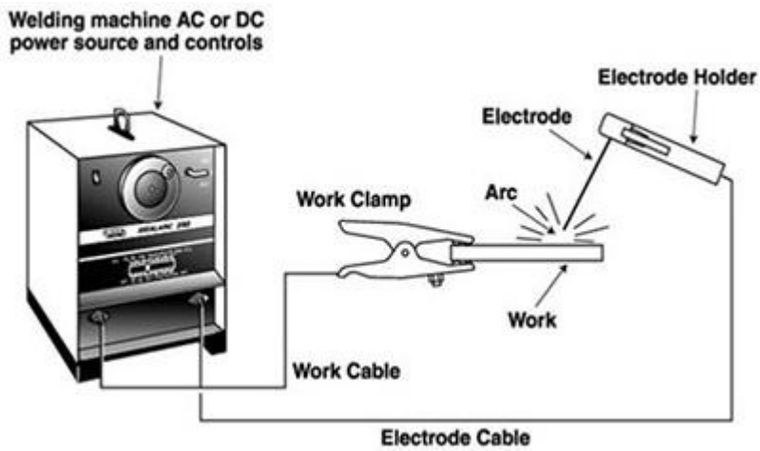
EXERCISE:

No.	Give the meaning of the following Acronyms:	Answer
1.	AWS	
2.	ASME	
3.	WPS	
4.	API	

Name:	Date:	Score:
Subject : SMAW WELDING PROCEDURE		
Lesson Title : PRE-WELDING FAMILIARIZATION		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://mikearrant.wordpress.com/teach/smaw-welding-procedure/		LAS No.: 21

CONCEPT NOTES:

Prior to welding, you should read the user-manual of your SMAW welding machine. Welders come with a wide variety of features, and can utilize AC or DC (current), and vary on amperage. Select an appropriate rod for your machine. A 6013 rod will work for most machines, and an amperage setting of approximately 100 amps using AC will work best with the rod. Again, the user manual provided with the welding machine will layout the procedure for checking this configuration.



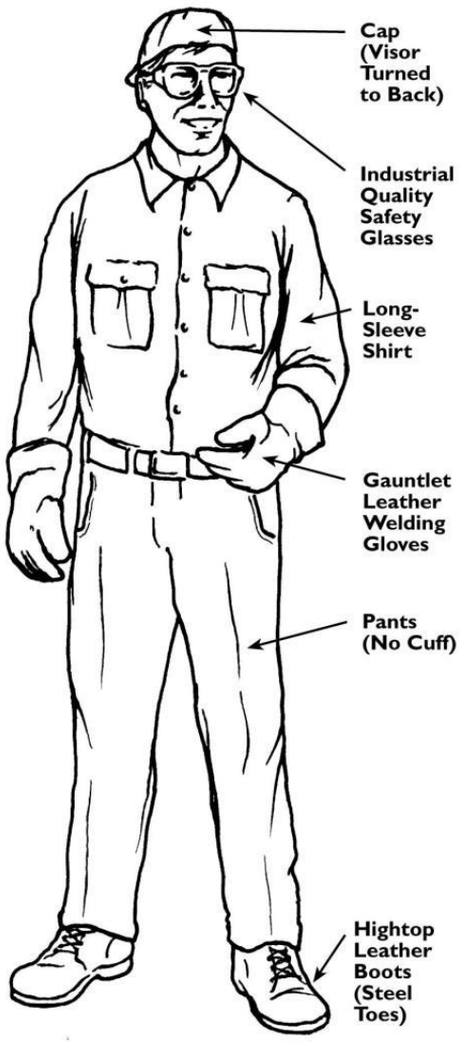
EXERCISE: Check the appropriate box

No.	Pre-Welding Checklist:	Answer
1.	SMAW Welding Machine	
2.	SMAW Welding Machine user's manual	
3.	6013 rods	
4.	Hacksaw	
5.	Steel Brush	

Name:	Date:	Score:
Subject : SMAW WELDING PROCEDURE		
Lesson Title : SAFETY		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://mikearrant.wordpress.com/teach/smaw-welding-procedure/		LAS No.: 22

CONCEPT NOTES:

Ensure you are in a well-ventilated area before beginning welding. SMAW arc welding produces toxic fumes. Ensure you are wearing proper protective equipment. Proper equipment includes a long sleeve shirt, long pants, leather shoes, and gauntlet gloves. The long sleeve shirt is required because arc rays can cause minor skin burns identical to sun burns. Gauntlet Gloves are required because they protect your hands from the immense heat created during the welding process. The gloves must be loose fitting so that in case they catch on fire, they can be quickly and easily separated from your hands. Lastly you will need a face shield or helmet with a #10 shaded lens dawned or ready.



EXERCISE: Check the appropriate box

No.	Pre-Welding Safety Checklist:	Answer
1.	Well Ventilated Area	
2.	Face shield or helmet	
3.	Proper protective equipment	
4.	Leather shoes	
5.	Gauntlet gloves	

Name:	Date:	Score:
Subject : SMAW WELDING PROCEDURE		
Lesson Title : SET-UP		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://mikearrant.wordpress.com/teach/smaw-welding-procedure/		LAS No.: 23

CONCEPT NOTES:

Ensure the welding equipment is properly set up, plugged in and the ground is connected to the piece of metal you are working on. SMAW welding uses high voltage electricity which runs from the outlet through the machine, into the stick, through the arc, into the piece of metal being welded, through the ground clamp, back into the machine, and back into the outlet. This flow of electricity is critical to the weld, and compromising it could result in sever shock of the welder.

Note: *The picture on the right depicts the welding ground attached to the table This is done if a metal welding table is used. For other projects, the clamp should be directly attached to the piece of metal being worked on.*

EXERCISE: Check the appropriate box

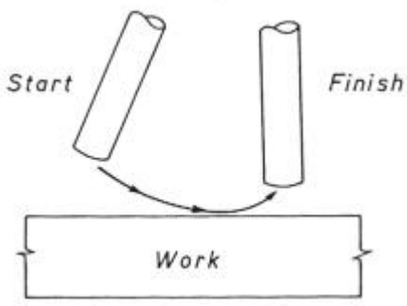
No.	Pre-Welding Setup Checklist:	Answer
1.	Welding Equipment properly plugged-in	
2.	Ground is properly connected to the piece of metal being worked on.	
3.	Glass of water in the working table	

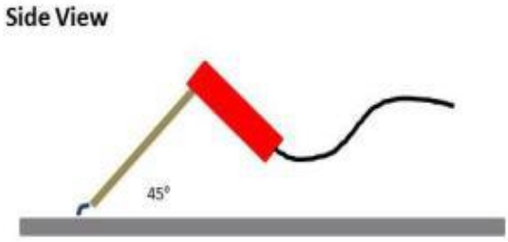
Name:	Date:	Score:
Subject: SMAW WELDING PROCEDURE		
Lesson Title: STRIKE AND ARC AND POSITION ROD		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference: https://mikearrant.wordpress.com/teach/smaw-welding-procedure/		LAS No.: 24

CONCEPT NOTES:

With the piece of metal prepared and ready, it is time to begin welding. Turn the SMAW welding machine on, and down your helmet. Strike an arc by quickly brushing the rod against the piece of metal that you are attempting to weld. After brushing the rod across the metal, try to maintain a distance of about 1/16" between the end of the rod, and the piece of metal you are welding. This distance is crucial to make a good weld. You will notice a bright arc that is constant and stable if done correctly.

With the arc struck, the rod should be held pointing directly away from you and in line with the intended weld. The rod should be held at a 45-degree vertical angle with the metal being welded.





Note: *The picture above (red) depicts the motion used only, and not the molten metal, or "pool" produced when welding. Using the motion described will produce a pool that is overlapped with each pass so that no space can be seen between zig-zag strokes.*

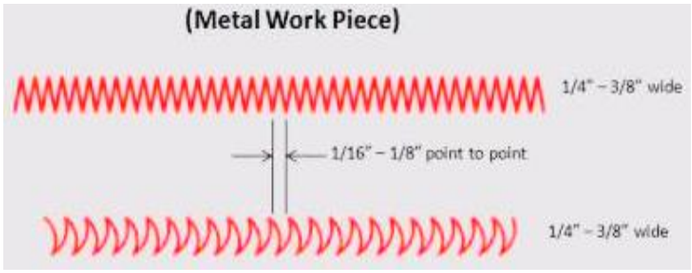
EXERCISE: Check the appropriate box

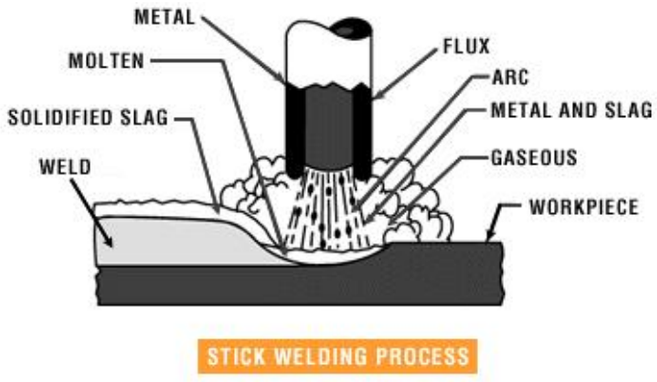
No.	Select the proper set-up.	Answer
1.	Turn-on Machine > strike an arc > down your helmet	
2.	Turn-on Machine > down your helmet > strike an arc	

Name:	Date:	Score:
Subject : SMAW WELDING PROCEDURE		
Lesson Title : BEGIN WELDING THE BEAD		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://mikearrant.wordpress.com/teach/smaw-welding-procedure/		LAS No.: 25

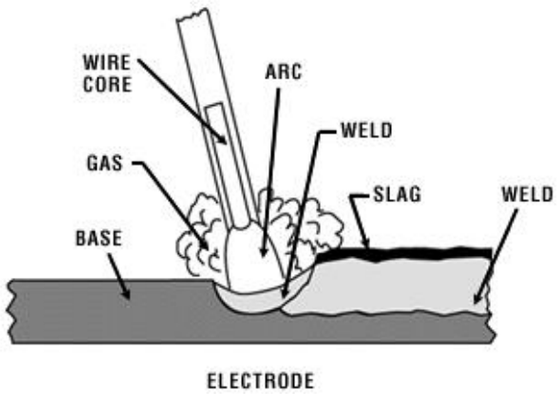
CONCEPT NOTES:

Now, with the arc struck, and the rod position correct, begin welding by pulling the rod towards you in a zig-zag or semi-circular motion. The proper angle and the 1/16" distance between the rod and the metal should be maintained throughout the entire welding process. Remember, that as long as the arc is struck, the rod will continue to get shorter because metal from the rod is "flowing" across the arc and onto the metal being welded. Therefore it is difficult to maintain the 1/16" arc distance and will require lots of practice.





STICK WELDING PROCESS



EXERCISE:

No.	Activity	Answer
1.	Familiarize the Illustration and Perform the Operation in the Workshop later.	
2.	You will be assisted and your activity will be assessed by your trainer.	

Name:	Date:	Score:
Subject : SMAW WELDING PROCEDURE		
Lesson Title : REMOVE SLUG AND EXAMINE THE WELD		
Learning Competency: LO1. WELD CARBON STEEL PLATES		
Reference : https://mikearrant.wordpress.com/teach/smaw-welding-procedure/		LAS No.: 26

CONCEPT NOTES:

After the weld is complete, the metal will be extremely hot. First ensure you turned the power off on the SMAW arc welder. Then use the slag hammer to strike the bead you just made. A small amount of crusted material called the slag should chip away from the weld revealing the actual bead. Use the wire brush to clean the remaining slag from the bead. Gripping the metal with pliers, dunk it into the bucket of water to cool the metal. After removing from the water, wipe the metal dry clean with the wire brush again if needed. Finally examine your weld.

The welding speed will vary with different welding rods; however, the correct speed should be fairly slow and extremely steady. If done correctly the weld should look like it does. If the weld is not continuous, common faults are motions that are spread too far apart, or moving too fast across the metal. It will take several attempts before you can successfully lay down a bead weld. It will require constant practice.

EXERCISE:

No.	Activity	Answer
1.	Familiarize the Illustration and Perform the Operation in the Workshop Later.	
2.	You will be assisted and your activity will be assessed by your trainer.	

EXERCISE/S KEY

SHIELDED METAL ARC WELDING NC-II

ACTIVITY NUMBER	LEARNING ACTIVITY TITLE	EXERCISE ITEMS	KEY		TOTAL ITEMS
1	Shock Hazards	1	Electric Shock		5
		2	Safe		
		3	Safe		
		4	Electric Shock		
		5	Electric Shock		
2	Safe Welding Practices - Radiation	1	Exposed		5
		2	Exposed		
		3	Safe		
		4	Safe		
		5	Exposed		
3	Safe Welding Practices - Fumes	1	√		9
		2	√	6	√
		3	√	7	√
		4	√	8	√
		5	√	9	
4	Safe Welding Practices – Proper Ventilation	1	True		5
		2	True		
		3	False		
		4	True		
		5	True		
5	Safe Welding Practices – Fire Hazards	1	True		5
		2	False		
		3	False		
		4	True		
		5	True		
6	Safe Welding Practices – Explosion Hazards	1	True		5
		2	True		
		3	False		
		4	True		
		5	True		
7	Essentials in Welding – Angle of Electrode	1	AWS D10.11		5
		2	AWS A03.0		
		3	AWS D10.12		
		4	AWS D11.2		

		5	AWS A02.4	
8	Essentials in Welding –Electrode Selection by: Sir Richard Tiempo	1		5
		2	Ni-Cl	
		3	6010/6011	
		4	6013	
		5		
9	Essentials in Welding – Current Setting	1	7018 3/32”	5
		2	7024 1/8”	
		3	6011 5/32”	
		4	6013 1/8”	
		5	6010 1/8”	
10	Essentials in Welding – Angle of Electrode	1	false	5
		2	false	
		3	true	
		4	true	
		5	false	
11	Essentials in Welding – Length of Arc	1	true	5
		2	false	
		3	false	
		4	false	
		5	false	
12	Essentials in Welding – Travel Speed	1	normal	3
		2	fast	
		3	slow	
13	Acceptable Weld Profiles	1	acceptable	5
		2	unacceptable	
		3	unacceptable	
		4	acceptable	
		5	unacceptable	
14	Weld Defects - Overlap	1	B	1
15	Weld Defects - Porosity	1	C	1
16	Weld Defects - Spatter	1	D	1
17	Weld Defects - Undercut	1	A	1
18	Weld Defects – Weld Crack	1	B	1
19	Welding Specifications	1	1	5
		2	2	
		3	F	
		4	G	
		5	6G	
20	Welding Procedure Specifications	1	American Welding	4

			Society	
		2	American Society of Mechanical Engineers	
		3	Welding Procedure Specification	
		4	American Petroleum Institute	
21	Pre-welding Familiarization	1	Check	5
		2	Check	
		3	Check	
		4	No Check	
		5	No Check	
22	Safety	1	Check	5
		2	Check	
		3	Check	
		4	Check	
		5	Check	
23	Set-up	1	Check	3
		2	Check	
		3	No Check	
24	Strike an Arc and Position Rod	1	No Check	2
		2	Check	
25	Welding the Bead	1	Activity	2
		2	Activity	
26	Remove Slug and Examine the Bead	1	Activity	2
		2	Activity	