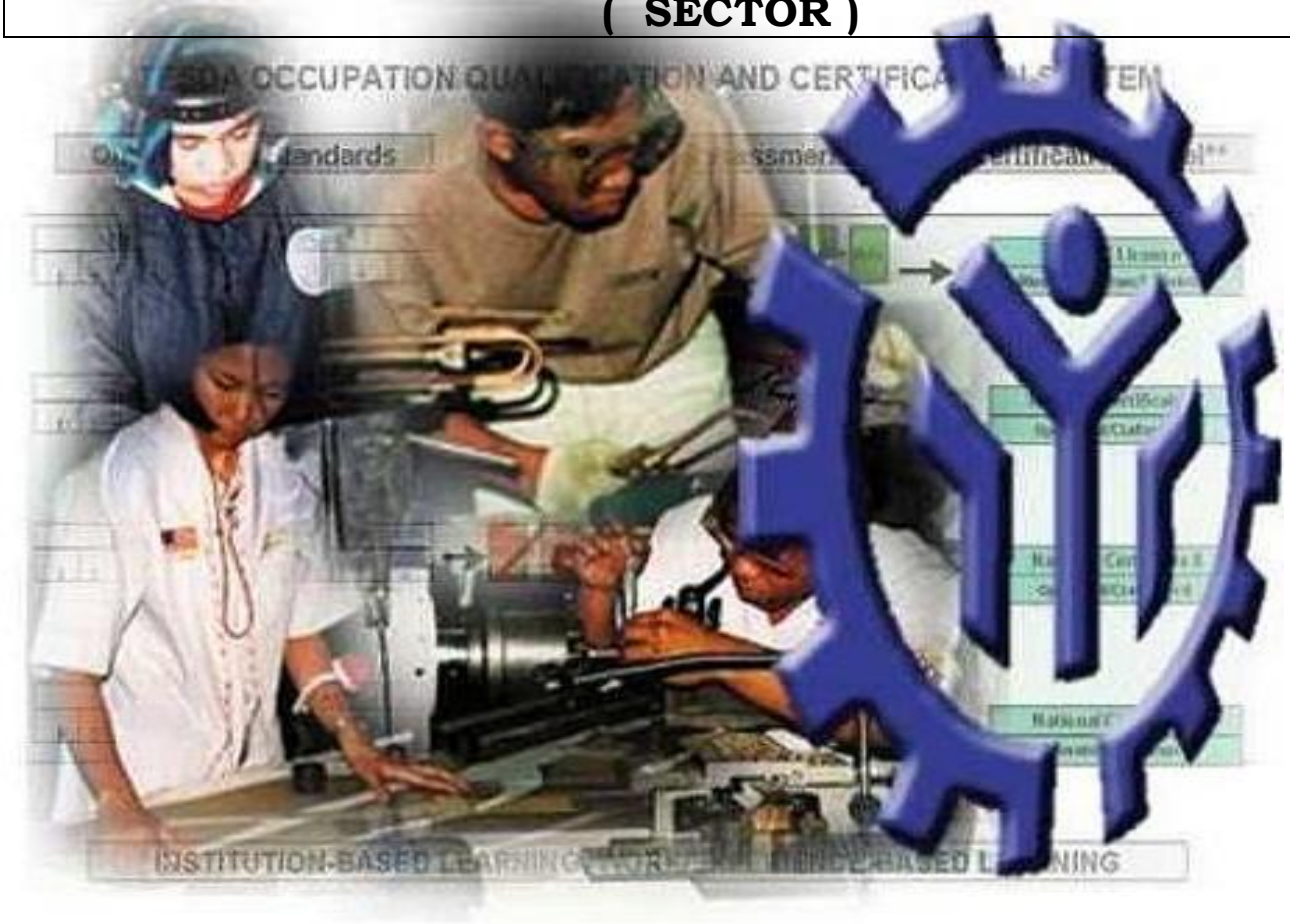
COMPETENCY - BASED LEARNING MATERIALS

Sector:	**METALS AND ENGINEERING (SECTOR)**



Qualification: **SHIELDED METAL ARC WELDING NC II**
Unit of Competency: **WELD CARBON STEEL PIPES USING SMAW**
Module Title: **WELDING ON CARBON STEEL PIPES**
Institution: **LMMSAT - TESDA** **Poblacion West, Asingan, Pangasinan**

LMMSAT - TESDA QA SYSTEM	**Shielded Metal Arc Welding NC II**	Date Developed:	Document N.	
			Issued by:	
		Developed by: Jerry R. Torrado	Revision No.__	Page _ of __

LIST OF COMPETENCIES

No.	Unit of Competency	Module Title	Code
1.	Weld Carbon Steel Plates using SMAW	Welding Carbon Steel Plates using SMAW	MEE721306
2.	Weld Carbon Steel Pipes Using SMAW	Welding Carbon Steel Pipes Using SMAW	MEE721306

HOW TO USE THIS COMPETENCY BASED LEARNING MATERIAL

Welcome to the module in **Welding Carbon Steel Pipes Using SMAW.** This module contains training materials and activities for you to complete.

The unit of competency **"Weld Carbon Steel Pipes Using SMAW"** contains knowledge, skills and attitudes required for **Shielded Metal Arc Welding NC II.** It is one of the specialized modules at National Certificates Level (NC II).

You are required to go through a series of learning activities in order to complete each learning outcome of the module. In each learning outcome are ***Information Sheets*** and ***Resources Sheets*** (Reference Materials for further reading to help you better understand the required activities). Follow these activities on your own and answer the self-check at the end of each learning outcome. You may remove a blank ***answer sheet*** at the end of each module (or get one from your facilitator/trainer) to write your answers for each self-check. If you have questions, don't hesitate to ask you facilitator for assistance.

Recognition of Prior Learning (RPL)

You may already have some or most of the knowledge and skills covered in this learner's guide because you have:

- been working for some time
- already completed training in this area

If you can demonstrate to your trainer that you are competent in a particular skill or skills, talk to him/her about having them formally recognized so you don't have to do the same training again. If you have a qualification or Certificate of Competency from previous trainings, show it to your trainer. If the skills you acquired are still current and relevant to the unit/s of competency they may become part of the evidence you can present for RPL. If you are not sure about the currency of your skills, discuss this with your trainer.

At the end of this module is a ***Learner's Diary.*** Use this diary to record important dates, jobs undertaken and other workplace events that will assist you in providing further details to your trainer or assessor. A **Record of Achievement** is also provided for your trainer to complete once you complete the module.

This module was prepared to help you achieve competency, in **Welding Carbon Steel Pipes Using SMAW**. This will be the source of information for you to

acquire knowledge and skills in this particular trade independently and at your own pace, with minimum supervision or help from your instructor.

- Talk to your trainer and agree on how you will both organize the Training of this unit. Read through the module carefully. It is divided into sections, which cover all the skills, and knowledge you need to successfully complete this module.

QUALIFICATION: **SHIELDED METAL ARC WELDING NC II**

UNIT OF COMPETENCY: Weld Carbon Steel Pipes Using SMAW

MODULE TITLE: Welding Carbon Steel Pipes Using SMAW

INTRODUCTION: This module covers the knowledge, skills and proper attitude in groove welding on carbon steel pipes in performing root pass, clean root pass, weld subsequent/ filling passes, and perform capping.

NOMINAL DURATION: 80 HOURS

LEARNING OUTCOMES:

Upon completion of this module, the trainee/student must be able to:

1. Perform root pass
2. Clean root pass
3. Weld subsequent/filling pass
4. Perform capping

ASSESSMENT CRITERIA:

1. Root pass is performed in accordance with WPS and/or client specifications.
2. Task is performed in accordance with company or industry requirement and safety procedure.
3. Weld is visually checked for defects and repaired, as
4. required
5. Weld is visually acceptable in accordance with applicable codes and standards
6. Root pass is cleaned and free from defects and discontinuities
7. Task is performed in accordance with approved WPS
8. Subsequent/ filling passes is performed in accordance with approved WPS

9. Weld is visually checked for defects and repaired, as required
10. Weld is visually acceptable in accordance with applicable codes and standards
11. Capping is performed in accordance with WPS and/or client specifications
12. Weld is visually checked for defects and repaired, as required
13. Weld is visually acceptable in accordance with applicable codes and standards

PRE-REQUISITE:

BASIC AND COMMON COMPETENCIES

LEARNING OUTCOME #1: Perform root pass

Learning Contents:

1. Essentials of welding
2. Safe welding practices
3. Weld defects, causes and remedies
4. Welding Procedure and Specifications (WPS)
5. International welding codes and standards
6. Acceptable weld profiles
7. Welding technique and procedures

ASSESSMENT CRITERIA:

1. Root pass is performed in accordance with *WPS* and/or client specifications.
2. Task is performed in accordance with company or industry requirement and safety procedure.
3. Weld is visually checked for *defects* and repaired, as required
4. Weld is visually acceptable in accordance with applicable codes and standards

CONDITIONS:

Equipment

- AC-DC Welding Machine
- Welding Table
- Portable Grinder
- Portable Oven
- Welding Booth

Tools/Accessories

- Welding Mask
- Steel Brush
- Clear glass
- Chipping Hammer
- Dark glass

Supplies/Materials

- Electrodes

- Carbon steel plates
- Cutting grinding disc

Personal Protective Equipment

- Safety shoes
- Apron
- apron
- Leggings
- Safety goggles
- Gloves

Training Manuals

- Arc welding manuals
- Welding procedures specifications
- Welding standards

ASSESSMENT METHODS:

- Observation and interview
- Demonstration and interview
- Written test
- Portfolio

LEARNING EXPERIENCES

Activities	Special Instructions
1. Read Information Sheet 1.1 – 1 on the Essentials of welding .	Read the information sheet carefully
2. Answer Self – Check 1.1-1.	Compare to answer key 1.1-1.
3. Read Information Sheet 1.1-2 on the Safe welding practices.	Read the information sheet carefully
4. Answer Self – Check 1.1-2.	Compare to answer key 1.1-2.
5. Read Information Sheet 1.1-3 in identifying weld defects, causes and remedies	Read the information sheet carefully
6. Answer Self – Check 1.1 -3.	Compare to answer key 1.1-3.
7. Read Information Sheet 1.1 – 4 on Welding Procedures and Specifications (WPS).	Read the information sheet carefully
8. Answer Self – Check 1.1 -4 (Written Test)	Compare to answer key 1.1-4.
9. Read Information Sheet 1.1-5 on International welding codes and standards**.**	Read the information sheet carefully
10. Answer Self – Check 1.1 -5 (Written Test)	Compare to answer key 1.1-5.
11. Read Information Sheet 1.1-6 on acceptable weld profiles.	Read the information sheet carefully
12. Answer Self – Check 1.1 -6 (Written Test)	Compare to answer key 1.1-6.
13. Guided by information sheet 1.1-7, observe the trainer as he demonstrates the different welding techniques and procedures correctly and properly**.**	Jot down observations.
14. Perform Job Sheets 1.1-7a-c on the different welding techniques and procedures.	Trainer evaluates performance and work outputs and makes recommendations.

INFORMATION SHEET No. 1.1-1

ESSENTIALS OF WELDING

After reading the Information Sheet, the trainee must be able to determine the essentials of welding.

Weld quality and consistency can only be maintained with respect to the five essentials. The five essentials of welding include the use of correct electrode size, current, arc length or voltage, travel speed and electrode angles. All five must be collectively and consistently maintain to successfully control the puddle and produce a weld that is uniform in appearance, have consistent ripples, smooth face contour, and no noticeable defect. Once the welder masters the ability to consistently maintain the five essentials, the ability to control the puddle will follow.

ELECTRODE SIZE

Choosing the correct electrode size involves many factors. If a smaller recommended electrode is used, welding time and heat to the joint will increase. It can result in increase costs, heat affected zone, cracking or distortion.

Larger electrode can cause melt – through and can be difficult to control in out of position
joints. Poor appearance and possible defects can result. The welding procedure designates the correct electrode size, generally based on metal type and thickness. However, if no procedure or instruction is available the welder will have to choose the correct electrode size.

CURRENT

The correct current setting is vital for maintaining consistency in weld quality. If the current is too high, the electrode melts too fast, and the molten pool is larger and irregular. If the current is too high when welding single vee-groove, it might blow holes through the joint and cause large molten metal droplets to fall out of the groove.

If the current is too low, there is not enough heat to melt the base metal. The molten pool will be too small, piles up, and looks irregular. Poor penetration and incomplete fusion in the joint can result.

TRAVEL SPEED

Incorrect travel is a common mistake. Sometimes travel speed is the only condition a welder may need to change. Travelling too fast causes the puddle to freeze too quickly. Because of this, impurities and gases can become entrapped, making the bead face narrow with pointing ripple. Incomplete penetration due to loss of the keyhole in root pass is possible.

Travelling too slow will cause the puddle to be large, with pile – up, and a straight ripple pattern. For out of position welding, slow travel sped can cause the puddle to drip out the joint.

ELECTRODE ANGLE

One of the most essentials is the use of the correct electrode angles. For fillet and groove welds, correct electrode angles are vital for preventing undercut and inadequate fill. When depositing a fillet weld the electrode should be held so that it bisects the angle between the plates and is perpendicular to the line of the weld. On groove weld, the technique is much the same; although varying slightly with multiple pass welding.

There are two teams to specify electrode angles. These are **travel angle** and **work angles.**

The travel angle applies to the position the electrode make with a reference perpendicular to the axis of the weld in plane of the weld axis. It can be either a **drag angle** or a **push angle**. A drag angle is when the electrode is pointing backward, meaning the welder's hand and electrode holder proceeds the puddle. A push angle is when electrode is pointing just the opposite of the drag.

The work angle is the position the electrode makes with reference to the surface of the plate on a plane perpendicular to the weld axis. On butt joints the work angle is usually 90 degrees to the surface of the plate.

T o some degree, you can correct for an improper condition by varying the essential variables. It is better though to have all conditions as correct as possible.

ARC LENGTH

Arc length is very important for weld puddle control. Correct arc length will cause the deposit to be neat of even ripple and of good penetration.

Too long arc length will cause the deposit to coarse rippled and flatter than normal with an increase in spatter. When welding a root pass in an open root vee groove, the keyhole can grow too large and loose of weld control can result.

Too short an arc will cause deposited to be narrow, uneven and irregular rippled and with poor fusion. The arc length reduces the voltage and increases the amperage slightly but the electrode may stick to the work. When welding root passes, too short an arc length often results n loss of the keyhole.

SELF – CHECK 1.1-1

(Essentials of Welding)

TRUE OR FALSE

Direction: Read each statement below carefully. Write **TRUE** if the statement is correct and **FALSE** if the statement is not correct.

_____ 1. Using a larger electrode diameter can cause melt – through/ burn – through.

_____ 2. Travelling too fast will make the bead face narrow with pointing ripple.

_____ 3. If the current is too low, the electrode melts too fast.

_____ 4. Quality or sound weld is the result of correct current, constant voltage, travel speed, electrode angle and correct electrode size.

_____ 5. In fillet weld, electrode angle is not necessary for preventing undercut and under fill.

ANSWER KEY 1.1 – 1

Essentials of Welding

1. TRUE
2. TRUE
3. FALSE
4. TRUE
5. FALSE

INFORMATION SHEET NO. 1.1 -2

Welding Personal Protective Equipment (PPE)

After reading the Information Sheet, the trainee must be able to identify the different personal protective equipment and their uses.

The hazards in arc welding can endanger a welder's life if he/she is not wearing the proper protective clothing and equipment. Here are some information on the suitable outfit that a welder must wear while welding:

WELDING SHIELD/HELMET

Welding shield/helmet is used to protect the face and eyes from the arc rays (Infrared Rays, Ultra Violet Rays) and heat and spatter from the 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.

The recommended minimum protective filter based on the welding current to be used is shown in the table below:

Approximate Range Of Welding Current	Filter Lens Number
Up to 100	8
100 - 200	10
200 - 300	11
300 - 400	12
Over 400	13

LEATHER JACKET

Leather jacket is made of chrome leather and prevents the entry of sparks between the welder's clothes and body.

LEATHER APRON

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

LEATHER GLOVES

Gloves are made of chrome leather and protect the welder's hands from heat, spatter, and radiation.

LEATHER SPATS

Spats are made of chrome leather and protect the feet from spatter.

SAFETY GLASSES

Safety clear glasses are used to protect the eyes when chipping slag and grinding.

WELDERS CAP

Welders cap is used to protect welder's head from spatters in out of position welding or in confined spaces.

WELDERS LEATHER BOOTS

Welding Leather Boots is used to protect our feet from falling spatter, sparks, and hot metals when welding overhead and confined spaces.

FACE SHIELD

Face Shield must also be worn where required to protect eyes. Welders must wear safety glasses and chippers and grinders often use face shield in addition to safety glasses.

SELF – CHECK 1.1-2

Welding Personal Protective Equipment (PPE)

MULTIPLE CHOICE: Choose the correct answer and write the letter that correspond to your choice on the answer sheet provided.

1. A safety gadget used to protect the face and eyes from the arc rays, heat and spatter.
   a. Welding gloves
   b. Welding jacket
   c. Safety shoes
   d. Welding helmet/shield

2. The most serious danger from exposure to welding arc is,
   a. X – rays
   b. Beta – rays
   c. Ultra Violet Rays
   d. Sun rays

3. Protect the entry of falling hot slag and spatter.
   a. Leggings
   b. Welding gloves
   c. Welding helmet
   d. Clear glass

4. When welding at a current setting of 120 amperes, what is the recommended filter lens number?
   a. 8
   b. 12
   c. 10
   d. 11

5. Safety gadget used to protect the eyes when chipping slag and grinding.
   a. Safety glasses
   b. Leather spats
   c. Leggings
   d. Welding gloves

ANSWER KEY 1.1 – 2

Welding Personal Protective Equipment (PPE)

1. **d**
2. **c**
3. **a**
4. **c**
5. **a**

INFORMATION SHEET 1.1 -3

Identifying Weld Defects, Causes and Remedies

After reading the Information Sheet, the trainee must be able to:

1. **Identify the different welding defects and causes; and**
2. **Know the causes and remedies for these defects.**

As previously explained, weld quality can only be attained by following the five essentials, as preconditions for welding. Without due regard to these essentials, defects will occur. The most common defects and corresponding causes and preventions are discussed below.

A. 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

B.POOR PENETRATION

CAUSES:

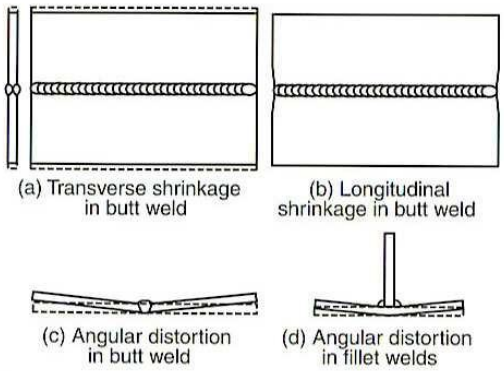
1. Speed too fast
2. Electrode too large
3. Current too low
4. Faulty penetration

REMEDIES:

1. Use enough current to obtain desired penetration- weld slowly
2. Select electrodes according to welding groove size
3. Leave proper gap at bottom of weld

C.WARPING

CAUSES:



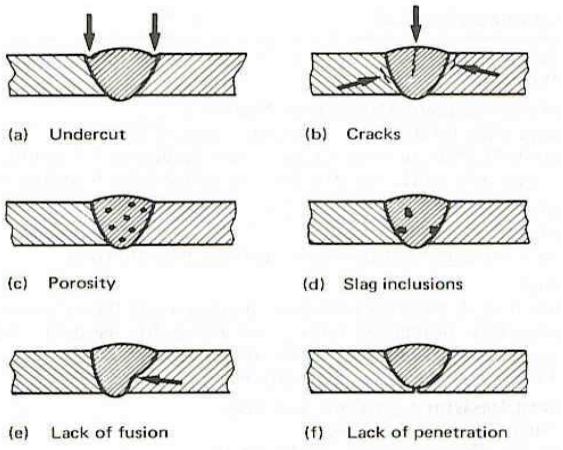
1. Shrinkage of weld metal
2. Faulty clamping of parts
3. Faulty preparation
4. Over heating at joint

REMEDIES:

1. Peen joint edges before welding
2. Weld more rapidly
3. Avoid excessive space between parts
4. Pre-form parts before welding
5. Use proper sequence
6. Clamp or tack parts properly – back up to cool
7. Adopt a proper welding procedure
8. Use high speed, moderate penetration process

D.UNDERCUTING

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

E. CRACK WELDS

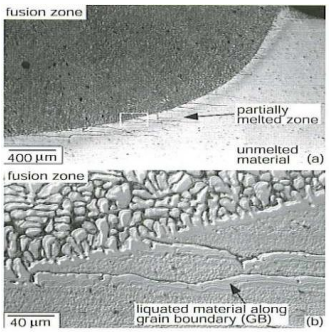
CAUSES:

1. Wrong electrode
2. Weld and parts sizes unbalanced
3. Faulty welds
4. Faulty preparation
5. Rigid joint

REMEDIES:

1. Design structure to eliminate rigid joints
2 Heat parts before welding
3. Avoid welds in string beads
4. Keep ends free to move as long as possible
5. Make sound welds of good fusion
6 Adjust weld size to parts size
7. Allow joints a proper and uniform gap
8 Work with amperage as low as possible

F.POOR APPEARANCE



CAUSES:

1. Faulty electrode
2. over hang
3. Improper use of electrode
4. Wrong arc voltage and current

REMEDIES:

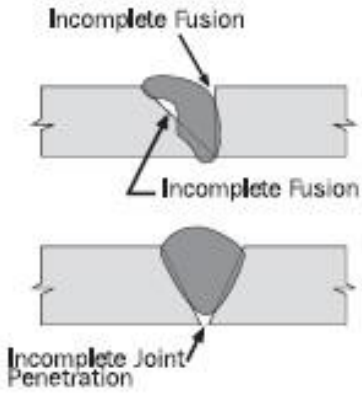
1. Use a proper welding technique
2. Avoid over heating
3. Use a uniform weave
4. Avoid overly high current

G.POOR FUSION

Lack of fusion, also called cold lapping or cold shuts

CAUSES:

1. Wrong speed
2. Current improperly adjusted
3. Faulty preparation
4. Improper electrode size



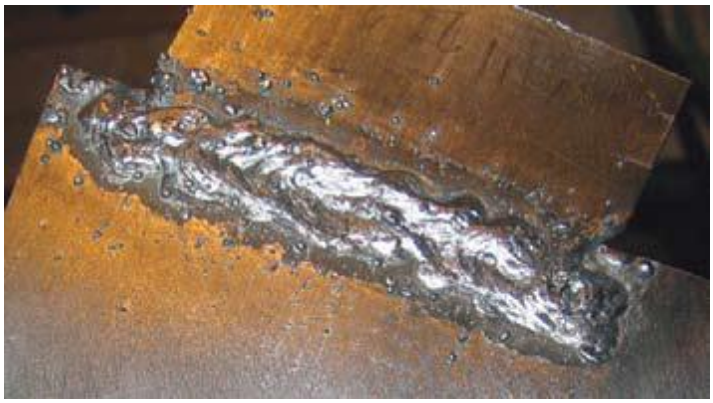
REMEDIES:

1. Adjust electrode to match joint
2. Weave must be sufficient to melt sides of joint
3. Select proper current and voltage
4. Keep weld metal from flowing away from plates

H. SPATTER

CAUSES:

1. Arc blow
2. Current too high
3. Arc too long
4. Faulty electrode



REMEDIES:

1. Clean parts in weld area
2. Adjust current
3. Adjust voltage
4. Pick suitable electrode

SELF – CHECK 1.1-3

Identifying Weld Defects, Causes and Remedies

MULTIPLE CHOICE: Choose the correct answer and write the letter that correspond to your choice on the answer sheet provided.

1. When electrode coating absorbs moisture, what will be the effect to the weld bead?
   a. poor penetration
   b. porosities
   c. excessive penetration
   d. undercut

2. Incomplete sidewall fusion is normally found between
   a. weld and base metal
   b. HAZ and base metal
   c. root joint
   d. cover pass and filling pass

3. Welding distortion, warp and stresses are cause by
   a. weaving technique
   b. intermittent welding
   c. high temperature heat
   d. backstop welding

4. The most common cause of undercut in a weld is too
   a. low a current
   b. high an arc
   c. short an arc
   d. high a current

5. Which of the following weld defects DOES NOT have any tolerance for acceptance?
   a. crack
   b. porosity
   c. slag inclusion
   d. undercut

ANSWER KEY 1.1 –3

Identifying Weld Defects, Causes and Remedies

1. **b**
2. **a**
3. **c**
4. **d**
5. **a**

INFORMATION SHEET 1.1 -4

Welding Procedure Specification (WPS)

After reading the Information Sheet, the trainee must be able to:

1. **Identify welding procedure specification:**
2. **Interpret welding procedures specification.**

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. A WPS is developed for each material alloy and for each welding type used. Specific codes and/or engineering societies are often the driving force behind the development of a company's WPS. A WPS is supported by a Procedure Qualification Record (PQR or WPQR). A PQR is a record of a test weld performed and tested (more rigorously) to ensure that the procedure will produce a good weld. Individual welders are certified with a qualification test documented in a Welder Qualification Test Record (WQTR) that shows they have the understanding and demonstrated ability to work within the specified WPS.

The following are definitions for WPS and PQR found in various codes and standards:

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 AWS defines welding PQR as a record of welding variables used to produce an acceptable test weldment and the results of tests conducted on the weldment to qualify a Welding Procedure Specification.

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. ASME also defines welding PQR as a record of variables recorded during the welding of the test coupon. The record also contains the test results of the tested specimens.

In Europe, the European Committee for Standardization (CEN) has adopted the ISO standards on welding procedure qualification (ISO 15607 to ISO 15614) and on welder qualification (ISO 9606), with the exception of qualification for steel welders, where a new version of the old European EN 287-1 standard still applies. EN ISO 15706 defines a WPS as "A document that has been qualified by one of the methods described in clause 6 and provides the required variables of the welding procedure to ensure repeatability during production welding". The same standard

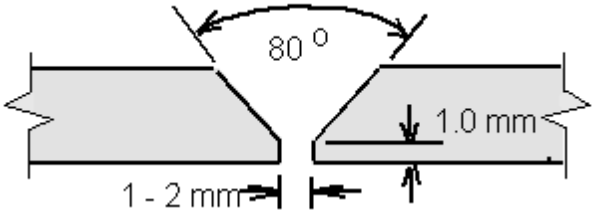
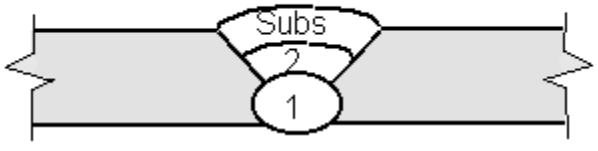
defines a ***Welding Procedure Qualification Record*** **(WPQR)** as "Record comprising all necessary data needed for qualification of a preliminary welding procedure specification ".In addition to the standard WPS qualification procedure specified in ISO 15614, the ISO 156xx series of standards provides also for alternative WPS approval methods. These include: ***Tested welding consumables*** **(ISO 15610),** ***Previous welding experience*** **(ISO 15611),** ***Standard welding procedure*** **(ISO 15612) and** ***Preproduction welding test*** **(ISO 15613).**

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.

Welding Procedure Specification:- (Example FORM)

Weld Procedure Number	30 P1 TIG 01 Issue A
Qualifying Welding Procedure (WPAR)	WP T17/A

Manufacturer:	National Fabs Ltd 25 Lane End Birkenshaw Leeds	Method Of Preparation and Cleaning:	Machine and Degrease
		Parent Metal Specification:	Grade 304L Stainless Steel
Location:	Workshop	Parent Metal Thickness	3 to 8mm Wall
Welding Process:	Manual TIG	Pipe Outside Diameter	25 to 100mm
Joint Type:	Single Sided Butt Weld	Welding Position:	All Positions
		Welding Progression:	Upwards

Joint Design	Welding Sequences
	

Welding Consumables:- Type, Designation Trade Name: Any Special Baking or Drying: Gas Flux: Gas Flow Rate - Shield: - Backing: Tungsten Electrode Type/ Size: Details of Back Gouging/Backing: Preheat Temperature: Interpass temperature: <u>Post Weld Heat Treatment</u> Time, temperature, method: Heating and Cooling Rates*:	 BS 2901 Part 2 : 308S92 No Argon 99.99% Purity 8 - 12 LPM 5 LPM 2% Thoriated 2.4mm Dia. Gas Backing 5°C Min 200°C Max Not Required	<u>Production Sequence</u> 1. Clean weld and 25mm borders to bright metal using approved solvent. 2. Position items to be welded ensuring good fit up and apply purge 3. Tack weld parts together using TIG, tacks to at least 5mm min length 4. Deposit root run using 1.2mm dia. wire. 5. Inspect root run internally 6. Complete weld using 1.6mm dia.

		wire using stringer beads as required. 7. 100% Visual inspection of completed weld

SELF – CHECK 1.1 – 4

Welding Procedure Specification (WPS)

Test I – IDENTIFY THE FOLLOWING:

1. **ASME**
2. **AWS**
3. **API 1104**
4. **ISO 15612**
5. **ISO 15613**

Test II – ESSAY (5pts.)

1. **What is WPS?**

ANSWER KEY 1.1 -4

Welding Procedure Specifications

Test I:

1. Welding Procedure Specification
2. American Welding Society
3. American Petroleum Institute 1104 - oil and gas pipeline sector
4. Tested welding consumables
5. Standard welding procedure

Test II

1. 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.

Information Sheet No. 1.1-5

International Welding Codes and Standard

After reading the Information Sheet, the trainee must be able to:

1. **Identify international welding codes and standards; and**
2. **Interpret/apply international welding codes and standards.**

Welder Qualifications

This information sheet is designed to give you a broad overview of the specifications, codes and standards that are widely used in welded fabrication, construction and maintenance work.

The begins with definition of codes, standards, specifications and related terms. Another section deals with the advantages associated with the standardization. In addition, the module identifies various agencies and societies that sets codes and standards. The module then moves on to the identification and study of specifications, codes and standards that govern welding in relation to:

- structural steel,
- boilers and pressure vessels,
- piping systems,
- pipelines and transmission system and
- storage tanks

Before a welder can begin working on any job covered by a welding code or specification be must become a certified under the code that applies. Many different codes are in use today and it is exceeding important that the specific code is referred to when taking qualifications test. In general the following type of work is covered by codes pressure piping, high way and rail ways bridges, public buildings tanks and containers that will hold flammable or explosive, materials cross country pipe line aircraft ordinance.

Certification is obtained differently under the various codes certification under one code will not necessarily qualify a welder under a different code. In most cases certification for one employer will not allow the welder to work for another employer .Also the welder uses a different process or if the procedure

adhere drastically re- certification is not required providing the work performed meets the quality requirement. An exception is the air craft code which requires re-qualification every six months.

Qualification test may be begin by responsible manufacturers or contractors. On pressure vessel work the welding procedure must also be qualified and this must be done before the welders can be qualified. Under these codes, this is not necessary. To become qualified and the welder must make specified welds using the required process, base metal ,thickness, electrode, type position and joint design .Test specimen must be made according to standardize size sand under observation of a qualified person .In most cases government specifications a inspector must witness the making of welding specimen must be properly identified prepared for testing. The most common test is the guided bead test, however in some cases x-ray examinations, fracture test or in order test are employed satisfactory completion of test specimen and providing that they meet acceptability standards will qualify the welder for specific for the specific types of welding. The welding that will be allowed again depends on the particular code. In general however the range of thickness may be welded less difficult positions may be employed and steels of fewer alloys are usually included.

Qualifications of welder is an extremely technical subject and cannot be covered .It is recommended that the code be obtained and studied prior to taking any test.

Terms Used In This Section:

- Codes – documents that govern and guide welding and other activities. Codes generally use the word *shall* to indicate the mandatory use of certain types of materials, methods and procedures.
- Standards – Documents that govern and guide welding and other activities. Standards generally describe the requirements for materials, process, products, systems or services rendered. Standards often specify the procedures, methods, equipments and tests that determine if standards requirements have been met. Standards can be in the form of codes, specifications, classifications and guides.
- Specifications – Are similar to codes excepts that specifications mainly provide requirements for products rather than processes.

Purpose:

The purpose of Codes, Standards and specifications is to secure that safe and reliable products are produced and that those persons working around welded structures and equipment are not exposed to undue danger or hazard to their health.

Welding Specifications:

- G – GROOVE
- F – FILLET

PLATE

- 1 – FLAT POSITION
- 2 – HORIZONTAL POSITION
- 3 – VERTICAL POSTION
- 4 – OVER – HEAD POSITION

PIPE

- 1 – MOVABLE PIPE POSITION
- 2 – FIXED / MOVABLE VERTICAL PIPE POSITION
- 5 – FIXED HORIZONTAL PIPE POSITION
- 6 – FIXED 45 DEGREE PIPE POSITION

1. 2G – MEANS PIPE GROOVE, FIXED / MOVABLE VERTICAL PIPE POSITION
2. 5G - MEANS PIPE GROOVE, FIXED HORIZONTAL PIPE POSITION
3. 6G - MEANS PIPE GROOVE FIXED 45 DEGREE PIPE POSITION

SELF – CHECK 1.1 – 5

International Welding Codes and Standard

MATCHING TYPE: Match column A to column B. Write only the letter on your answer sheet.

Column A	Column B
___ 1. Means Pipe Groove, Fixed Horizontal Pipe Position	A. 1F Plate
___ 2. Groove Weld Horizontal Position Plate	B. 6G Pipe
___ 3. Movable Pipe Position	C. 2G Pipe
___ 4. Means Pipe Groove, Fixed / Movable Vertical Pipe Position	D. 1G Pipe
___ 5. Means Pipe Groove Fixed 45 Degree Pipe Position	E. 4G Plate
___ 6. Groove Weld Over – Head Position Plate	F. 2G Plate
___ 7. Fillet Weld Flat Position Plate	G. 5G Pipe

ANSWER KEY 1.1 – 5

International welding codes and standards

1. **G**
2. **F**
3. **D**
4. **C**
5. **B**
6. **E**
7. **A**

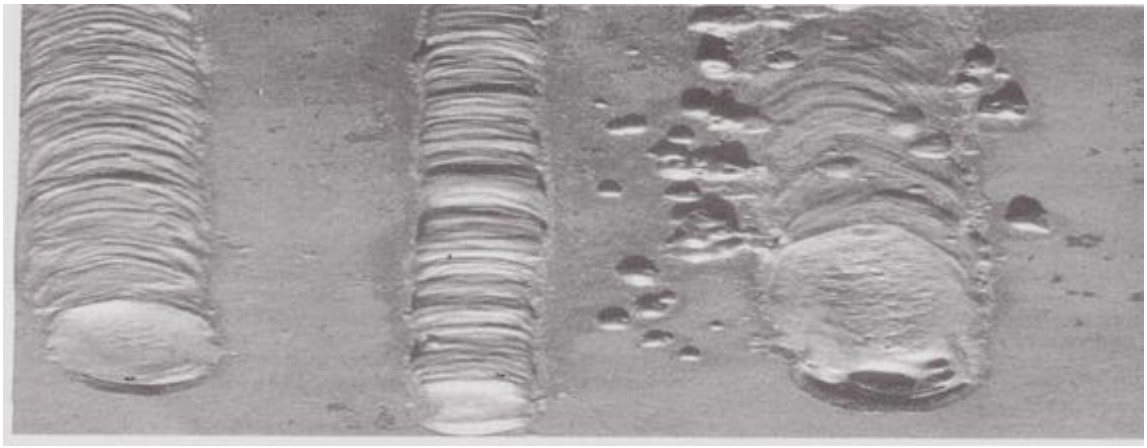
Information Sheet no. 1.1 – 6

Weld Profiles

After reading the Information Sheet and viewing of Good and Bad welds indicators video, the trainee must be able to:

1. Different Weld Profiles; and
3. Identify Good and Bad Welds.

Different Weld Profiles



A **B** **C**

A) Amperage correct (GOOD)
B) Amperage too low (BAD)
C) Amperage too high (BAD)

Indicators of Good Weld	Indicators of Bad Weld
1. Proper Current/ voltage/speed 2. Nice Convex 3. Straight line/ edge 4. Smooth weld bead 5. Uniform weave/Ripples 6. An efficient Weld 7. Excellent Weld 8. No Defects 9. Good Penetration 10. No Spatter	1. Welding Current too high 2. Arc too long/ voltage high 3. Excessive filling up of weld metal 4. over lapping bead 5. Bead very irregular 6. Irregular deposit 7. Weld not properly 8. Welding speed too fast 9. Welding speed too slow 10. Poor Penetration 11. Poor weld Appearance 12. No bead 13. War page metal 14. Distortion of metal 15. Warping of metal 16. Crack Welds 17. Weld Streets 18. Shrinkage metal 19. Poor internal fusion weld 20. Brittle Welds 21. Magnetic Blow 22. Pinholes 23. Cold laps 24. Concavity

SELF – CHECK 1.1 – 6

Weld Profiles

MATCHING TYPE: Match indicators in column A to its results in column B. Write only the letter on your answer sheet.

Column A	**Column B**
____ 1. Voltage High	A. Wet Electrode
____ 2. High Current	B. Arc Length Too Long
	C. Spatter
____ 3. Arc Strike	D. Low Current
_____ 4. Slag Inclusion	E. Failure To Clean The Weld
_____ 5. Porosity	F. Improper Starting Of Arc
_____ 6. Arc Blow	G. Undercut
_____ 7. Poor Penetration	

ANSWER KEY 1.1 – 6

Weld Profiles

1. **B**
2. **G**
3. **F**
4. **E**
5. **A**
6. **C**
7. **D**

Job Sheet No. 1.1.7a
Welding Technique and Procedure

Title: Perform Root Pass

Performance Objectives: Perform root pass in a multiple pass groove weld in Flat position (1G)

Supplies and Materials: **2 pcs. Flat bar 10mmx60mmx150mm MS**
2 pcs. Welding Electrode E6011/E6010 #3.2mm

Tools and Equipment: **Welding Machine w/ complete accessories**
Automatic cutting machine
Chipping hammer
Steel brush
Welding gloves
Welding jacket
Welding helmet

Steps:

1. Proceed to the Workstation at the SMAW Practical Work Area
2. Prepare the edge of the two(2) plates, with a bevel angle of 30 degrees and 2mm root face.
3. Wear suitable protective clothing to avoid burns and radiation
4. Set the welding machine;
   Current setting:3.2mm, E6013: 90 – 120 amperes
5. Put the plates on the welding table in flat position and make sure that the root gap is 3.2mm.
6. Position the plates;
   Clamp the plates in the positioner in a flat position.
7. Position yourself comfortably with the electrode grip to the holder.
8. Strike the arc and hold the electrode at 90 degrees work angle and 75 – 80 degrees travel.
9. Maintain a short arc.
10. Move the electrode using a whipping motion and maintain a keyhole Until you reach the other end of the plates.
11. Clean and check your work based on the Performance Criteria Checklist.
12. After doing the task, present your work to your Trainer for evaluation.

Assessment Method:

Performance Test and Evaluation of finished output

Performance Criteria Checklist

Job Sheet 1.1-7

Welding Technique and Procedure

Trainees Name _____ **Date:** _____

CRITERIA	YES	NO
Root pass is performed in accordance with *WPS* and/or client specifications or as specified by welding codes and standards on:		
• concavity		
• convexity		
• undercut		
• excess penetration		
• lack of fusion		
• cracks		
• burn – through		
Task is performed using PPE		
Weld is visually checked for *defects* and repaired, as required		
Weld is visually acceptable in accordance with applicable codes and standards		

_____ _____

JERRY R. TORRADO, Trainer **Date**

Terms and Definitions

1) **base metal** – the metal that is to be worked or welded
2)**weld bead –** a deposit of filler metal from a single welding pass
3)**weld defect–** an irregularity that spoils the weld appearance or impairs the effectiveness of the weld or weldment by causing weakness or failure
4) **weld line –** the junction of weld metal and the base metal, or the junction of base metal parts when filler metal is not used
5) **weldment –** an assembly or structure whose component parts are joined by welding
6) **welding –** joining two metals by applying heat to melt and fuse them, with or without filler metal
7) **welding electrode** – the current-carrying rod used to strike an arc between rod and metal
8) **welding rod –** filler metal in the form of a rod or heavy wire
9) **welding torch –**a gas mixing and burning tool for the welding of metal
10) **undercut –** is a groove at the toe (or at the root) of a weld run due on welding.
11**) slag inclusion –** these are caused by slag trapped in the weld metal.
12**) incomplete penetration –** failure of weldment to extend into the root of the joint to provide full throat depth.
13) **porosity –** is entrapped gas cavities formed during solidification of the weld
14) **cracks** – are fractured that displace an opening or a split in the weld or base metal.
15) **Codes –** documents that govern and guide welding and other activities. Codes generally use the word *shall* to indicate the mandatory use of certain types of materials, methods and procedures.
16) **Standards –** Documents that govern and guide welding and other activities. Standards generally describe the requirements for materials, process, products, systems or services rendered.
17) **Specifications –** Are similar to codes excepts that specifications mainly provide requirements for products rather than processes.
18) **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.
19) **welding helmet –** is used to protect the face and eyes from the arc rays, heat and spatter.
20) **welding gloves –** are made of chrome leather to protect welder's hands from heat spatter and radiation.