BỘ LAO ĐỘNG -THƯƠNG BINH VÀ XÃ HỘI
TỔNG CỤC DẠY NGHỀ

GIÁO TRÌNH
Tiếng Anh chuyên ngành
NGHỀ: HÀN
TRÌNH ĐỘ: TRUNG CẤP NGHỀ

(Ban hành kèm theo Quyết định số:120/QĐ-TCDN, Ngày 25 tháng 02 năm 2013 của Tổng Cục trưởng Tổng cục Dạy nghề)

Hà Nội, năm 2013

LỜI GIỚI THIỆU

Để đáp ứng nhu cầu về tài liệu học tập ngoại ngữ chuyên ngành cho học sinh - sinh viên và giáo trình giảng dạy cho giáo viên các trường dạy nghề, Tổ môn Ngoại ngữ Trường Cao đẳng nghề GTVT Trung ương 2 đã biên soạn cuốn giáo trình ***"Anh văn chuyên ngành công nghệ Hàn".*** Cuốn giáo trình được biên soạn với mục tiêu giúp người học đọc hiểu các ký hiệu, ký tự trên bản vẽ bằng Tiếng Anh; đọc hiểu các tài liệu Tiếng Anh về nguyên lý và cách vận hành các loại máy hàn; đọc hiểu các nội dung tài liệu viết bằng Tiếng Anh về các loại vật liệu hàn; đọc hiểu các loại quy trình hàn và các phương pháp gia nhiệt theo tiêu chuẩn quốc tế; dịch tài liệu ngành hàn từ Tiếng Anh sang Tiếng Việt; viết các quy trình hàn bằng Tiếng Anh.

Trong quá trình biên soạn, chúng tôi đã tham khảo nhiều tài liệu của các trường đại học, cao đẳng, chương trình khung của Tổng cục dạy nghề ban hành, các trường dạy nghề quốc tế như City & Guilds, Sunderland – Anh Quốc, cũng như các tài liệu, tiêu chuẩn nước ngoài như ASME, ANSI, AWS, AIP....để đáp ứng các yêu cầu thực tế đặt ra trong quá trình sản xuất. Trang bị cho giáo viên các kiến thức chuyên môn trong hội nhập quốc tế đáp ứng yêu cầu của doanh nghiệp.

Mặc dù đã có nhiều cố gắng song không thể tránh khỏi những thiếu sót. Rất mong được đồng nghiệp và các bạn đọc đóng góp ý kiến để giáo trình ngày càng hoàn chỉnh hơn./.

Chúng tôi xin chân thành cảm ơn!

Hà Nội, ngày tháng năm 2013

Chủ biên: Trịnh Thị Kim Huế

MỤC LỤC

TRANG

TÊN MÔN HỌC: ANH VĂN CHUYÊN NGÀNH HÀN

Mã môn học: **MH 20**

Vị trí, tính chất, ý nghĩa và vai trò của môn học:

- Vị trí: Là môn học được bố trí cho người học sau khi đã học xong các môn học chung theo quy định của Bộ LĐTB-XH.
- Tính chất: Là môn học chuyên môn nghề.
- Ý nghĩa và vai trò: Môn học Anh văn chuyên ngành hàn có ý nghĩa và vai trò vô cùng quan trọng và cần thiết đối với các học sinh, sinh viên học nghề trong thời kỳ hội nhập bởi nó cung cấp một số lượng lớn các từ vựng chuyên ngành hàn, các nội dung về nghề hàn và mẫu câu cần thiết để học sinh, sinh viên có thể đọc hiểu và dịch được các tài liệu chuyên môn bằng Tiếng Anh.

Mục tiêu của môn học

- Đọc hiểu các ký hiệu, ký tự trên bản vẽ bằng Tiếng Anh.
- Đọc hiểu các tài liệu Tiếng Anh về nguyên lý và cách vận hành các loại máy hàn.
- Đọc hiểu các nội dung tài liệu viết bằng Tiếng Anh về các loại vật liệu hàn.
- Đọc hiểu các loại quy trình hàn và các phương pháp gia nhiệt theo tiêu chuẩn quốc tế.
- Dịch tài liệu ngành hàn từ Tiếng Anh sang Tiếng Việt.
- Viết các quy trình hàn bằng Tiếng Anh.

Nội dung của môn học:

Số TT	Tên chương mục	Thời gian			
		Tổng số	Lý thuyết	Bài tập thực hành	Kiểm tra* (LT hoặc TH)
I	**Terminology and standard**	**4**	**4**	**0**	**0**
	1. Vocabulary	1	1	0	0
	2. Grammar	1	1	0	0
	3. Main text	2	2	0	0
II	**Welded joint and weld**	**8**	**4**	**4**	**0**
	1. Vocabulary	1	1	0	0
	2. Grammar	2	2	0	0
	3. Main text	5	1	4	0
III	**Imperfection welding**	**16**	**8**	**8**	**0**
	1. Vocabulary	3	2	1	0
	2. Grammar	4	1	3	0
	3. Main text	9	5	4	0
IV	**Welding technology**	**24**	**10**	**13**	**1**
	1. Vocabulary	2	2	0	0
	2. Grammar	4	1	3	0

Số TT	Tên chương mục	Thời gian			
		Tổng số	Lý thuyết	Bài tập thực hành	Kiểm tra* (LT hoặc TH)
	3. Main text	18	7	10	1
V	**Welding procedure**	**24**	**10**	**13**	**1**
	1. Vocabulary	2	2	0	0
	2. Grammar	4	1	3	0
	3. Main text	18	7	10	1
VI	**Equipment and tools for welding**	**12**	**4**	**8**	**0**
	1. Vocabulary	1	1	0	0
	2. Grammar	3	1	2	0
	3. Main text	8	2	6	0
VII	**Kiểm tra kết thúc**	**2**	**0**	**0**	**2**
	Cộng	**90**	**40**	**46**	**4**

UNIT 1: TERMINOLOGY AND STANDARD
Mã bài: MH 20.1

Giới thiệu:

Để đọc và dịch Tiếng Anh chuyên ngành hàn hiệu quả thì việc hiểu và vận dụng các thuật ngữ trong ngành hàn, các ký hiệu viết tắt về phương pháp hàn, các tiêu chuẩn, quy phạm kỹ thuật là vô cùng quan trọng và cần thiết.

Mục tiêu:

- Đọc hiểu các thuật ngữ trong ngành hàn bằng Tiếng Anh;
- Đọc hiểu các ký hiệu viết tắt Tiếng Anh về các phương pháp hàn;
- Đọc hiểu các tiêu chuẩn, quy phạm kỹ thuật Tiếng Anh trong cơ khí nói chung và ngành hàn nói riêng;
- Dịch các tài liệu tiếng việt về thuật ngữ hàn sang Tiếng Anh.

1. Vocabulary

Mục tiêu:

- Liệt kê được một số thuật ngữ trong ngành hàn: các phương pháp hàn, các liên kết hàn, các thiết bị hàn.
- Phát âm chuẩn và nắm vững nghĩa của các thuật ngữ đó.
- Tuân thủ các quy tắc phát âm theo ký hiệu phiên âm quốc tế.

1.1. Reading

- Arc: Hồ quang
- Edge : Cạnh hàn
- Metal: Kim loại hàn
- Joint: Liên kết hàn
- Electrode : Điện cực
- Welding : Hàn
- Welded joint: Liên kết hàn
- Welding process: Quy trình hàn
- Weld: Mối hàn
- Welding structure: Kết cấu hàn
- Melt: Sự nóng chảy
- Molten: Nấu chảy
- Mass: Khối lượng
- Cool: Làm nguội
- Clamp: Kẹp lại, giữ lại
- Base metal: Kim loại cơ bản
- Circuit: Mạch điện
- Stream: Dòng, luồng
- Temperature: Nhiệt độ
- Bright: Sáng, sáng chói
- Welding machine: Máy hàn
- Amperage: Cường độ dòng điện
- Voltage: Điện áp
- Generator: Máy phát điện
- Transformer: Máy biến thế

- Rectifier: Bộ chỉnh lưu

1. 2. Explanation

- Base metal: Kim loại cơ bản **-** Kim loại hoặc hợp kim được hàn hoặc cắt.

*In chemistry, the term **base metal** is used informally to refer to a metal that oxidizes or corrodes relatively easily, and reacts variably with diluted hydrochloric acid (HCl) to form hydrogen. Examples include iron, nickel, lead and zinc. Copper is considered a base metal as it oxidizes relatively easily, although it does not react with HCl.*

- Welding process: Quá trình Hàn - Tập hợp các nguyên công cơ bản được sử dụng trong hàn, cắt bằng nhiệt hoặc phun phủ bằng nhiệt.

The AWS definition for a welding process is "a materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone and with or without the use of filler material".

- Welded joint: Liên kết hàn là liên kết được thực hiện bằng phương pháp hàn.

The joining of two or more metallic components by introducing fused metal (welding rod) into a fillet between the components or by raising the temperature of their surfaces or edges to the fusion temperature and applying pressure (flash welding).

1.3. Examples

- *There are many different kinds of **welding machines** nowsaday.*

- *Several approaches have been developed to analyze **welding structures**.*

2. Grammar: Passive voice

Mục tiêu:

- Trình bày được cách sử dụng, cấu trúc của câu bị động.
- Kết hợp sử dụng các thuật ngữ chuyên ngành để đặt câu theo cấu trúc bị động (chuyển câu chủ động sang câu bị động và ngược lại).
- Tuân thủ nghiêm túc các bước chuyển từ câu chủ động sang câu bị động và ngược lại.

2.1. Form and use

Subject (S) + Verb (V) + Object (O)

S + Be + V_{ed} (past participle) + (by….)

- The passive of an active tense is formed by putting the verb to be into the same tense as the active verb and adding the past participle of the active verb. The subject of the active verb becomes the '**agent**' of the passive verb.

The '**agent'** is very often not mentioned. When it is mentioned it is preceded by **by** and placed at the end of the clause:

E.g:This metal of plate was welded by my father.

- Passive voice is used when the focus is on the action. It is not important or not known, however, who or what is performing the action.

2.2. Present and past tenses

S + V + O
S + is / are + V-$_{ed}$

Active: We build this bridge.
Passive: This bridge is built.

S + V (past simple) + O
S + was / were + V_$_{ed}$

Active: They broke the window.
Passive: The window was broken.

2.3. The passive of continuous tenses

S + is / am / are + V_$_{ing}$ + O
S + is / are + being + V_$_{ed}$ (past participle)

Active: they are repairing the bridge.
Passive: The bridge is being repaired.

2.4. Modal verbs: Can & should

S + should / can + V + O
S + should / can + be + V_$_{ed}$ (past participle)

Active: You should shut these doors
Passive: These doors should be shut
Active: You can use the process to deposit metal to form a surface with alternative properties.
Passive: The process can also be used to deposit metal to form a surface with alternative properties.

3. Main text

Mục tiêu:

-Trình bày được định nghĩa, đặc điểm của hàn hồ quang tay; các loại máy hàn và những yêu cầu về nguồn điện để đảm bảo chất lượng mối hàn; một số kí hiệu về tiêu chuẩn mối hàn.

- Đọc và trả lời được các câu hỏi liên quan đến nội dung bài đọc.

- Thực hiện nghiêm túc và hiệu quả kĩ năng đọc hiểu.

3.1. Arc welding

3.1.1. Reading

This lesson is a method of joining two pieces of metal into one solid piece. To do this, the heat of an electric arc is concentrated on the edges of two pieces of metal to be joined. The metal melts and, while these edges are still molten, addition melted metal is added. This molten mass cools and solidifies into one solid piece.

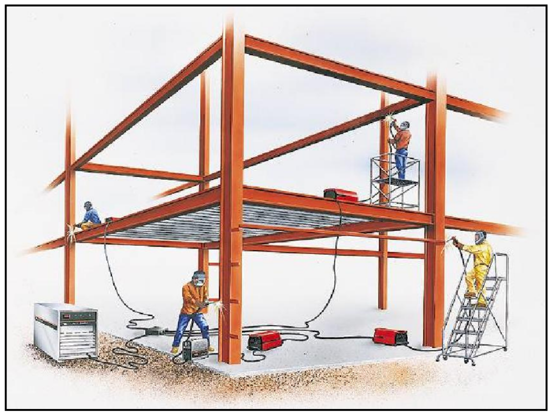


Figure 1.1

The electric arc is made between the work and the tip and of a small metal wire, the electrode, which is clamped in a holder and held in the hand. A gap is made in the welding circuit by holding the tip of the electrode 1/16’’-1/8’’ away from or base metal being welded. The electric current jumps this gap and make an arc, which is held and moved along the joint to be welded, melting the metal as it is moved.

Arc welding is a manual skill requiring a steady hand, good general physical conditions, and good eyesight. The operator controls the welding arc and, therefore, the quality of the weld made.

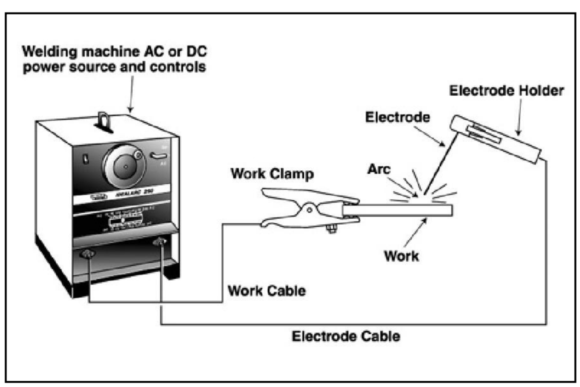


Figure1.2

Figure 1.3 Illustrates the action that takes place in the electric arc. It closely resembles what is actualy seen during welding

The " arc stream " is seen in the middle of the picture. This is the electric arc created by the electric current flowing through the space between the end of the electrode and the work. The temperature of this arc is about 6000^0C, which is more than enough to melt metal. The arc is very bright, as well as hot, and cannot be looked at with the naked eye without risking painful, though usualy temporary injury.

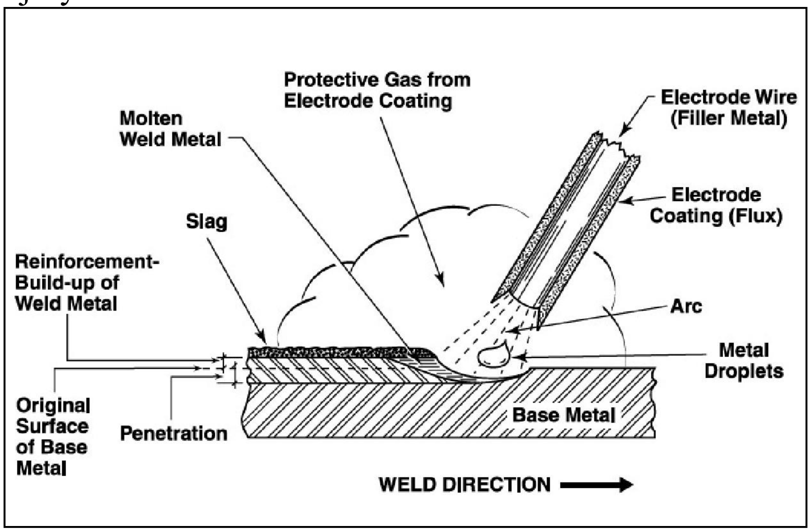


Figure 1.3

The arc melts the plate, or base, metal and actually digs into it, much as the water through a nozzle on a garden hose digs into the earth. The molten metal forms a molten pool or crater and tends to flow away from the arc. As it moves away from the arc, it cools and solidifies. A slag forms on top of the weld to protect it during cooling.

The several types of welding machines include motor-generators, engine-driven generators, transformers, rectifiers, and combination transformer and rectifiers. Each type has its place and purpose. The basic function of each is the same-providing a source of controlled electric power for welding. This controlled electric power has the characteristic of high amperage at low voltage. The high amperage is repuired to provide sufficient heat at the arc. The voltage must be low enough to be safe for handling and yet high enough to maintain the arc. The welder (machine) permits the welder (operator) to control the amount of current he uses. This, in turn, controls the amount of heat of the arc. Some welders also permits the operator to select either a forceful or soft arc and to control its charcteristics to suit the job.

3.1.2. Words and phrases

- Solid piece
- Melted metal
- A gap is made in the welding circuit
- Make an arc
- The quality of the weld made
- Welding arc

- Arc stream
- Crater
- Flow away from the arc

3.1.3. Questions

1. Give main ideas of the paragraph?
2. What is arc welding?
3. What happens in the arc?
4. What do the electrodes affect to the arc?
5. Name some types of welding machines?

3.2. Some of the Standards

3.2.1. Reading

These are some standards that are used for welding

1. ASME (American society of machanical engineers): include:
2. ASME boiler& pressure vessel code
3. ASME code for pressure piping
4. AWS (American welding society)
5. AWS D1.1- steel structural welding code
6. API (American Welding Institute) :
7. API 650 – welding storage tanks for oil storage
8. API 1104 – welding of pipelines and related facilities
9. ISO (International Standardization Organization)
10. EN (European Nations)
11. JIS – Japanese Industrial Standards

3.2.2. Words and phrases

- pressure piping
- welding society
- structural welding code
- welding storage tanks
- welding of pipelines

3.2.3. Questions

1. List and explain the uses of the standards?

UNIT 2: WELDED JOINT AND WELD
Mã bài: MH 20.2

Giới thiệu:

Liên kết hàn là liên kết giữa các vật liệu (chủ yếu là kim loại) được tạo ra bằng hàn - hàn (công nghệ). Năm loại liên kết hàn cơ bản nhất là các liên kết giáp mối (còn được gọi là giáp mép, giáp mí), chữ T, chồng, góc, và mép. Về thực chất, liên kết hàn bao gồm phần kim loại của mối hàn, cộng với vùng ảnh hưởng nhiệt và phần kim loại cơ bản liền kế ở trạng thái ứng suất và biến dạng khác rõ rệt so với phần còn lại của kim loại cơ bản.

Mục tiêu:

- Liệt kê các thuật ngữ trong ngành hàn bằng Tiếng Anh ;
- Đọc hiểu các liên kết mối hàn, đường hàn bằng Tiếng Anh;
- Thực hành đọc hiểu các tài liệu Tiếng Anh về liên kết mối hàn;
- Dịch các tài liệu Tiếng Việt về thuật ngữ hàn sang Tiếng Anh.
- Nghiêm túc, hợp tác với giáo viên để hoàn thành bài học.

1. Vocabulary

Mục tiêu:

- Liệt kê được một số thuật ngữ trong ngành hàn: các liên kết hàn, các mối hàn và vị trí hàn.
- Phát âm chuẩn và nắm vững nghĩa của các thuật ngữ đó.
- Tuân thủ các quy tắc phát âm theo ký hiệu phiên âm quốc tế.

1.1. Reading

- Welding position : Vị trí hàn
- Flat: Hàn bằng
- Vertical : Hàn đứng
- Overhead : Hàn ngửa
- Horizonatal : Hàn ngang
- Butt joint: Liên kết giáp mối
- Corner joint: Liên kết góc
- Lap joint: Liên kết chồng
- Tee joint: Liên kết chữ T
- Edge joint : Liên kết cạnh
- Butt weld: Mối hàn giáp mối
- Fillet weld: Mối hàn góc
- Groove angle: Góc vát
- Groove weld: Mối hàn giáp nối có vát mép
- Spot weld: Mối hàn điểm
- Spot : Điểm hàn
- Geometry : Hình học
- Configuration : Hình dạng, Hình thể
- Preparation : Sự chuẩn bị
- Surface : Bề mặt
- Weld reinforcement:Độ lồi mối hàn
- Weld concavity: Độ lõm mối hàn

- Weld width: Chiều rộng mối hàn
- Leg of a fillet weld: Chiều cao mối hàn góc
- Sealing run: Mối hàn lót

1.2. Explanation

- Welding position: Vị trí hàn là quan hệ giữa vũng hàn, liên kết, các phần tử liên kết với nguồn nhiệt hàn. Xem vị trí hàn bằng, vị trí hàn ngang, vị trí hàn đứng và vị trí hàn trần.

+ Flat Welding Position; Horizontal Welding Position; Vertical Welding Position; Overhead Welding Position

- Butt welds: are welds where two pieces of metal are joined at surfaces that are at 90 degree angles to the surface of at least one of

- Weld reinforcement: Phần lồi mối hàn là phần kim loại đắp vượt ra ngoài bề mặt so với kích thước yêu cầu của mối hàn giáp mối hoặc mối hàn góc.

Weld metal in excess of the quantity required to fill a joint

- weld defects, concavity, weld gap, torch offset, tailored blank laser established according to the analysis of reasons causing weld concavity.

1.3. Examples

*- When you start getting right into welding, you will eventually need to know what all the different **welding positions.***

*- A **fillet weld** is a means of connecting two pieces of metal at a 90° angle*

*- The fifth major type of welding connection is the **corner joint***

2. Grammar

Mục tiêu:

- Trình bày khái niệm về tính từ ngắn và tính từ dài; các cấu trúc so sánh hơn và hơn nhất với tính từ; quy tắc thành lập danh từ ghép.

- Đặt được câu sử dụng các cấp so sánh, các danh từ ghép.

- Tuân thủ nghiêm túc các cấu trúc của các cấp so sánh với tính từ và quy tắc sử dụng danh từ ghép.

2.1.THE COMPARISON OF ADJECTIVES

2.1.1. Short and long adjectives

- Short adjectives: are short words which have only one syllable.

E.g: high, small, big, nice, hot....

- Long adjectives: are long words which have more than one syllables.

E.g: expensive, beatilful, difficult.....

2.1.2. Comparatives

Adjecctives	**Comparatives**
Clean	Cleaner
Strong	Stronger
Long	Longer
Big	Bigger
Beautiful	More beautiful
Difficult	More difficult
Bad	Worse
Good	Better

*** Examples:**

- This metal is stronger than that kind.

- Overhead welding is more difficult than flat welding.

2.1.3. Superlatives

Adjecctives	**Superlatives**
Clean	Cleanest
Strong	Strongest
Long	Longest
Big	Biggest
Beautiful	Most beautiful
Difficult	Most difficult
Bad	Worst
Good	Best

* Examples:

- This welding position is the most difficult.

- That butt weld is the most beautiful of all.

*** Notes on the comparison of shorter adjectives**

**** Spelling of comparative and superlative forms:***

- Most one-syllable adjectives form their comparatives and superlatives like clean:

- er and –est are added to their basic form.

- Many one-syllable adjectives end with a single consonant after a single vowel-letter. This consonant doubles in the comparative and superlative, as in the case of big: bigger, biggest.

- Many one-syllable adjectives end in –e, like nice or safe. These add –r and –st to the basic form: safer, safest.

- Some adjectives, like dry, end in –y with a cosonant letter before it. These adjectives are usually two-syllable. In the comparative and superlative –y is replaced by i: drier, driest.

***Longer adjectives:**

Most longer adjectives combine with quantifiers more / less to form their comparatives and most / least to form their superlatives

Ex: This joint is more beautiful than that one.

This position is the most difficult job when welding a fabrication.

2.2. Compound nouns

- A ***compound noun*** is a noun that is made up of two or more words. Most ***compound nouns*** in English are formed by nouns modified by other nouns or adjectives.

<u>Noun + Noun/ Adjective + Noun</u>

Ex: butt joint, lap joint, classroom, hard metal, sharp edge

3. Main text

Mục tiêu:

- Trình bày được đặc điểm của các loại mối hàn, các vị trí hàn.
- Đọc và trả lời được các câu hỏi liên quan đến nội dung bài đọc.

- Thực hiện nghiêm túc và hiệu quả kĩ năng đọc hiểu.

3.1. Types of joints

3.1.1. Reading

There are numerous types of welded joints and various positions in which they are welded. Figure below shows a variety of these joints as they may appear on welding jobs.

There are four basic welding positions: FLAT (F), VERTICAL (V), OVERHEAD (OH); HORIZONATAL (H). It is possible to weld any type of joint in any of the four positions, but whenever possible joints are placed in the flat position. Welding in the flat position is much faster and easier than any of other positions.

A summary of the basic types of joints and basic types of welds is shown in figure below.

In a joint, the adjoining members may contact each other in several ways, as illustrated by the butt, T, corner, lap and edge joints. These general descriptions of the joint geometry, however, do not define the weld joint configuration, since it can be made in various ways. Thus, a weld butt joint can be made square, double-square, single-bevel, double-bevel, single-V, double-V, or by four other joint configurations. A T connection can be made with a double fillet, as shown: or it may be made with a single or double-bevel or single or double J. V and U weld joints are feasible only for butt and corner welds because of the need for the preparation of both surfaces.

1. Butt Joint

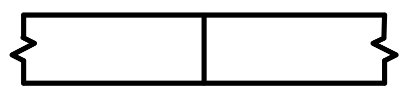


Figure 2.1

2. Tee Joint

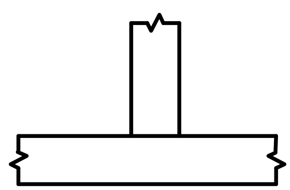


Figure 2.2

3. Corner Joint

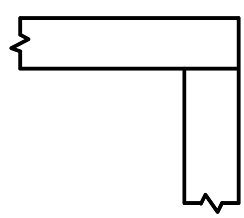


Figure 2.3

***4. Lap* Joint**

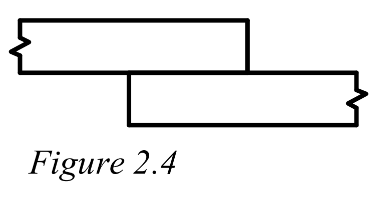


Figure 2.4

5. Edge Joint

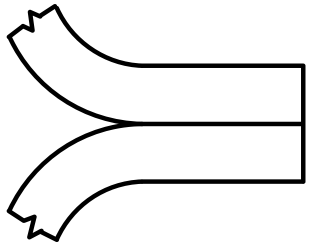


Figure 2.5

3.1.2. Words & phrases

- Flat position
- Ajoining members
- Edge joints
- Joint geometry
- Weld joint configuration

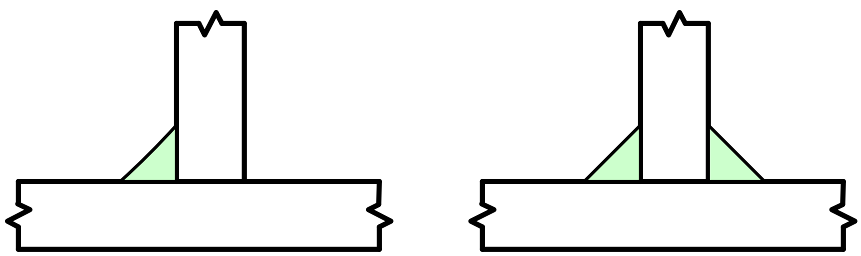
3.1.3. Questions

1. How many types of welded joints are there?
2. How many types of welding positions are there?
3. Which welding position is the easiest?
4. How can a weld butt joint be made?

3.2.Types of welds

3.2.1. Reading

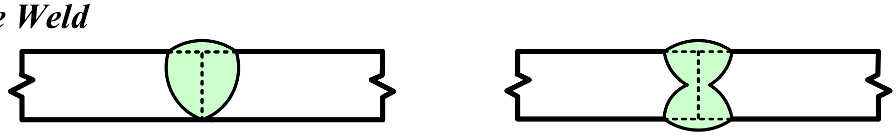
1. Fillet Weld



Single *Double*

Figure 2.6

2. Square Weld



Single *Double*

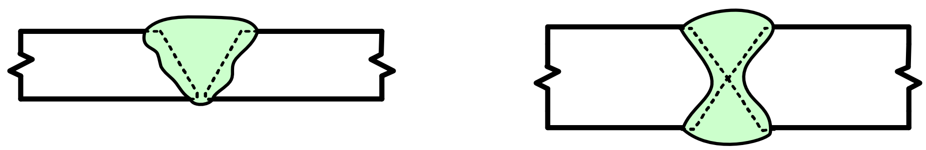
Figure 2.7

***3.* Bevel Groove Weld**

Single *Double*

Figure 2.8

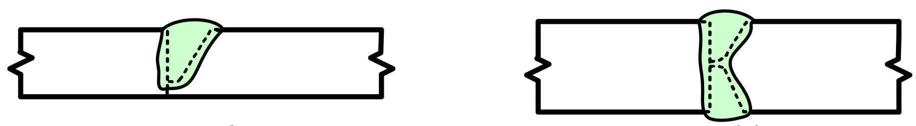
4. Vee Groove Weld



Single *Double*

Figure 2.9

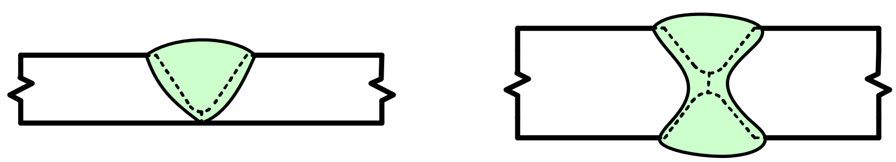
5. J Groove Weld



Single *Double*

Figure 2.10

6. U Groove Weld



Single *Double*

Figure 2.10

3.2.2. Words & phrases

- Fillet Weld
- Square Weld
- Bevel Groove Weld
- Vee Groove Weld
- J Groove Weld
- U Groove Weld

3.2.3. Questions

1. What is the difference between Fillet Weld and Square Weld ?
2. What is the difference between Bevel Groove Weld and Vee Groove Weld?
3. What is the difference between J Groove Weld and U Groove Weld?

UNIT 3: IMPERFECTION WELDING
Mã bài: MH 20.3

Giới thiệu:

Mối hàn có nhiều loại khuyết tật. Các khuyết tật hàn do rất nhiều nguyên nhân gây ra. Nó có liên quan tới các mặt như: kim loại hàn, chế độ hàn và quy trình công nghệ. Sự tồn tại của những khuyết tật đó sẽ ảnh hưởng trực tiếp đến độ bền của đầu mối hàn. Do đó, người thợ hàn phải chọn quy trình hàn chính xác và nghiêm chỉnh chấp hành các quy trình hàn.

Mục tiêu:

- Liệt kê các thuật ngữ trong ngành hàn bằng Tiếng Anh;
- Đọc hiểu các ký hiệu về khuyết tật trong Tiếng Anh;
- Thực hành đọc hiểu các tài liệu Tiếng Anh về các khuyết tật về mối hàn;
- Dịch các tài liệu Tiếng Việt về thuật ngữ khuyết tật hàn sang Tiếng Anh.
- Nghiêm túc, hợp tác với giáo viên để hoàn thành bài học.

1. Vocabulary

Mục tiêu:

- Liệt kê được một số thuật ngữ trong ngành hàn về các loại khuyết tật mối hàn
- Phát âm chuẩn và nắm vững nghĩa của các thuật ngữ đó.
- Tuân thủ các quy tắc phát âm theo ký hiệu phiên âm quốc tế.

1.1. Reading

- Undercut: Cháy chân
- Overlap: Chảy tràn
- Fish eye: Mắt cá
- Slag inclusion: Lẫn xỉ
- Pit, surface pore: Rỗ bề mặt
- Porosity: Rỗ
- Tungsten inclusion: Lẫn vonfram
- Burn through: Cháy xuyên
- Incomplete joint: Hàn không ngấu
- Incomplete fusion: Hàn không ngấu
- Weld crack: Vết nứt mối hàn
- Longitudinal crack: Vết nứt dọc
- Transverse crack: Vết nứt ngang
- Underbead crack: Vết nứt dưới lượt hàn
- Toe crack: Vết nứt chân mối hàn
- Hot crack: Vết nứt nóng
- Cold crack: Vết nứt nguội
- Reheat crack: Vết nứt gia nhiệt
- Root crack: Vết nứt đáy mối hàn
- Crater crack: Vết nứt hố
- Lamellar tear: Vết tách lớp
- Sub-surface: Bề mặt nhỏ

- Notch: Dấu
- Focal point: Tiêu điểm
- Fatigue life: Sức bền, sự chống chịu
- Stray: Phân tán, rò
- Fuse: Nóng chảy
- In service: Trong thời gian sử dụng, trong khi sử dụng
- Discontinuity: Gián đoạn
- Diffusion: Sự khuyếch tán
- Martensitic: Mactensit, hóa già
- Union: Sự liên kết
- Adjacent: Lân cận, gần kề
- Insufficient: Thiếu, không đủ
- Elongate: Giãn ra, kéo dài ra, nối dài
- Solidification: Sự cứng lại, sự đông đặc, sự hóa rắn
- nozzle: Đầu phun, khe mở
- Molten: Nóng chảy

1.2. Explanation

- Incomplete fusion: Hàn không ngấu sinh ra ở góc mối hàn, mép hàn hoặc giữa các lớp hàn. Phần lớn kết cấu bị phá huỷ đều do hàn không ngấu.

The lack of complete integration between the weld metal and adjoining weld beads. Incomplete fusion is caused by faulty operator technique, improper preparation of the base metal, insufficient welding heat, lack of access to the adjoining beads, and improper joint design.

- Weld crack: Nứt mối hàn là các vết nứt tạo ra trong mối hàn.

The cracking is the result of solidification, cooling, and the stresses that develop due to weld shrinkage

- Slag inclusion: Lẫn xỉ là hiện tượng xỉ còn lẫn lại trong kim loại đắp hoặc vùng nóng chảy với kim loại cơ bản

Slag inclusions are nonmetallic solid material entrapped in weld metal or between weld metal and base metal

- Porosity: Rỗ khí sinh ra do hiện tượng khí trong kim loại không kịp thoát ra ngoài trước khi kim loại đông đặc. Rỗ khí có thể sinh ra ở bên trong hoặc bề mặt mối hàn

Cavity may be either gas cavity due to entrapment of gas or due to shrinkage caused by shrinkage during solidification. The types of cavities that are formed by entrapment of gas are:

- *Gas pore*
- *Worm hole*
- *Surface pore*

1.3. Examples

- ***Incomplete fusion*** *is caused by faulty operator technique.*

- ***Crater cracks*** *occur when a crater is not filled before the arc is broken*

2. Grammar: The article - a / an and the

Mục tiêu:

- Trình bày cách sử dụng các mạo từ xác định và không xác định.
- Làm các bài tập về kiến thức ngữ pháp liên quan.
- Tuân thủ nghiêm túc, chuẩn xác các cách sử dụng mạo từ.

2.1. The indefinite article (a/an)

The form a is used before a word beginning with a consonant, or a vowel with a consonant sound:

Example:

a steel　　　a bar of steel　　　a joint

The form an is used before words beginning with a vowel (a, e, i, o, u) or words beginning with a mute h:

Example:

an iron　　　an imperfection　　　an irregular

or individual letters spoken with a vowel sound:

Example:

an L-plate

2.2. The use of a/ an

A/ an is used before a singular noun which is countable when it is mentioned for the first time and represents no particular person or thing:

Example:

a butt joint　　　a lap joint　　　a position　　　a way

2.3. The definite article (the)

The definite article is used before a noun which has become definite as a result of being mentioned a second time:

Example:

There is *a student* repairing electric in the shop. *The student* that you asked to help me yesterday.

And before a noun made definite by the addition of a phrase or clause:

Example:

The body of the weld
The area of the arc strike
The damage on the parent material
At the end of
The side of the weld

2.4. Practice

Fill each blank with 'a', 'an', 'the' or leave it blank.

1. He left _____ home without informing anyone.
2. There is _____ box of electrodes on _____ table.
3. Do you need _____ degree in Economics or _____ degree in finance to be a better manager?
4. When we arrived, she went straight to _____ welding cabin and started to prepare _____ base metals to weld.

5. He has _____ cut on his leg and _____ bruise on _____ chin.
6. _____ Mt. Everest is _____ highest mountain in _____ world.
7. Switch off _____ air-conditioner please. I have _____ cold.
8. We reached _____ top of _____ hill during _____ afternoon.
9. Do you like _____ weather here? Isn't it too hot during _____ day but it is very cold at _____ night?
10. _____ attempt has been made to collect _____ funds to start _____ public welding association in _____ town where I live.

3. Main text

Mục tiêu:

- Trình bày được đặc điểm của các các loại khuyết tật mối hàn.
- Đọc và trả lời được các câu hỏi liên quan đến nội dung bài đọc.
- Thực hiện nghiêm túc và hiệu quả kĩ năng đọc hiểu.

3.1. External defects: Defects detected by surface inspection

3.1.1. Undercut

An irregular groove at a toe of a run in the parent metal or in previously deposited weld metal. If created sub-surface it becomes a very effective slag trap in the body of the weld. Undercut is essentially a notch that in turn becomes a focal point for stress loading, thereby reducing the fatigue life of the joint. (Figure 3.1)

Causes - current too high, voltage too high, travelspeed too high, electrode too small, electrode angle.

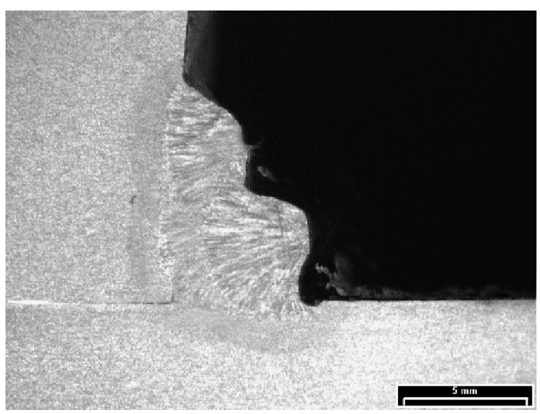


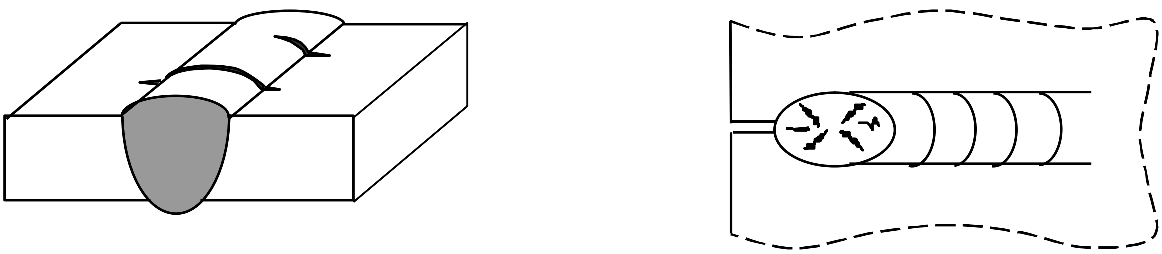
Figure 3.1

3.1.2. Surface cracks

A crack is a linear discontinuity produced by fracture. Cracks may be longitudinal, transverse, edge, crater, centreline, fusion zone, underbead, weld metal or parent metal (Figure 3.2 – 3.4).

Longitudinal, in the weld metal (centreline) Longitudinal, in the
parent plate

Figure 3.2



Transverse Crater (star cracking)

Figure 3.3

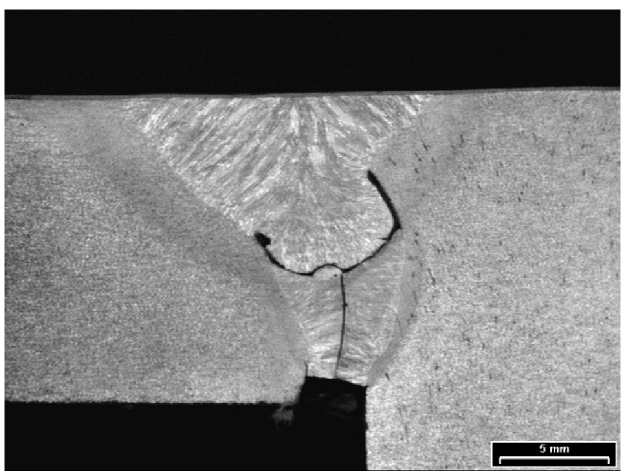


Figure 3.4

3.1.3. Overlap

An imperfection at the toe or root of a weld caused by weld metal flowing on to the surface of the parent plate without fusing to it.

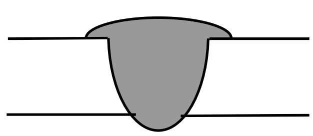


Figure 3.5

Causes - slow travel speed, large electrode, tilt angle, poor pre-cleaning.

3.1.4. Root defects (Figure 3.6)

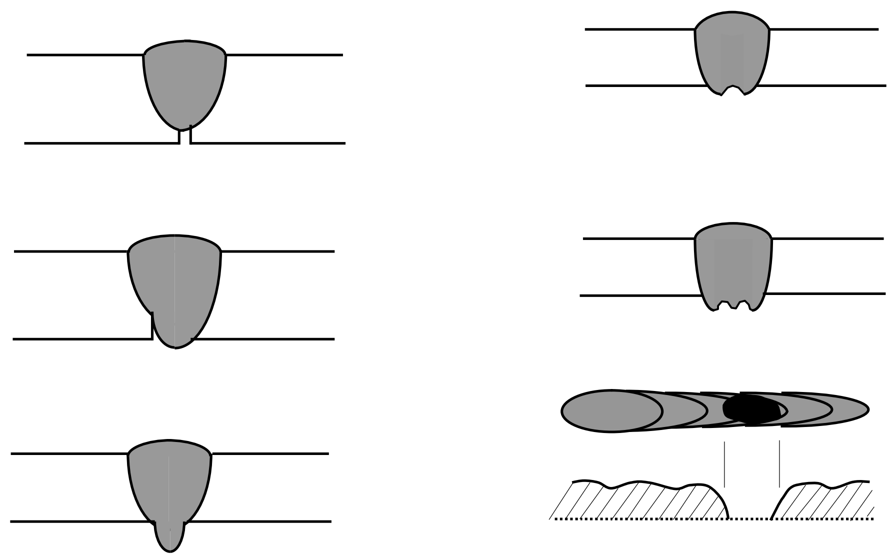


Figure 3.6

Incomplete root penetration.

Failure of weld metal to extend into the root of the weld. Causes - poor weld prep, root gap too small, root face too big, small included angle, heat input too low.

Lack of root fusion.

Lack of union at the root of a joint. Causes - poor weld prep, uneven bevel, root face too large, linear misalignment

Excess penetration bead.

Excess weld metal protruding through the root of a fusion weld made from one side only. Causes - high heat input, poor weld prep - large included angle.

Root concavity. (suck-back, underwashing)

A shallow groove which may occur in the root of a butt weld. Causes - purge pressure, wide root gap, and residual stresses in root.

3.1.5. Questions

1. What is an undercut?
2. How does the undercut affect the jont?
3. What are the causes of the undercut?
4. What is an overlap? What are the causes of the overlap?
5. What is a crack? How many types of cracks are there?

6. How many types of root defects are there? What are the causes of root concavity?

3.2. Internal defects

3.2.1. Lack of fusion.

Definition of lack of fusion

In welds, incompletely fused spots, called lack of fusion, persist. A weld can lack union with the parent metal or with a previous weld bead. An adhesion joint forms, which can be rather strong in certain cases. It is much like a brazed joint or joint formed in metallisation. The purer lack of fusion is, the more difficult it is to detect it.

With regard to the position of the lack-of-fusion defects in a weld, three types of lack of fusion are distinguished:

1. lack of side-wall fusion,
2. lack of inter-run fusion,
3. lack of fusion at the root of the weld.

As to the appearance of the fracture face, one distinguishes the lack of fusion due to unmelted oxide inclusions and the lack of fusion due to melted oxide inclusions. The lack-of-fusion defects due to unmelted oxide inclusions consist of oxides and non-metallic inclusions. Lack of fusion, of which three types, i.e. IIW references 4011, 4012, and 4013, are distinguished in a standard should not be mixed up with lack of penetration, i.e. IIW reference 402. The defects located at the surface are efficiently detected by a visual inspection. Lack of penetration inside the weld, however, can be detected by X-ray or ultrasonic inspection methods.

As to the possibility of detecting, different types of lack of fusion can be classified into two groups, i.e., the one in which lack of fusion includes voids or non-metallic inclusions which can be detected by non-destructive methods, and the one in which the lack of fusion shows no discontinuity in the material since it is a structural defect and thus cannot be detected by non-destructive methods.

Characteristics of lack of fusion

It was found in metallographic examinations that in a weld three types of lack of fusion can be found:

1. pure lack of fusion or lack of fusion due to melted oxide inclusions,
2. open lack of fusion,
3. lack of fusion consisting of non-metallic inclusions.

The pure lack of fusion is a structural defect. In this case the molten metal sticks to the parent metal which has not melted enough during welding. A joint between the solid phase and the liquid one forms. It is like a brazed joint. This type of lack of fusion cannot be detected by non-destructive testing methods but with a microscopic inspection. A straight fusion line indicates that there may be the lack of fusion between the parent metal and the weld. The inter-run lack of fusion is even more hidden. It can be detected only by an accurate microscopic inspection with a 50-times magnification. An example of the pure lack of fusion is shown in Fig. 3.7.

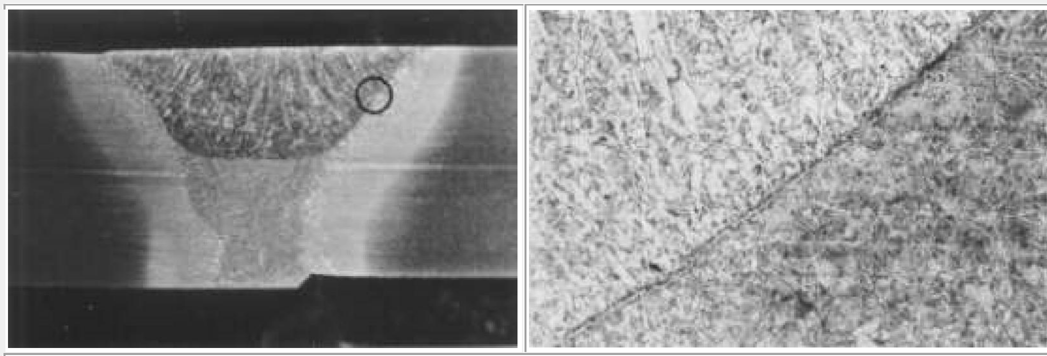


Fig 3.7: Pure lack of fusion between the final run and the parent metal. a) macrograph: x3.5; micrograph: x100.

Because of internal stresses produced during weld solidification and cooling, the faces sticking to each other will separate. A void having a width of only some hundredths of a millimeter forms. This gap in the weld is very muck like a crack. It can, however, be detected by non-destructive testing methods. Such a type of lack of fusion is difficult to distinguish from a crack. An example of the open lack of fusion is shown in Fig. 3.8.

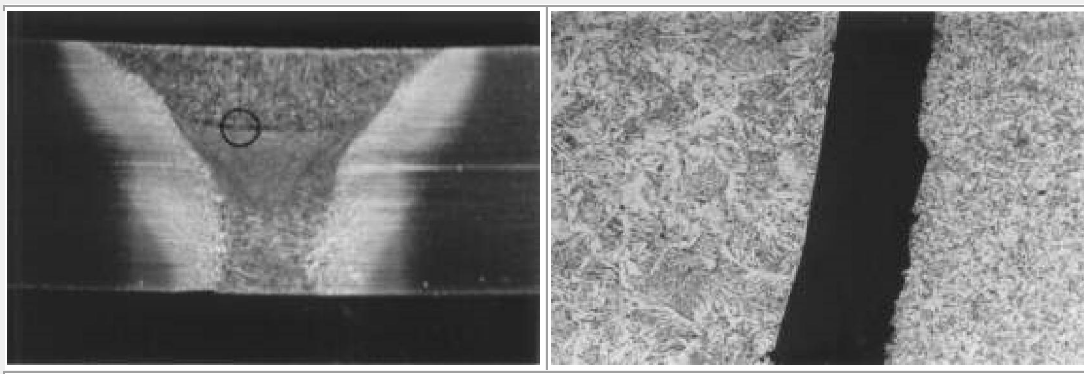


Fig 3.8: Open lack of fusion between the central and final runs. a) macrograph, x3.5; b) micrograph: x100.

Where the lack of fusion is there are very often also oxides and non-metalic inclusions. Such a case is shown in Fig.3.9. If the oxide layer does not melt, the inclusions are uniformly distributed across the entire surface of the lack-of-fusion defect. If they melt, however, the non-metallic inclusions become spherical.

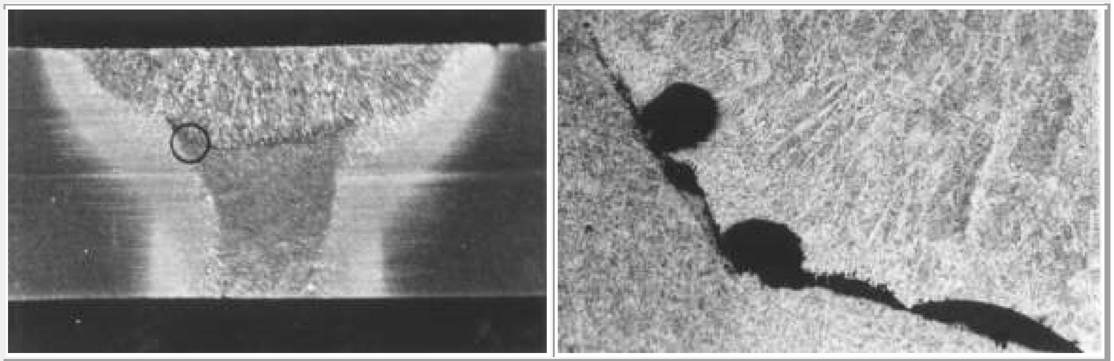


Fig 3.9: Inclusions at the faces sticking together. a) The macrograph shows lack of fusion between the central and final runs; b) The micrograph shows inclusions at the faces sticked together.

Location of lack-of-fusion defects

The lack of fusion is a planar defect. It may appear at the edge of the parent metal or between runs. The lack of fusion between the parent metal and the weld metal shows a flat face. The lack of inter-run fusion, however, shows an irregular shape.

The lack of fusion is usually to be found at the weld inside. It rarely reaches the final runs or the root run. Location of typical types of lack of fusion are shown in Fig. 3.10.

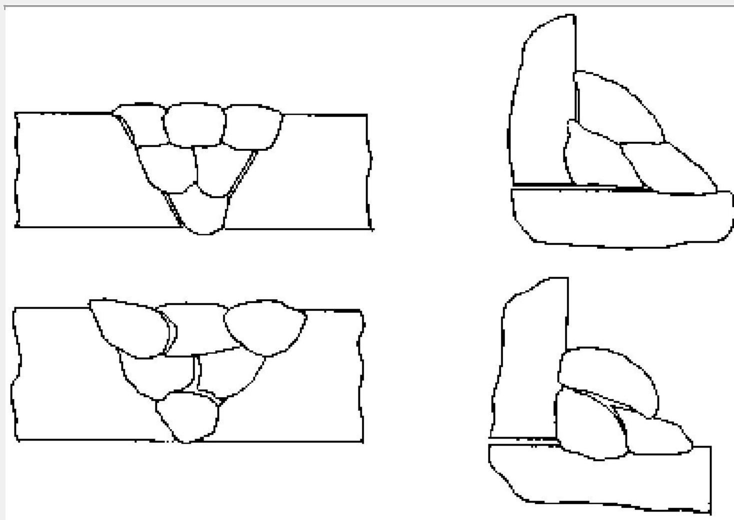


Fig 3.10: Lack of fusion in a weld: lack of side-wall fusion (above), lack of inter-run fusion (below).

3.2.2. Cracks

Definition: A depression left at the termination of the weld where the weld pool is left unfilled.

Cause: Improper weld termination techniques

Repair: If no cracks exist, simply fill in the crater. Generally welding from beyond the crater back into the crater.

Longitudinal Crack
Definition: A crack running in the direction of the weld axis. May be found in the weld or base metal.
Cause: Preheat or fast cooling problem. Also caused by shrinkage stresses in high constraint areas.
Prevention: Weld toward areas of less constraint. Also preheat to even out the cooling rates.
Repair: Remove and reweld
Transverse Crack
Definition: A crack running into or inside a weld, transverse to the weld axis direction.
Cause: Weld metal hardness problem
Crater Crack
Definition: A crack, generally in the shape of an "X" which is found in a crater. Crater cracks are hot cracks.
Cause: The center of the weld pool becomes solid before the outside of the weld pool, pulling the center apart during cooling
Prevention: Use crater fill, fill the crater at weld termination and/or preheat to even out the cooling of the puddle
Throat Crack
Definition: A longitudinal crack located in the weld throat area.
Cause: Transverse Stresses, probably from shrinkage. Indicates inadequate filler metal selection or welding procedure. May be due to crater crack propagation.
Prevention: Correct initial cause. Increasing preheat may prevent it. be sure not to leave a crater. Use a more ductile filler material.
Repair: Remove and reweld using appropriate procedure. Be sure to correct initial problem first.
Toe Crack
Definition: A crack in the base metal beginning at the toe of the weld
Cause: Transverse shrinkage stresses. Indicates a HAZ brittleness problem.
Prevention: Increase preheat if possible, or use a more ductile filler material.
Root Crack
Definition: A crack in the weld at the weld root.
Cause: Transverse shrinkage stresses. Same as a throat crack.
Prevention: Same as a throat crack
Underbead Crack
Definition: A crack in the unmelted parent metal of the HAZ.
Cause: Hydrogen embrittlement
Prevention: Use LOW HYDROGEN electrodes and/or preheat
Repair: (only found using NDT). Remove and reweld.
Hot Crack
Definition: A crack in the weld that occurs during solidification.
Cause: Micro stresses from weld metal shrinkage pulling apart weld metal as it cools from liquid to solid temp.
Prevention: Preheat or use a low tensile filler material.

Repair: Remove and reweld, correct problem first, preheat may be necessary, increase weld size.

Cold Crack

Definition: A crack that occurs after the metal has completely solidified

Cause: Shrinkage, Highly restrained welds, Discontinuities

Prevention: Preheat, weld toward areas of less constraint, use a more ductile weld metal

Repair: Remove and reweld, correct problem first, preheat may be necessary.

Repairs to Cracks

Determine the cause

Correct the problem

Take precautions to prevent reoccurrence

Generally required to repair using a smaller electrode

3.2.3. Porosity

A group of gas pores.

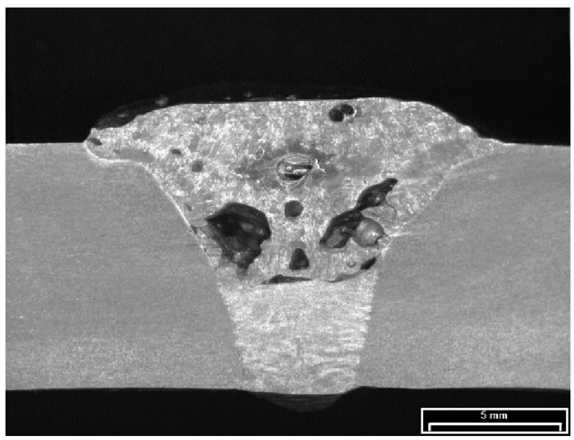


Figure 3.11

Elongated cavities.	A string of gas pores situated parallel to the weld axis. (Linear porosity.)
Blowhole.	A cavity generally over 1.5mm in diameter formed by entrapped gas during the solidification of molten metal.
Wormhole.	An elongated or tubular cavity formed by entrapped gas during the solidification of molten metal.

Porosity in welding is a result of dissolved gases or gases released during the welding process, being trapped in the metal when there is insufficient time to escape prior to solidification. If in the shape of rounded holes, the gas is called spherical porosity or just porosity. However, if elongated the terminology is wormholes or piping. Causes of porosity are;

- excessively long or short arc length
- welding current too high
- insufficient or moist shielding gas
- travel speed to fast
- base metal covered with oil, grease, moisture etc.
- wet, unclean or damaged electrodes.

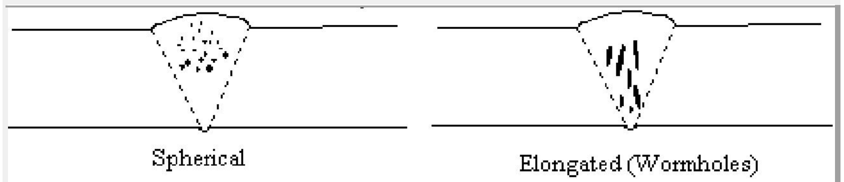


Fig 3.12: Porosity in Welds

With the advent of fitness-for-purpose acceptance criteria, more and more pressure is being put on NDT to not only identify and characterise flaws, but to also size them.

Quan and Scott(*H.R.Chin Quan and I.G.Scott , "Operator Performance and Reliability", Department of National Defence, Australia; Research Techniques in Nondestructive Testing, ed. R.S.Sharpe*)noted as one of their conclusions that; "An entirely different set of problems arises when the operator is asked to make measurements. Present NDT equipment is not designed for this purpose and the operators' training is unsuitable. The requirement arises when improvements in structural reliability are sought using NDT and fracture mechanics."The effect of porosity on the weld strength is a much-debated topic, but generally it is acknowledged to be over rated and its significance poorly reflected by the stringent workmanship requirements imposed on it. Recent fitness-for-purpose acceptance criteria such as API Standard 1104*(American Petroleum Institute, Welding of Pipeline and Related Facilities, API Standard 1104, 19th Edition, Washington, D.C., 1999)* and others permit treatment of porosity as a planar defect. This too is a very conservative treatment of the flaw type but provides a handy method of allowing some sort of quantification for ultrasonic testing.

Too often though, the quantification is linked to expectations that ultrasonics should provide similar results as seen by radiography, which uses comparison figures (as in API 1104 para.9.3.9) and projected areas. In 1992 the author attempted to rationalise a porosity quantification policy based on projected area *(E.Ginzel, R.Ginzel, B.Gross, M.Hoff, P.Manuel, Developments in Ultrasonic Inspection for Total Inspection of Pipeline Girth Welds, 8th Symposium on Pipeline Research, Houston, Texas, 1993*) to "match" the radiographic criteria because no separate ultrasonic criteria was available. This was subsequently abandoned as the regulatory body permitted treatment of porosity as a planar flaw.

More recently some practitioners have returned to efforts to "quantify" aspects of porosity based on both amplitude and duration of signals. Some have applied the idea to pulse-echo signals while others propose it for TOFD analysis. The following discussion will show that there is no definitive link between porosity (size, density and extent) and ultrasonic signal amplitude and "duration".

3.2.4. Slag

Slag is the residue left on a weld bead from the flux. It shields the hot metal from atmospheric contaminants that may weaken the weld joint. Slag can also be globules of molten metal that are expelled from the joint and then re solidify on the metal surface. in either case, they are usually chipped away with a slag hammer

Slag or other foreign matter entrapped during welding. The defect is more irregular in shape than a gas pore.

Oxide inclusion.	Metallic oxide entrapped during welding.
Tungsten inclusion.	An inclusion of tungsten from the electrode during TIG welding.
Copper inclusion.	An inclusion of copper due to the accidental melting of the contact tube or nozzle in self adjusting or controlled arc welding or due to pick up by contact between the copper nozzle and the molten panel during TIG welding.
Puckering.	The formation of an oxide covered weld run or bead with irregular surfaces and with deeply entrained oxide films, which can occur when materials forming refractory oxides (e.g. aluminium and its alloys) are being welded.

3.2.5. Questions

1. What is a lack of fusion?
2. What are the characteristics of lack of fusion?
3. Where is the location of lack-of-fusion defects?
4. How many types of the lack of fusion are there?
5. What are the cracks?
6. How many types of cracks are there?
7. What are the differences between hot and cold cracks?
8. How can we repair cracks?
9. What is a porosity? What are the causes?
10. What is a slag?

UNIT 4: WELDING TECHNOLOGY
Mã bài: MH 20.4

Giới thiệu:

Hàn là quá trình công nghệ sản xuất các kết cấu không thể tháo rời được từ kim loại, hợp kim và các vật liệu khác. Bằng sự hàn nóng chảy có thể liên kết được hầu hết các kim loại và hợp kim với chiều dày bất kỳ. Lịch sử ngành hàn đã có những bước tiến lớn về công nghệ. Ngày nay, công nghệ hàn đang ở một giai đoạn mà các phương pháp hàn đã có những cải tiến hiện đại và ngày càng đạt hiệu quả tinh vi, chất lượng hàn cao.

Mục tiêu:

- Liệt kê các thuật ngữ trong ngành hàn bằng Tiếng Anh;
- Thực hành đọc hiểu các tài liệu Tiếng Anh về các phương pháp hàn mối hàn;
- Thực hành giao tiếp thuyết trình nguyên lý vận hành các phương pháp hàn;
- Dịch các tài liệu Tiếng Anh về thuật ngữ phương pháp hàn từ Tiếng Anh sang Tiếng Việt và từ Việt sang Anh.
- Nghiêm túc, hợp tác với giáo viên để hoàn thành bài học.

1. Vocabulary

Mục tiêu:

- Liệt kê được một số thuật ngữ trong ngành hàn về phương pháp hàn mối hàn.
- Phát âm chuẩn và nắm vững nghĩa của các thuật ngữ đó.
- Tuân thủ các quy tắc phát âm theo ký hiệu phiên âm quốc tế.

1.1. Reading

- Manual welding: Hàn tay
- Mechanized welding : Hàn cơ giới
- Automated welding : Hàn tự động
- Fusion welding: Hàn nóng chảy
- Arc welding: Hàn hồ quang
- Surfacing: Hàn đắp
- Arc welding using a consumable electrode: Hàn hồ quang dùng điện cực nóng chảy
- Arc welding using non-consumable electrode: Hàn hồ quang dùng điện cực không nóng chảy
- Submerged arc welding: Hàn dưới lớp thuốc (Hồ quang chìm)
- Gas shielded arc welding: Hàn hồ quang trong môi trường khí bảo vệ
- TIG (Tungsten inert gas welding): Hàn điện cực wonfram trong môi trường khí trơ (Hàn điện cực không nóng chảy trong mội trường khí bảo vệ)
- MIG – Metal inert gas welding: Hàn điện cực nóng chảy trong mội trường khí trơ.
- MAG – Metal active gas welding: Hàn điện cực nóng chảy trong mội trường khí hoạt tính.

- Self-shielded arc welding: Hàn hồ quang tự bảo vệ
- Pulsed arc welding: Hàn hồ quang xung
- Manual arc welding: Hàn hồ quang tay
- Automatic arc welding: Hàn hồ quang tự động
- Robotic welding: Hàn robot
- Double arc welding: Hàn hai hồ quang
- Multi-arc welding: Hàn nhiều hồ quang
- Twin electrode welding: Hàn 2 que hàn
- Semi-automatic arc welding:Hàn bán tự động
- Plasma welding: Hàn plasma
- Electroslag welding: Hàn điện xỉ
- Laser welding: Hàn laze
- Gas welding: Hàn khí
- Resistance welding: Hàn tiếp xúc
- Spot welding: Hàn điểm
- Resistance seam welding: Hàn đường
- Step-by-step welding: Hàn bước
- Constant: Liên tục
- Heat source: Nguồn nhiệt
- Gap: Khoảng trống, khe
- Withdraw: Rút, hủy bỏ
- Spark gap: Bộ phóng điện, khe đánh lửa, khe phóng điện
- Protect: Bảo vệ
- Adjust: Điều chỉnh
- Maintain: Duy trì
- Stainless steel: Thép không gỉ
- Concentrate on: Tập trung
- Equal: Cân bằng

1.2. Explanation

- Manual arc welding: Hàn hồ quang tay (hay còn gọi là hàn que) là quá trình hàn điện nóng chảy sử dụng điện cực dưới dạng que hàn (thường có vỏ bọc) và không sử dụng khí bảo vệ, trong đó tất cả các thao tác (gây hồ quang, dịch chuyển que hàn, thay que hàn ,vv..) đều do người thợ hàn thực hiện bằng tay.

- Hàn hồ quang plasma (Plasma Arc Welding -PAW) là một quá trình hàn tương tự như hàn điện cực nóng chảy trong môi trường khí bảo vệ (GTAW). Khi hàn hồ quang plasma, điện cực không nóng chảy vonfram và một phần cột hồ quang nằm bên trong một buồng khí bao quanh bằng kim loại và được làm mát bằng nước. Buồng này kết thúc bằng một lỗ phun hình trụ đồng trục với điện cực.

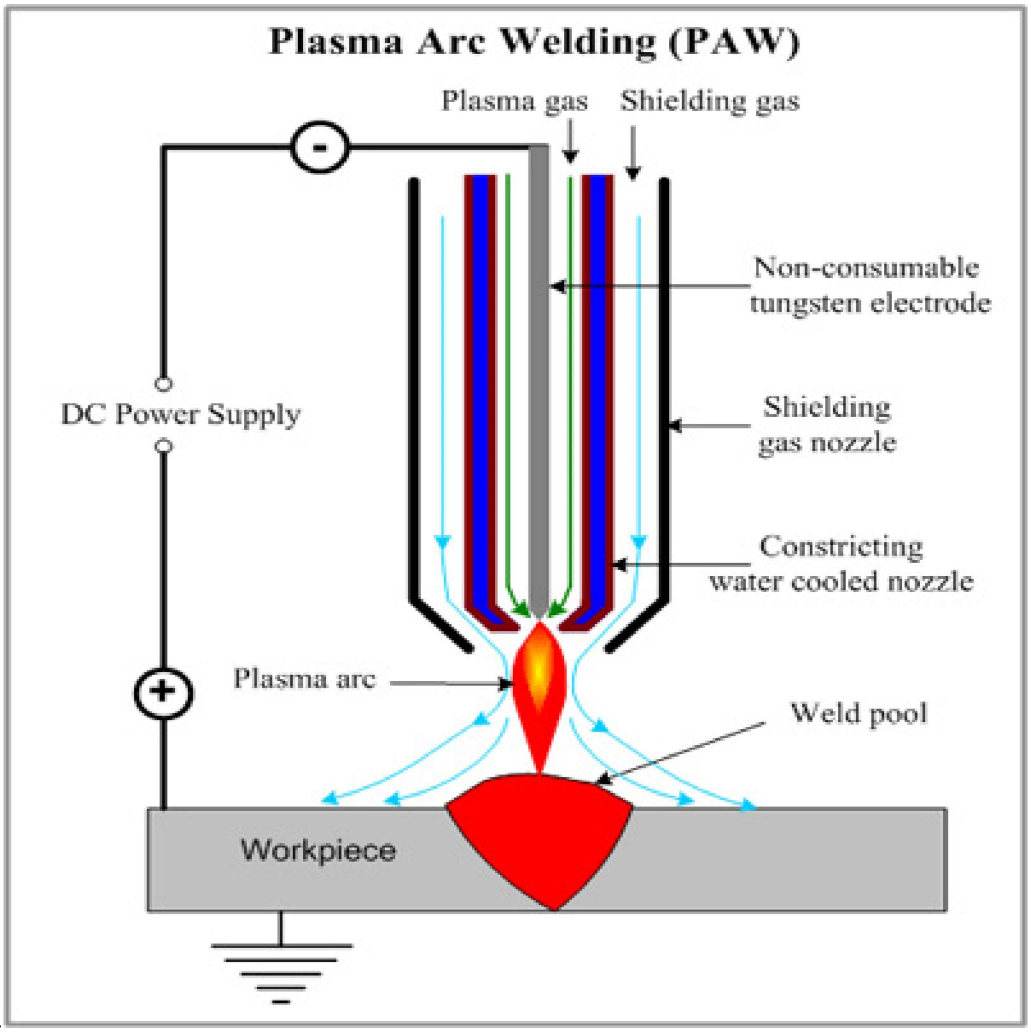


Figure 4.1

- **Plasma arc welding** (**PAW**) is an arc welding process similar to gas tungsten arc welding (GTAW). The electric arc is formed between an electrode (which is usually but not always made of sintered tungsten) and the workpiece. The key difference from GTAW is that in PAW, by positioning the electrode within the body of the torch, the plasma arc can be separated from the shielding gas envelope. The plasma is then forced through a fine-bore copper nozzle which constricts the arc and the plasma exits the orifice at high velocities (approaching the speed of sound) and a temperature approaching 20,000 °C. Plasma arc welding is an advancement over the GTAW process. This process uses a non-consumable tungsten electrode and an arc constricted through a fine-bore copper nozzle. PAW can be used to join all metals that are weldable with GTAW (i.e., most commercial metals and alloys).

1.3. Examples

- The gas is required to protect the fresh **weld** from contamination both from the atmosphere as well as any contaminates on the steel itself, such as oil or paint. In applications such as ship building, **manual welding** techniques would differ from those used in the construction of sky-scrapers.

- The TIG **welding** method became popular and useful in the early 1940s and, as a result, has greatly propelled the use of aluminum for **welding** and structural processes. TIG **welding** is commonly used for both high quality and **manual welding**. During the process of TIG **welding**, an arc is formed between a pointed tungsten electrode and the area to be **welded**.

2. Grammar: Passive voice with modal verbs (be continued)

Mục tiêu:

- Trình bày cách sử dụng và cấu trúc câu bị động với các động từ khuyết thiếu.

- Đặt được câu bị động sử dụng các động từ khuyết thiếu.

- Tuân thủ nghiêm túc, chuẩn xác cấu trúc và các bước chuyển sang câu bị động và ngược lại.

- The passive voice with *may, can, should* and *must*

S + can / may / should / must + V + O

S + can / may / should / must + be + V_ ed (past participle)

2.1. Can

- S + can be + P2.

Active: You can use the process to deposit metal to form a surface with alternative properties.

Passive: The process can also be used to deposit metal to form a surface with alternative properties.

2.2. May

- S + may be + P2

Active: The welder may use this parent metal.

Passive: This parent metal may be used by the welder.

2.3. Should

- S + should be + P2

Active: You should shut these doors

Passive: These doors should be shut

2.4. Must

- S + must be + P2

Active: The operator must check the base metals before welding.

Passive: The base metals must be checked before welding by the operator.

3. Main text

Mục tiêu:

- Trình bày được đặc điểm của phương pháp hàn các mối hàn.

- Đọc và trả lời được các câu hỏi liên quan đến nội dung bài đọc.

- Thực hiện nghiêm túc và hiệu quả kĩ năng đọc hiểu.

3.1. Shielded metal arc welding

3.1.1. Reading

Shielded metal arc welding (SMAW), also known as manual metal arc (MMA) welding, flux shielded arc welding, stick, and electric arc welding is a constant current drooping arc process (Figure 4.2).

In manual metal arc welding the heat source is an electric arc, which is formed between a consumable electrode and the parent plate. The arc is formed by momentarily touching the tip of the electrode unto the plate and then lifting the electrode to give a gap of 3 mm – 6 mm between the tip and the plate. When the electrode touches the plate, current commences to flow and as it is withdrawn the current continues to flow in the form of a small spark across the gap, which will cause the air in the gap to become ionised, or made conductive. As a result of this, the current continues to flow even when the gap is quite large. The heat generated is sufficient to melt the parent plate and also melt the end of the electrode – the molten metal so formed is transferred as small globules across the arc into the molten pool.

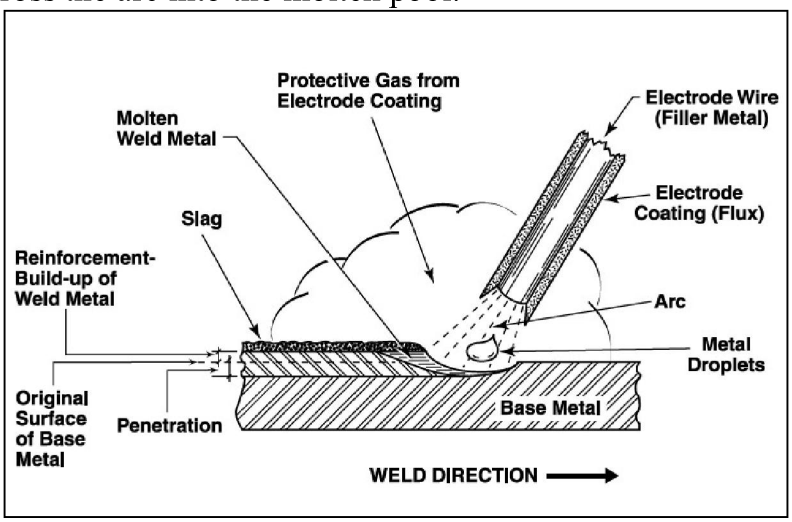


Figure 4.2

SMAW weld area

To strike the electric arc, the electrode is brought into contact with the workpiece by a very light touch with the electrode to the base metal then is pulled back slightly. This initiates the arc and thus the melting of the workpiece and the consumable electrode, and causes droplets of the electrode to be passed from the electrode to the weld pool. As the electrode melts, the flux covering disintegrates, giving off shielding gases that protect the weld area from oxygen and other atmospheric gases. In addition, the flux provides molten slag which covers the filler metal as it travels from the electrode to the weld pool. Once part of the weld pool, the slag floats to the surface and protects the weld from contamination as it solidifies. Once hardened, it must be chipped away to reveal the finished weld. As welding progresses and the electrode melts, the welder must periodically stop welding to remove the remaining electrode stub and insert a new electrode into the electrode holder. This activity, combined with chipping away the slag, reduce the amount of time that the welder can spend laying the weld, making SMAW one of the least efficient welding processes. In general, the operator factor, or the percentage of operator's time spent laying weld, is approximately 25%.

The actual welding technique utilized depends on the electrode, the composition of the workpiece, and the position of the joint being welded. The choice of electrode and welding position also determine the welding speed. Flat welds require the least operator skill, and can be done with electrodes that melt quickly but solidify slowly. This permits higher welding speeds. Sloped, vertical or upside-down welding requires more operator skill, and often necessitates the use of an electrode that solidifies quickly to prevent the molten metal from flowing out of the weld pool. However, this generally means that the electrode melts less quickly, thus increasing the time required to lay the weld.

Quality

The most common quality problems associated with SMAW include weld spatter, porosity, poor fusion, shallow penetration, and cracking. Weld spatter, while not affecting the integrity of the weld, damages its appearance and increases cleaning costs. It can be caused by excessively high current, a long arc, or arc blow, a condition associated with direct current characterized by the electric arc being deflected away from the weld pool by magnetic forces. Arc blow can also cause porosity in the weld, as can joint contamination, high welding speed, and a long welding arc, especially when low-hydrogen electrodes are used. Porosity, often not visible without the use of advanced nondestructive testing methods, is a serious concern because it can potentially weaken the weld. Another defect affecting the strength of the weld is poor fusion, though it is often easily visible. It is caused by low current, contaminated joint surfaces, or the use of an improper electrode. Shallow penetration, another detriment to weld strength, can be addressed by decreasing welding speed, increasing the current or using a smaller electrode. Any of these weld-strength-related defects can make the weld prone to cracking, but other factors are involved as well. High carbon, alloy or sulfur content in the base material can lead to cracking, especially if low-hydrogen electrodes and preheating are not employed. Furthermore, the workpieces should not be excessively restrained, as this introduces residual stresses into the weld and can cause cracking as the weld cools and contracts.

Safety

SMAW welding, like other welding methods, can be a dangerous and unhealthy practice if proper precautions are not taken. The process uses an open electric arc, which presents a risk of burns which are prevented by personal protective equipment in the form of heavy leather gloves and long sleeve jackets. Additionally, the brightness of the weld area can lead to a condition called arc eye, in which ultraviolet light causes inflammation of the cornea and can burn the retinas of the eyes. Welding helmets with dark face plates are worn to prevent this exposure, and in recent years, new helmet models have been produced that feature a face plate that self-darkens upon exposure to high amounts of UV light. To protect bystanders, especially in industrial environments, transparent welding curtains often surround the welding area. These curtains, made of a polyvinyl chloride plastic film, shield nearby workers from exposure to the UV light from the electric arc, but should not be used to replace the filter glass used in helmets.

In addition, the vaporizing metal and flux materials expose welders to dangerous gases and particulate matter. The smoke produced contains particles of various types of oxides. The size of the particles in question tends to influence the toxicity of the fumes, with smaller particles presenting a greater danger. Additionally, gases like carbon dioxide and ozone can form, which can prove dangerous if ventilation is inadequate. Some of the latest welding masks are fitted with an electric powered fan to help disperse harmful fumes.

Application and materials

Shielded metal arc welding is one of the world's most popular welding processes, accounting for over half of all welding in some countries. Because of its versatility and simplicity, it is particularly dominant in the maintenance and repair industry, and is heavily used in the construction of steel structures and in industrial fabrication. In recent years its use has declined as flux-cored arc welding has expanded in the construction industry and gas metal arc welding has become more popular in industrial environments. However, because of the low equipment cost and wide applicability, the process will likely remain popular, especially among amateurs and small businesses where specialized welding processes are uneconomical and unnecessary.

SMAW is often used to weld carbon steel, low and high alloy steel, stainless steel, cast iron, and ductile iron. While less popular for nonferrous materials, it can be used on nickel and copper and their alloys and, in rare cases, on aluminium. The thickness of the material being welded is bounded on the low end primarily by the skill of the welder, but rarely does it drop below 0.05 in (1.5 mm). No upper bound exists: with proper joint preparation and use of multiple passes, materials of virtually unlimited thicknesses can be joined. Furthermore, depending on the electrode used and the skill of the welder, SMAW can be used in any position.

3.1.2. Words & phrases

- flux shielded arc welding
- heat source
- electric arc
- consumable electrode
- parent plate
- spark
-conductive
- globules
- molten pool
- nonferrous materials
- applicability
- versatility

- stainless steel

3.1.3. Questions

1. What is SMAW?
2. What kind of the heat source is it in MMA welding?
3. How is the arc for med?
4. What are the advantages of the flux?
5. Is the slag good for the weld?
6. What determine the welding speech?
7. Which welding position requires the least operator skill?
8. Can arc blow cause porosity in the weld?
9. How can shallow penetration be addressed?
10. Wht kind of contents in the base material can lead to cracking?
11. Why is SMAW welding welding said to be dangerous and unhealthy?
12. What kinds of steel and iron is often used with SMAW?

3.2. Gas metal arc welding

3.2.1. Reading

Gas metal arc welding (GMAW), sometimes referred to by its subtypes **metal inert gas (MIG) welding** or **metal active gas (MAG) welding**, is a welding process in which an electric arc is formed between a consumable wire electrode and the workpiece metal(s), which heats the workpiece metal(s), causing them to melt, and join. Along with the wire electrode, a shielding gas is fed through the welding gun, which shields the process from contaminants in the air. The process can be semi-automatic or automatic. A constant voltage, direct current power source is most commonly used with GMAW, but constant current systems, as well as alternating current, can be used. There are four primary methods of metal transfer in GMAW, called globular, short-circuiting, spray, and pulsed-spray, each of which has distinct properties and corresponding advantages and limitations.

Originally developed for welding aluminum and other non-ferrous materials in the 1940s, GMAW was soon applied to steels because it allowed for lower welding time compared to other welding processes. The cost of inert gas limited its use in steels until several years later, when the use of semi-inert gases such as carbon dioxide became common. Further developments during the 1950s and 1960s gave the process more versatility and as a result, it became a highly used industrial process. Today, GMAW is the most common industrial welding process, preferred for its versatility, speed and the relative ease of adapting the process to robotic automation. Unlike welding processes that do not employ a shielding gas, such as shielded metal arc welding, it is rarely used outdoors or in other areas of air volatility. A related process, flux cored arc welding, often does not utilize a shielding gas, instead employing a hollow electrode wire that is filled with flux on the inside.

With a 'flat' volts/amps characteristic an attempted alteration in arc length (volts) will have little effect, hence arc length (volts) remains constant but a significant change in current will result. This is often referred to as the 'self-adjusting arc'. Metal Inert Gas (MIG) welding is a 'flat' arc process (constant) voltage. Also known as Metal Active Gas (MAG); CO2; Metal-arc Gas Shielded, flux core and GMAW (US). MIG can be used on all materials, in all positions, with high productivity and low heat input. There is no CO2 MIG welding with stainless steel. Normally DC positive though some flux core uses DC negative (Figure 4.3)

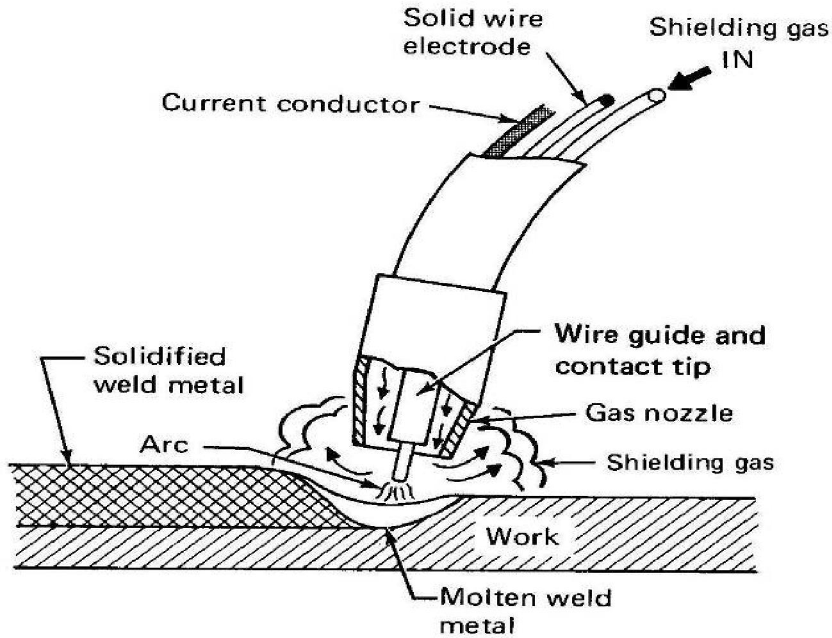


Figure 4.3

3.2.2. Words and phrases

- subtypes
- a consumable wire electrode
- a shielding gas
- welding gun
- contaminants
- semi-automatic
- constant voltage
- alternating current
- short-circuiting
- pulsed-spray
- non-ferrous materials
- inert gas
- versatility
- volatility
- 'self-adjusting arc'
- flux core

3.2.3. Questions

1. How is an electric arc formed?
2. Is the welding process semi-automatic or automatic?
3. How many primary methods of metal transfer in GMAW? What are they?
4. What is the most common industrial welding process today?
5. What is “ self - adjusting arc”?
6. Can MIG be used on all materials, in all positions?

3.3. Gas tungsten arc welding (GTAW)

3.3.1. Reading

Gas tungsten arc welding (**GTAW**), also known as **tungsten inert gas** (**TIG**) **welding**, is an arc welding process that uses a nonconsumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by a shielding gas (usually an inert gas such as argon), and a filler metal is normally used, though some welds, known as autogenous welds, do not require it. A constant-current welding power supply produces energy which is conducted across the arc through a column of highly ionized gas and metal vapors known as a plasma.

GTAW is most commonly used to weld thin sections of stainless steel and non-ferrous metals such as aluminum, magnesium, and copper alloys. The process grants the operator greater control over the weld than competing processes such as shielded metal arc welding and gas metal arc welding, allowing for stronger, higher quality welds. However, GTAW is comparatively more complex and difficult to master, and furthermore, it is significantly slower than most other welding techniques. A related process, plasma arc welding, uses a slightly different welding torch to create a more focused welding arc and as a result is often automated.

Tungsten inert gas welding is a constant current drooping arc process. It is also known as TIG, gas tungsten arc welding – GTAW, wolfram inert gas – WIG, and under the trade names of argon arc and heli arc (Figure 4.4).

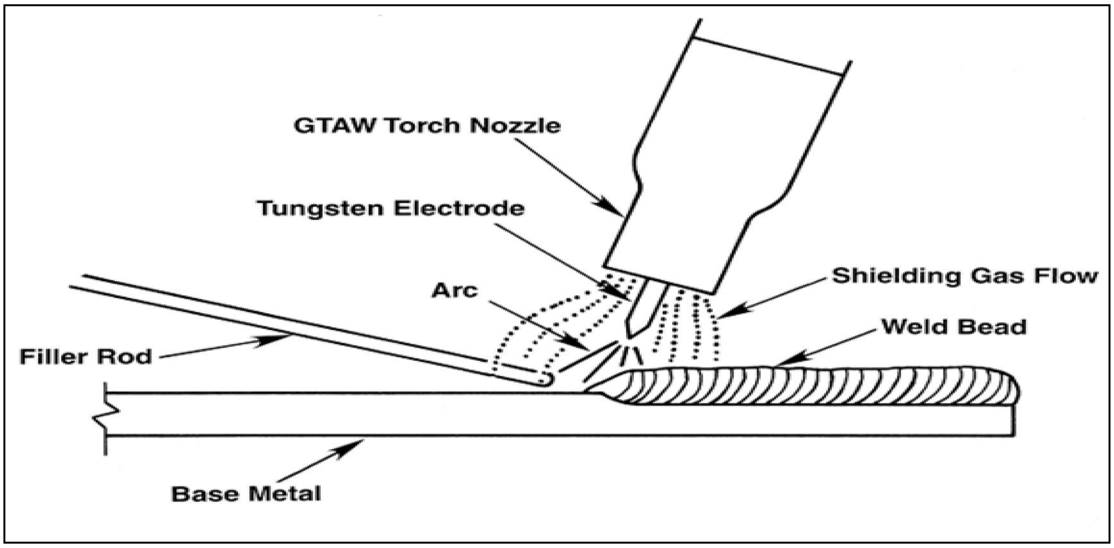


Figure 4.4

3.3.2. Words and phrases

- atmospheric contamination
- filler metal
- autogenous welds
- highly ionized gas
- metal vapors
- magnesium
- stainless steel
- shielded metal
- automated

3.3.3. Questions

1. What is GTAW?
2. For what kinds of metal is GTAW most commonly used?
3. How is GTAW compared to other welding techniques?
4. Is plasma arc welding often automated?
5. What does WIG stand for?

3.4. SUBMERGED ARC WELDING

3.4.1. Reading

Submerged arc welding (SAW) is a common arc welding process. Originally developed by the Linde - Union Carbide Company. It requires a continuously fed consumable solid or tubular (flux cored) electrode. The molten weld and the arc zone are protected from atmospheric contamination by being “submerged” under a blanket of granular fusible flux consisting of lime, silica, manganese oxide, calcium fluoride, and other compounds. When molten, the flux becomes conductive, and provides a current path between the electrode and the work. This thick layer of flux completely covers the molten metal thus preventing spatter and sparks as well as suppressing the intense ultraviolet radiation and fumes that are a part of the shielded metal arc welding (SMAW) process.

SAW is normally operated in the automatic or mechanized mode, however, semi-automatic (hand-held) SAW guns with pressurized or gravity flux feed delivery are available. The process is normally limited to the flat or horizontal-fillet welding positions (although horizontal groove position welds have been done with a special arrangement to support the flux). Deposition rates approaching 100 lb/h (45 kg/h) have been reported — this compares to ~10 lb/h (5 kg/h) (max) for shielded metal arc welding. Although Currents ranging from 300 to 2000 A are commonly utilized,[1] currents of up to 5000 A have also been used (multiple arcs).

Single or multiple (2 to 5) electrode wire variations of the process exist. SAW strip-cladding utilizes a flat strip electrode (e.g. 60 mm wide x 0.5 mm thick). DC or AC power can be used, and combinations of DC and AC are common on multiple electrode systems. Constant voltage welding power supplies are most commonly used; however, constant current systems in combination with a voltage sensing wire-feeder are available.

A flat arc process - (constant) voltage. It is used in beam, boom, tractor and multi-head type rigs (figure 4.5).

Type of Operation.

Mechanised, automatic or semi-automatic.

Mode of Operation.

An arc is maintained between the end of a bare wire electrode and the work. As the electrode is melted, it is fed into the arc by a set of rolls, driven by a governed motor. Wire feed speed is automatically controlled to equal the rate at which the electrode is melted, thus arc length is constant (similar to MIG/MAG - constant voltage). The arc operates under a layer of granular flux, hence submerged arc. Some of the flux melts to provide a protective blanket over the weld pool. The remainder of the flux is unaffected and can be recovered and re-used, provided it is dry and not contaminated.

A semi-automatic version is available in which the operator has control of a welding gun that carries a small quantity of flux in a hopper.

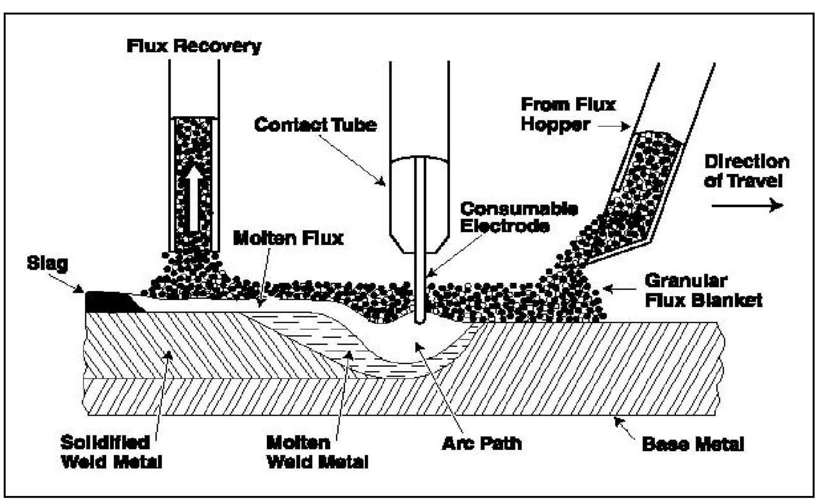


Figure 4.5

3.4.2. Words and phrases

- Tubular (flux cored) electrode
- “submerged”
- Blanket of granular fusible flux
- Silica
- Manganese oxide
- Compounds
- Spatter and sparks
- Intense ultraviolet radiation
- Wire variations
- Mechanised
- Motor
- Remainder

3.4.3. Questions (TEST 1)

1. What is an inert gas? Name two. Name a widely used GMAW gas that is not inert?
2. What’s the purpose of the gas in the GMAW process?
3. What is one advantage of GMAW over semiautomatic submerged-arc? Over flux-cored electrode welding?
4. Explain the principle of SMAW.
5. Explain the principle of MIG/MAG.
6. Explain the principle of TIG.
7. Explain the principle of SAW.

ASSESSMENT OF STUDENTS' STUDY

N.0	Criteria	Methods	Full marks	Results
I	**Knowledge**			
1	- Definition of an inert gas - Name a widely used GMAW gas that is not inert	Answer the questions with reference to the main text	**2**	
1.1 1.2	- The definition must be fully accurate. - Name exactly the gas required.		**1** **1**	
2	**-** the purpose of the gas in the GMAW process.	Answer the questions with reference to the main text	**1**	
2.1	- Present the purpose fully and accurately.		**1**	
3	**-** One advantage of GMAW over semiautomatic submerged-arc; Over flux-cored electrode welding.	Answer the questions with reference to the main text	**1**	
3.1	- Introduce the advantages fully & accurately as required.		**1**	
4	Explain the principle of SMAW fully & accurately as required.	Answer the questions with reference to the main text	**1,5**	
5	Explain the principle of MIG/MAG fully & accurately as required.	Answer the questions with reference to the main text	**1,5**	
6	Explain the principle of TIG fully & accurately as required.	Answer the questions with reference to the main text	**1,5**	
7	Explain the principle of SAW fully & accurately as required.	Answer the questions with reference to the main text	**1,5**	
	Total:		**10**	
II	**Skills**			
1	- Present the definition fully & accurately	Check the information of the definition	**2,5**	
2	- Present the purpose fully & accurately	Check the information of the purpose	**2,5**	

3	- Introduce the advantages fully & accurately	Check the advantages	**2,5**	
4	- Explain the principle fully & persuasively.	Check the steps & elements of the principle	**2,5**	
Total:			**10**	
III	**Attitude**			
1	Be on time	Watching & taking notes	**2**	
2	No cheating	Watching & taking notes	**2**	
3	Be accurate & careful	Watching & checking	**2**	
4	Be self- confident	Watching	**2**	
5	Try to finish the work within time allowance	Watching & checking	**2**	
Total:			**10**	

STUDY RESULTS

Criteria	**Mark for task accomplishment**	**Coefficient**	**Total Mark**
Knowlege		0,3	
Skills		0,5	
Attitude		0,2	
Total:			

UNIT 5: WELDING PROCEDURE
Mã bài: MH 20.5

Giới thiệu:

Quy trình hàn là cách mà chúng ta kiểm soát quá trình hàn bao gồm các yếu tố: vật liệu cơ bản, quá trình hàn, thiết kế mối hàn, vị trí hàn, xử lý nhiệt. Quy trình này giúp định hướng người thợ hàn hàn theo đúng quy cách và các tiêu chuẩn đề ra để từ đó có các mối hàn theo đúng thiết kế.

Mục tiêu:

- Liệt kê các thuật ngữ trong ngành hàn bằng Tiếng Anh;
- Đọc hiểu các ký hiệu về các mục Tiếng Anh của quy trình hàn;
- Thực hành đọc hiểu các tài liệu Tiếng Anh về các quy trình hàn;
- Dịch các tài liệu Tiếng Việt quy trình hàn sang Tiếng Anh và ngược lại.
- Nghiêm túc, hợp tác với giáo viên để hoàn thành bài học.

1. Vocabulary

Mục tiêu:

- Liệt kê được một số thuật ngữ trong ngành hàn về quy trình hàn, tên kim loại hàn.
- Phát âm chuẩn và nắm vững nghĩa của các thuật ngữ đó.
- Tuân thủ các quy tắc phát âm theo ký hiệu phiên âm quốc tế.

1.1. Reading

- Welding procedure: Quy trình công nghệ hàn
- Welding processes: Phương pháp hàn
- Welding procedure specification (WPS): Yêu cầu kỹ thuật của quy trình công nghệ hàn đã được chấp thuận
- Approved welding procedure specification: Đặc tính kỹ thuật của quy trình hàn đã được chấp thuận
- Preliminary welding procedure specification (PWPS): Đặc tính kỹ thuật của quy trình hàn sơ bộ
- Welding procedure approval record (WPAR): Báo cáo chấp thuận quy trình hàn
- Welding procedure test: Thử quy trình hàn
- Welder : Thợ hàn
- Welding operator: Thợ vận hành máy hàn
- Direction of welding: Hướng hàn
- Pass: Lượt hàn, đường hàn
- Downhill welding in the inclined position: hàn trần xuống
- Uphill welding in the inclined position: Hàn dưới lên
- Edge preparation: Sang phanh (mở mép hàn)
- Root face: Chiều cao không vát mép
- Bevel angle: Góc vát mép hàn
- Groove angle: Góc mở mép hàn
- Root gap: Khe hở hàn
- Base metal: Kim loại cơ bản
- Filler metal: Kim loại điền đầy

- Weld metal: Kim loại mối hàn
- Depth of fusion: Độ sâu nóng chảy
- Molten pool: Bể hàn
- Complete fusion: Độ ngấu của mối hàn
- Heat affected zone: Vùng ảnh hưởng nhiệt
- Fusion zone: Vùng chảy
- Weld interface: Mặt phân cách mối hàn
- DCEN (Direct current electrode negative): Phân cực âm
- DCEP (Direct current electrode positive): Phân cực dương
- Flash : Bavia
- Welding without backing: Hàn không đệm lót
- Raised edge: Bẻ gập mép hàn
- Property: Đặc tính
- Obligation: Sự bắt buộc
- Ensure: Đảm bảo
- Mandatory: Bắt buộc
- Refer: Đề cập đến
- Devise: Chỉnh sửa
- Confirm: Chứng thực, khẳng định, xác nhận
- Meet: Đáp ứng, thỏa mãn
- Arrangement: Sự sắp xếp
- Metallurgical: Luyện kim
- Appropriate: Cần thiết
- Supervision: Sự giám sát
- Relevant: Liên quan
- Testpiece: Mẫu kiểm tra
- Fabrication: Cấu tạo, sự chế tạo, sự sản xuất
- cross-reference: Tham khảo cho
- alter: Thay đổi
- To comply with: Tuân theo, tuân thủ
- termination: Đầu cuối, điểm cuối
- destructive test: Thí nghiệm phá hủy
- acceptable: Có thể chấp nhận được
- Weldability : Tính hàn
- laid down: Được đặt xuống, được thiết lập
- Weight of electrode deposited per ampere per hour: Hệ số nóng chảy
- Weight of metal deposited per ampere per hour: Hệ số hàn đắp

1.2. Explanation

- ***Welding Procedures*** are the guidelines used to perform a weld. They are designed to provide a record of the welding variables used and the inspection results obtained during the procedure qualification test. They can also provide the instructions for the welder to use in production in order to produce acceptable welds.

- Weldability: tính hàn

*The **weldability**, also known as **joinability**, of a material refers to its ability to be welded. Many metals and thermoplastics can be welded, but some are easier to weld than others. A material's weldability is used to determine the welding process and to compare the final weld quality to other materials.*

- Root gap: khe hở hàn

*For a butt **weld**, the **root gap**, RG, is the separation of the pieces being joined and is provided for the electrode to access the base of a joint.*

- Fusion zone: vùng chảy - vùng kim loại cơ bản nóng chảy được xác định trên tiết diện ngang của mối hàn.

It is the area between the two pieces of metal being joined. (When using a rod or tig, you would fuse the metals together).

1.3. Examples

- ***Welding procedures*** are usually divided into two categories, the Procedure Qualification Record (PQR) and the Welding Procedure Specification (WPS).

- ***Welding Procedure Specifications*** are usually documented work instructions that can be used by the welder to conduct welding operations, and are based on, but not necessarily the same as, the parameters used for the Procedure Qualification Record.

2. Grammar: Conditional sentences

Mục tiêu:

- Trình bày được đặc điểm, cấu trúc và cách sử dụng của các câu điều kiện.
- Đặt câu điều kiện sử dụng các thuật ngữ chuyên môn.
- Tuân thủ nghiêm túc, chuẩn xác cấu trúc và cách sử dụng của các câu điều kiện.

2.1. Type 0: Cause and effect

Example:

If you heat ice, it melts.

These sentences are statements of universal truth and general validity, and in this type of sentence, if corresponds closely in meaning to when(ever). Statements in this form commonly appear in factual discussion or explanatory material. The tense in both the conditional and the main clause are the same.

2.2.Type 1: Open conditions

In these sentences, the conditional clauses represent open conditions; that is, conditions that may or may not be fulfilled.

If you touch the plate, you'll burn your hand.

The commonest sequence of tenses in this type of sentence is:

(If) present tense, (Main) Future (or modal verb) or imperative.

If you want to join this construction better, you should prepare carefully.

If you work without any detective blankets, your eyes will be damaged.

If the test is to be supervised by a representative of an independent authority he should be given all the relevant details of the testing required.

2.3. Practice

Conditional Exercise 1

Complete each sentence below with the BEST answer: If / When

1. **......**I am late to work, my boss gets very angry. That is why I am always on time.
2. **..................**I leave work, I usually go to the fitness center to work out.
3. **.........**he eats, he tries to choose healthy foods.
4. His car is very reliable, and he rarely has any trouble with it. But he has had a couple of difficulties in the past. **..............**his car breaks down or he has any problems, he calls the auto club.
5. His car is terrible! It always breaks down. **.............**his car breaks down or he has any problems, he calls the auto club.
6. Mary gets six weeks paid vacation a year. She loves to travel. **...........**she goes on vacation, she always goes somewhere exotic.
7. Diane works harder than anyone I know. I don't think she has taken a day off in three years. But she does really love to travel. **..............**she goes on vacation, she goes somewhere exotic.
8. He loves going to the movies. **.................**he goes to the movies, he always gets a large popcorn with tons of butter.
9. She hates TV. She thinks television is a waste of time. **................**she watches any television at all, it is usually a documentary or a news program.
10. My friend always keeps in touch by mail. **....................**I get a letter, I usually write back immediately.

Conditional Exercise 2

Answer these following questions

1. What will you do if you have a day off work?

....

2. What will you do If the weather is nice tomorrow?

....

3. What will you do if it rains next Sunday**?**

....

4. What should the welder do if there is a crack in the weld joint?

....

5. What should you do if the power is too weak for welding?

....

3. Maintext

Mục tiêu:

- Trình bày được đặc điểm của quy trình hàn, kim loại hàn và vị trí hàn.
- Đọc và trả lời được các câu hỏi liên quan đến nội dung bài đọc.
- Thực hiện nghiêm túc và hiệu quả kĩ năng đọc hiểu.

3.1. Parameters of welding procedure

THE WELDING PROCEDURE

A welding procedure is a way of controlling the welding operation.

Purpose of procedure:

1) To prove a joint can meet design procedure - *consistency*
2) Instruction for welder
3) Ensure *repeatability*

Welding procedures are approved to ensure they are functional and fulfil the physical and mechanical properties necessary to reach the required standard (to establish the essential variables for contractual obligations).

Welders are approved to ensure a particular welder is capable of welding to a procedure and obtaining a result that meets specification.

The task of collecting the data and drafting(biên tập) the documentation is often referred to as 'writing' a weld procedure. In many ways this is an unfortunate term as the writing of documents is the last in a sequence of tasks.

Producing a weld procedure involves:

Planning the tasks
Collecting the data
Writing a procedure for use or for trial(thử nghiệm)
Making test welds
Evaluating the results of the tests
Approving the procedure of the relevant code
Preparing the documentation

In each code reference is made to how the procedures are to be devised and whether approval of these procedures is required. In most codes approval is mandatory and tests to confirm the skill of the welder are specified. Details are also given of acceptance criteria for the finished joint.

COMPONENTS OF A WELD PROCEDURE

Items to be included in the procedure can be some of the following:

Parent Metal

a. Type
b. Thickness (for pipe this includes outside diameter)
c. Surface condition
d. Identifying marks

Welding Process

a. Type of process (MMA, TIG, SAW etc.)
b. Equipment
c. Make, brand, type of welding consumables

d. When appropriate, the temperature and time adopted for drying and baking of electrodes
and / or consumables

Joint Design

a. Welding position
b. Edge preparation
c. Method of cleaning, degreasing(tẩy) etc.
d. Fit up of joint
e. Jigging(lắp đồ gá) or tacking procedure
f. Type of backing

Welding Position

a. Whether shop or site weld
b. Arrangement of runs and weld sequence
c. Filler material, composition and size (diameter)
d. Welding variables - voltage, current, travel speed
e. Weld size
f. Back gouging
g. Any specific features, e.g. heat input control, run-out length

Thermal Treatment

a. Preheat and interpass temperatures including method and control
b. Post weld treatment including method and control

3.1.1.Welding process

a. Type of process (MMA, TIG, SAW etc.)
b. Equipment
c. Make, brand, type of welding consumables
d. When appropriate, the temperature and time adopted for drying and baking of electrodes and/or consumables.

3.1.1.1. Reading

Gas metal arc welding uses an arc between a continuous filler metal (consumable) electrode and the weld pool. Shielding is provided by an externally supplied shielding gas. This process is also known as MIG welding or MAG welding. MIG (Metal Inert Gas) welding means the use of an inert (i.e. non active) gas. MAG (Metal Active Gas) welding requires the use of an active gas (i.e. carbon dioxide and oxygen). CO_2 is a more commonly used shortening of MAG welding gas.

The process consists of a DC arc burning between a thin bare metal wire electrode and the workpiece. The arc and weld area are enveloped in a protective gas shield. The wire electrode is fed from a spool, through a welding torch which is connected to the positive terminal into the weld zone. MIG/MAG welding is the most widely used process in the world today. It is a versatile method which offers a lot of advantages. The technique is easy to use and there is no need for slag-cleaning. Another advantage is the extremely high productivity that MIG/MAG welding makes possible.

MIG/MAG welding is used on all thicknesses of steels, aluminium, nickel, stainless steels etc. The MAG process is suitable both for steel and unalloyed, low-alloy and high-alloy based materials. The MIG process, on the other hand, is used for welding aluminium and copper materials

TIG Welding

In TIG welding an arc is created between a nonconsumable tungsten electrode and the metal being welded. The arc produces the heat needed to melt the work. The shielding gas keeps oxygen in the air away from the molten weld pool and the hot tungsten. Gas is fed through the torch in order to shield the electrode and the molten weld pool. The shielding gas used is pure argon. There may or may not be filler metal added to the molten weld pool during the process. Tungsten is used for the electrode because of its high melting temperature and good electrical characteristics.

The main advantage of TIG welding is the wide range of materials that it can weld. TIG welding is used to a great extent for welding different kinds of alloys of aluminium and stainless steel, specially when quality is of great importance. This technique is mainly used in aeronautical constructions and in the chemical and the nuclear power industry.

Submerged Arc Welding

Submerged arc welding (SAW) is an arc welding process that fuses together the parts to be welded by heating them with one or more electric arcs between one or more bare electrodes and the work piece. The submerged arc welding process utilizes the heat of an arc between a continuously fed electrode and the work. The heat of the arc melts the surface of the base metal and the end of the electrode. The metal melted off the electrode is transferred through the arc to the workpiece, where it becomes the deposited weld metal.

Shielding is obtained from a blanket of granular flux, which is laid directly over the weld area. The flux close to the arc melts and intermixes with the molten weld metal and helps purify and fortify it. The flux forms a glasslike slag that is lighter in weight than the deposited weld metal and floats on the surface as a protective cover. The weld is submerged under this layer of flux and slag- hence the name submerged arc welding.

3.1.1.2. Words and phrases

- filler metal (consumable)
- weld pool
- Shielding
- weld zone
- slag-cleaning
- high-alloy based materials
- a nonconsumable tungsten electrode
- The flux

- Submerged
- bare electrodes
- slag- hence

3.1.1.3. Questions

1. What is a welding procedure?
2. Why do we have to approve the welding procedures?
3. What are involved in producing a weld procedure?
4. What are the components of a weld procedure?
5. What do MIG & MAG welding mean?
6. What are the advantages of MIG & MAG welding?
7. In which field/area is TIG welding mainly used? Why?
8. What is formed by the flux in SAW?

3.1.2. Welding positions

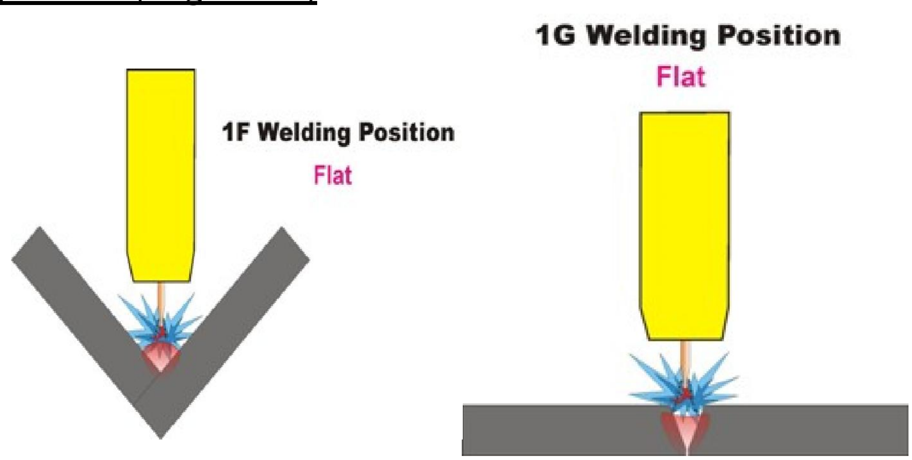
a. Whether shop or site weld
b. Arrangement of runs and weld sequence
c. Filler material, composition and size (diameter)
d. Welding variables - voltage, current, travel speed
e. Weld size
f. Back gouging
g. Any specific features, e.g. heat input control, run-out length

3.1.2.1. Reading

When you start getting right into welding you will eventually need to know what all the different welding positions are.
As not all welds that you have to do will be in the flat posititon.

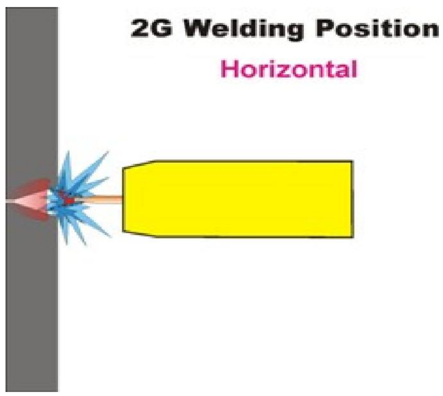
Below are some diagrams showing the different welding postions and also the name if the welding position and code has been listed.

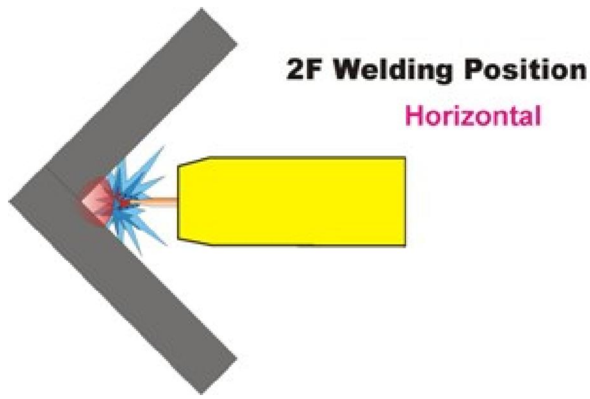
Flat Welding Position(Figure 5.1)



The flat welding position when welding like this is called the 1G or 1F. It is the most basic and easiest welding position there is. If you can't weld one of these welds, don't even bother trying the ones listed below.

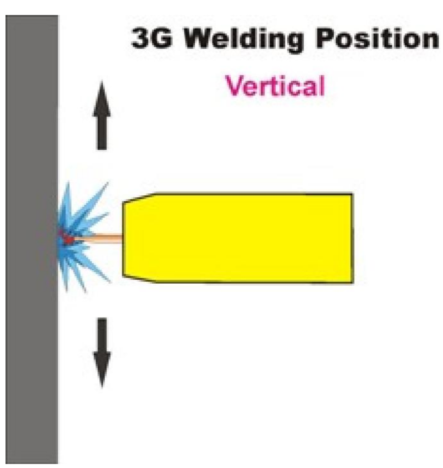
Horizontal Welding Position(Figure 5.2)

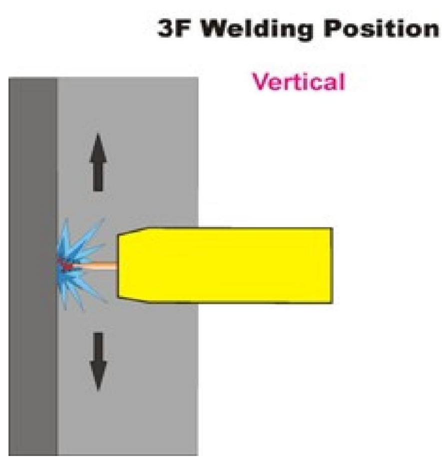




The horizontal welding position is also refferd to as the 2G or 2F. It is slightly harder to do than the flat weld as gravity is trying to pull the molten metal down to wards the ground. But it is still easy to do.

Vertical Welding Position(Figure 5.3)

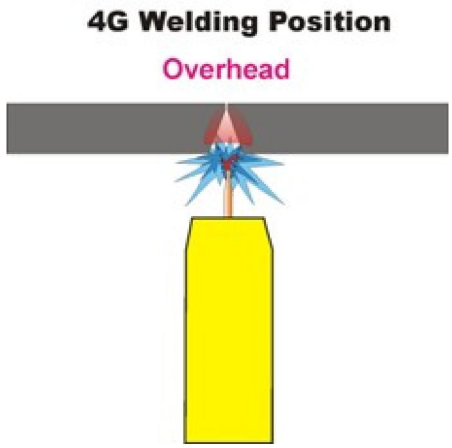


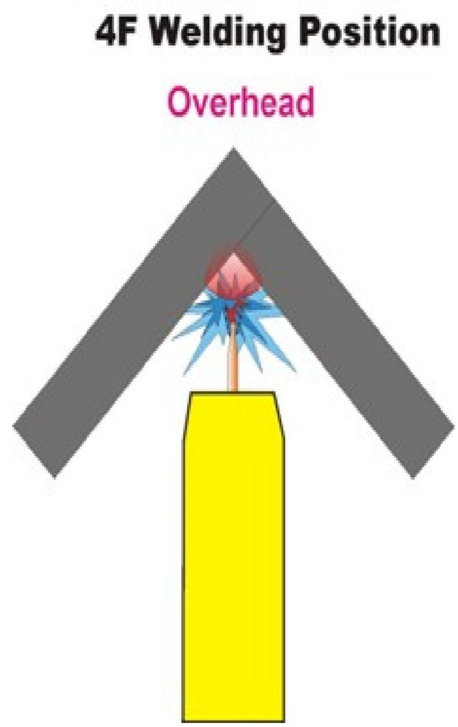


This is the one that we all have trouble with the dredded vertical up weld. This is also called the 3G or 3F, and you can go up or down. As mention before going up in this position is called the vertical up weld and going down is the vertical down weld.

The vertical down weld is way easier than going up, but it only has limited penetration.

Overhead Welding Position(Figure 5.4)





The overheadwelding position is just that, overhead. The welding position here is also refferd to as the 4G or 4F.

3.1.2.2 Words and phrases

- flat posititon
- welding position
- horizontal welding position
- gravity
- molten metal
- penetration.
- Vertical Welding Position
- Overhead Welding Position

3.1.2.3. Questions

1. What should we do first before you start welding?
2. How many welding positions are there? What are they?
3. What is the difference between the flat welding position & horizontal welding position?
4. Which welding position is the most difficult? Why?
5. Is the vertical down weld easier than going up?

3.1.3 Base metal

3.1.3.1. Reading

What is the definition of base metal?

One of the two or more metals to be welded together to form a joint.

Class Vocabulary		
alloy		A metal consisting of a mixture of two or more materials. One of these materials must be a metal.

Class Vocabulary		
aluminum		A silver-white metal that is soft, light, and conductive.
aluminum oxide		A chemical compound of aluminum and oxygen, which forms a thin layer on the surface of aluminum when exposed to air. Aluminum oxides should be removed before welding.
annealing		The steady heating of a metal at a certain temperature followed by a gradual cooling process. Annealing is often used when welding nonferrous metals.
arc welding		A fusion welding process that uses electricity to generate the heat needed to melt the base metals.
argon		A colorless, odorless type of inert gas. Argon is commonly used as shielding gas.
austenitic stainless steel		Stainless steel with very high strength, as well as excellent ductility and toughness. Austenitic stainless steel is the most corrosion-resistant stainless steel.
base metal		One of the two or more metals to be welded together to form a joint.
boiling point		The temperature at which a liquid changes to a vapor. The boiling point of zinc is below the melting temperature of most steels.
brass		An alloy of copper and zinc. Brass has poor weldability.
bronze		An alloy of copper and tin. Bronze is the most weldable of the copper alloys.
burnthrough		Excessive melt through or a hole in the base metal. Extremely high welding temperatures can cause burnthrough.
cast nickel alloy		An alloy containing nickel that has been poured as a liquid into a mold and cooled into a solid shape. Cast nickel alloys are often difficult to weld because of their high silicon content.
cold working		The shaping of metal at temperatures substantially below the point of recrystallization. Cold working adds strength and hardness.

Class Vocabulary		
compressive strength		A metal's ability to resist forces that attempt to squeeze or crush it.
copper		A reddish metal that is very ductile, thermally and electrically conductive, and corrosive resistant. Copper is often used to make electrical wire.
copper-lead alloy		An alloy containing copper and lead, which has the poorest weldability because the toxic lead often contaminates the weld.
copper-tin alloy		An alloy containing copper and tin, which is the most weldable of the copper alloys. Tin adds strength and hardness to copper. Copper-tin alloys are also known as bronze.
copper-zinc alloy		An alloy containing copper and zinc, which has poor weldability and tends to give off offensive fumes. Copper-zinc alloys are also known as brass.
corrosion resistance		A metal's ability to resist attack by other elements and chemicals.
cracking		A fracture that develops in the weld after solidification is complete. Welds with high hardness can cause cracking.
ductility		A metal's ability to be drawn, stretched, or formed without breaking.
electrical conductivity		A metal's ability to conduct an electrical current.
electrode		A device that conducts electricity. In arc welding, the electrode also can act as the filler metal.
ferrous metal		A metal that contains iron. Steel is the most popular ferrous metal.
filler metal		A type of metal sometimes added to the joint in fusion welding. Filler metal adds to the strength and mass of the welded joint.
galvanizing		The process of adding a zinc coating to steel. Galvanized steel is used to manufacture car parts, building frames, and ducting.
gas torch		A device that emits heat in the form of a gas. Gas torches are used to preheat base metals.
gauge		A standard of measure used to determine a specific

Class Vocabulary		
		thickness of sheet metal.
grain structure		The relationship between the small, individual crystals in a metal or alloy.
grinding		The use of an abrasive to wear away at the surface of a workpiece.
hardness		A metal's ability to resist indentation, penetration, and scratching. The heat from welding may change a metal's hardness.
heat treatment		The controlled heating and cooling processes used to change the structure of a material and alter its physical and mechanical properties.
heat-affected zone		The portion of the base metal that has not been melted, but its mechanical properties have been altered by the heat of welding.
heat-treatable alloy		Alloys that can be heated after welding to restore their strength properties.
joint		The meeting point of the two materials that are joined together. Welding creates a permanent joint.
lead		A soft, heavy, toxic metallic element. Lead is often used in gasoline.
magnesium		A grayish white, extremely light metal that is also brittle and has poor wear resistance.
mechanical properties		The properties that describe a material's ability to compress, stretch, bend, scratch, dent, or break.
melting temperature		The temperature necessary to change a metal from solid to a liquid. Also known as melting point.
nickel		A hard, malleable, silvery white metal used in various alloys to add strength, toughness, and impact resistance to metals.
nonferrous metal		A metal that does not contain iron. Aluminum and copper are common nonferrous metals.
nonheat-treatable alloy		Alloys that rely primarily on cold working to increase their strength properties.
physical properties		The properties that describe a metal's ability to melt, emit heat, conduct electricity, and expand or shrink.

Class Vocabulary		
post heating		The application of heat to the weld immediately after welding. Post heating helps reduce stress in the weld metal.
precipitate		The separation of elements from a type of solution. Elements that precipitate out of a solution change a metal's properties.
precipitation hardening		The process of heating to a temperature at which certain elements precipitate, forming a harder structure, and then cooling at a rate to prevent return to the original structure.
preheating		The application of heat to a base metal immediately before welding. Preheating helps reduce hardness in the metal.
properties		A characteristic of a material that distinguishes it from other materials.
recrystallization		The formation of a new grain structure. Recrystallization is often the result of annealing.
silicon		A nonmetallic element often found in sand and used to make glass. High amounts of silicon in a weld metal can cause cracking.
solution heat treating		A heat treatment method used to heat an alloy to a specific temperature for a certain period of time to allow one or more alloy elements to dissolve in a solid solution and then cool rapidly.
steel		A metal consisting of iron and carbon, usually with small amounts of other elements. Steel is the most common manufacturing metal.
strength		A metal's ability to resist outside forces that are trying to break or deform the metal.
supersaturated solution		A solution that is completely filled with alloying elements.
tack weld		A weld made to hold the parts of a weld in proper alignment before the final welds are made. Tack welds are also used to aid in preheating.
tensile strength		A metal's ability to resist forces that attempt to pull it apart or stretch it.

Class Vocabulary		
thermal conductivity		The rate at which heat flows through metal.
thermal expansion		The increase in the dimensions of a metal due to an increase in its temperature.
tin		A silver-white, soft metal used in many alloys. Tin is often used to coat other metals to prevent corrosion.
titanium		A silver-gray, strong, but lightweight metal known for its corrosion resistance. Titanium is often used in the aerospace industry.
toughness		A metal's ability to withstand a sharp blow.
weave		Movement of the electrode in a back and forth motion to deposit weld metal into a joint.
weld		A mix of metals that joins at least two separate parts. Welds can be produced by applying heat, or pressure, or both heat and pressure, and they may or may not use an additional filler metal.
weldability		The ability of a material to be welded under imposed conditions into a specific, suitable structure and to perform satisfactorily for its intended use.
wrought nickel alloy		An alloy containing nickel that has been bent, hammered, or physically formed into a desired shape. Wrought nickel alloys are often welded under the same conditions as certain types of steel.
yield strength		A metal's ability to resist gradual progressive force without permanent deformation.
zinc		A bluish white metal that is corrosive resistant and has a relatively low melting point. Zinc is often used as a coating on steel.

3.1.3.2. Words and phrases

- alloy
- inert gas
- stainless steel
- toxic
- contaminate
- solidification
- hardness
- electrical current
- filler metal

- ferrous metal
- nonferrous metal
- colourless
- odorless
- corrosion
- resist forces
- attempt to pull it apart or stretch it.
- give off offensive fumes
- to change a metal from solid to a liquid
- cooling at a rate

3.1.3.3. Questions

1. What is the definition of base metal?
2. What is an alloy?
3. What are the features of argon?
4. What is the advantage of cold working?
5. What can cause cracking in the weld?

3.1.4. Filler metal

3.1.4.1 Reading

A **filler metal** is a metal added in the making of a joint through welding, brazing, or soldering. Four types of filler metals exist - covered electrodes, bare electrode wire or rod, tubular electrode wire, and welding fluxes. Sometimes non-consumable electrodes are included as well, but since these metals are not consumed by the welding process, they are normally excluded.

There are many types of materials used to produce welds. These welding materials are generally categorized under the term **filler metals**, defined as "the metal to be added in making a welded, brazed, or soldered joint."

The filler metals are used or consumed and become a part of the finished weld. The definition has been expanded and now includes electrodes normally considered non-consumable such as tungsten and carbon electrodes, fluxes for brazing, submerged arc welding, electroslag welding, etc. The term filler metal does not include electrodes used for resistance welding, nor does it include the studs involved in stud welding.

The American Welding Society has issued 26 specifications covering filler materials. This table also shows the welding process for which each specification is intended. These specifications are periodically updated and a two-digit suffix indicating the year issued is added to the specification number. Additional specifications are added from time to time.

Table 1. *AWS filter metal specification and welding processes.*

AWS Specification	Specifications Title	for process shown bellow					
		OAW	SMAW	GTAW	GMAW	SAW	Other
A 5.1	Carbon steel covered arc-welding electrodes		X				
A 5.2	Iron & steel gas welding rods	X					
A 5.3	Aluminum & aluminum alloy arc welding electrodes		X				
A 5.4	Corrosion-resisting chromium & chromium-nickel steel covered welding electrodes		X				
A 5.5	Low-alloy steel covered arc welding electrodes		X				
A 5.6	Copper & copper alloy covered electrodes				X		
A 5.7	Copper & copper alloy welding rods	X		X			PAW
A 5.8	Brazing filler metal						BR
A 5.9	Corrosion - resisting chromium & chromium-nickel steel bare & composite			X	X	X	PAW

	metal cored & standard arc welding electrodes & rods						
A 5.10	Aluminum & aluminum alloy welding rods & bare electrodes	X		X	X		PAW
A 5.11	Nickel & nickel alloy covered welding electrodes		X				
A 5.12	Tungsten arc welding electrodes			X			PAW
A 5.13	Surfacing welding rods & electrodes	X		X			CAW
A 5.14	Nickel & nickel alloy bare welding rods and electrodes	X		X	X	X	PAW
A 5.15	Welding rods & covered electrodes for welding cast iron	X	X				CAW
A 5.16	Titanium & titanium alloy bare welding rods & electrodes			X	X		PAW
A 5.17	Bare carbon steel electrodes & fluxes for submerged-arc welding					X	

A 5.18	Carbon steel filler metals for gas shielded arc welding			X	X		PAW
A 5.19	Magnesium alloy welding rods & bare electrodes	X		X	X		PAW
A 5.20	Carbon steel electrodes for flux cored arc welding						FCAW
A 5.21	Composite surfacing welding rods & electrodes	X	X	X			
A 5.22	Flux cored corrosion-resisting chromium & chromium-nickel steel electrodes						FCAW
A 5.23	Bare low-alloy steel electrodes and fluxes for submerged arc welding	X					
A 5.24	Zirconium & zirconium alloy bare welding rods and electrodes			X	X		PAW
A 5.25	Consumables used for electro-slag welding of carbon & high strength low alloy steels						ES
A 5.26	Consumables used for				X		FCAW

	electrogas welding of carbon and high strength low-alloy steels						
A 5.27	Copper and copper alloy gas welding rods	X					
A 5.28	Low-alloy steel filler metals for gas shielded arc welding			X	X		PAW

Fluxes for welding

There is a number of different types of fluxes used in welding, brazing, and soldering. These include fluxes for oxyfuel gas welding, fluxes for brazing, fluxes for soldering, fluxes for oxygen cutting of certain hard-to-cut metals, fluxes for electroslag welding, and fluxes for submerged arc welding.

There are no specifications written for any of these fluxes. The American Welding Society provides a specification for weld metal deposited by different combinations of steel electrodes and fluxes for submerged arc welding.

The major function of the submerged arc flux is to produce a slag which will protect the molten metal from the atmosphere by providing a mechanical barrier. When it is molten, this slag should provide ionization to permit a stable arc. It should be fluid and of relatively low density so that it will float and cover the top of the deposited weld metal.

The melting temperature should be related to that of the molten weld metal and it should have a different coefficient of expansion, providing that it can easily be removed after cooling. The slag should provide deoxidizers to help cleanse and purify the weld metal. It should also help reduce phosphorous and sulphur that might be present in the base metal. It should not introduce hydrogen into the weld. Finally, the flux should be granular and convenient to handle, should not provide noxious fumes, but should provide for a smooth weld surface.

3.1.4.2 Words & phrases

- filler metal
- electrode wire
- soldered joint
- submerged arc welding
- resistance welding
- stud welding.
- specifications

- hard-to-cut metals
- eoxidizers
- become a part of
- be expanded
- be considered
- be issued
- be added to

3.1.4.3. Questions

1. What is a filler metal?
2. How many types of filler metal are there?
3. How many specifications covering filler materials has the AWS issued?
4. How many types of fluxes used in welding, brazing & soldering? What are they?
5. What is the major function of the submerged flux?

3.2.1.WPS of SMAW - 3G

3.2.1.1. Reading

Read the WPS below:

	THE CENTRAL VOCATIONAL COLLEGE OF TRANSPORT No.II Add: Hong Thai - An Duong - Hai Phong Tel: 0318602835 Fax: 0313670794 E-mail: truongcdngtvttw2@gmail.com Website: www.cvcot.edu.vn	
WELDING PROCEDURE SPECIFICATION (WPS) **WPS No CVCOT 2 - 03**		
PREPARED BY	**CVCOT 2**	**LLOYD'S REGISTER**

THE CENTRAL VOCATIONNAL COLLEGE OF TRANSPOR N0.II

Add: Hong Thai - An Dương - Hải Phong

Tel: 0318602835 Fax: 0313670794

E-mail: truongcdngtvttw2@gmail.com

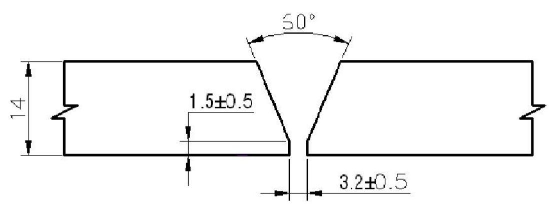
Website: www.cvcot.edu.vn

WELDING PROCEDURE SPECIFICATION (WPS)

WPS No:			
Supporting PQR No:	**CVCOT 2 - 03**	Revision:	**0**
Welding Process:	**CVCOT 2 - 03**		
Applicable Code:	**SMAW**	Type:	**Manual**
Prepared by:	**AWS D1.1 – 2006**		
		Date:	**22nd, June, 2008**

JOINT DESIGN USED: **JOINT DETAILS**

Type:	**Single V Butt Weld**
Backing:	**N/A**
Backing material:	**N/A**
Root Opening:	**2.5 ± 0.5 mm**
Root Face:	**1.5± 0.5 mm**
Groove Angle:	**60^0**
Back Gouging:	**N/A**



BASE METALS:

Material Specification:	**Group 1 to Group 1**
Type or Grade:	**JIS G3101Grade SS400**
Thickness range (plate):	Groove: **3.0mm to 28mm**
Diameter(pipe):	Groove: **OD > 600mm**

FILLER METALS:

AWS Specification:	**AWS A 5.1**
AWS Classification:	**E 7016**
A No.:	**1**
F No.:	**4**
Trade name:	**Lincoln / Kobelco / Huyndai**

SHIELDING:

Gas: **N/A**
Percent **N/A**
Composition: **N/A**
Flow rate: **N/A**
Gas cup Size: **N/A**
Electrode – Flux:

PREHEAT:
Preheat Temperature: **Min. 25^{0}C**
Interpass Temperature: **Max. 250^{0}C**
Preheat Maintenance method: **N/A**

POST WELD HEAT TREATMENT:
Temperature range:
N/A
Time range:
N/A

POSITION:
Position of Groove: **3G**
Position of Fillet: **F,H,V**
Weding Progression(Up/Down): **N/A**

ELECTRICAL CHARACTERISTICS:
Transfer Mode(GMAW): **N/A**
Current: **DCEP**
Other: **N/A**
Tungsten Electrode(GTAW): **N/A**

TECHNIQUE:
Travel speed: **SEE TABLE**
Stringer or Weave Bead: **Stringer and Weaving**
Multi-pass or Single Pass: **Multi-Pass**
Number of Electrodes: **1**
Peening: **N/A**
Interpass Cleaning: **Grinding and Brushing**
Contact tube to work distance: **N/A**

WELDING PROCEDURE

Weld layer No.	Welding Process	Filler Metal		Current		Volts (V)	Travel Speed (mm/min)	Heat input (KJ/mm)
		Class	Dia. (mm)	Polarity	Ampe (A)			
1st	SMAW	E7016	2.6	DCEP	65 – 90	20 - 26	60 – 105	0.8 – 2.0

2nd	SMAW	E7016	3.2	DCEP	65 – 95	22 - 28	60 - 100	0.8 – 2.0
3rd	SMAW	E7016	3.2	DCEP	65 – 95	22 - 28	60 - 100	0.8 – 2.0
4th and over	SMAW	E7016	3.2	DCEP	65 – 95	22 - 28	60 - 100	0.8 – 2.0
		E7016	2.6	DCEP	65 – 90	20 - 26	60 – 105	0.8 – 2.0

3.2.1.2. Words & phrases

- Percent Composition
- Flow rate
- Gas cup Size
- Electrode – Flux
- Preheat Temperature
- Interpass Temperature
- Preheat Maintenance method
- Temperature range
- Time range
- Position of Groove
- Position of Fillet
- Stringer or Weave Bead
- Multi-pass or Single Pass
- Number of Electrodes
- Peening
- Interpass Cleaning

3.2.1.3. Questions

1. What is the applicable code & type of the WPS?
2. What is the joint design used?
3. What is the material specification and the thickness range of the base metals?
4. Is the preheat temperature below 25o C? What is the limited temperature?
5. What are the positions of filler?

6. Give data about the weld layer N0.1?

3.2.2. WPS of (GTAW + SMAW) - 6G

3.2.2.1. Reading

Read the WPS below:

	THE CENTRAL VOCATIONAL COLLEGE OF TRANSPORT N_0.II Add: Hong Thai - An Dương - Hải Phong Tel: 0318602835 Fax: 0313670794 E-mail: truongcdngtvttw2@gmail.com Website: www.cvcot.edu.vn	

WELDING PROCEDURE SPECIFICATION (WPS)
WPS No: CVCOT 2 - 05

PREPARED BY	CVCOT 2	LLOYD'S REGISTER

	THE CENTRAL VOCATIONNAL COLLEGE OF TRANSPOR N_0.II Add: Hong Thai - An Dương - Hải Phong Tel: 0318602835 Fax: 0313670794 E-mail: truongcdngtvttw2@gmail.com Website: www.cvcot.edu.vn	

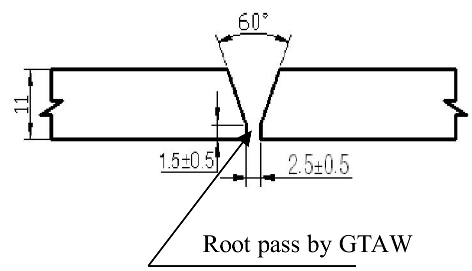
WELDING PROCEDURE SPECIFICATION (WPS)

WPS No:	**CVCOT 2 - 05**	Revision:	**0**
Supporting PQR	**CVCOT 2 - 05**		
No:	**GTAW + SMAW**	Type:	**Manual**
Welding Process:	**AWS D1.1 – 2006**		
Applicable Code:		Date:	**22nd, June, 2008**
Prepared by:			

JOINT DESIGN USED: **Single V Butt Weld**

JOINT DETAILS

Type:	**GTAW: No - SMAW: Ye**
Backing:	**For SMAW: Weld Metal**
Backing material:	**2.5 ± 0.5 mm**
Root Opening:	**1.5 ± 0.5 mm**
Root Face:	**60^0**
Groove Angle:	**N/A**
Back Gouging:	



BASE METALS:		
Material	**Group 1 to Group 1**	
Specification:	**A 106 Gr.B**	
Type or Grade:	Groove: **3.0mm to 28mm**	
Thickness range:	Groove: **Unlimited**	Fillet: All
Diameter(pipe):		Fillet: All

FILLER METALS:	**GTAW**	**SMAW**
AWS Specification:	**AWS A 5.18**	**AWS A 5.1**
AWS Classification:	**ER70S-G**	**E 7016**
F. No :	**6**	**4**
A. No :	**1**	**1**
Size of filler metal:	**Ø 2.4 mm**	**Ø 2.6 - Ø 3.2 mm**
Trade name:	**TGS - 50 By KOBELCO / HUYNDAI**	**LINCOLN / KOBELCO / HUYNDAI**

SHIELDING:	**GTAW**	**SMAW**
Gas:	**Argon**	**N/A**
Percent Composition:	**99,95%**	**N/A**
Flow rate:	**8 – 14 litre/min**	**N/A**
Gas cup Size:	**5 – 8 mm**	**N/A**
Electrode – Flux	**N/A**	**N/A**

PREHEAT:

Preheat Temperature:	**Min. 25^0C**
Interpass	**Max. 250^0C**
Temperature:	**N/A**

Preheat Maintenance method:		
POST WELD HEAT TREATMENT: Temperature range: **N/A** Time range: **N/A**		
POSITION: Position of Groove: **6G** Position of Fillet: **ALL** Weding Progression(Up/Down): **UPHILL**		
ELECTRICAL CHARACTERISTICS:	**GTAW**	**SMAW**
Transfer Mode(GMAW):	**N/A**	**N/A**
Current:	**DCEN**	**DCEP**
Tungsten Electrode(GTAW):	**2%ThO_2**	**N/A**
TECHNIQUE:	**GTAW**	**SMAW**
Travel speed:	**SEE TABLE**	**SEE TABLE**
Stringer or Weave Bead:	**Stringer and Weaving**	**Stringer and Weaving**
Multi-pass or Single Pass:	**Single-Pass**	**Multi-Pass**
Number of Electrodes:	**1**	**1**
Peening:	**N/A**	**N/A**
Interpass Cleaning:	**Grinding and Brushing**	**Grinding and Brushing**
Contact tube to work distance:	**N/A**	**N/A**

WELDING PROCEDURE

Weld layer No.	Welding Process	Filler Metal		Current		Volts (V)	Travel Speed (Cm/min)	Heat input (Kj/mm)
		Class	Dia. (mm)	Polarity	Ampe (A)			
1st	GTAW	ER70S-G	2.6	DCEN	85 - 105	12 - 18	65 - 95	0.8 – 2.0
2nd And over	SMAW	E7016	3.2	DCEP	90 - 120	25 - 30	70 - 100	0.8 – 2.0
			2.6	DCEP	70 - 90	23 - 28	70 - 110	0.8 – 2.0

3.2.2.2. Words & phrases

- Backing
- Backing material
- Root Opening

- Root Face
- Groove Angle
- Back Gouging
- Material Specification
- Type or Grade
- Thickness range
- Diameter
- Position of Groove
- Position of Fillet
- Weding Progression
- Transfer Mode
- Current
- Tungsten Electrode
- Stringer and Weaving
- Single-Pass
- Stringer and Weaving
- Multi-Pass
- Grinding and Brushing

3.2.2.3 Questions

1. What is the welding process?
2. Does the root opening range from 1,5 mm to 0,5 mm?
3. What is the type or grade of the base metals?
4. What is the difference about the size of filler metal between GTAW & SMAW?
5. What kind of gas for GTAW is it?
6. Compare the travel speed between GATW's first weld layer and SMAW's 2nd and over weld layer?

ASSESSMENT OF STUDENTS' STUDY

N0	Criteria	Methods	Full marks	Results
I	**Knowlege**			
1	JOINT DESIGN USED	Answer the questions with reference to the WPS	**1**	
2	BASE METALS		**1**	
3	FILLER METALS		**1**	
4	SHIELDING		**1**	
5	PREHEAT		**1**	
6	POST WELD HEAT TREATMENT		**1**	

7	POSITION		**1**	
8	ELECTRICAL CHARACTERISTICS		**1**	
9	TECHNIQUE		**2**	
	Total:		**10**	
II	**Skills**			
1	- Read the WPS (drawings & numbers) fully & accurately	Checking the information in comparision with the WPS.	**5**	
2	- Explain the WPS (drawings & numbers) fully & persuasively.	Checking the information in comparision with the WPS.	**5**	
	Total:		**10**	
III	**Attitude**			
1	Be on time	Watching & taking notes	**2**	
2	No cheating	Watching & taking notes	**2**	
3	Be accurate & careful	Watching & checking	**2**	
4	Be self- confident	Watching	**2**	
5	Try to finish the work within time allowance	Watching & checking	**2**	
	Total:		**10**	

STUDY RESULTS

Criteria	Mark for task accomplishment	Coefficient	Total Mark
Knowledge		0,3	
Skills		0,5	
Attitude		0,2	
Total:			

UNIT 6: EQUIPMENT AND TOOLS FOR WELDING
Mã bài: MH 20.6

Giới thiệu:

Một trong những khâu quan trọng để hiểu rõ hơn về nghề hàn đó là việc tìm hiểu các thuật ngữ về các thiết bị, dụng cụ của nghề hàn. Lựa chọn đúng các thiết bị và dụng cụ cũng như hiểu một cách thấu đáo việc sử dụng chúng một cách an toàn và hiệu quả sẽ cho chất lượng mối hàn tốt nhất.

Mục tiêu:

- Liệt kê các thuật ngữ Tiếng Anh trong ngành hàn;
- Đọc hiểu các thiết bị và dụng cụ hàn bằng Tiếng Anh;
- Thực hành đọc hiểu các tài liệu Tiếng Anh về thiết bị và dụng cụ trong máy hàn;
- Dịch các tài liệu Tiếng Việt về thuật ngữ dụng cụ và thiết bị hàn sang Tiếng Anh.
- Nghiêm túc, hợp tác với giáo viên để hoàn thành bài học.

1. Vocabulary

Mục tiêu:

- Liệt kê được một số thuật ngữ về các thiết bị, dụng cụ của nghề hàn.
- Phát âm chuẩn và nắm vững nghĩa của các thuật ngữ đó.
- Tuân thủ các quy tắc phát âm theo ký hiệu phiên âm quốc tế.

1.1. Reading

- Welding equipment: Thiết bị hàn
- Welding head: Đầu hàn
- Torch welding (for inert gas arc welding): Mỏ hàn hồ quang (trong môi trường khí bảo vệ)
- Multi-operator welding set: Máy hàn nhiều vị trí
- Accessory : Đồ phụ tùng
- Maintain : Duy trì
- Manufacturer : Nhà sản xuất
- Capacity : Khả năng
- Overload : Quá tải
- Efficiently : Hiệu quả
- Duty : Công suất
- Transformer : Biến áp
- Single-phase : Một pha
- Three-phase : Ba pha
- Rectifier : Máy chỉnh lưu
- Alternating : Qua lại
- Inherent : Vốn có, cố hữu
- Control : Điều khiển
- Filter : Bộ lọc
- Inductor: Điện cảm
- Cable : Cáp điện
- Electrode holder : Kìm kẹp que hàn

- Working clamp : Kìm nối mát
- Weld-cleaning devide : Thiết bị làm sạch mối hàn
- Protective equipment : Thiết bị bảo vệ
- Diameter : Đường kính
- Depend on : Tùy thuộc vào
- Rubber coating : Lớp vỏ bọc cao su
- Reinforcement : Sự tăng cường, sự gia cố
- Grip : Sự kẹp chặt
- Well-insulated : Cách ly tốt
- Withstand : Chịu đựng, chống chịu
- Spring-grip : Lò xo kẹp
- Release : Cái ngắt điện
- Wire reel : Cuộn dây hàn
- Gas supply : Khí cấp
- Welding gun : Súng hàn
- Wire feed unit : Bộ cấp dây hàn
- Power supply : Nguồn cấp
- Flowmeter : Thiết bị đo lưu lượng
- Flow adjustment valve : Van chỉnh lưu lượng
- Cylinder pressure gauge : Đồng hồ đo áp lực

1.2. Explanation

- A **transformer** is a device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or *primary* winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic field through the *secondary* winding. This varying magnetic field induces a varying electromotive force (EMF), or "voltage", in the secondary winding. This effect is called inductive coupling.

- **Electrode holder** : Kìm kẹp que hàn

Dụng cụ kẹp và nối điện cho que hàn trong hàn hồ quang tay.

- A **rectifier** is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as **rectification**.

1.3. Examples


- The typical GMAW **welding gun** has a number of key parts—a control switch, a contact tip, a power cable...

- A **power supply** is a device that supplies electric power to one or more electric loads

-  As the name implies a **Flow Meter** is an instrument for monitoring, measuring, or recording the rate of flow, pressure...

2. Grammar: Conjunctions

Mục tiêu:

- Trình bày được cách sử dụng của các liên từ.
- Đặt được câu với các liên từ đó.
- Tuân thủ nghiêm túc, chuẩn xác cách sử dụng các liên từ.

2.1.Co-ordinating conjunctions: ***and, but, both … and, or, either … or, neither … nor, not only … but also.***

2.1.1. Uses

Coordinating conjunctions connect words, phrases, and clauses. Look at the examples that follow:

2.1.2. Examples

- The bowl of squid eyeball stew is hot ***and*** delicious.
- The squid eyeball stew is so thick that you can eat it with ***either*** a fork ***or*** spoon.
- Rocky, my orange tomcat, loves having his head scratched ***but*** hates getting his claws trimmed.
- Rocky terrorizes the poodles next door ***yet*** adores the German shepherd across the street.
- Rocky refuses to eat dry cat food, ***nor*** will he touch a saucer of squid eyeball stew.
- I hate to waste a single drop of squid eyeball stew, ***for*** it is expensive and time-consuming to make.
- He makes butt joint ***and*** tee joint
- He works quickly ***and/but*** accurately.
- The construction is beautiful ***but*** dangerous
- ***Not only*** skillful ***but also*** active when do some weld jobs.

2.2. Coordinatin conjunctions: ***Besides, however, nevertheless, otherwise, so, therefore, still.***

2.2.1. Uses

These adverbs/conjuntions can join clauses or sentences and are then often known as “conjunts”. Their position will vary according to how they are used.

2.2.2. Examples

- Even though I added cream to the squid eyeball stew, Rocky ignored his serving, ***so*** I got a spoon and ate it myself.

- Everyone was sure that the company would offer John a promotion. ***Howeve***r, John decided to go work for a new company.

- He chose the right welding tools. ***Therefore***, the joint was very nice.

3. Main text

Mục tiêu:

- Trình bày được đặc điểm của các loại thiết bị và dụng cụ hàn.
- Đọc và trả lời được các câu hỏi liên quan đến nội dung bài đọc.
- Thực hiện nghiêm túc và hiệu quả kĩ năng đọc hiểu.

3.1. Welding machine

3.1.1. Reading

The success of welding as a metal-joining process rests on the fact that a good weld with common steels is as strong or stronger than the plate in which it is made. This success has been established through the years by the gradual development of welding machines, accessories and electrodes that satisfy the complex requirements of the arc process.

Figure 6.1

Arc welding requires a continuous supply of electric, current, sufficient in amount (amperes) and of proper voltage to maintain an arc. The current may be either alternating AC or direct DC, but it must be provided through a source that can be adjusted.

Welding machines are rated according to their current output, voltage, and duty cycle and are available in a wide range of sizes. The national electrical manufacturers association establishes minimum standards for rating welding machines and most manufacturers follow these standards. The standards are established on a conservative basis, requiring a rating well below the maximum overload capacity of the machine so that it will provide safe operation efficiently over a long period of the time. Ratings are given with a percentage duty cycle. The duty cycle of a welder is the percentage of a ten-minute period that a welder can operate at a given output current setting. If a welder is rated 300 amperes at a 60% duty cycle, it means that the machine can be operated safely at 300 amperes welding current for 6 out of every 10 minutes. If this duty cycle is reduced in actual operation, the maximum permissible current is increased. At 35% duty cycle, a 300 ampere machine could be operated at 375 amperes.

Transformer welders are available for operation on single-phase power lines. They transform high-voltage-low-ampereinput current to a low-voltage – high-amperage welding current.

3.1.2. Words & phrases

- accessories
- a metal-joining process
- alternating AC or direct DC
- current output
- voltage
- a conservative basis
- duty cycle
- single-phase power lines
- high-voltage-low-ampereinput current
- welding current

3.1.3. Questions

1. How can we maintain an arc?
2. Is the current alternating AC or direct DC?
3. How can welding machines rated?
4. Are there any standards for welding machines?
5. With what are ratings given? How long is the duty cycle of a welder?
7. What can be inferred if a welder is rated 300 amperes at a 60 % duty cycle?
8. What will happen if this duty cycle is reduced?
9. On which power line are transformer welders available for operation?
10. Can transformer welders transform high- voltage- low- ampere input current to a low one?

3.2. Tools for welding

3.2.1 Reading

Rectifier sets are basically three-phase or single-phase transformers to which have been added silicon or other rectifiers to change the output current from alternating to direct current. These machines have the basic control and output characteristics that are inherent in transformers (Figure 6.2).

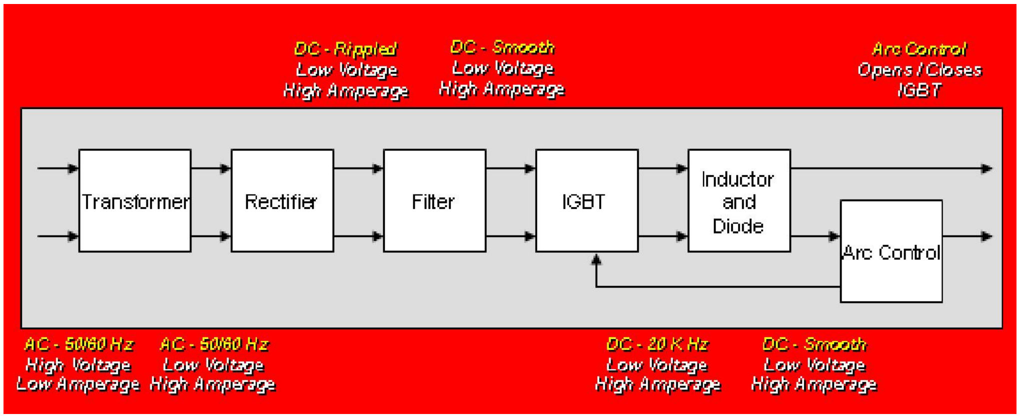


Figure 6.2

Current-carrying cables, cable lugs, electrode holder, working clamp, weld-cleaning devides, protective equipment are essential for each welding machine and operator. These are called accessories.

The size (diameter) of the cables used in welding varies, depending upon the capacity of the machine and the length o cable required. Cable size is selected carefully because of its current carrying capacity (Figure 6.3).

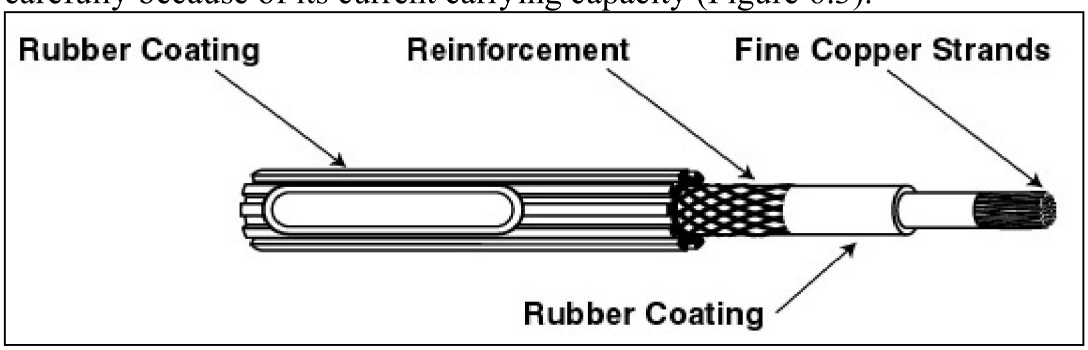


Figure6.3

The electrode holder (figure 6.4) grips the electrode during the welding process. This holder should be reasonably light, well-insulated, and sturdy enough to withstand the wear of continual handling. A spring-grip holder for quick insertion or release of the electrode is best

Figure 6.4

A work clamp (figure 6.5) fastened to the work or the table on which the work is mounted completes the welding circuit. A spring-pressure work clamp is the quickest and easiest to use.

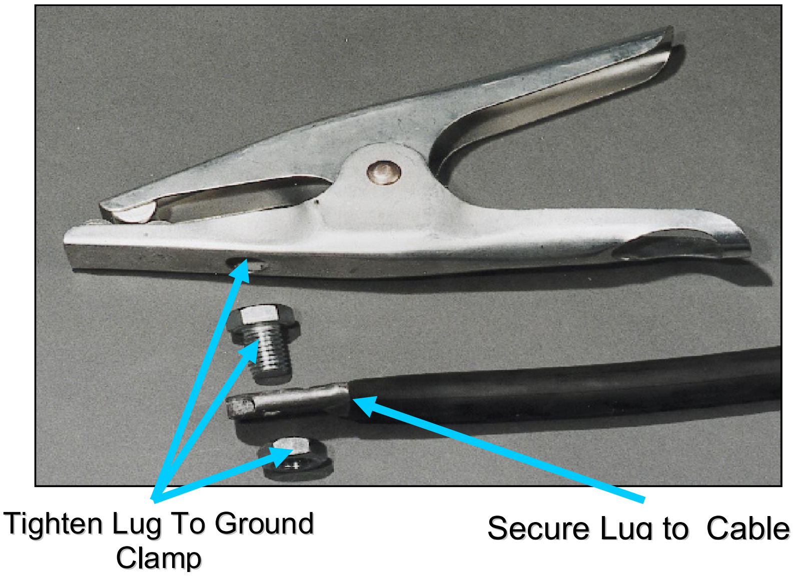


Figure 6.5

A shield for the face and eyes is necessary for protection from arc rays and heat, and the spatter of molten metal

Welding Shield or Helmet.

A welding shield or helmet is necessary for protection from arc ray and heat, and the spatter from the molten metal. The arc is viewed through a filter that reduces the intensity of the radiation, but allows a safe amount of light to pass for viewing the weld pool and the end of the electrode.

MANUAL METAL ARC WELDING (Figure 6.6)

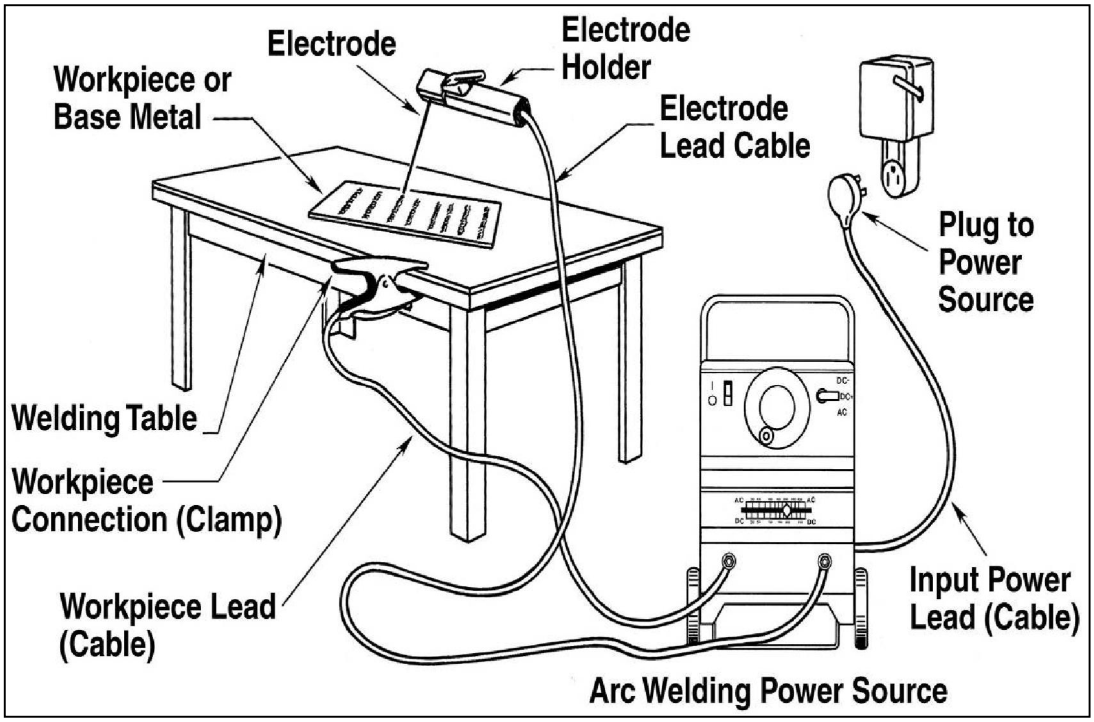


Figure 6.6

WELDING SETS

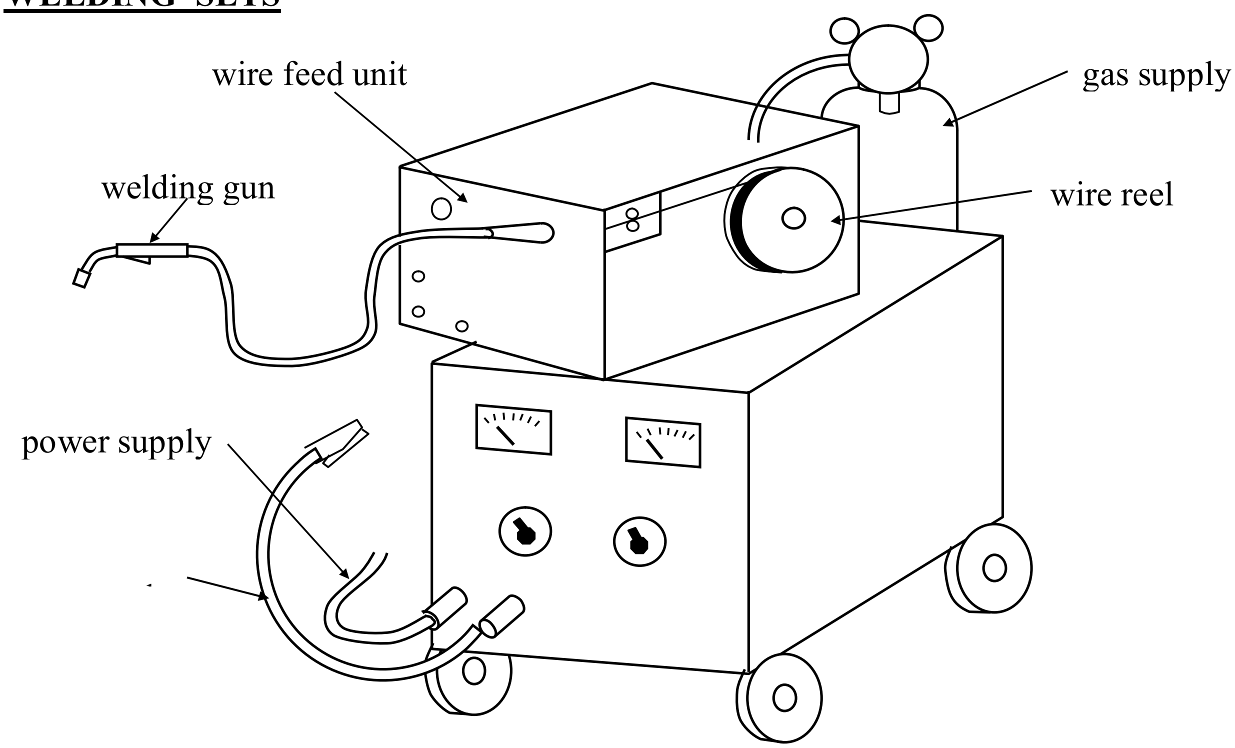


Figure6.7

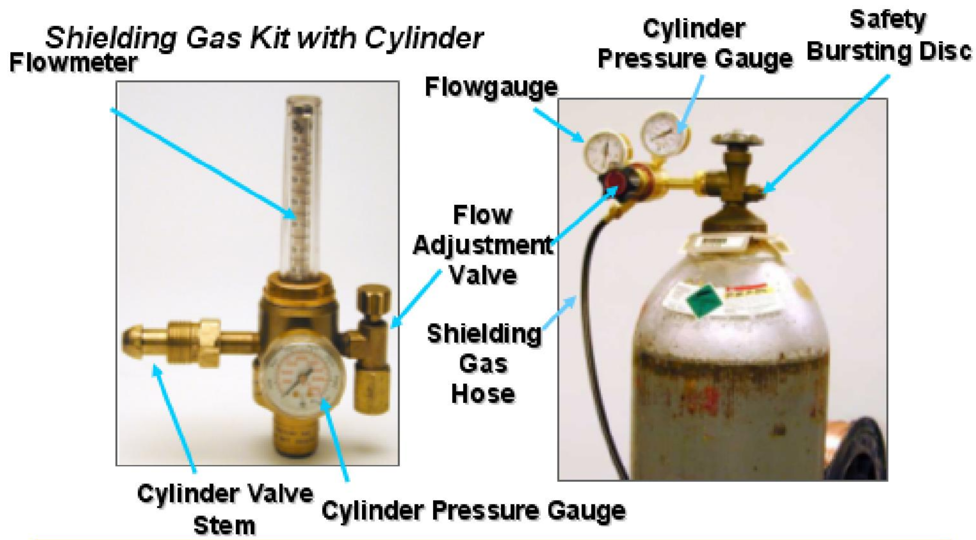


Figure 6.8

3.2.2. Words & phrases

- single-phase transformers
- inherent
- alternating to direct current
- cable lugs
- current-carrying cables
- welding circuit
- a spring-pressure work clamp
- a welding shield
- radiation
- the spatter
- weld pool

3.2.3. Questions

1. What is the advantage of the rectifier sets?
2. Name some kinds of accessories for each welding machine & operator?
3. Does the cable size vary? How?
4. Why should welders choose the cable size carefully?
5. What is the coating of the cable made of?
6. What is the function of the electrode holder?
7. What sort of work clamp is the quickest and easiest to use?
8. What are some of the features of the holder?
9. Why does the welder have to wear a welding shield or helmet?
10. Where should welders put the work pieces or base metals?

FINAL TEST

TEST 1

1. Pipe welding codes are set up by:
   a. Welding operators.
   b. State governments.
   c. Associations, societies, insurance companies, manufacturers and the military.
   d. Construction unions.

2. The different grain structure between the weld deposit and the base metal can be determined by:
   a. A face bend test.
   b. A root bend test.
   c. A hardness test.
   d. An etching test.

3. A root bend test is used to test the amount of weld:
   a. Ductility.
   b. Elongation.
   c. Hardness.
   d. Penetration.

4. What would be observed if a fillet weld were sectioned and macro-etched?
   a. The grain of the other beads is coarser than the final bead.
   b. The penetration and fusion into the root is very deep.
   c. Each bead appears to be distinctly separated from the adjoining beads.
   d. The grain structure remains the same in all passes.

5. What is the most common cause of failure in root bend tests?
   a. Too high a current setting.
   b. Too long a pause in the down cycle of the weave.
   c. Lack of fusion and penetration.
   d. Too high a travel speed.

6. The purpose of a nick break specimen is to provide a test for:
   a. Tensile strength and fracture appearance.
   b. Ductility and fracture appearance.
   c. Elongation and fracture appearance.
   d. Soundness and fracture appearance.

7. Which organisation publishes the most commonly used code for boiler and pressure vessel welding?

a. American Welding Society.
b. American Society of Mechanical Engineers.
c. American Petroleum Institute.
d. American National Standards Institute.

8. The second run in a three run butt weld using the stovepipe technique is known as the:
   a. Filling run.
   b. Hot pass.
   c. Intermediate run.
   d. Sealing run.

9. Which type of electrode coating gives the most voluminous gas shield?
   a. Rutile.
   b. Basic.
   c. Oxidising.
   d. Cellulosic.

10. Which of the following steels is likely to be more susceptible to hydrogen cracking?
    a. Carbon equivalent of less than 0.25 %.
    b. Carbon equivalent of 0.35%.
    c. Carbon equivalent of 0.38%.
    d. Carbon equivalent of 0.43%.

11. Preheating and interpass heating are used primarily for:
    a. Aiding fusion.
    b. Reducing hydrogen content of weld preparation prior to welding.
    c. Ensure a fine grain size.
    d. Slow down the cooling rate after welding.

12. Submerged arc welds made with re-cycled flux are liable to:
    a. Porosity.
    b. Course grain size.
    c. Undercut.
    d. Incomplete penetration.

13. Incomplete penetration in a single 'V' butt joint could be caused by:
    a. Too large a root gap.
    b. Too small a root gap.
    c. Too high a heat input.
    d. Too small a root face.

14. In submerged arc welding, which of the following width to depth ratios would be likely to result in solidification cracking?

a. 1 : 3.
b. 3 : 1.
c. 2 : 1.
d. 1 : 1.

15. You are responsible for controlling welding on site. A large incidence of porosity has been reported in recent welding. Would you investigate?
    a. The electrode type.
    b. Power source.
    c. Electrode storage.
    d. Day temperature.

16. The main reason why all adhering scale should be removed when the pipe end preparation is made by oxy-gas cutting is?
    a. Oxidisation of the weld metal is minimised.
    b. The speed of welding is increased.
    c. Pipe bore alignment is made easier.
    d. Reduction of the weld deposit is prevented.

17. When manual metal arc welding low carbon steel, which electrode covering will give the greatest degree of penetration?
    a. Iron powder.
    b. Rutile.
    c. Cellulosic.
    d. Low hydrogen.

18. When tungsten arc gas shielded welding stainless steel, which one of the following should be used?
    a. Alternator.
    b. A. C. transformer.
    c. D. C. generator.
    d. Constant potential rectifier.

19. Which gas shroud should be used when tungsten arc gas shielded welding aluminium alloys?
    a. Nitrogen.
    b. Carbon dioxide.
    c. Argon/carbon dioxide mixture.
    d. Argon.

20. The most common type of defect found in a structure when it is undergoing service is:
    a. Fatigue cracking.
    b. Crystallisation.
    c. Weld decay.

d. Stress fracture.

21. In the examination of a welded aluminium joint, macro etching may reveal:
    a. Lack of inter-run penetration.
    b. Carbon pick-up.
    c. Weld decay.
    d. Micro cracks.

22. MMA welds made with damaged electrode coatings are subject to:
    a. Porosity.
    b. Undercut.
    c. Excessive penetration.
    d. Excessive bead height.

23. Which of the following destructive tests is not normally required for welder approval?
    a. Bend tests.
    b. Macro examination.
    c. Impact tests.
    d. Fracture tests.

24. Too large a diameter of filler rod should not be used to make a welded joint because:
    a. Excess reinforcement profile will be difficult to obtain.
    b. The included bevel angle will have to be reduced.
    c. Root fusion may be difficult to obtain.
    d. The gap setting will have to be changed.

25. If pipe bores are not matched correctly it can result in:
    a. Lack of root penetration.
    b. Incorrect gap setting.
    c. Excessive root faces.
    d. Overheating during welding.

26. A correctly made tack weld should slope from the middle to the ends in order to:
    a. Aid better penetration at the join-up.
    b. Prevent porosity at the join-up.
    c. Reduce the electrode size required.
    d. Reduce the overall consumable consumption.

27. Two low carbon steel pipes, 150mm diameter and 6mm wall thickness, are to be butt welded using the TIG process. To ensure a full strength joint, which of the following preps is most suitable?

a. Open single bevel.
b. Open single Vee.
c. Open square preparation.
d. Closed square preparation

TEST 2

1. The British code for visual inspection requirements is:
   a. BS 4872
   b. BS 499
   c. BS 4870
   d. None of the above

2. A code of practice for visual inspection should include the following:
   a. Before, during and after welding activities
   b. Before welding activities only
   c. After welding activities only
   d. None of the above

3. Incomplete root penetration in a butt joint could be caused by:
   a. Excessive root face width
   b. Excessive root gap size
   c. Low current setting
   d. Both A and C

4. Incomplete root fusion would certainly be caused by:
   a. Linear misalignment
   b. Incorrect tilt angle
   c. Differing root face widths
   d. All of the above

5. When visually inspecting a completed single vee butt weld cap, you would certainly assess:
   a. Cap height
   b. Toe blend
   c. Weld width
   d. All the above

6. You notice a very 'veed' ripple shape. This is most likely caused by:
   a. Poor consumable choice
   b. Welding position
   c. Excessive travel speed
   d. All the above

7. Toe blending is important as it may affect:
   a. Corrosion
   b. Fatigue life
   c. Overlap type defects
   d. All the above

8. Slag inclusions would occur with:
   a. Manual metal arc
   b. Metal inert gas
   c. Submerged arc welding
   d. Both A and C

9. Undercut is principally caused by:
   a. Excessive amps
   b. Excessive volts
   c. Excessive travel speed
   d. All the above

10. Undercut is normally assessed by:
    a. Its depth
    b. Its length
    c. It's blending
    d. All the above

11. A welding procedure is useful to:
    a. Give information to the welder
    b. Give information to the inspector
    c. Give confidence to a product
    d. All the above

12. An essential variable may:
    a. Change the properties of a weld
    b. Influence the visual acceptability
    c. Require re-approval of a weld procedure
    d. All the above

13. A magnifying glass may be used during visual inspection, but BS 5289 states that its magnification should be:
    a. Up to 5 ∅
    b. 2 to 2.5 ∅
    c. 5 to 10 ∅
    d. None of the above

14. When visually inspecting a fillet weld it would normally be sized by:

- a. The leg lengths
- b. The actual throat thickness
- c. The design throat thickness
- d. Both A and C

15. A planar defect is:
    - a. Incomplete fusion defects
    - b. Slag inclusion
    - c. Incomplete penetration
    - d. Both A and C

16. Penetrant inspection and magnetic particle inspection are mainly used:
    - a. To aid visual inspection
    - b. Because the application says so
    - c. To confirm visual uncertainties
    - d. All the above

17. Defects outside the limits specified in a standard should always be:
    - a. Repaired
    - b. Reported to 'a senior person'
    - c. Assessed along with other defects
    - d. All the above

18. MIG welding tends to be susceptible to lack of fusion problems. This is because of:
    - a. Poor maintenance of equipment
    - b. Incorrect settings
    - c. Poor inter-run cleaning
    - d. All the above

19. MMA electrodes can be grouped into three <u>main</u> types. These are:
    - a. Basic, cellulosic and rutile
    - b. Neutral, cellulosic and rutile
    - c. Basic, cellulosic and neutral
    - d. None of the above

20. The main cause of porosity in welded joints is:
    - a. Poor access
    - b. Loss of gas shield
    - c. 'Dirty' materials
    - d. All the above

21. Cracks in welds may be due to:
    - a. Solidification problems
    - b. Hydrogen problems

c. Excessive stresses
d. All the above

22. A weave technique may give rise to:
    a. Better profiles
    b. Improved toe blending
    c. Improved ripple shape
    d. All the above

23. With reference to a root penetration bead you would certainly assess:
    a. Root fusion and penetration
    b. Root concavity
    c. Burnthrough
    d. All the above

24. In a fatigue failure the appearance of the fracture surface is characteristic. It would be:
    a. Rough and torn
    b. 'Chevron'-like
    c. Smooth
    d. None of the above

25. Stray arcing may be regarded as a serious defect because:
    a. It may reduce the thickness dimension of a component
    b. It may cause loquation cracks
    c. It may cause hard zones
    d. All the above

26. Overlap in welds could be influenced by:
    a. Poor welding technique
    b. Welding process
    c. Welding position
    d. All the above

27. Flame cut preparations may, during welding, increase the likelihood of:
    a. Cracking
    b. Misalignment problems
    c. Inclusions
    d. All the above

28. Macroscopic examination requires any specimen to be inspected:
    a. Once, after etching
    b. Twice, before and after etching
    c. Using a microscope
    d. None of the above

29. Which of the following may be classed as a more serious defect:
    a. Slag inclusions
    b. Fusion defects (inter-run)
    c. Fusion defects (surface)
    d. Porosity

30. A code of practice is:
    a. A standard for workmanship only
    b. A set of rules for manufacturing a specific product
    c. Levels of acceptability of a weldment
    d. None of the above

TEST 3

1. The ability of a material to withstand a load pulling it apart is called its _________.

2. The ability of a material to be stretched out without breaking is called _______.

3. An Izod impact machine is used to give indication of the _______ of a material.

4. The ability to withstand indentation is called _______.

5. Lack of ductility is called _______.

6. The property of a metal to return to its original shape is called _______.

7. Increase in carbon content causes an _______ in strength and hardness.

8. When carbon percentage increases, there is a decrease in _______.

9. Low carbon steel contains less than _______ carbon.

10. Low ductility in a weld metal could result in _______.

11. Alloying is used to _______ mechanical and physical properties of a steel.

12. Sulphur and phosphorus are not alloying elements; they are _______.

13. Alloying allows designers to use _______ sections and still have the same strength.

14. An alloy that contains a high percentage of chromium and nickel would have resistance to _______.
15. Quenching a carbon or low alloy steel will result in an _______ in hardness and a _______
in ductility.
16. The hard constituent that results when steel is quenched is called _______.
17. The tough laminated structure that is formed on slow cooling of ferrite and iron carbide
(cementite) is called _______.
18. The amount of martensite formed depends on the speed of _______ and the percentage
of _______.
19. After quenching, the structure may be improved by reheating to 200-300°C. This is called
________.
20. Small percentages of chromium will increase the strength and _______, while a small percentage of nickel will increase _______.

FINAL ASSESSMENT OF STUDENTS' STUDY

N0	Criteria	Methods	Full marks	Results
I	**Knowlege**			
1	Pipe welding codes	Answer the questions with reference to the main texts	**0.5**	
2	The weld deposit and the base metal	Answer the questions with reference to the main texts	**0.5**	
3	A root bend test	Answer the questions with reference to the main texts	**0.5**	
4	A fillet weld	Answer the questions with reference to the main texts	**0.5**	
5	The most common cause of failure in root bend tests	Answer the questions with reference to the main texts	**0.5**	
6	A nick break specimen	Answer the questions with reference to the main texts	**0.5**	
7	Organisation publishes the most commonly used code for boiler and pressure	Answer the questions with reference to the main texts	**0.5**	

	vessel welding			
8	Type of electrode coating gives the most voluminous gas shield	Answer the questions with reference to the main texts	**0.5**	
9	Steels are likely to be more susceptible to hydrogen cracking	Answer the questions with reference to the main texts	**0.5**	
10	Preheating and interpass heating	Answer the questions with reference to the main texts	**0.5**	
11	Submerged arc welds made with re-cycled flux	Answer the questions with reference to the main texts	**0.5**	
12	Incomplete penetration in a single 'V' butt joint	Answer the questions with reference to the main texts	**0.5**	
13	The main reason why all adhering scale should be removed when the pipe end preparation is made by oxy-gas cutting	Answer the questions with reference to the main texts	**0.5**	
14	Gas shroud should be used when tungsten arc gas shielded welding aluminium alloys	Answer the questions with reference to the main texts	**0.5**	
15	The most common type of defect found in a structure when it is undergoing service	Answer the questions with reference to the main texts	**0.5**	
16	MMA welds made with damaged electrode coatings	Answer the questions with reference to the main texts	**0.5**	
17	Too large a diameter of filler rod should not be used to make a welded joint	Answer the questions with reference to the main texts	**0.5**	
18	If pipe bores are not matched correctly	Answer the questions with reference to the main texts	**0.5**	
19	A correctly made tack weld should slope from the middle to the ends	Answer the questions with reference to the main texts	**0.5**	
20	The second run in a	Answer the questions with	**0.5**	

	three run butt weld using the stovepipe technique	reference to the main texts		
Total:			**10**	
II	**Skills**			
1	The answers must be clearly & fully organized.	Checking the information in the answers	**2.5**	
2	Data are correct	Check the data in both the answers and the mai texts	**2.5**	
3	Explanation is persuasive	Check the information	**2.5**	
4	The answers should be logical	Check the order of the information	**2.5**	
Total:			**10**	
III	**Attitude**			
1	Be on time	Watching & taking notes	**2**	
2	No cheating	Watching & taking notes	**2**	
3	Be accurate & careful	Watching & checking	**2**	
4	Be self- confident	Watching	**2**	
5	Try to finish the work within time allowance	Watching & checking	**2**	
Total:			**10**	

STUDY RESULTS

Criteria	Mark for task accomplishment	Coefficient	Total Mark
Knowlege		0,3	
Skills		0,5	
Attitude		0,2	
Total:			

ANSWER KEYS

UNIT 1

3.1.3

1. Main ideas of the paragraph:
- A method of joining two pieces of metal into one solid piece.
- How is the electric welding arc made, its temperature & functions
- The features of arc welding
- Types of welding machines & their functions

2. Arc welding is a manual skill requiring a steady hand, good general physical conditions, and good eyesight. The operator controls the welding arc and, therefore, the quality of the weld made.

3. The " arc stream " is seen in the middle of the picture. This is the electric arc created by the electric current flowing through the space between the end of the electrode and the work. The temperature of this arc is about 6000^0C, which is more than enough to melt metal. The arc is very bright, as well as hot, and cannot be looked at with the naked eye without risking paintful, though usualy temporary, injury.

4. The electric arc is made between the work and the tip and of a small metal wire, the electrode, which is clamped in a holder and held in the hand. A gap is made in the welding circuit by holding the tip of the electrode 1/16''-1/8'' away from or base metal being welded. The electric current jumps this gap and make an arc, which is held and moved along the joint to be welded, melting the metal as it is moved.

5. Motor-generators, engine-driven generators, transformers, rectifiers, and combination transformer and rectifiers.

3.2.3

* ***These are some standards that are used for welding***

12. ASME (American society of machanical engineers): include:
13. ASME boiler& pressure vessel code
14. ASME code for pressure piping
15. AWS (American welding society)
16. AWS D1.1- steel structural welding code
17. API (American Welding Institute) :
18. API 650 – welding storage tanks for oil storage
19. API 1104 – welding of pipelines and related facilities
20. ISO (International Standardization Organization)
21. EN (European Nations)
22. JIS – Japanese Industrial Standards

<u>UNIT 2</u>

3.1.3

1. There are numerous types of welded: butt, T, corner, lap and edge joints
2. There are four basic welding positions: FLAT (F), VERTICAL (V), OVERHEAD (OH); HORIZONATAL (H).
3. Welding in the flat position is much faster and easier than any of other positions.
4. A weld butt joint can be made square, double-square, single-bevel, double-bevel, single-V, double-V, or by four other joint configurations.

3.2.3

1. A fillet weld is the joint of 2 pieces of material, usually at a 90 degree angle.

- The square-groove is a butt welding joint with the two pieces being flat and parallel to each other. This joint is simple to prepare, economical to use, and provides satisfactory strength, but is limited by joint thickness. The closed square butt weld is a type of square-groove joint with no spacing in between the pieces. This joint type is common with gas and arc welding.

2. Single-bevel butt welds are welds where one piece in the joint is beveled and the other surface is perpendicular to the plane of the surface. These types of joints are used where adequate penetration cannot be achieved with a square-groove and the metals are to be welded in the horizontal position. Double-bevel butt welds are common in arc and gas welding processes. In this type both sides of one of the edges in the joint are beveled.

- Single-V butt welds are similar to a bevel joint, but instead of only one side having the beveled edge, both sides of the weld joint are beveled. In thick metals, and when welding can be performed from both sides of the work piece, a double-V joint is used. When welding thicker metals, a double-V joint requires less filler material because there are two narrower V-joints compared to a wider single-V joint. Also the double-V joint helps compensate for warping forces. With a single-V joint, stress tends to warp the piece in one direction when the V-joint is filled, but with a double-V-joint, there are welds on both sides of the material, having opposing stresses, straightening the material.

3. Single-J butt welds are when one piece of the weld is in the shape of a *J* that easily accepts filler material and the other piece is square. A J-groove is formed either with special cutting machinery or by grinding the joint edge into the form of a J. Although a J-groove is more difficult and costly to prepare than a V-groove, a single J-groove on metal between a half an inch and three quarters of an inch thick provides a stronger weld that requires less filler material. Double-J butt welds have one piece that has a *J* shape from both directions and the other piece is square.

- Single-U butt welds are welds that have both edges of the weld surface shaped like a J, but once they come together, they form a U. Double-U joints have a U formation on both the top and bottom of the prepared joint. U-joints are the most expensive edge to prepare and weld. They are usually used on thick base metals where a V-groove would be at such an extreme angle, that it would cost too much to fill.

UNIT 3

3.1.5.

1.An irregular groove at a toe of a run in the parent metal or in previously deposited weld metal. If created sub-surface it becomes a very effective slag trap in the body of the weld.

2. Undercut is essentially a notch that in turn becomes a focal point for stress loading, thereby reducing the fatigue life of the joint.

3. Causes - current too high, voltage too high, travelspeed too high, electrode too small, electrode angle.
4. An imperfection at the toe or root of a weld
caused by weld metal flowing on to the surface of the
parent plate without fusing to it.
- Causes - slow travel speed, large electrode, tilt angle,
poor pre-cleaning.
5. A crack is a linear discontinuity produced by fracture. Cracks may be longitudinal, transverse, edge, crater, centreline, fusion zone, underbead, weld metal or parent metal
6. There are 4 types of root defects: *Incomplete root penetration; Lack of root fusion; Excess penetration bead; Root concavity.*
- Causes of root concavity - purge pressure, wide root gap, and residual stresses
in root.

3.2.5
1. In welds, incompletely fused spots, called lack of fusion, persist. A weld can lack union with the parent metal or with a previous weld bead. An adhesion joint forms, which can be rather strong in certain cases. It is much like a brazed joint or joint formed in metallisation. The purer lack of fusion is, the more difficult it is to detect it.
2. It was found in metallographic examinations that in a weld three types of lack of fusion can be found:

- pure lack of fusion or lack of fusion due to melted oxide inclusions,

- open lack of fusion,

- lack of fusion consisting of non-metallic inclusions.

+ The pure lack of fusion is a structural defect. In this case the molten metal sticks to the parent metal which has not melted enough during welding. A joint between the solid phase and the liquid one forms. It is like a brazed joint. This type of lack of fusion cannot be detected by non-destructive testing methods but with a microscopic inspection

+ Because of internal stresses produced during weld solidification and cooling, the faces sticking to each other will separate. A void having a width of only some hundredths of a millimeter forms. This gap in the weld is very muck like a crack. It can, however, be detected by non-destructive testing methods. Such a type of lack of fusion is difficult to distinguish from a crack.

+ Where the lack of fusion is there are very often also oxides and non-metalic inclusions. Such a case is shown in Fig.12. If the oxide layer does not melt, the inclusions are uniformly distributed across the entire surface of the lack-of-fusion defect. If they melt, however, the non-metallic inclusions become spherical.

3. The lack of fusion is a planar defect. It may appear at the edge of the parent metal or between runs. The lack of fusion between the parent metal and the weld metal shows a flat face. The lack of inter-run fusion, however, shows an irregular shape.

The lack of fusion is usually to be found at the weld inside. It rarely reaches the final runs or the root run.

4. It was found in metallographic examinations that in a weld three types of lack of fusion can be found:

- pure lack of fusion or lack of fusion due to melted oxide inclusions,
- open lack of fusion,
- lack of fusion consisting of non-metallic inclusions.

5. A depression left at the termination of the weld where the weld pool is left unfilled.

6. Longitudinal Crack; Transverse Crack; Crater Crack; Throat Crack; Toe Crack

Root Crack; Underbead Crack; Hot Crack; Cold Crack; Repairs to Cracks;

7. **HotCrack**

Definition: A crack in the weld that occurs during solidification.

Cause: Micro stresses from weld metal shrinkage pulling apart weld metal as it cools from liquid to solid temp.

Prevention: Preheat or use a low tensile filler material.

Repair: Remove and reweld, correct problem first, preheat may be necessary, increase weld size.

Cold rack

Definition: A crack that occurs after the metal has completely solidified

Cause: Shrinkage, Highly restrained welds, Discontinuities

Prevention: Preheat, weld toward areas of less constraint, use a more ductile

weld metal
Repair: Remove and reweld, correct problem first, preheat may be necessary.
8.**Repairs to Cracks**
Determine the cause
Correct the problem
Take precautions to prevent reoccurrence
Generally required to repair using a smaller electrode

9. Porosity in welding is a result of dissolved gases or gases released during the welding process, being trapped in the metal when there is insufficient time to escape prior to solidification. If in the shape of rounded holes, the gas is called spherical porosity or just porosity. However, if elongated the terminology is wormholes or piping. Causes of porosity are;

- excessively long or short arc length
- welding current too high
- insufficient or moist shielding gas
- travel speed to fast
- base metal covered with oil, grease, moisture etc.
- wet, unclean or damaged electrodes.

10. **Slag** is the residue left on a weld bead from the flux. It shields the hot metal from atmospheric contaminants that may weaken the weld joint. Slag can also be globules of molten metal that are expelled from the joint and then re solidify on the metal surface in either case, they are usually chipped away with a slag hammer
Slag or other foreign matter entrapped during welding. The defect is more irregular in shape than a gas pore.

UNIT 4
3.1. 3
1. Shielded metal arc welding (SMAW), also known as manual metal arc (MMA) welding, flux shielded arc welding, stick, and electric arc welding is a constant current drooping arc process (Figure 17).
2. In manual metal arc welding the heat source is an electric arc, which is formed between a consumable electrode and the parent plate.
3. The arc is formed by momentarily touching the tip of the electrode unto the plate and then lifting the electrode to give a gap of 3 mm – 6 mm between the tip and the plate.
4. As the electrode melts, the flux covering disintegrates, giving off shielding gases that protect the weld area from oxygen and other atmospheric gases. In addition, the flux provides molten slag which covers the filler metal as it travels

from the electrode to the weld pool. Once part of the weld pool, the slag floats to the surface and protects the weld from contamination as it solidifies.
5. Yes, it is. It protects the weld from contamination as it solidifies.
6. The choice of electrode and welding position also determine the welding speed.
7. Flat welds require the least operator skill, and can be done with electrodes that melt quickly but solidify slowly.
8. Yes, it can.
9. Shallow penetration, another detriment to weld strength, can be addressed by decreasing welding speed, increasing the current or using a smaller electrode.
10. High carbon, alloy or sulfur content in the base material can lead to cracking, especially if low-hydrogen electrodes and preheating are not employed.
11. SMAW welding, like other welding methods, can be a dangerous and unhealthy practice if proper precautions are not taken. The process uses an open electric arc, which presents a risk of burns which are prevented by personal protective equipment in the form of heavy leather gloves and long sleeve jackets.
12. SMAW is often used to weld carbon steel, low and high alloy steel, stainless steel, cast iron, and ductile iron.

3.2.3

1. Gas metal arc welding (GMAW), sometimes referred to by its subtypes metal inert gas (MIG) welding or metal active gas (MAG) welding, is a welding process in which an electric arc is formed between a consumable wire electrode and the workpiece metal(s), which heats the workpiece metal(s), causing them to melt, and join.
2. The process can be semi-automatic or automatic.
3. There are four primary methods of metal transfer in GMAW, called globular, short-circuiting, spray, and pulsed-spray, each of which has distinct properties and corresponding advantages and limitations.
4. Today, GMAW is the most common industrial welding process, preferred for its versatility, speed and the relative ease of adapting the process to robotic automation.
5. With a 'flat' volts/amps characteristic an attempted alteration in arc length (volts) will have little effect, hence arc length (volts) remains constant but a significant change in current will result. This is often referred to as the 'self-adjusting arc'.
6. Yes, it can.

3.3.3

1. Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is an arc welding process that uses a non - consumable tungsten electrode to produce the weld.

2. GTAW is most commonly used to weld thin sections of stainless steel and non-ferrous metals such as aluminum, magnesium, and copper alloys.
3. GTAW is comparatively more complex and difficult to master, and furthermore, it is significantly slower than most other welding techniques.
4. Yes, it is.
5. wolfram inert gas – WIG

3.4.3

1. An **inert gas** is a gas which does not undergo chemical reactions under a set of given conditions. The noble gases and nitrogen often do not react with many substances.[1] Inert gases are used generally to avoid unwanted chemical reactions degrading a sample. These undesirable chemical reactions are often oxidation and hydrolysis reactions with the oxygen and moisture in air. The term *inert gas* is context-dependent because nitrogen gas and several of the noble gases can be made to react under certain conditions.
- Purified nitrogen and argon gases.
- Shielding gas.
2. GMAW - It is an arc welding process that incorporates the automatic feeding of a continuous, consumable electrode that is shielded by an externally supplied gas.
3. With GMAW, welding speed is faster, no slag is produced, there is deeper penetration, and the electrode wires are continuously fed so that longer welds can be made.
4. Shielded metal arc welding (SMAW), also known as manual metal arc (MMA) welding, flux shielded arc welding, stick, and electric arc welding is a constant current drooping arc process (Figure 17).

In manual metal arc welding the heat source is an electric arc, which is formed between a consumable electrode and the parent plate. The arc is formed by momentarily touching the tip of the electrode unto the plate and then lifting the electrode to give a gap of 3 mm – 6 mm between the tip and the plate. When the electrode touches the plate, current commences to flow and as it is withdrawn the current continues to flow in the form of a small spark across the gap, which will cause the air in the gap to become ionized, or made conductive. As a result of this, the current continues to flow even when the gap is quite large. The heat generated is sufficient to melt the parent plate and also melt the end of the electrode – the molten metal so formed is transferred as small globules across the arc into the molten pool.

5. Metal Inert Gas (MIG) welding is a 'flat' arc process (constant) voltage. Also known as Metal Active Gas (MAG); CO2; Metal-arc Gas Shielded, flux core and GMAW (US). MIG can be used on all materials, in all positions, with high productivity and low heat input. There is no CO2 MIG welding with stainless steel. Normally DC positive though some flux core uses DC negative (Figure18)

6. Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is an arc welding process that uses a nonconsumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by a shielding gas (usually an inert gas such as argon), and a filler metal is

normally used, though some welds, known as autogenous welds, do not require it. A constant-current welding power supply produces energy which is conducted across the arc through a column of highly ionized gas and metal vapors known as a plasma.

7. Submerged arc welding (SAW) is a common arc welding process. Originally developed by the Linde - Union Carbide Company. It requires a continuously fed consumable solid or tubular (flux cored) electrode. The molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under a blanket of granular fusible flux consisting of lime, silica, manganese oxide, calcium fluoride, and other compounds. When molten, the flux becomes conductive, and provides a current path between the electrode and the work. This thick layer of flux completely covers the molten metal thus preventing spatter and sparks as well as suppressing the intense ultraviolet radiation and fumes that are a part of the shielded metal arc welding (SMAW) process.

UNIT 5

3.1.1.3

1. A welding procedure is a way of controlling the welding operation.
2. Welding procedures are approved to ensure they are functional and fullfil the physical and mechanical properties necessary to reach the required standard (to establish the essential variables for contractual obligations).

Welders are approved to ensure a particular welder is capable of welding to a procedure and obtaining a result that meets specification.

3. Producing a weld procedure involves:
    - Planning the tasks
    - Collecting the data
    - Writing a procedure for use or for trial
    - Making test welds
    - Evaluating the results of the tests
    - Approving the procedure of the relevant code
    - Preparing the documentation
4. Items to be included in the procedure can be some of the following:

- Parent Metal
- Welding Process
- Joint Design
- Welding Position
- Thermal Treatment

5. Gas metal arc welding uses an arc between a continuous filler metal (consumable) electrode and the weld pool. Shielding is provided by an externally supplied shielding gas. This process is also known as MIG welding or MAG welding. MIG (Metal Inert Gas) welding means the use of an inert (i.e. non active) gas. MAG (Metal Active Gas) welding requires the use of an active gas (i.e. carbon dioxide and oxygen). CO_2 is a more commonly used shortening of MAG welding gas.

6. The technique is easy to use and there is no need for slag-cleaning. Another advantage is the extremely high productivity that MIG/MAG welding makes possible.

7. The main advantage of TIG welding is the wide range of materials that it can weld. TIG welding is used to a great extent for welding different kinds of alloys of aluminium and stainless steel, specially when quality is of great importance. This technique is mainly used in aeronautical constructions and in the chemical and the nuclear power industry.

8. Shielding is obtained from a blanket of granular flux, which is laid directly over the weld area. The flux close to the arc melts and intermixes with the molten weld metal and helps purify and fortify it. The flux forms a glasslike slag that is lighter in weight than the deposited weld metal and floats on the surface as a protective cover. The weld is submerged under this layer of flux and slag-hence the name submerged arc welding.

3. 1. 2. 3

1. When you start getting right into welding you will eventually need to know what all the different welding positions are.
2. There are 4 welding positions. They are: Flat Welding Position; Horizontal Welding Position; vertical Welding Position; Overhead Welding Position.

3. The flat welding position when welding like this is called the 1G or 1F. It is the most basic and easiest welding position there is. If you can't weld one of these welds, don't even bother trying the ones listed below.

- The horizontal welding position is also refferd to as the 2G or 2F. It is slightly harder to do than the flat weld as gravity is trying to pull the molten metal down to wards the ground. But it is still easy to do.

4. The overhead welding position is the most difficult because it is not easy for the welder to control the arc and move. Sometimes it ‘s rather dangerous because the welder may be burnt by the hot slag.

5. Yes, the vertical down weld is way easier than going up, but it only has limited penetration.

3.1.3.3

1. Base metal is one of the two or more metals to be welded together to form a joint.

2. An alloy is a metal consisting of a mixture of two or more materials. One of these materials must be a metal.

3. A colorless, odorless type of inert gas. Argon is commonly used as shielding gas.

4. The shaping of metal at temperatures substantially below the point of recrystallization. Cold working adds strength and hardness.

5. A fracture that develops in the weld after solidification is complete. Welds with high hardness can cause cracking.

3.1.4.3

1. A filler metal is a metal added in the making of a joint through welding, brazing, or soldering.

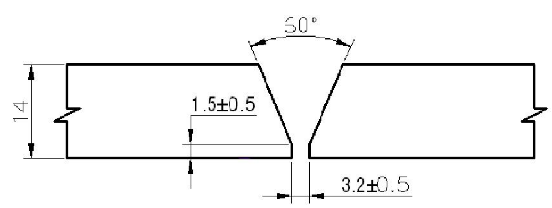
2. Four types of filler metals exist - covered electrodes, bare electrode wire or rod, tubular electrode wire, and welding fluxes.

3. The American Welding Society has issued 26 specifications covering filler materials.

4. There is a number of different types of fluxes used in welding, brazing, and soldering. These include fluxes for oxyfuel gas welding, fluxes for brazing, fluxes for soldering, fluxes for oxygen cutting of certain hard-to-cut metals, fluxes for electroslag welding, and fluxes for submerged arc welding.
5. The major function of the submerged arc flux is to produce a slag which will protect the molten metal from the atmosphere by providing a mechanical barrier. When it is molten, this slag should provide ionization to permit a stable arc. It should be fluid and of relatively low density so that it will float and cover the top of the deposited weld metal.

3. 2. 1. 3

1. SMAW/ Manual
2. Single V Butt Weld



3.

BASE METALS:

Material Specification:	Group 1 to Group 1
Type or Grade:	JIS G3101Grade SS400
Thickness range (plate):	
Diameter(pipe):	Groove: 3.0mm to 28mm
	Groove: OD > 600mm

4. No, it isn't. The limited temperature is Min. 25^0C.
5. The positions of fillet are F,H,V.
6.

Weld layer No.	Welding Process	Filler Metal		Current		Volts (V)	Travel Speed (mm/min)	Heat input (KJ/mm)
		Class	Dia. (mm)	Polarity	Ampe (A)			
1st	SMAW	E7016	2.6	DCEP	65 – 90	20 - 26	60 – 105	0.8 – 2.0

3.2.2.3

1. Welding Process: GTAW + SMAW
2. Yes, it does
3.

BASE METALS:	
Material Specification:	Group 1 to Group 1
Type or Grade:	A 106 Gr.B
Thickness range:	Groove: 3.0mm to 28mm
Diameter(pipe):	Groove: Unlimited

4.

FILLER METALS:	GTAW	SMAW
AWS Specification:	AWS A 5.18	AWS A 5.1
AWS Classification:	ER70S-G	E 7016
F. No :	6	4
A. No :	1	1
Size of filler metal:	Ø 2.4 mm	Ø 2.6 - Ø 3.2 mm

5. Argon
6.

WELDING PROCEDURE

Weld layer No.	Welding Process	Filler Metal		Current		Volts (V)	Travel Speed (Cm/min)	Heat input (Kj/mm)
		Class	Dia. (mm)	Polarity	Ampe (A)			
1st	GTAW	ER70S-G	2.6	DCEN	85-105	12 - 18	65 - 95	0.8 – 2.0
2nd And over	SMAW	E7016	3.2	DCEP	90-120	25 - 30	70 - 100	0.8 – 2.0
			2.6	DCEP	70 - 90	23 - 28	70 - 110	0.8 – 2.0

- The second layer is faster than the first one

UNIT 6

3. 1. 3

1. Arc welding requires a continuous supply of electric, current, sufficient in amount (amperes) and of proper voltage to maintain an arc.

2. The current may be either alternating AC or direct DC, but it must be provided through a source that can be adjusted.

3. Welding machines are rated according to their current output, voltage, and duty cycle and are available in a wide range of sizes.

4. The national electrical manufacturers association establishes minimum standards for rating welding machines and most manufacturers follow these standards. The standards are established on a conservative basis, requiring a rating well below the maximum overload capacity of the machine so that it will provide safe operation efficiently over a long period of the time.

5. Ratings are given with a percentage duty cycle. The duty cycle of a welder is the percentage of a ten-minute period that a welder can operate at a given output current setting.

6. If a welder is rated 300 amperes at a 60% duty cycle, it means that the machine can be operated safely at 300 amperes welding current for 6 out of every 10 minutes.

7. If this duty cycle is reduced in actual operation, the maximum permissible current is increased. At 35% duty cycle, a 300 ampere machine could be operated at 375 amperes.

8. Transformer welders are available for operation on single-phase power lines. They transform high-voltage-low-ampere input current to a low-voltage – high-amperage welding current.

9. Yes, they can.

3. 2. 3

1. Rectifier sets are basically three-phase or single-phase transformers to which have been added silicon or other rectifiers to change the output current from alternating to direct current. These machines have the basic control and output characteristics that are inherent in transformers

2. Current-carrying cables, cable lugs, electrode holder, working clamp, weld-cleaning devices, protective equipment are essential for each welding machine and operator. These are called accessories.

3. The size (diameter) of the cables used in welding varies, depending upon the capacity of the machine and the length o cable required.

4. Cable size is selected carefully because of its current carrying capacity.

5. It is made of rubber.

6. The electrode holder (figure 24) grips the electrode during the welding process.
7. A spring-pressure work clamp is the quickest and easiest to use.
8. This holder should be reasonably light, well-insulated, and sturdy enough to withstand the wear of continual handling. A spring-grip holder for quick insertion or release of the electrode is best.
9. A welding shield or helmet is necessary for protection from arc ray and heat, and the spatter from the molten metal. The arc is viewed through a filter that reduces the intensity of the radiation, but allows a safe amount of light to pass for viewing the weld pool and the end of the electrode.

10. They put the work pieces or base metals on the welding table.

GROSSARY AND DEFINITION

GROSSARY	DEFINITION
Hàn Welding	Quá trình tạo ra những liên kết vững chắc không thể tháo rời bằng cách thiết lập sự liên kết nguyên tử giữa các phần tử được nối.
Liên kết hàn Welded joint	Liên kết được thực hiện bằng hàn
Quá trình hàn Welding process	Các quá trình có hoặc không sử dụng: áp lực, kim loại phụ, làm chảy kim loại cơ bản
Mối hàn Weld	Một bộ phận của liên kết hàn tạo nên do kim loại nóng chảy kết tinh hoặc do biến dạng dẻo.
Kết cấu hàn Welding structure	Kết cấu kim loại được chế tạo bằng phương pháp hàn.
Nút hàn Welded assembly; weldment	Vị trí liên kết các chi tiết của kết cấu với nhau bằng hàn.
Liên kết hàn đồng nhất Homogeneous assembly	Liên kết hàn trong đó kim loại hàn và kim loại cơ bản không có sự khác nhau đáng kể về tính chất về tính chất cơ học và/hoặc thành phần hoá học. *Chú thích: một liên kết hàn được chế tạo từ các kim loại cơ bản tương tự nhau, không có kim loại bổ sung được coi là liên kết hàn đồng nhất.*
Liên kết hàn không đồng nhất Hetorogeneous assembly	Liên kết hàn trong đó kim loại hàn và kim loại cơ bản có sự khác nhau đáng kể về tính chất về tính chất cơ học và/hoặc thành phần hoá học.
Liên kết hàn các kim loại khác nhau Dissimilar metal joint	Liên kết hàn trong đó kim loại cơ bản khác nhau đáng kể về tính chất về tính chất cơ học và/hoặc thành phần hoá học.
Khuyết tật Imperfection	Sự không liên tục trong mối hàn học sai lệch về ngoại dạng so với yêu cầu.

	Chú thích: Trong TCVN 6115: 1996(ISO 6520) có liệt kê đầy đủ các loại khuyết tật.

WELDING TYPES

GROSSARY	DEFINITION
Hàn tay Manual welding	Hàn do người thực hện nhờ dụng cụ cầm tay nhận năng lượng từ một nguồn cấp chuyên dùng.
Hàn cơ giới Mechanized welding	Hàn được thực hiện nhờ sử dụng máy móc và cơ cấu do người điều khiển.
Hàn tự động Automated welding	Hàn được thực hiện bằng máy hoạt động theo chương trình cho trước, con người không trực tiếp tham gia.
Hàn nóng chảy Fusion welding	Hàn được thực hiện bằng làm nóng chảy cục bộ những phần được liên kết, không có lực tác dụng.
Hàn hồ quang Arc welding	Hàn nóng chảy, trong đó năng lược nhhiệt do hồ quang thực hiện.
Hàn đắp CN. Hàn phục hồi Surfacing	Hàn nóng chảy, đắp một lớp kim loại lên bề mặt sản phẩm.
Hàn hồ quang dùng điện cực nóng chảy Arc welding using a comsumale electrude	Hàn hồ quang dùng điện cực loại nóng chảy khi hàn, cùng kim loại cơ bản tạo nên mối hàn.
Hàn hồ quang dùng điện cực không nóng chảy Arc welding using a non-comsumale electrude	Hàn hồ quang dùng điện cực loại không nóng chảy
Hàn dưới lớp thuốc Submerged arc welding	Hàn hồ quang, trong đó hồ quang điện cháy dưới lớp thuốc hàn
Hàn trong môi trường khí bảo vệ Gas shielded arc welding	Hàn hồ quang, trong đó hồ quang và kim loại nóng chảy được bảo vệ trong môi trường của chất khí cấp vào vùng hàn nhờ thiết bị chuyên dùng.
Hàn hồ quang Argon Argon – shielded arc welding	Hàn hồ quang trong môi trường khí Argon bảo vệ.
Hàn TIG (hàn bằng điện cực Volfram trong môi trường khí trơ) TIG welding (Tungsten Inert Gas Welding)	Hàn hồ quang bằng điện cực Volfram trong môi trường khí trơ bảo vệ.
Hàn MIG (hàn khí trơ điện cực kim loại) MIG welding(Metal Inert	Hàn hồ quang điện cực nóng chảy trong môi trường khí trơ.

Gas Welding)	
Hàn MAG (hàn khí trơ điện cực kim loại) MAG welding(Metal Active Gas Welding)	Hàn hồ quang điện cực nóng chảy trong môi trường hoạt tính.
Hàn hồ quang tự bảo vệ Self – shielded welding	được thực hiện không có khí bảo vệ cung cấp từ bên ngoài, sử dụng điện cực dây lõi thuốc.
Hàn CO_2 CO_2 – Welding	Hàn hồ quang, trong đó CO_2 được dùng làm khí bảo vệ.
Hàn hồ quang xung Pulsed arc welding	Hàn hồ quang, trong đó dòng điện cung cấp cho hồ quang phát ra dưới dạng các xungtheo chương trình cho trước.
Hàn hồ quang tay Manual arc welding	Hàn hồ quang, trong đó mọi thao tác đều thực hiện bằng tay.
Hàn hồ quang cơ giới Mechanized arc welding	Hàn hồ quang, trong đó cấp dây hàn và di chuyển hồ quang được cơ khí hoá.
Hàn hồ quang tự động Automatic arc welding	Hàn hồ quang cơ giới, trong đó các cơ cấu máy hoạt động theo chương trình cho trước, con người không trực tiếp tham gia.
Hàn Rôbốt Robotic welding	Hàn tự động được thực hiện bằng rôbốt công nghiệp.
Hàn hai hồ quang Double arc welding	Hàn hồ quang được thực hiện đồng thời bằng hai hồ quang được cấp điện riêng biệt.
Hàn nhiều hồ quang Multi – arc welding	Hàn hồ quang được thực hiện đồng thời bằng hai hồ quang trở lên được cấp điện riêng biệt.
Hàn hai que hàn Two electrode welding	Hàn hồ quang được thực hiện đồng thời bằng hai que hàn dùng chung một dòng điện
Hàn nhiều que hàn Multi - electrode welding	Hàn hồ quang được thực hiện đồng thời bằng hai que hàn trở lên dùng chung một dòng điện
Hàn bằng que hàn nằm Fire cracker welding	Hàn hồ quang, trong đó que hàn bọc thống không chuyển động, đặt nằm dọc theo mép hàn, còn hồ quang sau khi được kích thích sẽ tự cháy và di chuyển tuỳ thuộc sự nóng chảy của que hàn.
Hàn bằng que hàn dựng nghiên Gravitation arc welding	Hàn hồ quang, trong đó que hàn thuốc bọc thuốc đặc nghiên so với mép hàn, tựa lên mép hàn và chuyển động dưới tác dụng của trọng lực hay lò xo tùy thuộc vào sự nóng chảy của nó.
Hàn dưới nước Under water welding	Hàn hồ quang trong điều kiện các phần hàn nằm ở dưới nước
Hàn hồ quang hở Open arc welding	Hàn hồ quang bằng điện cực nóng chảy không dùng khí bảo vệ hoặc thuốc hàn, cho phép quang sát vùng hồ quang.
Hàn bán tự động Semi – automatic arc	Hàn hồ quang trong đó chỉ có thao tác cấp dây hàn được cơ khí hóa.

welding	
Hàn rung Vibrating electrode arc welding	Hàn hồ quang dùng điện cực nóng chảy, trong đó điện cực rung theo một biên độ nhất định làm cho sự phóng điện hồ quang và sự ngắn mạch luân phiên xảy ra.
Hàn plasma Plasma welding	Hàn nóng chảy, trong đó nhiệt sử dụng cho hàn được thực hiện bằng hồ quang nén.
Hàn điện xỉ Electroslag welding	Hàn nóng chảy, trong đó nhiệt sinh ra do có dòng điện chạy qua xỉ lỏng thực hiện việc nóng chảy điện cực.
Hàn tia lửa điện Electron beam welding	Hàn nóng chảy, trong đó năng lượng của tia điện tử được dùng cho hàn.
Hàn laze Laze welding	Hàn nóng chảy, trong đó năng lượng bức xạ Laze được dùng cho hàn.
Hàn ti sáng Light beam welding	Hàng được thực hiện bằng cách sử dụng năng lượng ánh sáng đạt được bằng nguồn sáng công suất lớn thu được từ gương phản chiếu để tập trung vào mối hàn.
Hàn khí. CN hàn hơi Gas welding	Hàn nóng chảy, trong đó ngọn lữa hàn được tạo ra bằng khí cháy.
Hàn téc-mít Thermite welding	Hàn được thực hiện do năng lượng nhiệt sinh ra khi phản ứng của hỗn hợp tecmit.
Hàn bằng năng lượng tích tụ Stored energy welding	Hàn, trong đó năng lượng được tích lại trong các thiết bị chuyên dùng được sử dung tiếp để hàn.
Hàn tụ điện Capacitor Dischange	Hàn bằng năng lượng được tích lại trong các tụ điện
Hàn sử dụng áp lực Welding using pressure	Hàn trong điều kiện phải có tác dụng của lực ép các chi tiếp để tạo liên kết hàn.
Hàn tiếp xúc CN. Hàn điện tiếp xúc Resistance welding	Hàn sử dụng áp lực, trong đó nhiệt sử dụng để hàn được tạo ra khi dòng điện chạy qua mặt tiếp xúc giữa hai chi tiết được hàn.
Hàn tiếp xúc đối đầu CN. Hàn đối đầu Resistance butt welding	Hàn tiếp xúc, trong đó hai chi tiết được nối liền nhau ở mặt mút tiếp xúc.
Hàn điện trở đối đầu Upset welding	Hàn tiếp xúc đối đầu sử dụng năng lượng nhiệt sinh ra do điện trở tiếp xúc giữa hai chi tiết. Mặt mút tiếp xúc không nóng chảy.
Hàn nóng chảy đối đầu Flash welding	Hàn tiếp xúc đối đầu sử dụng năng lượng nhiệt sinh ra do do sự phóng điện hồ quang giữa hai chi tiết. Mặt mút tiếp xúc không nóng chảy.
Hàn tiếp xúc điểm CN. Hàn điểm Spot welding	Hàn tiếp xúc, bề mặt tiếp xúc nhỏ dạng điểm.
Hàn điểm lồi	Hàn tiếp xúc, bề mặt tiếp xúc nhỏ dạng điểm ở chỗ

Projection welding	lồi làm sẵn.
Hàn lăn CN. Hàn đường Resistance seam welding	Hàn tiếp xúc, trong đó liên kết hàn được hình thành giữa hai điện cực quay hình đĩa.
Hàn lăn cách quãng CN. Hàn bước Step – by - step welding	Hàn lăn, trong đó điện cực hình thành đĩa quay liên tục, dòng điện cung cấp theo chu kỳ.
Hàn cảm ứng CN. Hàn tầng số cao Induction welding	Hàn được sử dụng áp lực hoặc hàn nóng chảy, trong đó dóng điện tần số cao thực hiện việc gia nhiệt.
Hàn nổ Explosion welding	Hàn sử dụng áp lực do thuốc nổ tạo ra.
Hàn ma sát Friction welding	Hàn sử dụng áp lực, trong đó nhiệt tạo ra bằng ma sát.
Hàn xung từ Magnetic pulse welding	Hàn sử dụng áp lực, trong đó liên kết hàn được thực hiện nhờ va đập các chi tiết do tác dụng của từ trường xung.
Hàn áp lực Pressure welding	Hàn sử dụng áp lực được thực hiện nhờ biến dạng dẻo các chi tiết hàn ở nhiệt độ thấp hơn nhiệt độ chảy.
Hàn rèn Forge welding	Hàn áp lực, trong đó biến dạng dẻo được thực hiện do va đập của búa.
Hàn khí ép Pressure Gas welding	Hàn áp lực, trong đó mối hàn được tạo ra nhờ ngọn lửa hàn khí và áp lực.
Hàn khuyếch tán Diffusion welding	Hàn áp lực được thực hiện trong điều kiện các nguyên tử khuyếch tán qua lại ở những lớp mỏng bề mặt các chi tiết hàn dưới tác động tương đối lâu ở nhiệt độ cao và biến dạng dẻo không đáng kể.

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