Московский государственный технический университет
имени Н. Э. Баумана

Учебно-методическое пособие

Г. Г. ГУРОВА, Н. С. НИКОЛАЕВА

ОБУЧЕНИЕ РАЗГОВОРНОЙ РЕЧИ И ЧТЕНИЮ ЛИТЕРАТУРЫ НА АНГЛИЙСКОМ ЯЗЫКЕ ПО СПЕЦИАЛЬНОСТИ «СВАРКА»

Издательство МГТУ им. Н. Э. Баумана

Московский государственный технический университет
имени Н. Э. Баумана

Г. Г. Гурова, Н. С. Николаева

Обучение разговорной речи и чтению литературы на английском языке по специальности «Сварка»

Учебно-методическое пособие

Москва
Издательство МГТУ им. Н. Э. Баумана
2010

УДК 808.0
ББК 81.2 Англ.-923
Г95

Гурова Г. Г.

Г95 Обучение разговорной речи и чтению литературы на английском языке по специальности «Сварка» : учеб.-метод. пособие / Г. Г. Гурова, Н. С. Николаева. — М.: Изд-во МГТУ им. Н. Э. Баумана, 2010. — 54, [2] с. : ил.

В учебно-методическое пособие включены тексты из оригинальной научно-технической английской и американской литературы по специальности «Оборудование и технология сварочного производства», предназначенные для аудиторной и самостоятельной работы студентов. В каждый урок входят также задания по развитию навыков перевода с английского языка на русский, ведения беседы по основным проблемам, затронутым в пособии, переводу с русского языка на английский и отработке лексических и грамматических трудностей, встречающихся в текстах.

Для студентов старших курсов.

УДК 808.0
ББК 81.2 Англ.-923

© МГТУ им. Н. Э. Баумана, 2010

Предисловие

Учебно-методическое пособие состоит из трех разделов, в которых рассматриваются виды сварных соединений, их элементы и характеристики. В пособие включены тексты из оригинальной научно-технической английской и американской литературы по специальности «Оборудование и технология сварочного производства», предназначенные для аудиторной и самостоятельной работы студентов. В каждый урок входят также задания по развитию навыков перевода с английского языка на русский, ведения беседы по основным проблемам, затронутым в пособии, задания по переводу с русского языка на английский, отработке лексических и грамматических трудностей, встречающихся в текстах.

Предназначено для студентов старших курсов машиностроительных специальностей, изучающих сварочные процессы.

Unit 1

Weld Joints. Parts of a Joint

Preview. In this unit you will study different types of weld joints, ways of edge preparation and standard terms for the description of parts of a joint.

Warming-up.

1.1. Match the words in A with the definitions in B.

A	B
1. A lap joint	a. A joinery technique in which two members are joined by simply butting them together
2. A butt joint	b. A joinery technique in which two members are located at right angles to each other
3. An edge joint	c. A joinery technique used to join the edges of two or more members lying in the same plane
4. Corner and tee joints	d. A joinery technique used to produce a joint by overlapping two ends or edges

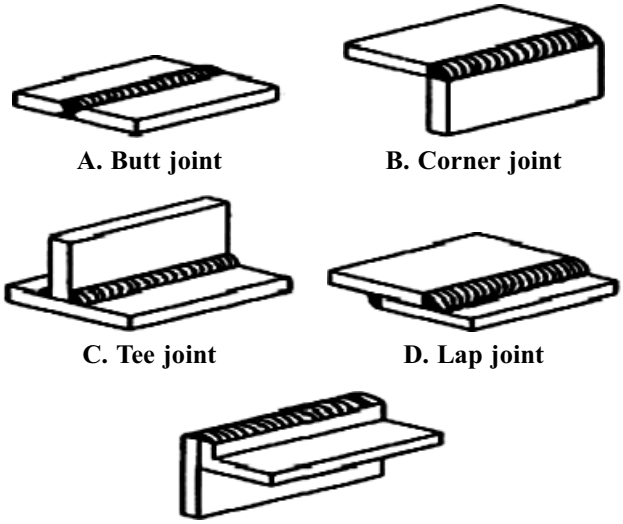
1.2. Before you start reading the text try to answer the following questions.

1. What parameters are welds classified by? 2. What types of welds do you know? 3. How can joints be subdivided within these types? 4. What does the choice of weld depend on?

1.3. Look through the text and grasp the general idea.

Weld Joints

The weld joint is where two or more metal parts are joined by welding. Welds can be geometrically prepared in many different ways. The five basic types of weld joints are the butt, corner, tee, lap, and edge. Other variations exist as well — for example, double-V preparation joints are characterized by the two pieces of material, each tapering to a single centre point at one-half their height. Single-U and double-U preparation joints are also fairly common — instead of having straight edges like the single-V and double-V preparation joints, they are curved, forming the shape of a U. Lap joints are also commonly more than two pieces thick — depending on the process used and the thickness of the material, many pieces can be welded together in a lap joint geometry.



A. Butt joint **B. Corner joint**

C. Tee joint **D. Lap joint**

E. Edge

Basic weld joints

A **butt** joint is used to join two members aligned in the same plane. This joint is frequently used in plate, sheet metal, and pipe work. A joint of this type may be either square or grooved.

Corner and **tee** joints are used to join two members located at right angles to each other. In cross section, the corner joint forms an L-shape, and the tee joint has the shape of the letter T.

Various joint designs of both types have uses in many types of metal structures. A **lap** joint, as the name implies, is made by lapping one piece of metal over another. This is one of the strongest types of joints available; however, for maximum joint efficiency, you should overlap the metals a minimum of three times the thickness of the thinnest member you are joining. Lap joints are commonly used with torch brazing and spot welding applications. An **edge** joint is used to join the edges of two or more members lying in the same plane. In most cases, one of the members is flanged. While this type of joint has some applications in platework, it is more frequently used in sheet metal work. An edge joint should only be used for joining metals 1/4 inch or less in thickness that are not subjected to heavy loads.

Often, particular joint designs are used exclusively or almost exclusively by certain welding processes. For example, resistance spot welding, laser beam welding, and electron beam welding are most frequently performed on lap joints. However, some welding methods, like shielded metal arc welding, are extremely versatile and can weld virtually any type of joint. Additionally, some processes can be used to make multipass welds, in which one weld is allowed to cool, and then another weld is performed on top of it. This allows for the welding of thick sections arranged in a single-V preparation joint, for example. The type of joint selected for any welding job may materially affect the quality and strength of the weld; the cost of labour and materials; the time and expense involved in preparing, jigging, and positioning the work; and other factors of like importance. The selection of the proper joint type depends on a number of factors, such as joint thickness and material, desired physical properties in the finished joint, size of the pieces being welded, accessibility of the joint, fit-up obtainable, available edge preparation equipment, number of pieces to be welded, and specifications of regulatory codes (if applicable). (3219)

From http://64.78.42.182/sweethaven/BldgConst/Welding/lessonmain.asp?lesNum=3&modNum=2

1.4. Vocabulary to the text “Weld Joints”. Try to memorize the following words and word combinations:

1) a weld, *n* — сварной шов;

2) to be subjected to heavy loads — подвергаться большим нагрузкам;

3) to taper [ˈteɪpə], *v* — сходить на конус, сужаться;

4) a preparation joint — подготовленное соединение под сварку;

5) to curve [kɜ:v], *v* — изгибаться;

6) a right angle — прямой угол;

7) a cross section — поперечное сечение;

8) a multipass weld — многопроходный шов;

9) the finished joint — чистовой шов;

10) applicable [ˈæplɪkəbl], *adj* — применимый, пригодный;

11) accessibility [əkˌsesɪˈbɪlətɪ], *n* — доступность, удобство осмотра и обслуживания;

12) to fit-up, *v* — сборка соединения под сварку;

13) positioning [pəˈzɪʃ(ə)nɪŋ], *n* — установка в удобном для сварки положении.

Word study

1.5. Read the words correctly. Consult the dictionary if necessary.

Geometrically, frequently, to characterize, various, structure, however, quality, to arrange, physical, strength, applicable, accessibility, to affect, angle, virtually, regulatory, jigging, particular, height.

1.6. Read the text again and find the correct endings for the phrases below.

1. Double-V preparation joints are characterized

a) by the two pieces of material each tapering to a single centre point at one-half their width;

b) by the two pieces of material each tapering to a single centre point at one-third their height;

c) by the two pieces of material not tapering to a single centre point at one-half their height;

d) by the two pieces of material each tapering to a single centre point at one-half their height.

2. A butt joint is used

a) to join two members located at right angles to each other;

b) to join two members aligned in the same plane;

c) to join two members by lapping one piece of metal over another;

d) to join the edges of two or more members lying in the same plane.

3. When making up a lap joint, for maximum joint efficiency

a) you should overlap the metals a minimum of three times the thickness of the thickest member you are joining;

b) you should overlap the metals a minimum of four times the thickness of the thinnest member you are joining;

c) you should overlap the metals a minimum of three times the thickness of the thinnest member you are joining;

d) you should overlap the metals not more than three times the thickness of the thinnest member you are joining.

4. An edge joint should only be used

a) for joining metals one forth inch or less in thickness that are not subjected to heavy loads;

b) for joining metals one forth inch or more in thickness that are not subjected to heavy loads;

c) for joining metals one forth inch or less in thickness that are subjected to heavy loads;

d) for joining metals one fifth inch or less in thickness that are not subjected to heavy loads.

5. Resistance spot welding

a) is most frequently performed on edge joints;

b) is most frequently performed on lap joints;

c) is less frequently performed on lap joints;

d) is most rarely performed on lap joints.

6. Shielded metal arc welding

a) can weld only joints that are not subjected to heavy loads;

b) is not versatile and can weld virtually only one type of joint;

c) is most frequently performed on lap joints;

d) is extremely versatile and can weld virtually any type of joint.

7. In cross section, the corner joint forms

a) an L-shape;

b) a T-shape;

c) a U-shape;
d) a V-shape.
8. What is one of the strongest types of joints available?
a) a butt joint;
b) a lap joint;
c) an edge joint;
d) a corner joint.
9. The selection of the proper joint type doesn't depend on
a) the joint thickness and material;
b) the number of pieces to be welded;
c) the accessibility of the joint;
d) the type of testing.
10. Some processes are most frequently performed on lap joints. Choose the odd one out:
a) resistance spot welding;
b) electron beam welding;
c) the electrogas welding;
d) laser beam welding.

1.7. Find in the text the English equivalents for the following phrases.

Другие варианты также существуют; вместо прямолинейных кромок; в зависимости от используемого процесса; как гласит название; применяются в обоих видах металлических конструкций; в 3 раза превышая толщину самого тонкого элемента; один из элементов делается с отбортовкой; под прямым углом друг к другу; которые не подвержены большим нагрузкам; дается возможность охладиться; это позволяет производить сварку; больших сечений; и других столь же важных факторов; количество деталей, которые необходимо сварить.

1.8. Fill in the gaps with the necessary prepositions.

1. The weld joint is where two or more metal parts are joined ... welding	a) in
2. An edge joint should only be used ... joining metals 1/4 inch or less in thickness	b) of

3. Lap joints are commonly used ... torch brazing and spot welding applications	c) on
4. A joint of this type may be ... square or grooved	d) by
5. Welds can be geometrically prepared ... many different ways	e) over
6. A lap joint is made by lapping one piece of metal ... another	f) for
7. Corner joints are used to join two members located ... right angles to each other	g) either
8. Instead ... having straight edges single-U and double-U preparation joints are curved, forming the shape of a U	h) to
9. Many pieces can be welded together in a lap joint geometry depending ... the process used and the thickness of the material	i) with
10. Double-V preparation joints are characterized by the two pieces of material each tapering ... a single centre point	j) at

1.9. Translate the following word combinations into Russian.

Two or more metal parts; the five basic types of weld; double-V preparation joints; the two pieces of material each tapering to a single centre point; two members located at right angles to each other; the edges of two or more members lying in the same plane; one piece of metal; sheet metal work; metals $1/4$ inch or less in thickness; thick sections arranged in a single-V preparation joint; the type of joint selected for any welding job; the pieces being welded; fit-up obtainable; available edge preparation equipment; available edge preparation equipment; a number of pieces to be welded.

1.10. Make up a summary in English to the text “Weld Joints”.

1.11. Scan the text “Weld joints” and fill in the table using the information from the text.

Types of welds	Characteristics	Applications

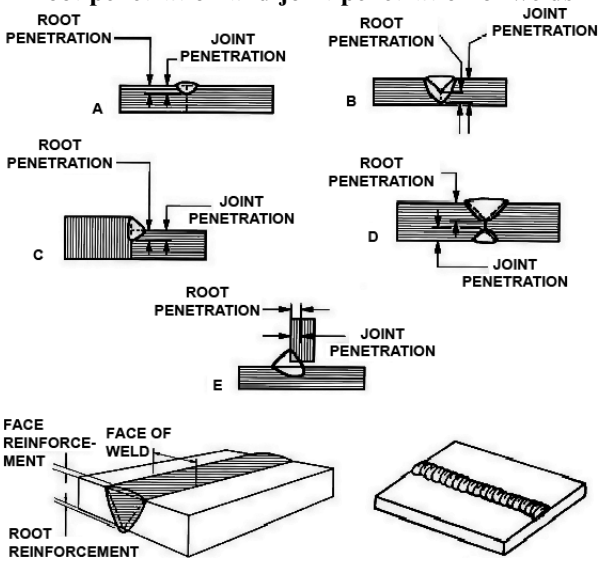
1.12. Read the text paying attention to the active terminological vocabulary.

Parts of Joints

While there are many variations of joints, the parts of the joint are described by standard terms. The root of a joint is that portion of the joint where the metals are closest to each other. The root may be a point, a line, or an area, when viewed in a cross section. A groove is an opening or space provided between the edges of the metal parts to be welded. The groove face is that surface of a metal part included in the groove. A given joint may have a root face or a root edge. The root face is the portion of the prepared edge of a part to be joined by a groove weld that has not been grooved. As you can see, the root face has relatively small dimensions. The root edge is basically a root face of zero width. The groove face and the root face are the same metal surfaces in some joints. The specified requirements for a particular joint are expressed in such terms as bevel angle, groove angle, groove radius, and root opening. The bevel angle is the angle formed between the prepared edge of a member and a plane perpendicular to the surface of the member. The groove angle is the total angle of the groove between the parts to be joined. For example, if the edge of each of two plates were bevelled to an angle of 30 degrees, the groove angle would be 60 degrees. This is often referred to as the "included angle" between the parts to be joined by a groove weld.

The groove radius is the radius used to form the shape of a J- or U-groove weld joint. It is used only for special groove joint designs. The root opening refers to the separation between the parts to be joined at the root of the joint. It is sometimes called the "root gap." To determine the bevel angle, groove angle, and root opening for a joint, you must consider the thickness of the weld material, the type of joint to be made, and the welding process to be used. As a general rule, gas welding requires a larger groove angle than manual metal-arc welding. The root opening is usually governed by the diameter of the filler material. This, in turn, depends on the thickness of the base metal and the welding position.

Root penetration and joint penetration of welds



Weld reinforcement **Simple weld bead**

Having an adequate root opening is essential for root penetration. Root penetration refers to the depth that a weld extends into the root of the joint. Root penetration is measured on the centre line of the root cross section. Joint penetration refers to the minimum depth that a groove (or a flange) weld extends from its face into a joint, exclusive of weld reinforcement. As you can see in the figure, the terms, root penetration and joint penetration, often refer to the same dimension. Weld reinforcement is a term used to describe weld metal in excess of the metal necessary to fill a joint. (2830)

From http://64.78.42.182/sweethaven/BldgConst/Welding/lessonmain.asp?lesNum=3&modNum=2

1.13. Try to memorize the following words and word combinations:

1) a groove, *n* — подготовка (разделка) кромок под сварку;

2) a root, *n* — корень шва, вершина разделки кромок, пространство между свариваемыми кромками в месте их наибольшего сближения;

3) a groove face — свариваемая кромка, поверхность разделки;

4) a groove weld — шов с разделкой кромок;
5) relatively [ˈrelətɪvlɪ], *adv* — относительно, сравнительно;
6) a bevel [ˈbev(ə)l] angle — угол скоса кромки;
7) a groove angle — угол разделки кромок;
8) an included angle — угол разделки (раскрытия) кромок;
9) a groove radius — радиус закругления кромки;
10) a root opening — зазор между свариваемыми кромками;
11) to govern [ˈgʌv(ə)n], *v* — управлять, обусловливать;
12) root penetration — проплавление (провар) корня шва;
13) joint penetration — проплавление (провар) соединения;
14) to extend, *v* — расширяться, удлиняться;
15) weld reinforcement [ˌri:ɪnˈfɔ:smənt] — усиление шва;
16) in excess of — больше, свыше, сверх нормы.

Word Study

1.14. Read the words correctly. Consult the dictionary if necessary.

Diameter, variations, area, zero, width, view, groove, requirement, particular, perpendicular, angle, radius, design, measure.

1.15. Translate the following sentences into Russian paying attention to the words underlined.

1. A groove is an opening or space provided between the edges of the metal parts to be welded. 2. The root face, also shown in view A, is the portion of the prepared edge of a part to be joined by a groove weld. 3. The groove radius is the radius used to form the shape of a J- or U-groove weld joint. 4. The root opening refers to the separation between the parts to be joined at the root of the joint. 5. Weld reinforcement is a term used to describe weld metal in excess of the metal necessary to fill a joint. 6. To determine the bevel angle, groove angle and root opening for a joint, you must consider the thickness of the weld material, the type of joint to be made, and the welding process to be used. 7. To determine the bevel angle, groove angle and root opening for a joint is necessary to get a high quality weld.

1.16. Fill in the gaps with the necessary prepositions.

1. Root penetration refers ... the depth that a weld extends into the root of the joint	a) at ... of
2. The root opening refers to the separation between the parts to be joined ... the root ... the joint	b) on
3. The root may be a point, a line, or an area, when viewed ... cross section	c) from ... into
4. The groove radius is the radius used to form the shape ... a J- or U-groove weld joint	d) by ... of
5. While there are many variations of joints, the parts of the joint are described ... standard terms	e) to
6. The specified requirements for a particular joint are expressed ... such terms bevel angle, groove angle, groove radius, and root opening	f) in
7. This depends ... the thickness of the base metal and the welding position	g) of
8. The root opening is usually governed ... the diameter ... the filler material	h) in ... of
9. Root penetration is measured ... the centre line ... the root cross section	i) by
10. Joint penetration refers to the minimum depth that a groove weld extends ... its face ... a joint, exclusive of weld reinforcement	j) in ... as
11. Weld reinforcement is a term used to describe weld metal ... excess ... the metal necessary to fill a joint	k) on ... of

1.17. Read the text again and choose the correct variant to the following.

1. What is the portion of the joint where the metals are closest to each other?

a) groove;

b) a root;

c) a root opening;

d) an included angle.

2. What configuration doesn't the root have in the cross section?

a) line;

b) point;

c) curve;

d) area.

3. The root edge

a) is basically a root face of zero width;

b) is basically a groove face of zero width;

c) is basically a root face of two in. width;

d)is basically a root face of zero thickness.

4. A groove is

a) an opening or space provided under the edges of the metal parts to be welded;

b) an opening or space provided between the edges of the metal parts to be welded;

c) an opening or space provided between the edges of the metal parts to be cut;

d) an opening or space provided between the surface of the metal parts to be welded.

5. The bevel angle is the angle formed

a) between the weld reinforcement and a plane perpendicular to the surface of the member;

b) between the prepared edge of a member and a plane perpendicular to the surface of the member;

c) between the prepared edge of a member and a plane parallel to the surface of the member;

d) between the prepared edge of a member and a plane perpendicular to the centre line of the root cross section.

6. What is a groove angle? It is

a) the angle between the surface of the member and the plane perpendicular to the edge of it;

b) the prepared edge of a member and a plane perpendicular to the surface of the member;

c) the partial angle of the groove between the parts to be joined;

d) the total angle of the groove between the parts to be joined.

7. What is not necessary to consider to determine the bevel angle, groove angle and root opening for a joint?

a) the type of joint to be made;

b) the thickness of the weld material;

c) the weld reinforcement;

d) the welding process to be used.

8. Weld reinforcement is a term used to describe

a) weld metal in excess of the metal necessary to fill a joint;

b) the filler metal used to make up a weld;

c) the molten metal necessary to fill a joint.

1.18. Scan the text and fill in the left part of the table using the information from the text. Find the information in the Internet and your textbooks to fill in the right part.

Term	Definition in English	Translation	Definition in Russian

1.19. Before reading the text "Heat-affected Zone" try to answer the following questions.

1. What in your opinion influences the heat-affected zone?

2. What are the characteristics of the process of shielded metal arc welding?

3. What are the characteristics of the process of gas metal arc welding?

4. What are the characteristics of the process of submerged arc welding?

5. What are the characteristics of the process of gas tungsten arc welding?

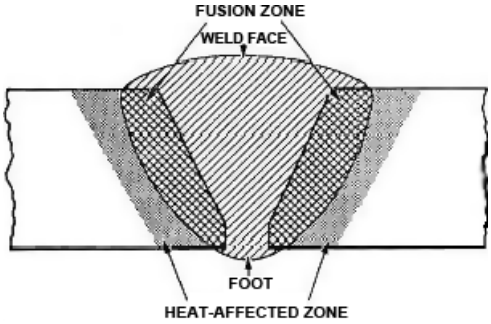
6. How do these characteristics influence the heat-affected zone?

1.20. Read the text "Heat-affected Zone" paying attention to the active terminological vocabulary to check if your predictions were correct.

Heat-affected Zone

The zone of interest for the welder is the heat-affected zone. This zone includes that portion of the base metal that has not been melted;

however, the structural or mechanical properties of the metal have been altered by the welding heat. Because the mechanical properties of the base metal are affected by the welding heat, it is important that you learn techniques to control the heat input. One technique often used to minimize heat input is the intermittent weld. In the picture you can see the HAZ of a pipe weld, with the blue area being the metal most affected by the heat.



Zones in a weld. The effects of welding on the material surrounding the weld can be detrimental — depending on the materials used and the heat input of the welding process used, the HAZ can be of varying size and strength. The thermal diffusivity of the base material plays a large role — if the diffusivity is high, the material cooling rate is high and the HAZ is relatively small. Conversely, a low diffusivity leads to slower cooling and a larger HAZ. The amount of heat injected by the welding process plays an important role as well, as processes like oxyacetylene welding have an unconcentrated heat input and increase the size of the HAZ. Processes like laser beam welding give a highly concentrated, limited amount of heat, resulting in a small HAZ. Arc welding falls between these two extremes, with the individual processes varying somewhat in heat input. To calculate the heat input for arc welding procedures, the following formula can be used:

$$Q = \left(\frac{V \cdot I \cdot 60}{S \cdot 1000}\right) \times \text{Efficiency},$$

where $Q =$ heat input (kJ/mm), $V =$ voltage (V), $I =$ current (A) and $S =$ welding speed (mm/min). The efficiency is dependent on the welding process used, with shielded metal arc welding having a value of

0.75, gas metal arc welding and submerged arc welding, 0.9, and gas tungsten arc welding, 0.8.

From http://en.wikipedia.org/wiki/Welding#_note-27#_note-27

1.21. Vocabulary to the text "Heat-affected Zone". Try tomemorize the following words and word combinations:

1) a heat-affected zone — зона термического влияния;
2) to alter [ˈɔ:ltə], *v* — меняться;
3) heat input — ввод тепла;
4) an intermittent weld — прерывистый шов;
5) to surround, *v* — окружать;
6) detrimental [ˌdetrɪˈment(ə)l], *adj* — вредный, пагубный;
7) thermal diffusivity — теплопроводность, коэффициент теплопроводности;
8) conversely [ˈkonvɜ:slɪ], *adv* — обратно, противоположно, наоборот;
9) to result in, *v* — привести к...;
10) voltage [ˈvɒltɪʤ], *n* — электрическое напряжение;
11) current [ˈkʌr(ə)nt], *n* — электрический ток;
12) a value [ˈvælju:], *n* — значение.

Word Study

1.22. Read the words correctly. Consult the dictionary if necessary.

To minimize, procedure, formula, technique, to vary, diffusivity, to inject, voltage.

1.23. Translate the following sentences into Russian paying attention to the underlined words.

1. One technique often used to minimize heat input is the intermittent weld. 2. The effects of welding on the material surrounding the weld can be detrimental—depending on the materials used and the heat input of the welding process used. 3. The welder must also carefully add filler metal at the proper times doing manual GTAW. 4. Gas tungsten arc welding is a process used to produce high-quality welds in virtually all weldable metals. 5. Having initiated the arc between the welding electrode and the base metal, the welder controls correct arc length. 6. The electrodes on small spot welders, used to weld thin materials, may be air-cooled. 7. The welding machine electrodes are flat plates called platens. 8. This

causes the materials being joined to vibrate at a corresponding rate. 9. A coupling system transmits the mechanical vibration to the welding tip and thus into the metals being joined. 10. The pressure used is less and the welding time is shorter, than those used in resistance welding. 11. Aluminum welded by the cold welding has a tensile strength of up to 152 MPa.

1.24. Translate the following sentences into Russian paying attention to the underlined words.

1. In the picture you can see the HAZ of a pipe weld, with the blue area being the metal most affected by the heat. 2. Arc welding falls between these two extremes, with the individual processes varying somewhat in heat input. 3. The efficiency is dependent on the welding process used, with shielded metal arc welding having a value of 0.75. 4. Double-V preparation joints are characterized by the two pieces of material, each tapering to a single centre point at one-half their height. 5. This type of joint having some applications in platework, it is more frequently used in sheet metal work. 6. The HAZ includes the portion of the base metal that has not been melted, the structural or mechanical properties of the metal having been altered by the welding heat. 7. The diffusivity being high, the material cooling rate is high and the HAZ is relatively small. 8. Many variations of joints being used, the parts of the joint are described by standard terms. 9. The heat of the electric arc being controlled by the current setting and by the arc length, electrode diameter and flux material will determine the type (ac or dc) and amount of welding current required. 10. With the tungsten electrode being not consumed, it does not melt and enter the weld.

1.25. Match the two halves of the sentence fragments to make logical statements.

1.26. Translate the following text from Russian into English.

Правильная разделка кромок свариваемых деталей обеспечивает качественный и полный провар. В тексте были приведены наиболее часто применяемые формы разделки кромок листов для получения одностороннего шва. Сочетание минимального зазора между наклонными кромками свариваемых листов и угла между этими двумя наклонными кромками должно выбираться таким образом, чтобы

1. The heat-affected zone includes that portion of the base metal	a) it is important that you learn techniques to control the heat input
2. Because the mechanical properties of the base metal are affected by the welding heat	b) the material cooling rate is high and the HAZ is relatively small
3. One technique often used to minimize heat input	c) that has not been melted
4. The HAZ can be of varying size and strength	d) resulting in a small HAZ
5. If the diffusivity is high	e) depending on the materials used and the heat input of the welding process used
6. Processes like laser beam welding give a highly concentrated, limited amount of heat	f) with gas metal arc welding and submerged arc welding having a value of 0.9
7. The efficiency is dependent on the welding process used	g) is the intermittent weld

обеспечивалось равномерное и полное проваривание до корня шва. Оптимальная комбинация заданных параметров определяется большим числом факторов. Слишком малый зазор и малый угол могут не обеспечить полный провар. Неправильное сочетание ширины и глубины шва приводит к образованию трещин в шве. (656)

1.27. Answer the following questions.

1. What are the five basic types of weld joints? 2. Can you define a butt joint? an edge joint? a lap joint? corner and tee joints? 3. Where are they mainly used? 4. What does the type of joint selected for any welding job affect? 5. What is a multipass weld? 6. What factors influence the selection of the proper joint type? 7. What configuration can a root have? 8. How can the bevel angle and the groove angle be compared? 9. What is a groove radius? 10. How is the root penetration measured? 11. What zone is interesting for the welder? 12. Why does a welder have to control the heat input? 13. Why can the effects of welding on the material surrounding the weld be detrimental? 14. How does the thermal

diffusivity of the base material influence the HAZ? 15. Can you classify the welding processes according to the size of the HAZ?

1.28. Make up and practice short situations using the following words and word combinations:

1) can be geometrically prepared, basic types of weld joints, aligned in the same plane, at right angles to each other, for maximum joint efficiency, of two or more members lying in the same plane;

2) are most frequently performed, any type of joint, to make multi-pass welds, may materially affect, the quality and strength of the weld;

3) the parts of the joint, closest to each other, viewed in cross section, an opening or space;

4) the HAZ, has not been melted, the structural or mechanical properties, the intermittent weld, the blue area;

5) can be detrimental, varying size and strength, the thermal diffusivity of the base material, the amount of heat injected.

1.29. Make up dialogues using the word expressions of Ex. 1.28.

Writing.

1.30. Read the text and translate it in written form.

Welding Positions

The importance of welding in the flat position whenever possible cannot be stressed too strongly. The quality of the weld is better, the operation easier and faster. However, occasions will arise when it is necessary to work on parts fixed in position under which condition welds must be deposited horizontally, vertically and overhead. It must be realized at the very beginning that welding in these positions is difficult and will require constant practice to develop skill.

As in the case of welding in the flat position, it is best to start practicing by first running bead welds in the various positions. Then as facility is gained on these operations practice may be continued on butt and fillet welds (tee and lap joints) in these positions.

One of the first facts noted when welding in these positions is that the force of gravity tends to cause the molten metal to drip (fall) down. The technique used, therefore must be designed to overcome this and

since it is difficult it is best to approach this by steps. To accomplish this, start by making horizontal bead welds on plates inclined at 45 degrees. When this has been mastered so that uniform beads can be made consistently, practice on welding vertically may be started. Again begin with an easy operation such as running beads vertically on plates set at 45 degrees.

To progress with this practice it is necessary now to move the plates into vertical position. Welding vertically may be performed either by carrying the weld upward or starting from the top and welding down. It is generally conceded that working upward is easier and therefore, bead welds in this manner should be practiced. Since bead welds are of limited practical value, this experience must be extended by practicing on butt welds in the vertical and horizontal patterns.

In use, the beveled plate edges should be spaced on the backing strip and the strip tack welded to the plates on the reverse side. (1938)

From http://www.key-to-steel.com/default.aspx?ID=CheckArticle&LN=RU&NM=192

Unit 2

Butt Joint Welds

Preview. In this unit you will get more detailed information about butt joints.

Warming-up.

2.1. Before reading the texts of the Unit "Butt Joint Welds" try to answer the following questions.

1. What types of butt joints can you name? 2. Is the choice of the type dependant on the material thicknesses? 3. What are the applications of each type?

2.2. Match the words in column A with their definitions in column B.

A	B
1) groove	a) the separation between the parts to be joined at the root of the joint
2) root face	b) the portion of the prepared edge of a part to be joined by a groove weld that has not been grooved
3) reinforcement	c) an opening or space provided between the edges of the metal parts to be welded
4) stringer bead	d) a term used to describe weld metal in excess of the metal necessary to fill a joint.
5) root opening	e) the portion of the joint where the metals are closest to each other
6) tack	f) a weld bead made without much weaving motion

7) root	g) to hold parts of an assembly in proper alignment temporarily until the final welds are made.

2.3. In pairs/groups discuss the following.

What type of butt joint weld would you choose to:

- weld parts less than 5/16-inch thick;
- weld parts more than 5/16-inch thick;
- get multipass submerged arc welds;
- two-pass submerged arc welds.

2.4. Read the text making paying attention to the active vocabulary to check if your predictions were correct.

Square Groove Butt Joint Welds

Good quality single pass welds up to 5/16-in. thick can be made using the square groove butt joint without root opening and with suitable backing.

Weld reinforcement, which tends to become excessive for thicker welds, can be controlled by adjusting the root opening. Variations in root opening, alignment of welding wire with the joint, and the amount of weld metal required generally limit the thickness of this type of weld to 3/4-in. Two pass welds up to 5/8-in. thick are made without root opening. It is essential in two-pass welds that the edges be closely butted since weld backing is not used. The maximum permissible root opening is 1/32-in. unless the joint is backed sufficiently to prevent the welding composition from flowing through the root opening. With such support greater root openings can be used. When the root opening exceeds 1/16-in., however, the opening should be closely filled with submerged arc welding flux ahead of the weld. The maximum root opening is approximately 1/8-in. because of the difficulty of refusing the welding flux at the base of the first pass weld. If the root gap is maintained constant for the entire length of the seam, plate up to 3/4-in. can be welded with square butt joints. The first weld is a backing weld made on the reverse side of the joint; the work is then turned over and the finishing weld is made. The finishing weld pene-

trates down into and refuses a portion of the backing weld to ensure a continuous weld structure throughout the plate thickness.

A satisfactory method of getting the required penetration of the finishing weld without excessive reinforcement is to back gouge a groove 1/8 to 5/16-in. deep in the top of the joint after the backing weld has been made. When gouging is used, no additional preparation or cleaning is needed except to remove any adhering slag. The advantage of the square groove butt joint is that it requires a minimum of edge preparation yet produces good quality welds with adequate penetration. (1995)

From http://www.esabna.com/EUWeb/SA_handbook/585sa2_28.htm

2.5. Vocabulary to the text "Square Groove Butt Joint Welds". Try to memorize the following words and word combinations:

1) square butt groove — подготовка (разделка) стыкового соединения без скоса кромок;

2) weld backing — подкладка под шов;

3) to penetrate [ˈpenɪtreɪt] — проникать, проплавлять;

4) root face — поверхность притупления (кромки);

5) single pass — однопроходный;

6) excessive [ɪkˈsesɪv], *adv* — чрезмерный, избыточный;

7) alignment [əˈlaɪnment], *n* — расположение по одной линии, выравнивание;

8) to adjust [əˈʤʌst], *v* — настраивать, регулировать;

9) essential [ɪˈsen(t)ʃ(ə)l], *adj* — обязательный, непременный;

10) permissible [pəˈmɪsəbl], *adj* — допустимый;

11) sufficiently [səˈfɪʃ(ə)ntlɪ], *adv* — достаточно;

12) composition, *n* — структура, состав;

13) to maintain [meɪnˈteɪn], *v* — поддерживать, сохранять;

14) to refuse [rɪˈfjʊz], *v* — *зд.* переплавлять;

15) gouging [ˈgaʊʤɪŋ] — поверхностная резка, строжка;

16) adhering [ədˈhɪərɪŋ] slag — прилипший шлак.

Word Study

2.6. Read the words correctly. Consult the dictionary if necessary.

Sufficiently, adjusting, approximately, amount, permissible, maintain, reverse, gouge, throughout, adhere, adequate, ensure.

2.7. Translate the following word combinations into Russian.

Good quality single pass welds up to 5/16-in. thick; a square groove butt joint without root opening; weld reinforcement; alignment of welding wire with the joint; the amount of weld metal required; two pass welds up to 5/8-in. thick; submerged arc welding flux ahead of the weld; the welding composition; a satisfactory method of getting the required penetration; the finishing weld without excessive reinforcement.

2.8. Translate the following sentences into Russian paying attention to the underlined words.

1. The power source may also be a capacitor-discharge type. 2. Weld reinforcement, which tends to become excessive for thicker welds, can be controlled by adjusting the root opening. 3. Submerged arc welding can be used to make horizontal fillet welds. 4. When the root opening exceeds 1/16-in., the opening should be closely filled with submerged arc welding flux ahead of the weld. 5. Arc stud welding may be done using a dc power source similar to those used with the shielded metal arc welding process. 6. Prior to welding, the studs generally have a small nib or bump which is to help initiate the arc. 7. Current and gas flow rates must be carefully regulated to prevent too large a keyhole. 8. The welder should wear flash goggles, approved clothing, safety shoes, and leather gloves. 9. Single pass welds up to 5/16-in. thick can be made using the square groove butt joint without root opening. 10. Friction welding is a specialized process and has applications only where a sufficient volume of similar parts is to be welded because of the initial expense for equipment and tooling. 11. Welders must wear an approved helmet, gloves, and protective clothing.

2.9. Translate the following sentences into Russian paying attention to the underlined words.

1. Two pass welds up to 5/8-in. thick are made without root opening. 2. The joint is backed sufficiently to prevent the welding composition from flowing through the root opening. 3. If the root gap is maintained constant for the entire length of the seam, plate up to 3/4-in. can be welded with square butt joints. 4. The work is then turned over and the finishing weld is made. 5. A satisfactory method of getting the required penetration of the finishing weld without excessive reinforcement is to

back gouge a groove 1/8 to 5/16-in. deep in the top of the joint after the backing weld has been made. 6. When gouging is used, no additional preparation or cleaning is needed except to remove any adhering slag. 7. A backing weld is made on the reverse side of the joint. 8. The heat-affected zone includes that portion of the base metal that has not been melted. 9. However, the structural or mechanical properties of the metal have been altered by the welding heat. 10. Metal thicknesses up to 76 cm have been welded with this process.

2.10. Match the two halves of the sentence fragments to make logical statements.

1. When the root opening exceeds 1/16-in.	a) unless the joint is backed
2. When gouging is used	b) using the square groove butt joint without root opening and with suitable backing
3. Two pass welds up to 5/8-in. thick	c) plate up to 3/4-in. can be welded with square butt joints
4. The advantage of the square groove butt joint	d) the opening should be closely filled with submerged arc welding flux ahead of the weld
5. The maximum root opening is approximately 1/8-in.	e) is that it requires a minimum of edge preparation yet produces good quality welds with adequate penetration
6. If the root gap is maintained constant for the entire length of the seam	f) is a backing weld made on the reverse side of the joint
7. Good quality single pass welds up to 5/16-in. thick can be made	g) because of the difficulty of refusing the welding flux at the base of the first pass weld
8. Weld reinforcement	h) no additional preparation or cleaning is needed except to remove any adhering slag

9. The first weld	i) are made without root opening
10. The maximum permissible root opening is 1/32-in.	j) can be controlled by adjusting the root opening

2.11. Answer the following questions.

1. How can good quality single pass welds up to 5/16 inch thick be made? 2. What limits this dimension and how can we overcome this limitation? 3. What parameters limit the thickness of this type of weld to 3/4 inch? 4. Why is it essential that the edges in two-pass welds be closely butted? 5. How can we prevent the welding composition from flowing through the root opening? 6. What should be done if the root opening exceeds 1/16 inch? 7. Why is the maximum root opening limited? 8. How does gouging simplify the process? 9. What is a satisfactory method of getting the required penetration of the finishing weld without excessive reinforcement? 10. What is the advantage of the square groove butt joint?

2.12. Make up a summary in English of the text "Square Groove Butt Joint Welds".

2.13. Project Work. Choose several plate thicknesses within the proper range and speak about joining these plates using the information from the text and the Internet. You may simulate this process on your computer (make up a presentation) and demonstrate the results to your group-mates.

2.14. Read the text paying attention to the active vocabulary.

Single-V Groove Butt Joint Welds

Single-V Groove with Root Face is used with non-fusible backing for single-pass butt welds of 5/16-in. or greater thickness. For most industrial applications, the maximum thickness is in the neighbourhood of 1–1/4 to 1–1/2-in. The root face has several advantages. The square edges simplify assembly.

Excellent penetration and reinforcement can be obtained and normal practical variations in voltage, current, welding

speed, and edge preparation cause minimum damage to the backing. Relatively small quantities of wire are used because V preparation gives the desired penetration without excessive current and the volume of the V is considerably less than that required by other welding methods. With non-fusible backing, the root face dimension is 1/8 to 3/16-in. Root gap should not exceed 1/16-in. Fusible metallic backing is also used with this preparation with a root gap of at least 1/8-in. The single-V groove butt joint with root face and without external backing is also used for two pass welds where plate thickness exceeds 5/8-in. The first weld, usually the larger, is the backing weld made in the V side of the joint; the work is then turned over and the finishing weld made on the flat side. The finishing weld penetrates down into and refuses a portion of the backing weld to ensure complete penetration.

The root face is approximately 3/8-in. for all commercially welded plate thicknesses. The plate edges must be tightly butted (1/32-in. maximum gap) as with the square butt joint. When the welding composition is retained by a support below the joint, slightly greater root gaps are permissible; if the root gap exceeds 1/16-in., submerged arc welding flux should be tamped into the gap ahead of the weld.

The Single-V Groove without Root Face is commonly used for nearly all thicknesses when using submerged arc backing flux. It is not commonly used below 3/8-in. thickness since adequate penetration can be obtained for these thicknesses without bevelling. The single-V groove butt joint without root face must always have weld backing since the mass of metal at the joint root is not sufficient to provide weld metal support. Reasonable misalignment in fit-up and variation in root gap can be tolerated when using submerged arc backing flux because the granular material will shift to accommodate them. Copper backing is not recommended because of the tendency of the weld metal to fuse to the backing piece. Fusible metallic backing is acceptable if there is no objection to its remaining as part of the completed weld. (2542)

From http://www.esabna.com/EUWeb/SA_handbook/585sa2_28.htm

2.15. Vocabulary to the text "Single-V Groove Butt Joint Welds". Try to memorize the following words and word combinations:

1) in the neighbourhood [ˈneɪbəhʊd] of — приблизительно;
2) assembly [əˈsemblɪ], *n* — сборка;
3) to cause [kɔ:z], *v* — вызывать, быть причиной;
4) to turn over, *v* — переворачивать;
5) to retain [rɪˈteɪn], *v* — удерживать, сохранять;
6) a support [səˈpɔ:t], *n* — суппорт; снабжение;
7) slightly [ˈslaɪtlɪ], *adv* — немного, слегка;
8) bevelling — скашивание кромки, разделка кромок;
9) reasonable [ˈri:z(ə)nəbl], *adj* — обоснованный;
10) fit-up, *n* — сборка, соединение под сварку;
11) to tolerate [ˈtɒl(ə)reɪt], *v* — допускать;
12) to accommodate [əˈkɒmədeɪt], *v* — приспосабливать(ся);
13) to shift, *v* — передвигать(ся);
14) acceptable [əkˈseptəbl], *adj* — приемлемый;
15) an objection [əbˈʤekʃ(ə)n], *n* — возражение.

Word Study

2.16. Read the words correctly. Consult the dictionary if necessary.

Neighbourhood, advantages, variations, simplify, voltage, penetration, considerably, fusible, ensure, permissible, bevelling.

2.17. Translate the following words into Russian paying attention to the underlined prefixes.

Misalignment, independent, disassembly, refuse, unbend, imperfect, misconnection, indissoluble, non-fusible, unfluxible, disconnection, impermeable, nonconsumable, indiffusible, disassociation, nonhardenable, uncoated, retest, rewelding, imporosity, discontinuity, nonmagnetic, ungrease, restrike, reprecipitation, disintegration, uncombined, removal, impure, unload, inexplosive, nonporous, dissociate, unshielded.

2.18. Translate the following sentences into Russian paying attention to the underlined words.

1. This joint type is to be used with non-fusible backing for single-pass butt welds of 5/16-in. or greater thickness. 2. For most industrial applications, the maximum thickness is to be in the neighbourhood of 1–1/4 to 1–1/2-in. 3. The purpose of the finishing weld is to ensure

a continuous weld structure throughout the plate thickness. 4. Relatively small quantities of wire are to be used because V preparation gives the desired penetration. 5. Fusible metallic backing is to be used with this preparation with a root gap of at least 1/8-in. 6. The weld metal is to be fused to the backing piece. 7. The backing is to be non-fusible to provide the root face dimension in the range from 1/8 to 3/16-in. 8. The mass of metal at the joint root is not sufficient to provide weld metal support. 9. A satisfactory method of getting the required penetration of the finishing weld without excessive reinforcement is to back gouge a groove 1/8 in. deep. 10. Copper backing is not to be used because of the tendency of the weld metal to fuse to the backing piece.

2.19. Fill in the gaps with the necessary prepositions.

1. For most industrial applications, the maximum thickness is ... the neighbourhood ... 1–1/4 to 1–1/2-in.	a) without
2. With non-fusible backing, the root face dimension is 1/8 to 3/16-in.	b) since
3. the work is turned ... and the finishing weld made on the flat side	c) as
4. The plate edges must be tightly butted (1/32-in. maximum gap) ... with the square butt joint	d) in ... of ...
5. V preparation gives the desired penetration ... excessive current and the volume of the V is considerably less than that required by other welding methods	e) for
6. When the welding composition is retained ... a support below the joint, slightly greater root gaps are permissible	f) with
7. The single-V groove without root face is commonly used ... nearly all thicknesses when using submerged arc backing flux	g) by
8. It is not commonly used below 3/8-in. thickness ... adequate penetration can be obtained for these thicknesses without bevelling	h) over

9. Copper backing is not recommended ... the tendency of the weld metal to fuse to the backing piece	i) because of

2.20. Right or wrong?

1. Single-V Groove without Root Face is used with non-fusible backing for single-pass butt welds of 5/16-in. or greater thickness. 2. When using Single-V Groove with Root Face the maximum thickness of the plate is in the neighbourhood of 1–1/4 to 1–1/2-in. 3. The single-V groove butt joint with root face and without external backing is used for two pass welds where plate thickness exceeds 5/8-in. 4. With fusible backing, the root face dimension is 1/8 to 3/16-in. 5. With non-fusible backing, the root face dimension is 1/8 to 3/16-sm. 6. The finishing weld penetrates down into and refuses a portion of the backing weld to ensure complete penetration. 7. The plate edges must be tightly butted (1/16-in. maximum gap) as with the square butt joint. 8. The single-V groove without root face is commonly used for nearly all thicknesses when using submerged arc backing flux. 9. The single-V groove without root face is commonly used below 3/8-in. thickness since adequate penetration can be obtained for these thicknesses without bevelling. 10. Titanium backing is not recommended because of the tendency of the weld metal to fuse to the backing piece.

2.21. Read the text paying attention to the active vocabulary to check if your predictions were correct.

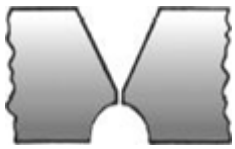
Groove Butt Joint Welds

Double-V Groove Butt Joint is the basic joint design for two-pass submerged arc welds. It is commonly used for thickness up to 2-in., and

even greater thicknesses have been welded successfully. For thicknesses above 2-in., however, the joint for multipass welding is recommended. The double-V groove joint is normally designed with a large root face to provide adequate support for the initial weld which serves as backing for the weld from the opposite side. The maximum possible misalignment in fit-up is 25 per cent of the root face. The root faces must be closely butted along their entire

length. The maximum permissible root gap is 1/32-in. If the root gap is larger the flow of material through the gap, when making the initial weld, must be prevented. Several methods are used. A small stringer bead can be laid manually in the bottom of the v in which the finishing weld is to be made. A length of wire may be tacked into the finishing weld. Submerged arc backing flux may be tamped into the gap ahead of the weld. The stringer bead, wire, or backing flux should be removed before making the finishing joint if a high-quality joint is required. To ensure 100-per cent penetration and the removal of any slag or porosity in the bottom of the backing weld, the finishing weld should penetrate into and refuse the backing weld to a depth of 3/16 to 5/16-in. Since this joint is widely used in pressure vessel fabrication, one limitation should be noted. When making circumferential welds, the ratio of joint thickness to cylinder diameter must be at least 1/25. Otherwise, the large pool of molten metal will tend to run, causing unstable welding action and undesirable weld shape. Manual weld backing is sometimes used with the double-V groove butt joint when the joint has a small (1/8-in. maximum) root face and a root gap of about 1/8-in. If conditions require that the manual weld be thicker than 3/8-in., however, the single-V and U groove butt joint is preferred.

The **Single-U Groove Butt Joint** is often used for multipass submerged arc welds. Any thickness of material can be welded using this joint design. A small manual backing weld is often made from the reverse side of the joint. If the manual weld is not made, the root faces must be closely butted (1/32-in. maximum root gap). For extremely thick material, double-U groove butt joints may be used. These are essentially two single-U groove butt joints with a common root. If a manual weld is used to back the first submerged arc weld pass, it may be desirable to remove it later if maximum quality is required. The use of gas metal-arc manual welds eliminates the need for removal prior to submerged arc welding. Because of the internal and external slag-free nature of gas metal arc deposits, subsequent submerged arc welds of excellent quality can be produced over them. (2843)



From http://www.esabna.com/EUWeb/SA_handbook/585sa2_28.htm

2.22. Vocabulary to the text "Groove Butt Joint Welds". Try to memorize the following words and word combinations.

1) Single-V Groove (butt) — V-образная разделка (стыкового соединения) со скосом двух кромок;

2) Single-U Groove (butt) — V-образная разделка (стыкового соединения) с одним криволинейным скосом двух кромок;

3) Double-V Groove (butt) — X-образная разделка (стыкового соединения) с двумя (симметричными) скосами двух кромок;

4) Double-U Groove (butt) — X-образная разделка (стыкового соединения) с двумя криволинейными скосами двух кромок;

5) stringer bead — валик, наплавленный без поперечных колебаний электрода, горелки;

6) to tack — сваривать прихваточным швом;

7) initial [ɪˈnɪʃ(ə)l], *adj* — начальный, исходный;

8) backing weld — подварочный шов;

9) circumferential [səˌkʌmf(ə)ˈren(t)ʃ(ə)l] weld — кольцевой (круговой) шов;

10) pressure vessel — сосуд высокого давления, автоклав.

Word Study

2.23. Read the words correctly. Consult the dictionary if necessary.

Reinforcement, approximately, misalignment, bevelling, relatively, subsequent, successfully, neighbourhood.

2.24. Pick out in the text all the expressions with the following words and give their Russian equivalents. Make up sentences of your own with these expressions.

Root; joint; backing; groove; thickness.

2.25. Translate the following word combinations into Russian.

Single-pass butt welds; relatively small quantities; desired penetration without excessive current; square groove butt joint without root opening; the basic joint design; excessive reinforcement; for most industrial applications; the internal and external slag-free nature of gas metal arc deposits; subsequent submerged arc welds of excellent quality; maximum permissible root gap.

2.26. Make up and practise short situations using the following words and word combinations:

1) weld reinforcement, flowing through the root opening, weld backing, reverse side of the joint;

2) root face, non-fusible backing, minimum damage to the backing;

3) adequate penetration, without bevelling, reasonable misalignment;

4) multipass welding, large root face, initial weld, several methods are used;

5) manual backing weld, from the reverse side of the joint, need for removal.

2.27. Make up dialogues using the word expressions of Ex. 2.26.

2.28. Put the verbs in brackets into the necessary form (Active or Passive). Translate the following sentences into Russian paying attention to the underlined words.

1. Any thickness of material can ... (to weld) using this joint design. 2. The root faces must ... closely (to butt) along their entire length. 3. The single-V groove butt joint without root face must always... (to have) weld backing. 4. The stringer bead, wire, or backing flux should ... (to remove) before making the finishing joint if a high-quality joint is required. 5. A small stringer bead can ... (to lay) manually in the bottom of the *v* in which the finishing weld is ... (to make). 6. Root gap should not ... (to exceed) 1/16-in. 7. For extremely thick material, double-U groove butt joints may ... (to use). 8. Weld reinforcement, which tends to become excessive for thicker welds, can ... (to control) by adjusting the root opening. 9. When the root opening exceeds 1/16-in., however, the opening should ... closely (to fill) with submerged arc welding flux ahead of the weld. 10. For instance, the 1G position weld refers to a groove weld that is ... (to make) in the flat position. 11. It is important that you have a good understanding and can ... (to apply) the techniques for welding in each of the test positions.

2.29. Scan the text and find the correct answers.

1. In which cases is square butt welding used? 2. Why are relatively small quantities of wire used in Single-V Groove welding with Root Face? 3. What kind of backing is recommended for Single-V Groove

welding without Root Face? Prove your answer. 4. What kind of joint is used for two-pass submerged arc welds? 5. How can the flow of material through the gap be prevented when making a double-V butt joint? 6. Why should the finishing weld penetrate into and refuse the backing weld to a depth of 3/16 to 5/16-in when making a double-V butt joint? 7. In which cases is double-U groove butt joint used?

2.30. Compare the types of butt joints.

Types of welds	Possible thicknesses	Number of passes	Dimensions of root openings	Advantages

2.31. Find in the texts the English equivalents for the following phrases:

1) поддерживается постоянным по всей длине шва; 2) обратная сторона соединения; 3) стремится стать чрезмерным для более толстых швов; 4) сравнительно небольшое количество проволоки; 5) так как это соединение часто используется; 6) не позволяет части подварочного шва осуществить полное проплавление; 7) так как нужное проплавление может быть достигнуто без разделки кромок; 8) зазор между свариваемыми кромками может быть допустим; 9) отношение толщины соединения к диаметру цилиндра; 10) чтобы обеспечить 100-процентное проплавление.

2.32. Group work. Describe main features of the types of welds shown in the pictures. You may simulate this process on your computer and demonstrate the results to your group-mates.

2.33. Make up a summary in English of the text “Groove Butt Joint Welds”.

Writing.

2.34. Read the text and translate it in written form.

Overhead-Position Welding

Overhead welding is the most difficult position in welding. Not only do you have to contend with the force of gravity but the majority of the time you also have to assume an awkward stance. Nevertheless, with

practice it is possible to make welds equal to those made in the other positions.

To retain complete control of the molten puddle, use a very short arc and reduce the amperage as recommended. As in the vertical position of welding, gravity causes the molten metal to drop or sag from the plate. When too long an arc is held, the transfer of metal from the electrode to the base metal becomes increasingly difficult, and the chances of large globules of molten metal dropping from the electrode increase. When you routinely shorten and lengthen the arc, the dropping of molten metal can be prevented; however, you will defeat your purpose should you carry too large a pool of molten metal in the weld.

One of the problems encountered in overhead welding is the weight of the cable. To reduce arm and wrist fatigue, drape the cable over your shoulder when welding in the standing position. When sitting, place the cable over your knee. With experience, cable placement will become second nature.

Prepare the plates for overhead butt welding in the same manner as required for the flat position. The best results are obtained when backing strips are used; however, you must remember that you will not always be able to use a backing strip. When you bevel the plates with a featheredge and do not use a backing strip, the weld will repeatedly burn through unless extreme care is taken by the operator.

For overhead butt welding, bead welds are preferred over weave welds. Clean each bead and chip out the rough areas before placing the next pass. Make the first pass with the electrode held at 90 degrees to the plate. When you use an electrode that is too large, you can not hold a short arc in the root area. This results in insufficient root penetration and inferior joints. (1978)

From http://64.78.42.182/sweethaven/BldgConst/Welding/lessonmain.asp?lesNum=7&modNum=7

Unit 3

Corner, Edge, Tee, and Lap Joints

Preview. In this unit you are going to study Corner, Edge, Tee, and Lap Joints.

Warm-up.

3.1. Before reading the text try to answer the following questions.

1. Try to give the definition to comer joints as its name implies.
2. What are the angles between the plates to be welded?

3.2. Match the words in column A with the definitions in column B.

A	B
1. A corner joint	a) is used for making corners in plates or foils that are too thin for other types of weld
2. A flange joint	b) is a butt weld between two pieces that are perpendicular rather than complainer
3. A melt through weld	c) is used to connect two parts together to form a corner
4. A butt weld corner joint	d) is a weld, where the corner is assembled and the beam is used to melt through the top component and into the lower component

3.3. Brush up the following auxiliary words *(due to, as well as, either ... or, as)* and fill in the following sentences with the proper one.

1. A butt joint may be ... square ... grooved. 2. Arc welding ... cutting produce intense sound. 3. ... the name implies, a corner joint is used to

connect two parts together to form a corner. 4. Copper backing in single V-groove butt joints is not recommended ... the tendency of the weld metal to fuse to the backing piece. 5. ... in the case with butt joints, the edges of the plates to be welded by corner joints may be machined prior to welding. 6. Because of ... the internal ... external slag-free nature of gas metal arc deposits, subsequent submerged arc welds of excellent quality can be produced. 7. ... the relatively low area of the weld, ... aesthetic appearance a corner joint weld may not be strong enough. 8. Plasma arc welding is used for metal spraying ... for cutting. 9. ... the high welding speeds, plasma arc welding is one of most efficient.

3.4. Read the text making use of the active terminological vocabulary to answer the following questions.

1. What makes the difference of corner joints? 2. What are the main types of corner joints? 3. How strong are the welds produced? 4. What is used to reinforce the weld? 5. Where is a flange joint applied?

Corner Joints

One of the major types of welding connection is the corner joint. As its name implies, this joint is used to connect two parts together to form a comer. This weld type is extremely useful and can be preformed with either a high or low energy density welder. There are a total of four common sub types of corner joint, each, as usual, having its own benefits and disadvantages.

The first common corner joint sub type is made by beveling both parts, usually at 45 degrees for a 90 degree joint, then placing the two faces together, and melting the outside edge. This is usually done with a low energy density welder but a high-energy density welder can be used. A weld bead may also be added to the inside of the comer to reinforce the weld. This weld is fairly fast and easy to create, but can have problems with strength due to the relatively low area of the weld, as well as aesthetic appearance.

The second type of comer joint is essentially a butt weld between two pieces that are perpendicular. This weld can be done with a low energy density welder if the parts are small enough, but is usually done with a high energy density beam. This allows deep penetration and can

form a weld that is as strong as the base material. This advantage of strength is countered by the increased proneness of joints to deformation, as well as the increased difficulty and equipment cost of the weld. As in the case with normal butt joints, the edges may be machined prior to welding to improve fit, alignment or welding properties.

The third type of corner welds is the melt through weld. In this weld, the corner is assembled and the beam is used to melt through the top component and into the lower component. This type of weld works best when the top piece is relatively thin compared to the bottom piece, allowing it to be melted through with a minimal energy input. This type of welds is preformed exclusively with high energy density sources. This weld can be made easily without the need to precisely follow a joint, but it can be weak due to the very low cross sectional area of the weld. If necessary, multiple passes can be made if the bottom piece is sufficiently thick, improving the weld strength.

The final major type of comer joints is truly a flange joint. This is used for making corners in plates or foils that are too thin for the other types of welds. To make this type of joints a 90-degree flange is made in one of the components. This flange is then aligned to the other piece to be welded, and the welder is run over the edges of the two parts. This melts the edges together and forms the weld bead. This method can be used with either a high or low energy density source and is fast and reliable, but tends to make extremely weak joints due to the leverage and odd stress angles that the flange causes. (2850)

From Joining Technologies | Newgate International Business Center (slightly abridged).

3.5. Vocabulary to the text “Corner Joints”. Try to memorize the following words and word combinations:

1) a corner joint — угловое соединение;

2) a welder, *n* — сварочный агрегат;

3) a melt through weld — сварной шов со сквозным проплавлением;

4) an input, *n* — подводимая мощность;

5) a flange [flænʤ] joint — сварное соединение, выполненное по отбортовке;

6) leverage [ˈli:v(ə)rɪʤ], *n* — сила, усилие;
7) an odd stress angle — необычный угол напряжения;
8) proneness [ˈprəʊnnəs], *n* — подверженность чему-либо;
9) a weld bead [bi:d] — наплавленный валик сварного шва.

3.6. Read the following words correctly (consult, if necessary, a dictionary).

Implies, extremely, essentially, beveling, relatively, perpendicular, exclusively, precisely, reliable, prior to, aligned, sufficiently.

3.7. Match the two halves of the sentence fragments to make logical statements.

1. A corner joint can be preformed with a) the relatively low area of the weld	a) the relatively low area of the
2. Corner joints can have problems with strength due to	b) if the bottom piece is sufficiently thick, improving the wells strength
3. Multiple passes can be made	c) when the top piece is relatively thin compared to the bottom piece, allowing it to be melted through with a minimal energy input
4. Flange joints tends to make extremely weak joints due to	d) the leverage and odd stress angles that the flange causes
5. Melt through weld works best	e) either a high or low energy density welder

3.8. Find in the text the English equivalents for the following phrases.

Соединение сваркой; как подразумевает название; в общей сложности — четыре обычных подтипа; при помощи разделки кромок обеих деталей; чтобы усилить шов; сварочная установка с низкой (высокой) плотностью энергии; благодаря сравнительно малой зоне шва; это делает возможным глубокое проплавление; повышенная склонность соединения к деформации; перед сваркой; отбортовка в 90°; деталь, которую необходимо сварить.

3.9. Scan the text and fill in the table using the information from the texts.

Subtype of corner joint	Energy source or welder	Quality of weld

3.10. In pairs discuss the reasons that make corner joints weak?

3.11. Make the text retelling using the table from ex. 3.9.

3.12. Before reading the text below translate the following sentences paying attention to the infinitives underlined.

1. The parts to be welded are placed together with the outside edge melted. 2. The method to be applied is fast and reliable, but tends to make extremely weak joints. 3. The top piece to be placed is thin enough compared with the bottom piece. 4. This type of welds tends to make extremely weak joints due to the stress angles to be caused by a flange. 5. The edges of the plates to be welded by corner joints may be machined prior to welding. 6. The method to be chosen for welding the pieces depends upon the material, configuration and other reasons. 7. T-joints occur when the members to be welded come together at right angles. 8. A root face is a portion of the prepared edge of a part to be joined by a groove weld. 9. Friction welding is a process to be applied where a sufficient volume of similar parts is provided because of the initial expense for equipment and tooling. 10. The new technology is widely approved because of its effectiveness and the possibility of the equipment to be adjusted for the new process easily.

3.13. Before reading the text try to recollect what other types of joints you know.

Other Types of Joints Part 1

Edge Joints

Edge joints are often used when the members to be welded will not be subjected to great stresses. Edge joints are not recommended where impact or great stress may occur to one or both of the welded members. An edge joint occurs when the edges of parallel or nearly

parallel members meet and are joined by a weld. If required, the joints can be altered by grinding, cutting or machining the edges into a groove.

The groove can be a square, beveled, V, J, or U. The main purpose of the groove is to allow proper penetration or depth of fusion. Complete joint penetration refers to weld metal that extends completely through the groove and has complete fusion into the base metal.

Lap Joints

Another joint design used a great deal in the welding industry is the lap joint. In order to weld two overlapping pieces of metal, the lap joint is used by means of connecting fillet, plug, slot, spot, projection, or seam welds. A single lap joint is welded from one side; however a single lap joint welded from two sides has a greater strength. The lap joint is the most common joint used in welding, since they are most applicable in welding thin materials.

A lap joint has good mechanical properties, especially when welded on both sides. The type of weld used on a lap joint is generally a fillet weld. If a groove weld is called for, it can be applied with a single or double bevel. The groove weld may or may not be followed with a fillet weld. The degree of overlap of the members is generally determined by the thickness of plate. In other words, the thicker the plate, the more overlap is required.

Fillet Welds

Fillet welds are approximately triangular in cross sectional shape and are made on members whose surfaces or edges are approximately 90° to each other. Fillet welds can be as strong, or stronger than the base metal if the weld is the correct size and the proper welding techniques are used. When discussing the size of fillet welds, weld contour must first be determined. Contour is the shape of the face of the weld.

There are three types of fillet weld contours: flat, convex, and concave depending upon a cross section profile.

T-Joints

A T-joint occurs when the surfaces of two members come together at approximately right angles, or 90°, and take the shape of a “T”. On this particular type of joint, a fillet weld is used. T-joints possess good

mechanical strength, especially when welded from both sides. They generally require little or no joint preparation and are easily welded when the correct parameters are used. The edges of the T-joint may be left square if only a fillet weld is required. For groove welding they may be altered by thermal cutting, machining or grinding. (2700)

From Joining Technologies | Newgate International Business Center | (slightly abridged).

3.14. Vocabulary to the text "Other Types of Joints. Part 1".

Try to memorize the following words and word combinations:

1) an edge joint — стыковое соединение;

2) grinding ['graɪndɪŋ], *n* — шлифование;

3) machining, *n* — обработка (на станке);

4) a T-joint, tee joint — тавровое соединение;

5) a fillet weld — сварной шов угловой;

6) a lap joint — соединение внахлестку;

7) to overlap, *v* — перекрывать, частично покрывать, заходить один на другой;

8) a fillet, *n* — кромка, желобок, углубление;

9) a plug [plʌg], *n* — пробка, заглушка, втулка;

10) a slot, n — щель, прорезь;

11) a spot, *n* — небольшой участок, пятнышко;

12) a projection, *n* — выступ, выступающая часть;

13) a seam weld — роликовый шов;

14) to call for, *v* — требовать;

15) flat, *adj* — плоский;

16) convex [ˌkɒn'vex], *adj* — выпуклый;

17) concave [kɒŋ'keɪv], *adj* — вогнутый.

3.15. In pairs discuss mechanical properties of each type of joints.

3.16. Make up and practise short situations with the following words and word combinations:

1) corner joint, four sub types, low energy density welder, high energy density welder;

2) edge joints, subjected to great stresses, groove, penetration or depth of fusion;

3) t-joint, right angle, fillet weld, little or no joint preparation;

4) lap joint, good mechanical properties, single or double bevel, thickness of the plate;

5) fillet weld, triangular shape, base material, cross section profile.

3.17. Make up questions with the words and word combinations from the previous exercise, and ask your partner.

3.18. Find in the text the English equivalents for the following phrases.

Быть подверженным большим напряжениям; сделать возможным необходимое проплавление; широко используемый; требуется стыковой шов; односторонний скос кромки; двойной скос кромки; чем толще пластина; тем больше требуется нахлест; в зависимости от профиля поперечного сечения; элементы соединяются под приблизительно прямым углом; приобретают форму буквы Т.

3.19. Define key words for each paragraph of the text "Other Types of Joints. Part 1".

3.20. Using the key words defined in the previous exercise shortly describe each type of joints.

3.21. Translate the first paragraph of the following text in written form without using a dictionary.

3.22. Scan the whole text and find additional information about T-joints compared to the information from the text above. Work with a partner.

Other Types of Joints. Part 2

T-joints

Tee joints are used when one part must be joined to the center of another part forming a T. Like the other types of weld, there are several ways that this joint can be prepared and welded, each with their own benefits and disadvantages. Most methods of welding tee joints involve welding the two joints between the parts, with either a high or low energy density beam. Like the other weld types, there are fundamental differences in the processes used with these two types of weld. When a tee joint is welded with either a high or low energy density system, the process usually involves first placing and clamping (clamp – скреплять)

the parts in the necessary configuration. If necessary, the parts may be tack welded (tack weld — соединять прихваточным швом) together to make welding the final joint easer. This can, however, case complications in the final weld, which will be elaborated (elaborate — тщательно обработать) on later.

In the case of low energy density welding, the joint is made by making a weld bead on one, or usually both, sides of the vertical plate. This is usually done with filler wire, and forms a very strong weld, usually with minimal distortion. However, it is not nearly as strong as the base metal. In this case, there are relatively few problems associated with spot welding before the final weld.

There are more options for welding tee joints with high energy density devices, such as the laser and electron beam. One option is to weld in a manner similar to that used in low energy density processes, along the joint. However, rather than simply welding on the surface, the beam penetrates deep into the piece, making a weld that can be comparable in strength to the base metal, Unfortunately, this method tends to case more distortion of the workpiece than low energy density methods. Welding both sides of the joint can help to correct this distortion, as well as strengthen the weld.

The second option when welding tee joints with a high energy density beam is to weld through the top of the "T" and into the perpendicular. This can be faster and easer, as it does not require that the joint be followed exactly, but tends to be far weaker than a weld from the side. This method also reduces distortion and is particularly well suited for welding a relatively thick piece to a thin plate, as the beam easily melts the thin plate that it must weld through but does not heat the second plate excessively. (2350)

From Joining Technologies | Newgate International Business Center | (slightly abridged).

3.23. Make up 3–4 questions to the text and ask them your partner.

3.24. Project work. Search Internet study magazine articles. Find the information about types of joints for composite and other new materials. Make presentations in PowerPoint.

3.25. Read the following text and translate it using the vocabulary.

В зависимости от взаимного расположения свариваемых деталей различают следующие сварные соединения: стыковые, угловые, торцевые, внахлестку и тавровые.

Стыковые соединения являются наиболее распространенным типом соединений при газовой сварке. При сварке металла толщиной до 2 мм применяют соединение встык с отбортовкой кромок, выполняемое без присадочного металла, или соединение встык без разделки кромок с применением присадочной проволоки. При толщине металла 2–5 мм стыковые соединения выполняют без разделки кромок с зазором между свариваемыми концами. Сваривая металлы толщиной более 5 мм, применяют стыковое соединение с V-образной или X-образной разделкой кромок.

Угловые и торцевые соединения также часто применяются при сварке металлов малой толщины. Торцевые соединения обычно выполняются без присадочного металла, и шов образуется за счет расплавления кромок основного металла.

Соединения внахлестку и тавровые можно применять при сварке деталей малой толщины. При сварке деталей толщиной больше 3–4 мм соединения этого типа нежелательны, так как они требуют более продолжительного нагрева металла при сварке, что приводит к короблению свариваемого изделия или образованию трещин.

Сварные швы по виду разделяются на стыковые и угловые. Стыковой шов располагается между кромками основного металла. Соединения внахлестку и тавровые выполняются угловыми швами. Угловой шов накладывается на поверхность свариваемых частей металла.

Writing.

3.26. Read the following text and translate it in written form.

A tack weld is a weld made to hold parts of an assembly in proper alignment temporarily until the final welds are made. Although the sizes of tack welds are not specified, they are normally between 1/2 inch to 3/4 inch in length, but never more than 1 inch in length. In determining the size and number of tack welds for a specific job, you should consider thicknesses of the metals being joined and the complexity of the object being assembled. Plug and slot welds are welds made through holes

or slots in one member of a lap joint. These welds are used to join that member to the surface of another member that has been exposed through hole. The hole may or may not be completely filled with weld metal. These types of welds are often used to join face-hardened plates from the backer soft side, to install liner metals inside tanks, or to fill up holes in a plate. Resistance welding is a metal fabricating process in which the fusing temperature is generated at the joint by the resistance to the flow of an electrical current. This is accomplished by clamping two or more sheets of metal between copper electrodes and then passing an electrical current through them. When the metals are heated to a melting temperature, forging pressure is applied through either a manual or automatic means to weld the pieces together. Spot and seam welding are two common types of resistance welding processes. Spot welding is probably the most commonly used type of resistance welding. The material to be joined is placed between two electrodes and pressure is applied. Next, a charge of electricity is sent from one electrode through the material to the other electrode. Spot welding is especially useful in fabricating sheet metal parts. Seam welding is like spot welding except that the spots overlap each other, making a continuous weld seam.

From http://en.wikipedia.org/wiki/Welding#_note-27#_note-27

Vocabulary

Acceptable, *adj* — приемлемый
accessibility, *n* — доступность, удобство осмотра и обслуживания
accommodate, *v* — приспосабливать(ся)
adhering slag — прилипший шлак
adjust, *v* — настраивать, регулировать
alter, *v* — меняться
alignment, *n* — расположение по одной линии, выравнивание
angle, *n* — угол
bevel angle — угол скоса кромки
odd stress angle — необычный угол напряжения
included angle — угол разделки (раскрытия) кромок
applicable, *adj* — применимый, пригодный
assembly, *n* — сборка

Bevelling — скашивание кромки, разделка кромок

Call for, *v* — требовать
cause, *v* — вызывать, быть причиной
composition, *n* — структура, состав
concave, *adj* — вогнутый
conversely, *adv* — обратно, противоположно, наоборот
convex, *adj* — выпуклый
cross section — поперечное сечение
current, *n* — электрический ток
curve, *v* — изгибаться

Detrimental, *adj* — вредный, пагубный

Excessive, *adv* — чрезмерный, избыточный
in excess of — больше, свыше, сверх нормы

in the neighbourhood of — приблизительно
essential, *adj* — обязательный, непременный
extend, *v* — расширяться, удлиняться

Fillet, *n* — кромка, желобок, углубление
finished joint — чистовой шов
fit-up, *n* — сборка соединения под сварку
flat, *adj* — плоский

Grinding, *n* — шлифование
gouging — поверхностная резка, строжка
govern, *v* — управлять, обусловливать
groove, *n* — подготовка (разделка) кромок под сварку
- groove angle — угол разделки кромок
- groove face — свариваемая кромка, поверхность разделки
- groove radius — радиус закругления кромки
- groove weld — шов с разделкой кромок
  - Single-V Groove (butt) — V-образная разделка (стыкового соединения) со скосом двух кромок
  - Single-U Groove (butt) — V-образная разделка (стыкового соединения) с одним криволинейным скосом двух кромок
  - Double-V Groove (butt) — X-образная разделка (стыкового соединения) с двумя (симметричными) скосами двух кромок
  - Double-U Groove (butt) — X-образная разделка (стыкового соединения) с двумя криволинейными скосами двух кромок

Heat-affected zone — зона термического влияния
heat input — ввод тепла

Initial, *adj* — начальный, исходный
input, *n* — подводимая мощность

Joint, *n* — соединение
- joint penetration — проплавление (провар) соединения
- T-joint, tee joint — тавровое соединение
- corner joint — угловое соединение

flange joint — сварное соединение, выполненное по отбортовке
edge joint — стыковое соединение
lap joint — соединение внахлестку

Leverage, *n* — сила, усилие

Machining, *n* — обработка (на станке)
maintain, *v* — поддерживать, сохранять

Objection, *n* — возражение
overlap, *v* — перекрывать, частично покрывать, заходить один на другой

Plug, *n* — пробка, заглушка, втулка
penetrate — проникать, проплавлять
permissible, *adj* — допустимый
positioning, *n* — установка в удобном для сварки положении
preparation joint — подготовленное соединение под сварку
pressure vessel — сосуд высокого давления, автоклав
projection, *n* — выступ, выступающая часть
proneness, *n* — подверженность чему-либо

Reasonable, *adj* — обоснованный
refuse, *v* — *зд.* переплавлять
relatively, *adv* — относительно, сравнительно
result in, *v* — привести к...
retain, *v* — удерживать, сохранять
right angle — прямой угол
root, *n* — корень шва, вершина разделки кромок, пространство между свариваемыми кромками в месте их наибольшего сближения
root face — поверхность притупления (кромки)
root opening — зазор между свариваемыми кромками
root penetration — проплавление (провар) корня шва

Shift, *v* — передвигать(ся)
single pass — однопроходный
slightly, *adv* — немного, слегка
slot, *n* — щель, прорезь

spot, *n* — небольшой участок, пятнышко

square butt groove — подготовка (разделка) стыкового соединения без скоса кромок

stringer bead — валик, наплавленный без поперечных колебаний электрода, горелки

subjected to heavy loads — подвергающийся большим нагрузкам

sufficiently, *adv* — достаточно

support, *n* — суппорт; снабжение

surround, *v* — окружать

Tack — сваривать прихваточным швом

taper, *v* — сходить на конус, сужаться

thermal diffusivity — теплопроводность, коэффициент теплопроводности

tolerate, *v* — допускать

turn over, *v* — переворачивать

Value, *n* — значение

voltage, *n* — электрическое напряжение

Weld, *n* — сварной шов

- backing weld — подварочный шов
- circumferential weld — кольцевой (круговой) шов
- fillet weld — сварной шов угловой
- intermittent weld — прерывистый шов
- melt through weld — сварной шов со сквозным проплавлением
- multipass weld — многопроходный шов
- seam weld — роликовый шов

weld backing — подкладка под шов

weld bead — наплавленный валик сварного шва

welder, *n* — сварочный агрегат

weld reinforcement — усиление шва

Keys to the Exercises

1.1. 1(d), 2(a), 3(c), 4(b).
1.6. 1(d), 2(b), 3(c), 4(a), 5(b), 6(d), 7(a), 8(b), 9(d), 10(c).
1.8. 1(d), 2(f), 3(i), 4(g), 5(a), 6(e), 7(j), 8(b), 9(c), 10(h).
1.16. 1(e), 2(a), 3(f), 4(g), 5(i), 6(j), 7(b), 8(d), 9(k), 10(c), 11(h).
1.17. 1(b), 2(c), 3(a), 4(b), 5(b), 6(d), 7(c), 8(a).
1.25. 1(c), 2(a), 3(g), 4(e), 5(b), 6(d), 7(f).
2.2. 1(c), 2(b), 3(d), 4(f), 5(a), 6(g), 7(e).
2.10. 1(d), 2(h), 3(i), 4(e), 5(g), 6(c), 7(b), 8(j), 9(f), 10(a).
2.19. 1 (d), 2(f), 3(h), 4(c), 5(a), 6(g), 7(e), 8(b), 9(i).
3.2. l(c), (a), 3(d), 4(b).
3.7. l(e), 2(a), 3(b), 4(d), 5(c).

Литература

1. *Н. И. Перлов*, *А. И. Истеев*, *В. А. Тюрин и др.* Англо-русский металлургический словарь. М.: Русский язык, 1985. 841 с.

2. *Англо-русский* словарь по машиностроению и автоматизации производства (около 100 тыс. терминов). М.: РУССО, 2001. 1008 с.

3. *Большой* англо-русский политехнический словарь: В 2 т. (около 200 тыс. терминов) / С. М. Баринов и др. М.: РУССО, 1999. 720 с.

4. *Oxford* Advanced Learner's Dictionary. Oxford University Press, 2005. 1700 p.

5. *Aldhouse D.* Modern Welding. The Goodheart-WillCox Company, Inc., 1997. 780 p.

6. http://www.rodovens.com/welding_articles/weld_machine.htm

Contents

Учебное издание

Гурова Галина Григорьевна
Николаева Наталия Сергеевна

Обучение разговорной речи и чтению литературы на английском языке по специальности «Сварка»

Корректоры *Л. Н. Петрова*, *Г. С. Беляева*
Компьютерная верстка *М. А. Голуба*

Подписано в печать 30.12.2009. Усл. печ. л. 3,26.
Формат $60\times84/16$. Тираж 100 экз. Изд. № 30.
Заказ

Издательство МГТУ им. Н. Э. Баумана.
Типография МГТУ им. Н. Э. Баумана.
105005, Москва, 2-я Бауманская ул., 5.