Государственное профессиональное образовательное учреждение Тульской области
«Узловский политехнический колледж»

Онлайн-курс по техническому английскому языку

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JOB DESCRIPTION AND WELDING EDUCATION

Module 1

1. From the list below choose the places where welders are not likely to work.

- machine-building factory workshop
- bridge construction site
- hospital
- university department
- shipyard
- bank
- repair shop
- assembly site
- bakery

2. Choose the correct word or both to complete the definition of welding.

Welding is the process of **cutting/joining** pieces of **metal/plastic** **detachably/permanently** with **metal/ceramic** filler, using **heat/pressure.**

READING

3. Read the text **Welding & Machine Trades** and fill in the table with the information from the text

Welding professions and levels	Trades where welding skill is used	Places/fields a welder can work at (in)	Personal qualities a welder should have

Welding & Machine Trades

Welding is a skill used by many trades: sheet metal workers, iron-workers, diesel mechanics, boilermakers, carpenters, marine construction, steamfitters, glaziers, repair and maintenance personnel in applications ranging from the sculpture home hobbyist to heavy fabrication of bridges, ships and many other projects. A variety of welding processes are used to join units of metal. As a welder, you may work for shipyards, manufacturers, contractors, federal, state, county, and city governments, firms requiring maintenance mechanics, and repair shops.

Welding, while very physically demanding, can be very rewarding for those who enjoy working with their hands. Welders need good eyesight, manual dexterity and hand-eye coordination. They should also be able to concentrate for long periods of time on very detailed work, as well as be in good enough physical shape to bend and stoop, often holding awkward positions for long periods of time. Welders work in a variety of environments, both indoors and out, using heat to melt and fuse separate pieces of metal together. Training and skill levels can vary, with a few weeks of school or on-the-job training for the lowest level job and several years of school and experience for the more skilled welding positions.

Skilled welders often select and set up the welding equipment, execute the weld, and then examine the welds in order to make sure they meet the appropriate specifications. They may also be trained to work in a variety of materials, such as plastic, titanium or aluminum. Those with less training perform more routine tasks, such as the welds on jobs that have already been laid out, and are not able to work with as many different materials.

While the need for welders as a whole should continue to grow about as fast as average, according the U.S. Bureau of Labor Statistics, the demand for low-skilled welders should decrease dramatically, as many companies move towards automation. However, this will be partially balanced out by the fact that the demand for machine setters, operators and tenders should increase. And more skilled welders on construction projects and equipment repair should not be affected, as most of these jobs cannot be easily automated. Because of the increased need for highly skilled welders, those with formal training will have a much better chance of getting the position they desire. For those considering to prepare themselves to a meaningful welding-career, there are many options available.

There are also different professional specialties and levels, that should be understood to make an informed choice. Some of these are: welder, welding machine operator, welding technician, welding schedule developer, welding procedure writer, testing laboratory technician, welding non destructive testing inspector, welding supervisor, welding instructor, welding engineer.

4. Answer the following questions on the text

- 1. What are the trades where welding skills are used?
- 2. Where can welders work?
- 3. What personal characteristics should welders have?
- 4. How does the environment in which welders work vary?
- 5. What does it take to be slow-skilled/skilled welder?
- 6. What are welders able to do in terms of complection of tasks and variety of materials?

5. Translate the following sentences from Russian into English

1. Сфера применения сварки охватывает большое количество областей промышленности.
2. Профессия сварщика требует физической выносливости из-за частой необходимости работы в нестационарных условиях.
3. Для того чтобы стать квалифицированным сварщиком, необходима длительная теоретическая подготовка и практический опыт работы.
4. Квалифицированный сварщик должен сам уметь подбирать необходимое сварочное оборудование, материалы и технику сварки.
5. Чем выше квалификация сварщика, тем больше количество материалов, с которыми он может работать, и разнообразнее виды выполняемых работ.
6. В настоящее время имеются большие возможности для освоения профессии сварщика.

SPEAKING

6. Discuss with a partner what the following specialists do. Ask and answer questions according to the model.

- What does a welder do?
- A welder uses some of various welding processes to join units of metal.
- welder
- welding machine operator
- welding technician
- welding schedule developer
- welding procedure writer
- testing laboratory technician
- welding non destructive testing inspector

WELDING PROCESSES & EQUIPMENT

Module 2

1. There are processes similar to welding which a welder should know about. Read the definitions of metal joining processes (1-6) and supply them with Russian equivalents from the list (a-f).

a) резка

b) пайка мягким (легкоплавким) припоем

c) свинцевание

d) клепка

e) лужение

f) пайка твердым припоем резка

1. Soldering: Bonding by melting a soft metal to the surface of pieces to be joined. Low temperature. Good for joining dissimilar materials. Most common solders are lead-tin alloys.

2. Tinning: A soldering process, where the surface of a metal is coated with solder.

3. Leading: A form of soldering, solder is used to fill in the surface of metal.

4. Brazing: Similar to soldering, but uses a higher temperature to fuse the filler metal to the work pieces. Stronger bond. (Includes "Silver Soldering") Work heated to pre-melt temperatures.

5. Cutting: Work is heated to melting point and beyond, and "cut" by owidizing metal. (Literally burning it away).

6. Riveting: A process of fastening with a rivet which is a heavy pin having a head at one end and the other end being hammered flat after being passed through holes in the pieces that are fastened together.

READING

2. Read the text and answer the questions

1. What is a weld?
2. How can the heat be supplied for welding?
3. Is pressure employed in solid-phase processes?
4. What does an arc column consist of?
5. How is heat applied during welding?
6. What is the role of inert atmospheres?
7. What can make a joint brittle while welding?
8. What does the weld metal comprise in arc welding?
9. What is the base metal influenced by?
10. How can residual stress in welded structures be controlled?

Basic Principles of Welding

A weld can be defined as a coalescence of metals produced by heating to a suitable temperature with or without the application of pressure, and with or without the use of a filler material.

In fusion welding a heat source generates sufficient heat to create and maintain a molten pool of metal of the required size. The heat may be supplied by electricity or by a gas flame. Electric resistance welding can be considered fusion welding because some molten metal is formed.

Solid-phase processes produce welds without melting the base material and without the addition of a filler metal. Pressure is always employed, and generally some heat is provided. Frictional heat is developed in ultrasonic and friction joining, and furnace heating is usually employed in diffusion bonding.

The electric arc used in welding is a high-current, low-voltage discharge generally in the range 10–2,000 amperes at 10–50 volts. An arc column is complex but, broadly speaking, consists of a cathode that emits electrons, a gas plasma for current conduction, and an anode region that becomes comparatively hotter than the cathode due to electron bombardment. A direct current (DC) arc is usually used, but alternating current (AC) arcs can be employed.

Total energy input in all welding processes exceeds that which is required to produce a joint, because not all the heat generated can be effectively utilized. Efficiencies vary from 60 to 90 percent, depending on the process; some special processes deviate widely from this figure. Heat is lost by conduction through the base metal and by radiation to the surroundings.

Most metals, when heated, react with the atmosphere or other nearby metals. These reactions can be extremely detrimental to the properties of a welded joint. Most metals, for example, rapidly oxidize when molten. A layer of oxide can prevent proper bonding of the metal. Molten-metal droplets coated with oxide become entrapped in the weld and make the joint brittle. Some valuable materials added for specific properties react so quickly on exposure to the air that the metal deposited does not have the same composition as it had initially. These problems have led to the use of fluxes and inert atmospheres.

In fusion welding the flux has a protective role in facilitating a controlled reaction of the metal and then preventing oxidation by forming a blanket over the molten material. Fluxes can be active and help in the process or inactive and simply protect the surfaces during joining.
Inert atmospheres play a protective role similar to that of fluxes. In gas-shielded metal-arc and gas-shielded tungsten-arc welding an inert gas—usually argon—flows from an annulus surrounding the torch in a continuous stream, displacing the air from around the arc. The gas does not chemically react with the metal but simply protects it from contact with the oxygen in the air.
The metallurgy of metal joining is important to the functional capabilities of the joint. The arc weld illustrates all the basic features of a joint. Three zones result from the passage of a welding arc: (1) the weld metal, or fusion zone, (2) the heat-affected zone, and (3) the unaffected zone.
The weld metal is that portion of the joint that has been melted during welding. The heat-affected zone is a region adjacent to the weld metal that has not been welded but has undergone a change in microstructure or mechanical properties due to the heat of welding. The unaffected material is that which was not heated sufficiently to alter its properties.
Weld-metal composition and the conditions under which it freezes (solidifies) significantly affect the ability of the joint to meet service requirements. In arc welding, the weld metal comprises filler material plus the base metal that has melted. After the arc passes, rapid cooling of the weld metal occurs. A one-pass weld has a cast structure with columnar grains extending from the edge of the molten pool to the centre of the weld. In a multipass weld, this cast structure may be modified, depending on the particular metal that is being welded.

The base metal adjacent to the weld, or the heat-affected zone, is subjected to a range of temperature cycles, and its change in structure is directly related to the peak temperature at any given point, the time of exposure, and the cooling rates. The types of base metal are too numerous to discuss here, but they can be grouped in three classes: (1) materials unaffected by welding heat, (2) materials hardened by structural change, (3) materials hardened by precipitation processes.

Welding produces stresses in materials. These forces are induced by contraction of the weld metal and by expansion and then contraction of the heat-affected zone. The unheated metal imposes a restraint on the above, and as contraction predominates, the weld metal cannot contract freely, and a stress is built up in the joint. This is generally known as residual stress, and for some critical applications must be removed by heat treatment of the whole fabrication. Residual stress is unavoidable in all welded structures, and if it is not controlled bowing or distortion of the weldment will take place. Control is exercised by welding technique, jigs and fixtures, fabrication procedures, and final heat treatment.

3. Find the English equivalents for the following words and word combinations.

- Расплавленный металл, необходимый размер, не нагретый металл, механические свойства, максимум температуры, защищать поверхности, быстрое охлаждение, осуществлять контроль, препятствовать окислению, вступать в химическую реакцию, термообработка, бомбардировка электронами, зона термического [теплового] воздействия, общая потребляемая энергия.

4. Complete the following sentences.

- **1. A characteristic feature of fusion welding is:**

a) molten metal b) low-voltage discharge c) inert atmosphere

- **2. Furnace heating is usually employed in**

a) friction joining b) diffusion bonding c) ultrasonic joining

- **3. The consumable electrode is made**

a) negative b) positive c) neither

- **4. Total energy input in all welding processes is**

a) is greater than required to produce a joint b) is smaller than required to produce a joint c) equals to required to produce a joint

- **5. Reactions of most metals with the atmosphere or other nearby metals can**

1) improve the properties of a welded joint b) make the properties of a welded joint worse c) never influence the properties of a welded joint

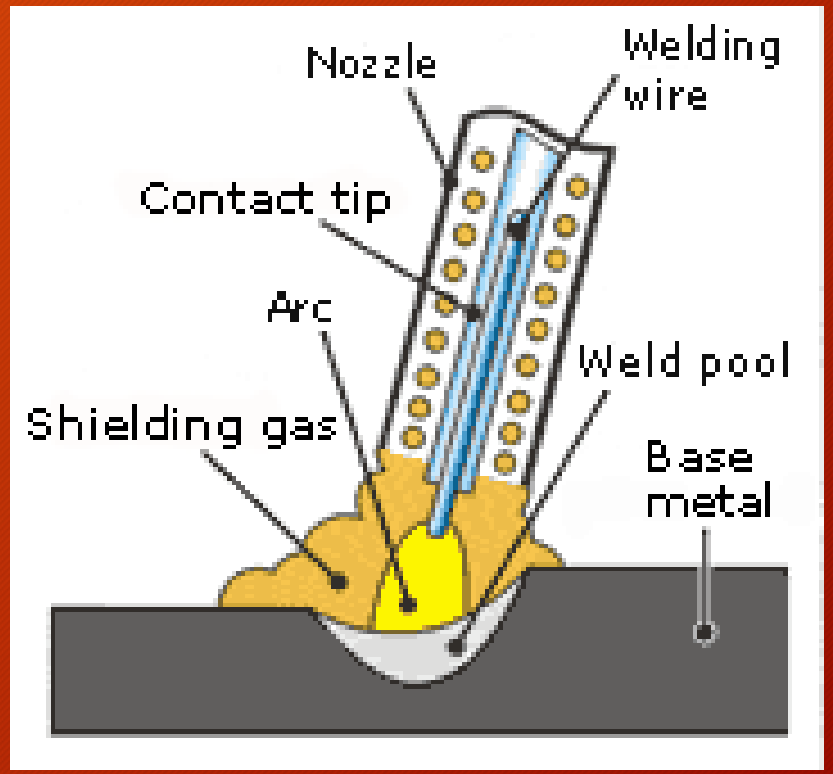
5. Say if the following sentences are true or false

1. There is always a welding pool in solid-phase welding processes.
2. Total energy input in all welding processes is greater than needed to produce a weld.
3. Reactions of metals with the atmosphere or other nearby metals are favorable to the properties of a welded joint.
4. Fluxes and inert atmospheres play a protective role and prevent oxidation.
5. The heat-affected zone is a region with unaltered properties.
6. Residual stress is present in all welded structures.

WRITING

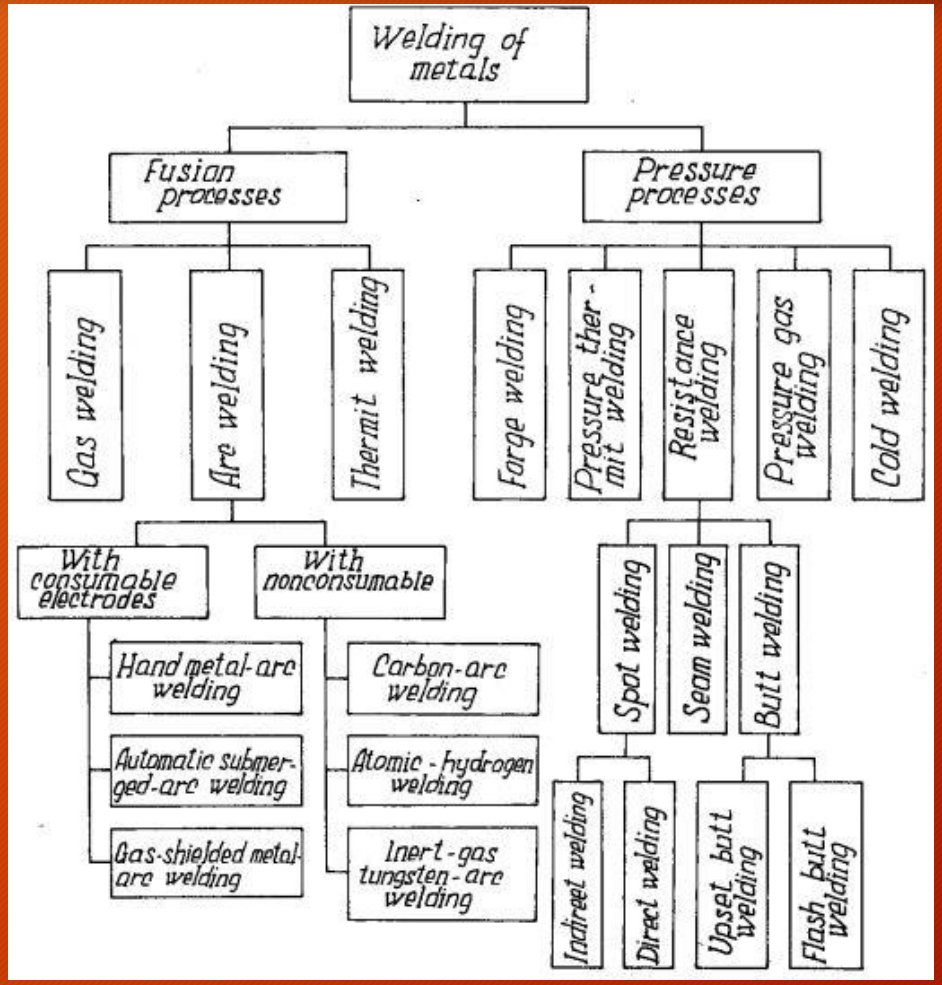
6. Write a short report on the subject below

Function of Fluxes and Inert Atmosphere in Welding



SPEAKING

7. Describe the classification of pressure processes. Use the verbs in bold from the previous exercise



1. You will read the text Alternative Types of Welding. Before you read suggest your answers to the following questions

1. What is the difference between the principle (“traditional”) and alternative types of welding?

2. Why are traditional welding processes not sufficient?

2. Match welding types (1-6) with their description (A-F). Then read the text and check your answers

1. Cold welding	**A. Light energy is used to weld parts together.**
2. Friction welding	B. The weld is formed at the expense of the applied pressure at a high temperature for a long period of time.
3. Laser welding	C. Vibration is used to generate heat necessary to produce a weld.
4. Diffusion bonding	D. The heat to accomplish the joint is generated by rotation.
5. Ultrasonic welding	E. The most important factor to accomplish the weld is pressure. No heat is applied.
6. Explosive welding	F. Rapid plastic deformation of the welded materials is caused by detonation.

Cold welding

Cold welding, the joining of materials without the use of heat, can be accomplished simply by pressing them together. Surfaces have to be well prepared, and pressure sufficient to produce 35 to 90 percent deformation at the joint is necessary, depending on the material. Lapped joints in sheets and cold-butt welding of wires constitute the major applications of this technique. Pressure can be applied by punch presses, rolling stands, or pneumatic tooling. Pressures of 1,400,000 to 2,800,000 kilopascals (200,000 to 400,000 pounds per square inch) are needed to produce a joint in aluminum; almost all other metals need higher pressures.

Friction welding

In friction welding two work pieces are brought together under load with one part rapidly revolving. Frictional heat is developed at the interface until the material becomes plastic, at which time the rotation is stopped and the load is increased to consolidate the joint. A strong joint results with the plastic deformation, and in this sense the process may be considered a variation of pressure welding. The process is self-regulating, for, as the temperature at the joint rises, the friction coefficient is reduced and overheating cannot occur. The machines are almost like lathes in appearance. Speed, force, and time are the main variables. The process has been automated for the production of axle casings in the automotive industry.

Laser welding

Laser welding is accomplished when the light energy emitted from a laser source focused upon a workpiece to fuse materials together. The limited availability of lasers of sufficient power for most welding purposes has so far restricted its use in this area. Another difficulty is that the speed and the thickness that can be welded are controlled not so much by power but by the thermal conductivity of the metals and by the avoidance of metal vaporization at the surface. Particular applications of the process with very thin materials up to 0.5 mm (0.02 inch) have, however, been very successful. The process is useful in the joining of miniaturized electrical circuitry.

Diffusion bonding

This type of bonding relies on the effect of applied pressure at an elevated temperature for an appreciable period of time. Generally, the pressure applied must be less than that necessary to cause 5 percent deformation so that the process can be applied to finished machine parts. The process has been used most extensively in the aerospace industries for joining materials and shapes that otherwise could not be made—for example, multiple-finned channels and honeycomb construction. Steel can be diffusion bonded at above 1,000° C (1,800° F) in a few minutes.

Ultrasonic welding

Ultrasonic joining is achieved by clamping the two pieces to be welded between an anvil and a vibrating probe or sonotrode. The vibration raises the temperature at the interface and produces the weld. The main variables are the clamping force, power input, and welding time. A weld can be made in 0.005 second on thin wires and up to 1 second with material 1.3 mm (0.05 inch) thick. Spot welds and continuous seam welds are made with good reliability. Applications include extensive use on lead bonding to integrated circuitry, transistor canning, and aluminum can bodies.

Explosive welding

Explosive welding takes place when two plates are impacted together under an explosive force at high velocity. The lower plate is laid on a firm surface, such as a heavier steel plate. The upper plate is placed carefully at an angle of approximately 5° to the lower plate with a sheet of explosive material on top. The charge is detonated from the hinge of the two plates, and a weld takes place in microseconds by very rapid plastic deformation of the material at the interface. A completed weld has the appearance of waves at the joint caused by a jetting action of metal between the plates.

3. Fill in the blanks with the right words (namely, types of welding) from the list below

1. …welding is successfully used in manufacture of small elements of electric circuits.
2. Heat is not used in … welding.
3. … is widely used in aerospace industries.
4. Vibration is used in …welding.
5. Plastic deformation is the basic principle in … welding.
6. … welding is impossible without pressure and high temperature.
7. In … welding one of the parts being welded revolves.

4. Translate the following sentences into Russian

1.При холодной сварке поверхности должны быть тщательно подготовлены.

2. Скорость и толщина свариваемых деталей зависит не столько от мощности лазера, сколько от теплопроводности металла.

3. Этот вид сварки наиболее широко используется в авиакосмической промышленности.

4. Холодная сварка – это сварка без использования тепловой энергии, когда две свариваемые поверхности, обладающие высокой пластичностью, с силой прижимают друг к другу.

5. Использование точечной и шовной сварки позволяет получать сварные соединения высокой прочности.

6. Основными переменными величинами при этом виде сварки являются подводимое тепло, время сварки и сила сжатия.

7. Фрикционным разогревом добиваются пластичности материала, затем вращение цапфы останавливают и увеличивают давление для обеспечения сваривания поверхностей.

8. Сварной шов имеет чешуйчатый вид, что является результатом обдува струей сжатого воздуха.

WRITING

5. Make a summary of alternative welding processes indicating their application capabilities.

Start like this:

1. Cold welding that is welding without heat makes it possible to join thin sheets of aluminum.

2. Friction welding…

SPEAKING

6. Choose an alternative welding method for the following applications. Explain your choice.

- to join some electrical wires to form a circuit
- a transistor can
- parts of a plane which have honeycomb construction
- to join two aluminum sheets laid one onto another

1. In each line of words (1-4) find the odd one out. Explain your choice

1. low-voltage, gas flame, direct current, discharge
2. gas welding, arc welding, … termit welding, resistance welding
3. friction, torch, flux, filler material
4. fusion, filler, heat-affected, unaffected

2. Complete the following sentences:

1. A characteristic feature of fusion welding is:

a) molten metal b) low-voltage discharge c) inert atmosphere

2. Furnace heating is usually employed in

a) friction joining b) diffusion bonding c) ultrasonic joining

3. The consumable electrode is made

a) negative b) positive c) neither

4. Total energy input in all welding processes is

a) is greater than required to produce a joint b) is smaller than required to produce a joint c) equals to required to produce a joint

5. Reactions of most metals with the atmosphere or other nearby metals can

a) improve the properties of a welded joint b) make the properties of a welded joint worse c) never influence the properties of a welded joint

6. The most common gas used in gas-shielded metal-arc and gas-shielded tungsten-arc welding is

a) argon b) oxygen c) carbon dioxide

7. If not controlled, residual stress results in

a) precipitation processes in welded structures, b) freezing of the weld-metal c) bowing or distortion of the weldment

3. Complete the following sentences:

1. The two basic welding processes are ... .
2. The fusion processes consist of … .
3. Among these, arc welding can be accomplished …
4. Arc welding with consumable electrodes includes the following types… .
5. Carbon arc welding, atomic hydrogen welding, inert gas tungsten arc welding refer to … .
6. The pressure processes include … .
7. Resistance welding is divided into three types … .

4. Translate the following text from Russian into English

Сварка – это процесс получения неразъёмного соединения деталей машин, конструкций и сооружений посредством местного разогрева (вплоть до плавления), пластической деформации или при совместном действии того и другого; суть сварки заключается в таком взаимном проникновении или сближении поверхностей свариваемых тел, при котором в месте соединения начинают действовать силы межатомного (межмолекулярного) сцепления. Различают сварку плавлением (дуговая, газовая, плазменная, электроннолучевая, лазерная) и сварку давлением (контактная, конденсаторная, холодная, ультразвуковая, термокомпрессионная, диффузионная). Выбор того или иного способа сварки зависит от физико-химических свойств свариваемых материалов, условий проведения сварки, от толщины соединяемых деталей и конструкции соединений.

5. Use the verbs from the left column and the phrases from the right column to speak about advantages of automated welding systems

1 to provide	**a) good overview of important events during welding**
2 to allow	b) valuable information for the planning of non-destructive testing
3 to enable the operator	c) easily-accessible documentation of the welding process
4 to result in	d) to choose to stop the process immediately, stop it after the completion of the bead or allow it to continue
5 to offer	e) better weld quality

6. Complete the following sentences.

1. Argon is a … gas.
2. Particulate fume is very … for man's health.
3. When exposed to particulate fume of high concentration for a long time, a welder may … .
4. Welding galvanised steel may cause … .
5. Asphyxiation may happen due to … .
6. To minimise the risk, special attention should be paid to controlling fumes which may contain chromium or … compounds.
7. In case of metal fume fever, …. recovery occurs soon after removal of the welder from the exposure.
8. … is a disease caused by fluid on the lungs.
9. MEL means maximum … limit.
10. OES is … exposure standard.
11. Gases encountered in welding are … .