Summary Report for Individual Task
551-88L-3075
Conduct Advanced Welding Procedures
Status: Approved

Condition: Given an operational welding machine aboard a vessel, at sea, at anchor or moored alongside a pier, day or night, under all sea and weather conditions, while wearing appropriate PPE, (i.e. hearing protection,welding gloves, eye protection, welding shield , apron, etc.), lock out tag out kit and a marine rail tool box.

Standard: The Soldier correctly conducted advance welding procedures aboard an Army vessel, IAW the appropriate Technical Manual and local SOPs, without injury to self or others and without damage to equipment.

Special Condition: None

Safety Risk: Medium

MOPP 4:

Task Statements

Cue: None

DANGER

None

WARNING

None

CAUTION

None

Remarks: None

Notes: None

Performance Steps

1. Demonstrate basic knowledge using the four basic welding positions.

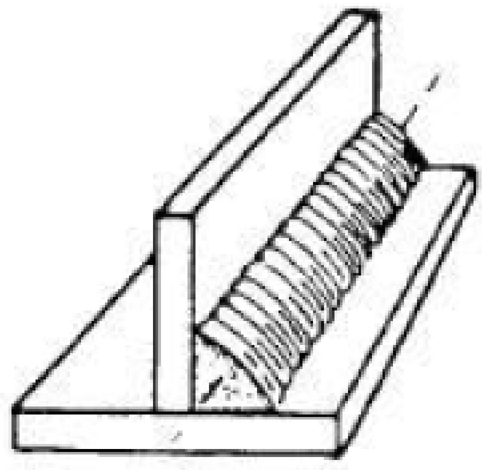
a. Flat position welding.

(1) In this position, the welding is performed from the upper side of the joint, and the face of the weld is approximately horizontal.

(2) Flat welding is the preferred term; however, the same position is sometimes called downhand.

Note: The axis of a weld is a line through the length of the weld, perpendicular to the cross section at its center of gravity.

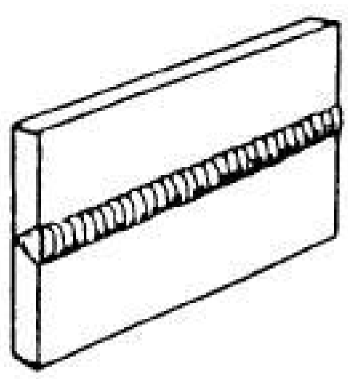
(a) Fillet weld - In this position, welding is performed on the upper side of an approximately horizontal surface and against an approximately vertical surface.



Fillet Weld

Figure 551-88L-3075_01

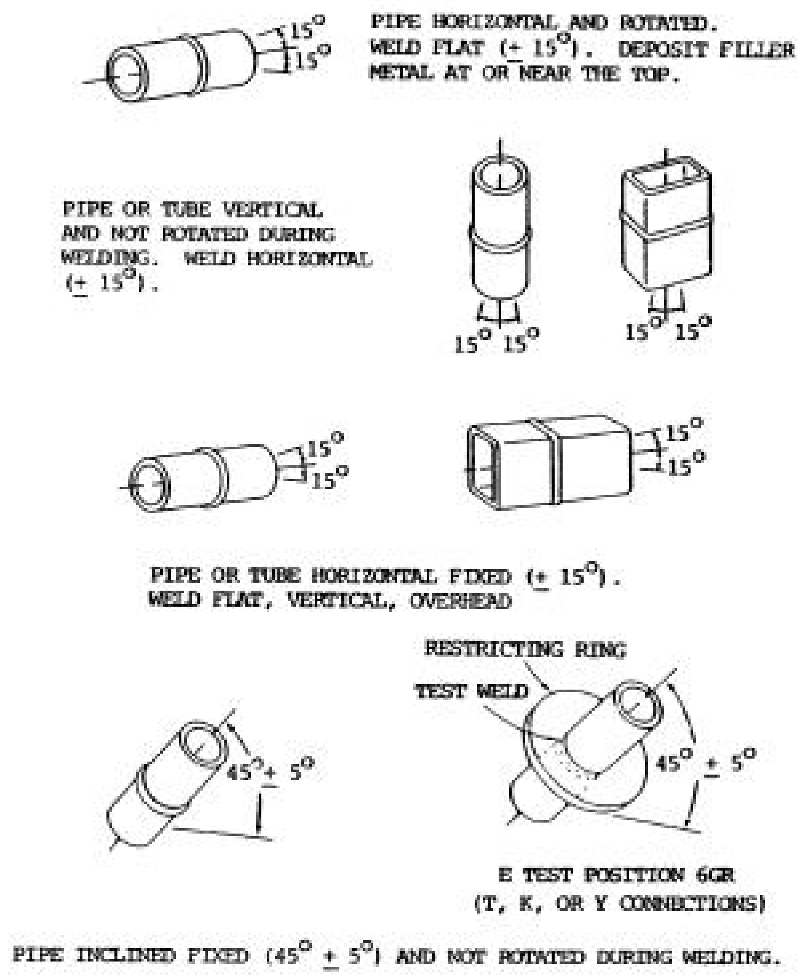
(b) Groove weld - In this position, the axis of the weld lies in an approximately horizontal plane and the face of the weld lies in an approximately vertical plane.



Groove Weld

Figure 551-88L-3075_02

(c) Horizontal fixed weld - In this pipe welding position, the axis of the pipe is approximately horizontal, and the pipe is not rotated during welding.



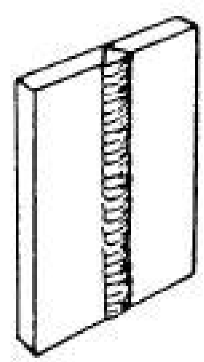
Horizontal Fixed and Rolled Weld
Figure 551-88L-3075_03

(d) Horizontal rolled weld - In this pipe welding position, welding is performed in the flat position by rotating the pipe.

b. Vertical position welding.

(1) In this position, the axis of the weld is approximately vertical.

(2) In vertical position pipe welding, the axis of the pipe is vertical, and the welding is performed in the horizontal position.

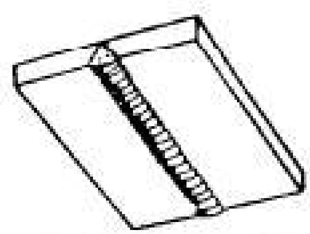


Vertical Position
Figure 551-88L-3075_04

c. Overhead position welding.

(1) In this welding position, the welding is performed from the underside of a joint.

(2) Overhead-position welding is the most difficult welding position.

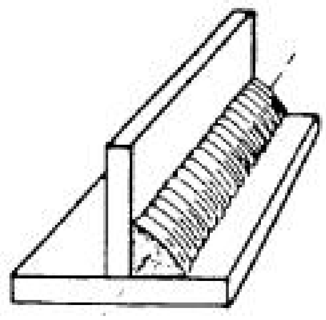


Overhead Position
Figure 551-88L-3075_05

d. Horizontal position welding.

(1) The weld axis is approximately horizontal, but the weld type dictates the complete definition.

(2) Butt welding in the horizontal position is a little more difficult to master than flat position.



Horizontal Weld
Figure 551-88L-3075_06

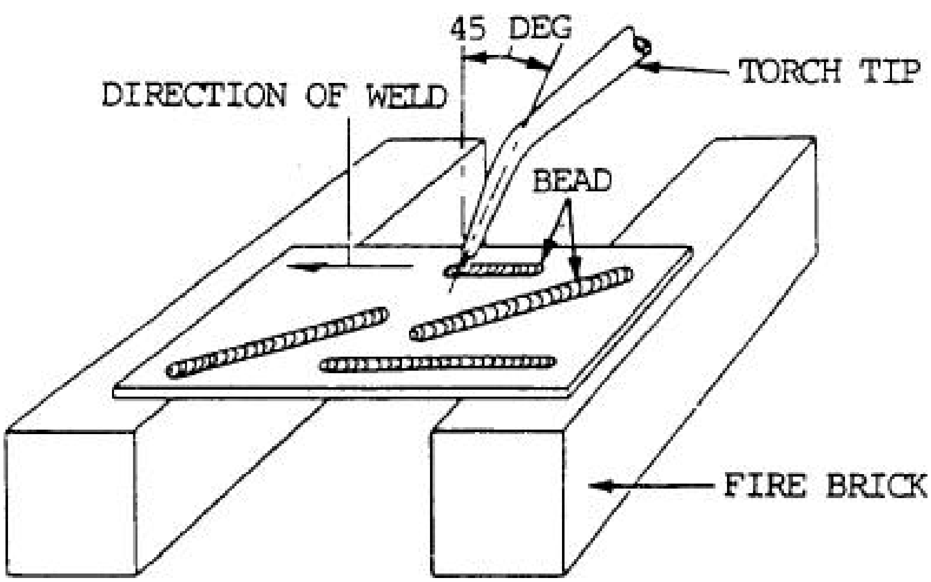
2. Conduct advanced welding procedures using the four basic positions.

a. Flat position welding procedures.

(1) In order to make satisfactory bead welds on a plate surface, the flare motion, tip angle, and position of the welding flame above the molten puddle should be carefully maintained.

(2) The welding torch should be adjusted to give the proper type of flame for the particular metal being welded.

(3) Narrow bead welds are made by raising and lowering the welding flare with a slight circular motion while progressing forward.



Flat Position Bead Weld
Figure 551-88L-3075_07

(4) The tip should form an angle of approximately 45 degrees with the plate surface.

(5) The flame will be pointed in the welding direction.

(6) TO increase the depth of fusion, either increase the angle between the tip and the plate surface , or decrease the welding speed.

(7) The size of the puddle should not be too large because this will cause the flame to burn through the plate.

(8) A small puddle should be formed on the surface when making a bead weld with a welding rod.

(9) The welding rod is inserted into the puddle and the base plate and rod are melted together.

(10) The torch should be moved slightly from side to side to obtain good fusion.

(11) The size of the bead can be controlled by varying the speed of welding and the amount of metal deposited from the welding rod.

b. Vertical position welding procedures.

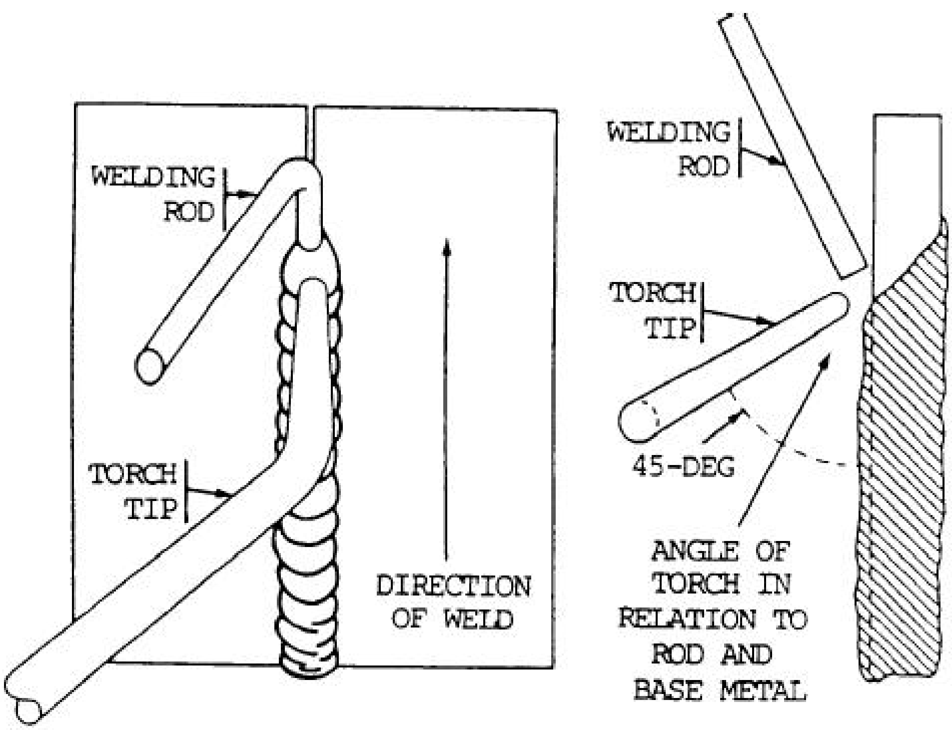
(1) When welding is done on a vertical surface, the molten metal has a tendency to run downward and pile up.

(2) The flew of metal can be controlled by pointing the flame upward at a 45 degree angle to the plate, and holding the rod between the flame and the molten puddle.

(3) The manipulation of the torch and the filler rod keeps the metal from sagging or falling and ensures good penetration and fusion at the joint.

(4) Both the torch and the welding rod should be oscillated to deposit a uniform bead.

(5) The welding rod should be held slightly above the center line of the joint, and the welding flame should sweep the molten metal across the joint to distribute it evenly.



Vertical Position Butt Joint

Figure 551-88L-3075_08

(6) Butt joints welded in the vertical position should be prepared for welding in the same manner as that required for welding in the flat position.

c. Overhead position welding procedures.

(1) Bead welds.

(a) In overhead welding, the metal deposited tends to drop or sag on the plate, causing the bead to have a high crown.

(b) To overcome this difficulty, the molten puddle should be kept small, and enough filler metal should be added to
obtain good fusion with some reinforcement at the bead.

(c) If the puddle becomes too large, the flame should be removed for an instant to permit the weld metal to freeze.

(d) When welding light sheets, the puddle size can be controlled by applying the heat equally to the base metal and filler rod.

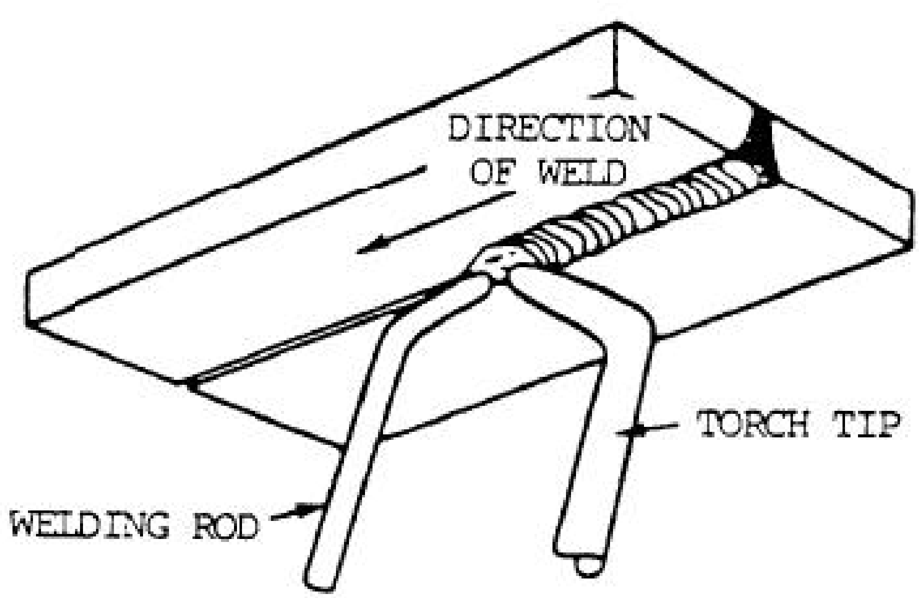
(2) Butt joints.

(a) The flame should be directed so as to melt both
edges of the joint.

(b) Sufficient filler metal should be added to maintain an adequate puddle with enough reinforcement.

(c) The welding flame should support the molten metal and
distribute it along the joint.

(d) Care should be taken to control the heat to avoid burning through the plates.



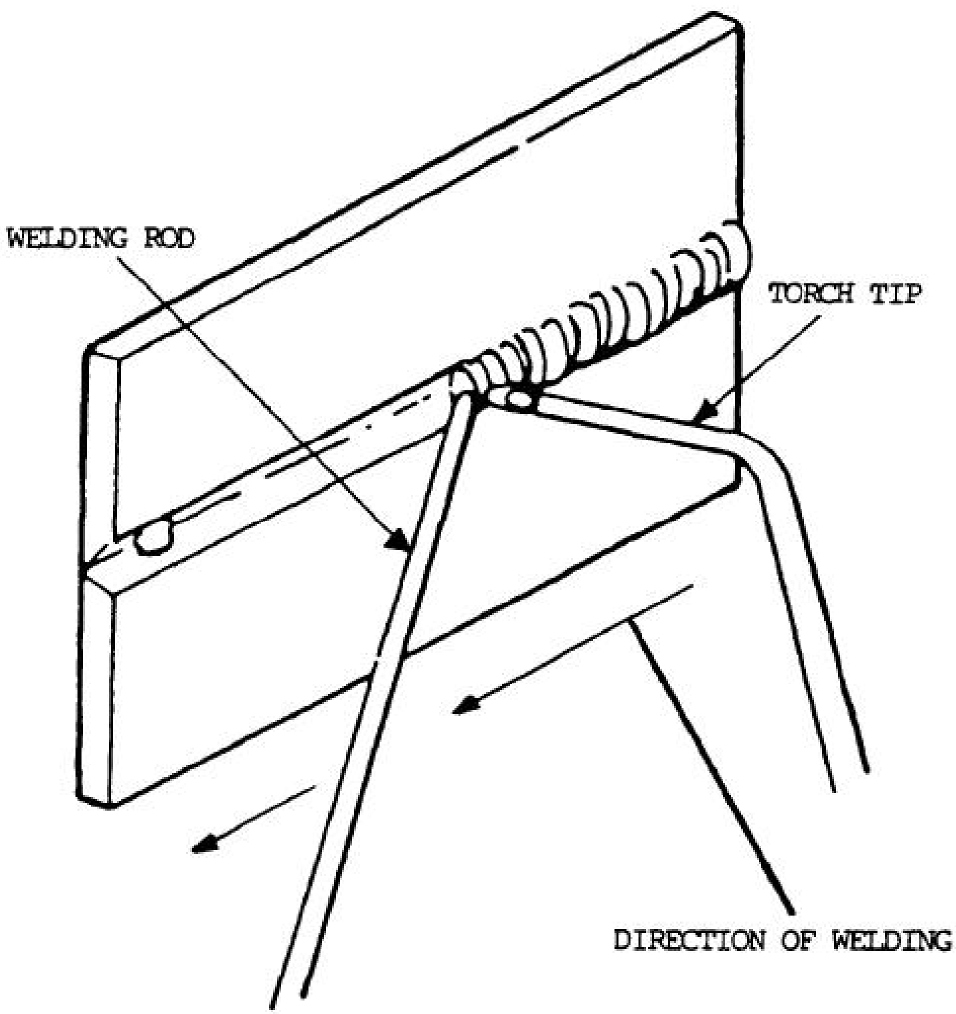
Overhead Butt Joint
Figure 551-88L-3075_09

d. Horizontal position welding procedures.

(1) Align the plates and tack weld at both ends.

(2) The torch should move with a slight oscillation up and down to distribute the heat equally to both sides of the joint, thereby holding the molten metal in a plastic state.

(3) This prevents excessive flow of the metal to the lower side of the joint, and permits faster solidification of the weld metal.



Horizontal Butt Joint
Figure 551-88L-3075_10

3. Demonstrate basic knowledge for destructive and nondestructive testing.

a. Performance testing.

(1) To ensure the satisfactory performance of a welded structure, the quality of the welds must be determined by adequate testing procedures.

(2) They are proof tested under conditions that are the same or more severe than those encountered by the welded structures in the field.

(3) These tests reveal weak or defective sections that can be corrected before the materiel is released for use in the field.

b. Inspection procedure.

(1) The finished weld should be inspected for undercut, overlap, surface checks, cracks, or other defects.

(2) When materiel has been repaired by standard welding procedures, visual inspection should be sufficient to determine the efficiency of the weld.

c. Visual inspection.

(1) Incomplete penetration

(a) Describe the failure of the filler and base metal to fuse together at the root of the joint.

(b) Bridging occurs in groove welds when the deposited metal and base metal are not fused at the root of the joint.

(c) The frequent cause of incomplete penetration is a joint design which is not suitable for the welding process or the conditions of construction.

(2) Lack of fusion.

(a) Failure of a welding process to fuse together layers of weld metal or weld metal and base metal.

(b) The weld metal just rolls over the plate surfaces.

(c) This is generally referred to as overlap.

(3) Undercutting

(a) The burning away of the base metal at the toe of the weld.

(b) A defect that appears as a groove in the parent metal directly along the edges of the weld; most common in lap fillet welds, but can also be encountered in fillet and butt joints.

(4) Slag inclusions

(a) Elongated or globular pockets of metallic oxides and other solids compounds.

(b) They produce porosity in the weld metal.

(5) Porosity

(a) The presence of pockets which do not contain any solid material.

(b) They differ from slag inclusions in that the pockets contain gas rather than a solid.

4. Demonstrate basic knowledge of physical nondestructive testing techniques.

a. Physical tests have been developed to check the skill of the welding operator as well as the quality of the weld metal and the strength of the welded joint. Some of these tests, such as tensile and bending tests, are destructive, in that the test specimens are loaded until they fail, so the desired information can be gained.

b. Non-destructive tests are designed to test a weld without destroying the weld or the metal.

c. Acid Etch Test. This test is used to determine the soundness of a weld. The acid attacks or reacts with the edges of cracks in the base or weld metal and discloses weld defects if present. It also accentuates the boundary between the base and weld metal and, in this manner, shows the size of the weld which may otherwise be indistinct. This test is usually performed on a cross section of the joint. Solutions of hydrochloric acid, nitric acid, ammonium per sulfate, or iodine and potassium iodide are commonly used for etching carbon and low alloy steels.

d. Hydrostatic Test. This is a nondestructive test used to check the quality of welds on closed containers such as pressure vessels and tanks. The test usually consists of filling the vessel with water and applying a pressure greater than the working pressure of the vessel. Sometimes, large tanks are filled with water which is not under pressure to detect possible leakage through defective welds. Another method is to test with oil and then steam out the vessel. Back seepage of oil from behind the liner shows up visibly.

e. Magnetic Particle Test. This is a test or inspection method used on welds and parts made of magnetic alloy steels. It is applicable only to ferromagnetic materials in which the deposited weld is also ferromagnetic. A strong magnetic field is set up in the piece being inspected by means of high amperage electric currents. A leakage field will be set up by any discontinuity that intercepts this field in the part. Local poles are produced by the leakage field. These poles attract and hold magnetic particles that are placed on the surface for this purpose. The particle pattern produced on the surface indicates the presence of a discontinuity of defect on or close to the surface of the part.

f. X-Ray Test. This is a radiographic test method used to reveal the presence and nature of internal defects in a weld, such as cracks, slag, blowholes, and zones where proper fusion is lacking. In practice, an x-ray tube is placed on one side of the welded plate and an x-ray film, with a special sensitive emulsion, on the other side. When developed, the defects in the metal show up as dark spots and bands, which can be interpreted by an operator experienced in this inspection method. Porosity and defective root penetration

Note: Instructions for handling X-ray apparatus to avoid harm to operating personnel are found in the "American Standard Code for the Industrial Use of X-rays.

g. Gamma Ray Test. This test is a radiographic inspection method similar to the x-ray method, except that the gamma rays emanate from a capsule of radium sulfate instead of an x-ray tube. Because of the short wave lengths of gamma rays, the penetration of sections of considerable thickness is possible, but the time required for exposure for any thickness of metal is much longer than that required for X-rays because of the slower rate at which the gamma rays are produced. X-ray testing is used for most radiographic inspections, but gamma ray equipment has the advantage of being extremely portable.

h. Fluorescent Penetration Test. Fluorescent penetrant inspection is a nondestructive test method by means of which cracks, pores, leaks, and other discontinuities can be located in solid materials. It is particularly useful for locating surface defects in nonmagnetic materials such as aluminum, magnesium, and austenitic steel welds and for locating leaks in all types of welds. This method makes use of a water washable, highly fluorescent material that has exceptional penetration qualities. This material is applied to the clean dry surface of the metal to be inspected by brushing, spraying, or dipping. The excess material is removed by rinsing, wiping with clean water-soaked cloths, or by sandblasting. A wet or dry type developer is then applied. Discontinuities in surfaces which have been properly cleaned, treated with the penetrant, rinsed, and treated with developer show brilliant fluorescent indications under black light.

i. Magnaflux Test. This is a rapid, non-destructive method of locating defects at or near the surface of steel and its magnetic alloys by means of correct magnetization and the application of ferromagnetic particles.

(1) For all practical purposes, Magnaflux inspection may be likened to the use of a magnifying glass. Instead of using a glass, however, a magnetic field and ferromagnetic powders are employed. The method of magnetic particle inspection is based upon two principles:

(a) One, that the magnetic field is produced in a piece of metal when an electric current is flowing through or around it

(b) Two, that minute poles are set up on the surface of the metal wherever this magnetic field is broken or distorted

(2) When ferromagnetic particles are brought into the vicinity of a magnetized part, they are strongly attracted by these poles and are held more firmly to them than to the rest of the surface of the part, thereby forming a visible indication

(Asterisks indicates a leader performance step.)

Evaluation Guidance: None

Evaluation Preparation: None

PERFORMANCE MEASURES	GO	NO-GO	N/A
1. Demonstrated basic knowledge using the four basic welding positions.			
a. Flat position welding.			
(1) Fillet weld			
(2) Groove weld			
(3) Horizontal fixed weld			
(4) Horizontal rolled weld			
b. Vertical position welding.			
c. Overhead position welding.			
d. Horizontal position welding.			
2. Conducted advanced welding procedures using the four basic positions.			
a. Flat position welding procedures.			
b. Vertical position welding procedures.			
c. Overhead position welding procedures.			
(1) Bead welds.			
(2) Butt joints.			
d. Horizontal position welding procedures.			
3. Demonstrated basic knowledge for destructive and nondestructive testing.			
a. Performance testing.			
b. Inspection procedures.			
c. Visual inspection.			
(1) Incomplete penetration.			
(2) Lack of fusion.			
(3) Undercutting.			
(4) Slag inclusions.			
(5) Porosity.			
4. Demonstrated basic knowledge of physical nondestructive testing techniques.			
a. Acid Etch Test.			
b. Hydrostatic Test.			
c. Magnetic Particle Test.			
d. X-Ray Test.			
e. Gamma Ray Test.			
f. Fluorescent Penetration Test.			
g. Magnaflux Test.			

Supporting Reference(s):

Step Number	Reference ID	Reference Name	Required	Primary
	TC 9-237	OPERATORS CIRCULAR WELDING THEORY AND APPLICATION	No	No

Environment: Environmental protection is not just the law but the right thing to do. It is a continual process and starts with deliberate planning. Always be alert to ways to protect our environment during training and missions. In doing so, you will contribute to the sustainment of our training resources while protecting people and the environment from harmful effects. Refer to FM 3-34.5 Environmental Considerations and GTA 05-08-002 ENVIRONMENTAL-RELATED RISK ASSESSMENT.

Safety: In a training environment, leaders must perform a risk assessment in accordance with ATP 5-19, Risk Management. Leaders will complete the current Deliberate Risk Assessment Worksheet in accordance with the TRADOC Safety Officer during the planning and completion of each task and sub-task by assessing mission, enemy, terrain and weather, troops and support available-time available and civil considerations, (METT-TC). Note: During MOPP training, leaders must ensure personnel are monitored for potential heat injury. Local policies and procedures must be followed during times of increased heat category in order to avoid heat related injury. Consider the MOPP work/rest cycles and water replacement guidelines IAW FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, FM 3-11.5, Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination.

Prerequisite Individual Tasks : None

Supporting Individual Tasks : None

Supported Individual Tasks : None

Supported Collective Tasks : None

ICTL Data :

ICTL Title	Personnel Type	MOS Data
88L30 Watercraft Engineer	Enlisted	MOS: 88L, Skill Level: SL3, Duty Pos: TFR, LIC: EN
88L40 Watercraft Engineer	Enlisted	MOS: 88L, Skill Level: SL4, Duty Pos: TGB, LIC: EN, SQI: O