

CHAPTER 9  
MAINTENANCE WELDING OPERATIONS  
FOR MILITARY EQUIPMENT

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## 9-1. SCOPE

a. This chapter contains information necessary to determine the size of the welding job and proper welding procedures for military items.

b. Appendix A contains references to formal DA publications covering additional equipment used by military item and other equipment not covered by standard welding procedures as set forth in other chapters of this manual. Appendix A also contains references to formal DA publications covering additional equipment used by military personnel which are not included in this chapter.

c. Welding techniques for equipment containing high yield strength, low alloy structural steels (such as TI) used for bulldozer blades, armor, and heavy structural work are covered in chapter 12, section VII of this circular.

## 9-2. SIZING UP THE JOB

a. General. All of the materials used in the manufacture of military materiel, as well as the assembled equipment are thoroughly tested before the material is issued to the using services in the field. Therefore, most of the damage to and failures of the equipment are due to accidents, overloading, or unusual shocks for which the equipment was not designed to withstand. It is in this class of repair work that field service welding is utilized most frequently.

b. Determination of Weldability. Before repairing any damaged materiel, it must be determined whether or not the materiel can be satisfactorily welded. This determination is based upon the factors listed below.

(1) Determine the nature and extent of the damage and the amount of straightening and fitting of the metal that will be required.

(2) Determine the possibility of restoring the structure to usable condition without the use of welding.

(3) Determine the type of metal used in the damaged part, whether it was heat treated, and if so, what heat treatment was used.

(4) Determine if the welding heat will distort the shape or in any manner impair the physical properties of the part to be repaired.

(5) Determine if heat treating or other equipment or materials will be required in order to make the repair by welding.

## 9-2. SIZING UP THE JOB (cont)

c. Repairing Heat Treated Parts.

(1) In emergency cases, some heat treated parts can be repaired in the heat treated condition by welding with stainless steel electrodes containing 25 percent chromium and 20 percent nickel, or an 18 percent chromium-8 nickel electrode containing manganese or molybdenum. These electrodes will produce a satisfactory weld, although a narrow zone in the base metal in the vicinity of the weld will be affected by the heat of welding.

(2) Minor defects on the surface of heat treated parts may be repaired by either hard surfacing or brazing, depending on their application in service. In any of these repairs, the heat treated part will lose some of its strength, hardness, or toughness, even though the weld metal deposited has good properties.

(3) The preferred metal of repairing heat treated steels, when practicable, requires the annealing of the broken part and welding with a high strength rod. This method produces a welded joint that can be heat treated. The entire part should be heat treated after welding to obtain the properties originally found in the welded parts. This method should not be attempted unless proper heat treating equipment is available.

## 9-3. IDENTIFYING THE METAL

Welding repairs should not be made until the type of metal used for the components or sections to be repaired has been determined. This information can be obtained by previous experience with similar materiel, by test procedures as described in chapter 7, or from assembly drawings of the components. These drawings should be carried by maintenance companies in the field and should show the type of material and the heat treatment of the parts.

## 9-4. DETERMINING THE WELDABLE PART

a. Welding operations on ordnance materiel are restricted largely to those parts whose essential physical properties are not impaired by the welding heat.

b. Successful welded repairs cannot be made on machined parts that carry a dynamic load. This applies particularly to high alloy steels that are heat treated for hardness or toughness, or both.

c. Gears, shafts, antifriction bearings, springs, connecting rods, piston rods, pistons, valves, and cam are considered to be unsuitable for field welding because welding heat alters or destroys the heat treatment of these parts.

## 9-5. SELECTING THE PROPER WELDING PROCEDURES

The use of welding equipment and the application of welding processes to different metals is covered in other chapters of this manual. A thorough working knowledge of these processes and metals is necessary before a welding procedure for any given job can be selected. When it has been decided by competent authority that the repair can be made by welding, the factors outlined below must be considered.

a. The proper type and size of electrode, together with the current and polarity setting, must be determined if an arc welding process is used. If a gas welding process is used, the proper type of welding rod, correct gas pressure, tip size, flux, and flame adjustment must be determined.

b. In preparing the edges of plates or parts to be welded, the proper cleaning and beveling of the parts to be joined must be considered. The need for backing strips, quench plates, tack welding, and preheating must be determined.

c. Reducing warping and internal stresses requires the use of the proper sequence for welding, control and proper distribution of the welding heat, spacing of the parts to permit some movement, control of the size and location of the deposited weld metal beads, and proper cooling procedure.

d. Military materiel is designed for lightness and the safety factors are, of necessity, low in some cases. This necessitates some reinforcement at the joint to compensate for the strength lost in the welded part due to the welding heat. A reinforcement must be designed that will provide the required strength without producing high local rigidity or excessive weight.

#### 9-6. PRELIMINARY PRECAUTIONS

Before beginning any welding or cutting operations on the equipment, the safety precautions listed below must be considered.

- a. Remove all ammunition from, on, or about the vehicle or materiel.
- b. Drain the fuel tank and close the fuel and oil tank shut off valves. If welding or cutting is to be done on the tanks, prepare them for welding in accordance with the instructions in chapter 2, section V.
- c. Have a fire extinguisher nearby.
- d. Keep heat away from optical elements.
- e. Be familiar with and observe the safety precautions prescribed in chapter 2 of this circular.

