QUALITY ASSURANCE SYSTEM

P-22

PROCEDURE FOR UNDERWATER WELDING PROCEDURES

1-GENERAL

The following welding procedures are typical of those which have been approved for dry chamber and wet welding repairs to ships. These procedures may be used for welder-diver training; they may also be used by activities as guidelines in developing their own underwater welding procedures.

2- UNDERWATER WELDING PROCEDURE FOR WELDING ORDINARY STRENGTH AND HIGHER STRENGTH CARBON STEELS USING CARBON STEEL ELECTRODES

2.1 Introduction. This welding procedure outlines the basic welding parameters, materials, and techniques to be used for dry chamber production welds at depths between 0 and 50 feet.

2.1.1 Variations in such parameters as travel speed, amperage, and voltage are dependent on production conditions. This procedure specifies the range of such variables shown to be valid based on the qualification tests performed.

2.2 References.


2.3 Welding Parameters.

2.3.1 Base Metal and Thickness Range.

a. Carbon steel, ordinary strength and higher strength, of MIL-S-22698

b. Thickness range, 1/8 inch to two times the qualification test specimen thickness

2.3.2 Weld Joint Design(s). Groove and fillet.

2.3.3 Welding Position and Direction. All positions. When welding vertical, progression shall be up.

2.3.4 Welding Process. Shielded metal arc welding (SMAW).
2.3.5 **Welding Consumables.** Soft Touch AWS E70 XX UW - CS - 1 1/8 inch electrodes.

2.3.6 **Welding Technique.** This procedure is qualified for single-pass and multiple-pass welding using either (or both) the stringer bead or the weave bead technique.

2.3.7 **Time Lapse between Passes.** No restriction on this time.

2.3.8 **Electrical Characteristics.**
   a. Open circuit voltage, 60-80 volts DC.
   b. Welding current type: Direct current, electrode positive (DCEP).

2.3.9 **Preheat and Interposes Temperature.** 125°F, minimum.

2.3.10 **Post-Weld Heat Treatment.** None.

2.3.11 **Welding Water Depth Range.** 0 to and including 50 feet.

2.4 **Electrode Handling Procedure.** All electrodes are to be received in hermetically sealed containers. Once the electrodes are removed from the containers, they shall be either stored in electrode holding ovens at 225°-300°F, or they shall be immediately sealed in plastic bags. Only enough electrodes for one day's use should be stored in the bags, and each bag shall contain 20 electrodes.

2.4.1 The sealed bags shall be transferred to the dry chamber in pressurized canisters for additional protection. Once the bags are removed from the canisters, they shall not be opened until welding is to begin, and only one bag of electrodes shall be opened at one time. Once a bag is opened, the maximum exposure time of the electrodes to the chamber atmosphere is 90 minutes. Electrodes exposed for more than 90 minutes shall be discarded.

2.4.2 Each electrode shall be visually examined prior to use. Any electrode that appears contaminated by water, or is otherwise in poor condition, shall not be used. All electrodes must be accounted for by the diving supervisor.

2.5 **Inspection and Quality Assurance.** All procedure and performance qualification testing shall be performed as required by Reference an as invoked in Reference c.

2.5.1 **Confirmation weld(s) shall be performed at the underwater work site.** Welding, testing and inspection shall be as required by Reference c.

2.6 **Welder Qualification.** All welder-divers shall be qualified prior to production welding. Qualification testing shall be as required by Reference an as invoked in Reference c.
2.7 General Notes.

2.7.1 Cables. Welding cables shall be copper of size 2/0 or larger.

2.7.2 Power Supplies. Welding power supplies shall be 300 ampere or larger with a minimum 60 percent duty cycle.

2.7.3 Cleaning. Surfaces to be welded shall be cleaned to sound metal using grinders, wire brushes, or other appropriate means. All contaminants that produce hydrogen or oxygen, such as petroleum products or rust, must be removed. Salt deposits shall also be removed using fresh water. All joint areas shall be dry prior to welding.

2.7.3.1 Each weld pass shall have the slag removed prior to depositing the next weld pass. Also, any visible irregularities that may affect the quality of the weld shall be removed prior to depositing the next weld pass.

2.7.4 Grounds. The ground connection shall be located as close as practical to the weld joint. All ground connections shall be secure in order to inhibit any stray currents.

2.7.5 Protection from Shock. Rubber gloves shall always be worn under leather gloves when welding or using electrical equipment.

2.7.6 Electrical Switching. Electrical power for welding shall be controlled through a knife switch located on the surface near the welding power source. The switch should remain open except when welding is taking place.

2.7.7 Leads. All welding leads should be in good condition with no unprepared breaks in the insulation. Only copper welding leads shall be used.

2.7.8 Addendums. Specific requirements for special applications will be addressed on an attached addendum sheet. Where such an addendum sheet is attached, it will become an integral part of this procedure.

3 - WET WELDING PROCEDURE FOR WELDING ORDINARY STRENGTH CARBON STEELS USING CARBON STEEL ELECTRODES

3.1 Introduction. This welding procedure outlines the basic welding parameters, materials and techniques to be used for wet production welding at depths between 7 and 50 feet.

3.1.1 Variations in such parameters as travel speed, amperage and voltage are dependent on production conditions. This procedure specifies the range of such variables shown to be valid based on the qualification tests performed.
3.2 References.


3.3 Welding Parameters.

3.3.1 Base Metal and Thickness Range.

a. Ordinary strength carbon steel of MIL-S-22698

b. Thickness range, 1/8 inch to and including 1 1/8 inch.

3.3.2 Weld Joint Design(s). Groove and fillet.

3.3.3 Welding Position and Direction. All positions. When welding vertical, progression shall be down.

3.3.4 Welding Process. Shielded metal arc welding (SMAW).

3.3.5 Welding Consumables. 1/8-inch diameter BROCO Soft Touch CS-1.

3.3.6 Welding Technique. This procedure is qualified for single-pass and multiple-pass welding using either (or both) the stringer bead or the weave bead technique.

3.3.7 Time Lapse between Passes. No restriction on this time.

3.3.8 Electrical Characteristics.

a. Open circuit voltage, 60-80 volts DC.

b. Welding current type: Direct current, electrode negative (DCEN).

3.3.9 Welding Water Depth Range. 7 to and including 50 feet.

3.4 Electrode Handling Procedure. Each electrode shall be visually examined prior to use. Any electrode that appears contaminated by water, or is otherwise in poor condition, shall not be used. All electrodes must be accounted for by the diving supervisor.

3.5 Inspection and Quality Assurance. All procedure and performance qualification testing shall be performed as required by Reference b as invoked in Reference c.

3.5.1 Confirmation weld(s) shall be performed at the underwater work site. Welding, testing, and inspection shall be as required by Reference c.

3.6 Welder Qualification. All welder-divers shall be qualified prior to production welding. Qualification testing shall be as required by Reference b as invoked in Reference c.
3.7 General Notes.

3.7.1 Cables. Welding cables shall be copper of size 2/0 or larger.

3.7.2 Power Supplies. Welding power supplies shall be 300 ampere or larger with a minimum 60 percent duty cycle.

3.7.3 Cleaning. Surfaces to be welded shall be cleaned to sound metal using grinders, wire brushes, or other appropriate means.

3.7.3.1 Each weld pass shall have the slag removed prior to depositing the next weld pass. Also, any visible irregularities that may affect the quality of the weld shall be removed prior to depositing the next weld pass.

3.7.4 Grounds. The ground connection shall be located as close as practical to the weld joint. All ground connections shall be secure in order to inhibit any stray currents.

3.7.5 Protection from Shock. Rubber gloves shall always be worn under leather gloves when welding.

3.7.6 Electrical Switching. Electrical power for welding shall be controlled through a knife switch located on the surface near the welding power source. The switch should remain open except when welding is taking place.

3.7.7 Leads. All welding leads should be in good condition with no unprepared breaks in the insulation. Only copper welding leads shall be used.

3.7.8 Addendums. Specific requirements for special applications will be addressed on an attached addendum sheet. Where such an addendum sheet is attached, it will become an integral part of this procedure.