

APPENDIX B

PREFACE

"WWT-1688 WELDER WORKMANSHIP TRAINING" was developed by Electric Boat as an aid to Electric Boat vendors for welder training. Prior to use, each activity electing to use this program shall customize the program as required for their specific materials and applications.

Customization shall consist of identifying acceptance criteria or requirements for each topic with explanatory figures and notes as necessary. The use of weld samples representing acceptable and unacceptable conditions for major items is beneficial but not mandatory. Customization can include omission of certain topics which are not performed by the activity. The customized program, including the welder examination forms and identification of personnel responsible for conducting the training shall be approved by a MIL-STD-271 certified level III nondestructive test examiner. No further approvals are required.

WWT-1688

WELDER WORKMANSHIP TRAINING

Prepared by

**General Dynamics
Electric Boat**

Introduction

This training is intended to assure that welders and welding operators understand:

- What is required for a weld to be visually acceptable.
- Basic workmanship requirements.

The topics contained herein are the minimum required to train welders and welding operators to the workmanship and visual inspection requirements necessary to perform welding in accordance with NAVSEA T9074-AD-GIB-010/1688 (MIL-STD-1688)

This program does not fulfill the requirements for training welders for welding titanium materials.

This training, and successful completion of the required examination, must be conducted at least once every 3 years in order to maintain active welder or welding operator qualifications.

The minimum passing grade shall be 75%.

Records of the examination shall be maintained as required by paragraph 5.2.3.1 (e) of NAVSEA S9074-A Q-GLB-010/248.

Successful completion of this program satisfies the requirement contained in paragraph 5.2.3 (a) of NAVSEA S9074-AQ-GIB-010/248.

Periodic audits of this training shall be conducted as required by paragraph 5.2.3.1 (g) of NAVSEA S9074-AQ-GIB-010/248.

WORKMANSHIP AND VISUAL INSPECTION TOPICS

VISUAL INSPECTION ZONE

- Weld and 1/2 inch of adjacent base material are included in the inspection zone.
- Inspected to the applicable class of MIL-STD-2035.

VISUAL INSPECTION ATTRIBUTES

- Weld cleanliness
- Weld contour
 - blend smoothly and gradually into base material
 - re-entrant angle
 - fillet contour
 - groove weld reinforcement
- Cracks
- Spatter
- Undercut (see table 7-1)
- End/corner-melt (see table 7-1)
- Arc strikes, nicks, gouges
- Porosity
- Slag
- Weld joint offset

WELD COMPLETENESS

- Welds shall be completed to the extent required by the fabrication document.
- Build-up at intersecting butt welds must be verified.
- Seal-off and wrap-around must be verified.
- Proper tapers to adjacent structure should be verified.

WELD MARKING

- Welds may be marked to maintain identification for mapping or record keeping.
- Marking shall not be located in an area that will interfere with any required non-destructive testing.

MATERIAL IDENTIFICATION

- Material identification shall be maintained to the point of initial fabrication in accordance with a written procedure.
- Welding filler materials shall be positively identified prior to production use.

CLEANING

- Joint surfaces, a minimum of 1/2 inch from the weld edges, shall be cleaned prior to welding
- Surfaces shall be free of paint, except for primer when allowed by weld procedure.
- Surfaces shall be dry and free of mill scale, oxides, oil, grease, etc.
- Surfaces shall be dry and free of zinc, galvanizing, or thermal spray aluminum.

TACK WELDS

- Must be made with approved filler materials.
- Must provide adequate restraint.
- Tacks of poor quality must be removed.
- Poor quality tacks on the joint backside can be removed during back gouging.

JOINT CONFIGURATION

- Joint preparations shall be in accordance with an approved configuration.
- When fit-up gaps for fillet welds exceed 1/16 inch, the size of the fillet shall be increased by an amount equal to the excess of the opening above 1/16 inch.
- Full penetration joints welded from both sides shall be back-gouged, or ground to sound metal and inspected, prior to welding the second side.

THERMAL CUT SURFACES

- Thermal cut surfaces shall meet the requirements of AWS C4.1

TEMPORARY SNIPES

- Must be provided at intersecting full penetration welds.
- Must be dimensioned to allow welding of the through joint.
- Proper bevels should be provided to allow proper closure.

WELD SURFACE PREPARATION

- Surfaces to be welded upon and adjacent surfaces shall be clean and dry.
- Surfaces to be welded upon shall be free of paint, oil, grease, rust, scale, etc.
- Slag shall be removed from all weld passes prior to depositing subsequent passes.

JOINT FIT-UP

- Joint preparation shall conform to the required joint design fit-up tolerances.
- Tack welds or mechanical devices may be used to hold the joints in alignment.
- Tack welds shall be made in accordance with approved procedures.

PEENING

- Peening may be used to help control weld related distortion.
- Any weld defects shall be removed prior to peening.
- Peening shall be performed with a blunt nosed tool.

REPAIRS

- Weld defects shall be removed and repaired as required to render the area acceptable.
- Efforts should be made to correct defects by grinding whenever possible.
- Repair welding shall be performed subject to all requirements of the original weld.

PREHEAT AND INTERPASS TEMPERATURE

- Specified in table 13-1
- Preheat method should ensure uniform temperature of the weld joint.
- Preheat and interpass temperatures must be included in the welding procedure.
- Preheat and interpass temperatures shall be verified by periodic checks using temperature indicating crayons or other approved devices.

Heat input

- Welders must be trained on the specific method used for measuring/controlling heat input.
- Must be checked during welding HY and HSLA materials.
- Values are based on base material thickness.
- Should not be confused with preheat.
- Is measured in joules per inch.

WELDING WITH MIL-120 & MIL-140 SERIES FILLER

- Requires procedures qualified in accordance with a NAVSEA approved program.
- Requires additional filler material conformance testing.

TEMPORARY ATTACHMENTS

- Should be kept to a minimum.
- Should be removed 1/16 inch away from base material
- Final 1/16 inch should be ground flush.
- Austenitic or nonferrous filler materials shall be removed and verified by etchant.

BACKGOUGED ROOT AREA

- Full penetration joints welded from both sides shall be backgouged prior to welding the second side.
- The gouged area shall have a bottom radius and sufficient width to allow proper welding from the second side.
- "Key-holing" should be avoided.

REFERENCES

- NAVSEA S9074-AQ-GIB-010/248 (formerly MIL-STD-248)
- NAVSEA S9074-AR-GIB-010/278 (formerly MIL-STD-278)
- NAVSEA T9074-AD-GIB-010/1688 (formerly MIL-STD-1688 and 1689)
- MIL-STD-2035