APPENDIX A

PREFACE

"WWT-278 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 that 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-278

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 and
- 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 S9074-A R-GIB-010/278 (MIL-STD-278).

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

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-AQ-GIB-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.

Welding of or to HY/HSLA steels shall meet the applicable requirements of NAVSEA T9074-GIB 010/1688 (formerly MIL-STD-1688 and 1689). A specific workmanship training program is required prior to welding those materials.

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 completeness
- Weld size
- Weld contour
  - Blend smoothly and gradually into base material
  - Re-entrant angle
  - Fillet contour
  - Butt weld reinforcement
  - Internal root reinforcement
    - Concavity
    - Convexity
- Cracks
- Spatter
- Undercut
- Burn-through /Melt-through
- Crater Pits
- Arc strikes, nicks, gouges
- Incomplete fusion
- Oxidation
- Porosity
- Slag
- Weld Joint Offset

WELD COMPLETENESS

- Welds shall be completed to the extent required by the fabrication document.
- All pressure containing welds shall consist of a minimum of two weld layers.
- Socket weld fillet sizes shall be in accordance with MIL-STD-22.
- Full weld penetration is required for 100% of length for piping groove welds and full penetration structural weld designs.

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 one inch from the weld edges, shall be cleaned prior to welding
- Surfaces shall be dry and free of mill scale, oxides, oil, grease, etc.

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 backgouged, 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

SURFACE PREPARATION

- Surfaces to be welded upon and adjacent surfaces shall be clean and dry.
- Surfaces to be welded upon and adjacent surfaces 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.
- Peening of the first or last layer of piping welds is prohibited.

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.
- Excavations must be inspected when required.

PREHEAT AND INTERPASS TEMPERATURE

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

SEAL WELDS

- Threads in seal weld areas must be removed prior to welding.
- Inspection area must also be free of threads.

PURGING

- The inner surface of all consumable insert type welds and all full penetration butt welds not employing a backing ring shall be purged with inert gas.
- Purging shall be continued until three layers or 3/16 inch of weld metal is applied.

REFERENCES

- NAVSEA S9074-AQ-GIB-010/248 (formerly MIL-STD-248)
- NA VSEA S9074-AR-GIB-010/278 (formerly MIL-STD-278)
- NA VSEA 79074-A D-GIB-010/1688 (formerly MIL-STD-7 688 and 1689)
- MIL-STD-2035