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Guide for Aluminum Hull Welding

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Guide for
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Abstract

This guide provides information on the welding of sea going aluminum hulls and other structures in marine construction. Included are sections on hull materials, construction preparation, welding equipment and processes, qualification requirements, welding techniques, and safety precautions.

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Guide for Aluminum Hull Welding

1. General

1.1 Scope. This standard makes sole use of U.S. Customary Units. Approximate mathematical equivalents in the International System of Units (SI) are provided for comparison in parentheses or in appropriate columns in tables and figures.

This guide provides information on proven processes, techniques, and procedures for welding aluminum hulls and related ship structures. The information presented applies chiefly to the welding of aluminum hulls that are over 30 ft (9 m) in length and made of sheet and plate 1/8 in. (3.2 mm) thick and greater. Thin-gage aluminum welding usually requires specific procedures in the area of fixturing, welding sequence, and other techniques for distortion control that are not necessarily applicable to thick plates. Similarly, the choice of welding process or applicable process conditions, or both, also differs according to thickness.

1.2 Welding Processes. The inert gas shielded welding processes have been employed as the principal joining method for the majority of aluminum naval and merchant ship structures built since the early 1950s. In their basic forms, these processes employ two distinct types of electrodes, although both use a protective shield of inert gas to prevent oxidation of the hot metal in the weld zone.

1.2.1 Gas Tungsten Arc Welding (GTAW).[1] The first inert gas welding process to be developed was gas tungsten arc welding which is sometimes referred to as TIG welding. Introduced in 1941, this process uses a nonconsumable tungsten electrode. Inert gas is fed through the welding torch while filler metal, when required, is added into the weld pool separately by hand or machine.

1.2.2 Gas Metal Arc Welding (GMAW).[2] The second process, gas metal arc welding, which is sometimes referred to as MIG welding, is employed for over 90% of the joining in a welded aluminum hull because it is much faster than GTAW. This process also uses an inert gas shield, but employs a continuous aluminum wire electrode that provides filler metal as it is fed mechanically through a welding gun. Introduced in 1948, GMAW is suitable for production welding of aluminum of 1/16 in. (1.6 mm) thickness and greater.

1.3 Comparison of Welding Processes. The gas shielded arc welding processes GMAW and GTAW offer speed, good weld strength, and ease of operation in all positions on a wide range of aluminum thicknesses and joint types.

Inert gas shielded arc welded joints in aluminum alloys, generally recommended for marine use, retain a high percentage of the original base metal strength. Similarly, properly made welded joints, produced with the correct filler metals have virtually the same corrosion resistance as the base metal.

Oxyfuel gas and shielded metal arc welding are not suitable for aluminum ship structures because weld quality is inadequate, and the residual chlorides from the flux must be removed.

1.4 Serviceability of Welded Aluminum Hulls. Service records of welded aluminum craft and other marine structures are excellent. Maintenance and repair cost records of hulls, which have been in service for 20 years or more, are impressive.

In many respects, preparation of aluminum hull plate for welding is simpler and more flexible than preparation of steel plate. Portable routers and radial saws, operating at relatively high speeds, and plasma arc cutting are widely used to advantage in cutting aluminum.

Machining operations to provide the required joint geometry for sound welds usually can be done with the same equipment employed for steel, but the cutting tools should be designed for aluminum. Shipyards already equipped with plate milling and planing machines, for example, employ the equipment for aluminum edge preparation using tools properly shaped for cutting aluminum.

1. Refer to AWS C5.5/C5.5M, *Recommended Practices for Gas Tungsten Arc Welding*, and the *Welding Handbook*, Vol. 2, 8th Ed. 73–108.
2. Refer to AWS C5.6, *Recommended Practices for Gas Metal Arc Welding*, and the *Welding Handbook*, Vol. 2, 8th Ed. 109–156.