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Guide for Steel Hull Welding

American Welding Society

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Guide for Steel Hull Welding

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Abstract

This guide provides information to users in the marine construction industry as to the best practical methods to weld steel hulls for ships, barges, mobile offshore drilling units, and other marine vessels. This guide provides information on steel plates, shapes, castings, and forgings; their selection; and their weldability. It discusses welding processes and proper design for welding. Hull construction is presented in terms of preparation of materials, erection and fitting, and control of distortion. Qualification of procedures and personnel are outlined, and inspection methods are discussed. A common shipyard problem, stray current protection, is discussed as is the health and safety of the work force. Supplementary nonmandatory appendices are provided for informational purposes.

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1. Materials

This section deals with the manufacture and heat treating of steel, properties of steel, specifications for steel and welding consumables, and the weldability of steel.[1]

1.1 Steel Manufacturing Processes. Ship steel is made primarily in basic oxygen furnaces (BOF), open-hearth furnaces, and electric furnaces. There are only a few open-hearth furnaces operating today. Electric furnaces are used to make high-alloy specialty steels, steels for castings, and in conjunction with continuous casters they are used to make small to medium sized shapes and some flat rolled products.

1.1.1 Plates and Shapes. Plates are rolled in one of three types of rolling mills to produce sheared plates, universal mill plates, and continuous strip.

Sheared plates are rolled on mills which have horizontal rolls only, and are produced with irregular edges and ends which must be cut or sheared on all sides to produce a rectangular plate. Sheared plates are rolled in both directions by rotating the slab at the roughing stand of the mill. This process, called *cross rolling*, provides the plate with more uniform longitudinal and transverse properties, and sheared plates are usually specified where stringent mechanical properties are required.

Universal mill plates are rolled on mills with both horizontal and vertical rolls. The vertical rolls provide the plate with a rolled edge which does not require cutting to establish its width. Universal mill plates are not cross-rolled, and as a result, the plates may have slightly lower ductility in the transverse direction. These plates are used where a finished edge is desirable.

Continuous strip mill plates are made on a hot strip mill and can be furnished in coils or as flat rectangular products. These plates are used primarily for structural applications, cold-formed shapes, or on automated barge construction lines. Hot strip mill plates may have directional properties between those of the sheared mill and universal mill products.

Structural shapes are usually rolled on a mill similar to a universal plate mill.

1.1.2 Chemistry. Steel is essentially a combination of iron, manganese and carbon. The carbon content normally ranges between 0.05–1.00%, while the manganese content range is 0.25–1.00%. Many other elements are added in relatively small amounts to vary the mechanical characteristics of the steel.

Plate steels generally fall in the category of either a carbon steel or an alloy steel. Carbon steels comprise those grades where no minimum content is specified or required for aluminum, boron, chromium, cobalt, columbium (niobium), molybdenum, nickel, titanium, tungsten, vanadium, or zirconium, or any other element added to obtain a desired alloying effect. When specified, minimum copper does not exceed 0.40%. The maximum content specified for any of the following elements shall not exceed the percentages noted: manganese 1.65, silicon 0.60, copper 0.60.

Alloy steels comprise those grades which exceed the above limits, plus any grade to which any element other than those mentioned above is added for the purpose of achieving a specific alloying effect. Carbon steels usually have a lower base price than alloy steels and therefore are much more widely applied.

For structural applications, plates normally do not exceed 0.30% carbon and 1.50% manganese.

1. Some of the information contained in this section comes from the following sources:

American Bureau of Shipping. *Rules for building and classing steel vessels*. Paraus, NJ: American Bureau of Shipping, 1990.

Bethlehem Steel Corp., *Plate selection guide, Book 1*. Bethlehem, PA: Bethlehem Steel Corporation, 1985.