

Aluminium welding in shipbuilding

The manufacture of marine gearbox casings with welding consumables and pulsed current power sources from ESAB

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For almost thirty years the company of Brunnhuber und Bandt (BuB GmbH) has been making high value welded constructions of different materials for the construction of plants and apparatus. Some ten years ago, faced with growing demand, BuB was specialising in the construction of gearbox casings of aluminium for high-speed ships.

Manufacture on time and to the correct quality are the virtues that customers appreciate about BuB GmbH. For example, the luxury yacht of Kuwaiti sheikh Aga Khan (Figure 1) relies on its Brunnhuber und Bandt gearbox casing.

With engines that deliver some 49,000 horsepower the yacht reaches top speeds of up to 80 km/h. With this vessel the sheikh won a special award for the fastest crossing of the Atlantic on water. Under the prevailing operating conditions, which are comparable to a race, the welded gearbox casings of AlMg4,5Mn (EN AW 5083) alloy are very highly stressed. Extensive testing of the weld seams after the crossing did not reveal the slightest indication of damage. This speaks highly of the reliability of the yacht and the high quality of the gearbox casings supplied by BuB.

Figure 2 shows the welded construction of a pre-assembled gearbox casing. Even at the planning stage, the manufacture of a casing such as this calls for extreme precision, especially when determining the welding parameters and welding sequences. Finite-element calculations formed the basis for the dimensioning of the casings. Extensive work samples and process tests were needed in order to assess the mechanical engineering properties of the welds. Taking later loads into account, the work samples were subjected to vibration endurance tests. All tests were done by independent institutes.

Naturally, the high standards imposed on the load capacity and quality of the gearbox casings meant equally strict demands on the quality and reliability of the welding technology. After all, seams free from pores and lack of fusion defects had to be produced with very good strength and ductility properties in aluminium parts with wall thicknesses up to 100 mm! A modern pulsed current source, the ESAB multi-function Aristo



Figure 1. Luxury yacht fitted with BuB gearbox casings.



Figure 2. Gearbox casings of AlMg4,5Mn (EN AW 5083).



Figure 3. Multi-function welding unit Aristo 2000 LUD 450.

2000 LUD 450 UW (Figure 3) was therefore chosen to be used for MIG and TIG welding. The ESAB weld metals used OK Autrod 18.16 ϕ 1.6 mm for MIG welding and OK Tigrod 18.16 ϕ 3.2 mm for TIG welding (SG-AlMg4,5Mn, ER5183). The ESAB welding technology used reproducibly delivers the highest seam quality in aluminium welding. Figure 4 shows a cross-section cut through a corner joint.

Metallographical investigations of the welds reveal a perfect structure in both cast and wrought alloys. By using specially modified end crater programs it was possible to produce defect-free seam ends with the ARISTO 2000 pulsed unit. This means that time-



Figure 4. Cross-section cut through a corner seam welded with OK Autrod 18.16.

consuming and costly reworking could be reduced to a minimum.

Bearing in mind the very close tolerances, especially in the region of the bearing shells, the manufacture of the high value welded construction demands precise observation of the predetermined welding sequences. After welding, the casing parts are heat-treated in a stationary annealing furnace for six hours at 320 °C in a protective gas atmosphere. Distortion due to the release of stresses had to be allowed for when pre-dimensioning the blanks. Subsequent machining was done on a CNC machining centre. Figure 5 shows the upper shell being placed on the lower part with the gears already installed.

High accuracy of fit, especially in the region of the bearing shells, is essential for smooth running of the gearbox and ultimately determines its life. Because of the high quality and the proven service record, there has been a growing demand for ships with gearbox casings from BuB. At present, casings are being manufactured for luxury yachts for Monaco and Spain. Growing success, much of which is due to high-quality, reliable products from ESAB.



Figure 5. Assembling the gearbox components.

About the authors

Helmut Schmidt Dipl. Ing. (TU) graduated from the Technical University of Munich (1985) and got a European Welding Engineer diploma at the SLV Munich (1986).

After the studies, he worked in the research department at SLV in Munich. For about ten years Mr Schmidt was responsible for the welding department in a reactor and shipbuilding company. In January 2001 I joined ESAB Germany as a teamleader, with the responsibility for application and sales in Southern Germany.

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