

CASE STUDY- Carbon Fibre Pressure Vessel for the Collins Class submarine

The Requirement. The Collins Class submarine required the development and manufacture of a light-weight replacement for a pressure vessel that was capable of taking the equivalent pressure of a mine blast. The current steel version weighs approximately 500kgs. The requirement was provided by the Australian Submarine Corporation (ASC) and this included specific and tight tolerance requirements for maximum external and minimum internal dimensions, as well as fixed attachment points and clearance to other components and structures. Also included were operator requirements for ease of opening and closing, as well as equipment restraint.

The Solution. BAC examined a range of materials that would suit the requirement, including Glass Fibre and “normal” carbon fibre, however both materials were incapable of meeting the strength requirement within the dimensional limitations. Intermediate modulus carbon fibres in pre-impregnated form were eventually identified as being able to meet the specification and using these fibres as a benchmark, BAC then worked through the design development with ASC. A new sealing and hatch-operating mechanism had to be designed and developed in conjunction with the vessel body, while the existing mounting arrangement was also considered. Both coupon testing and lay-up techniques were undertaken or developed to validate the design before Finite Element Analysis (FEA) was completed. **The completed CPV weighed 196kgs, a saving of over 300kgs**, while pressure testing was also successfully completed by the ASC.

CNC Milling for Tooling Manufacture. As new tooling (ie plugs and moulds) were needed to manufacture the body and hatch, BAC also developed the models for manufacture of the tooling, and then used our CNC milling machine in their manufacture. The work was complicated by the non-spherical shape of the hatch, as well as the tight dimensional tolerances necessary to avoid structural failure and the sealing arrangement. Removable silicone rubber “bumps” for the recessed equipment restraints were also manufactured.

