



## Directly Attaching Internals in Pressure Vessels

It is not uncommon for pressure vessel designers and engineers to require removal of the alloy layer before attachment of internals. The reasons for removing the clad can vary. Sometimes, internals are made from carbon steel (or the same metal as the base metal of the clad), and are intended to be overlaid after installation. Other times, the internals bear a very heavy load and the durability of the bond between the clad and base metals cannot be substantiated. In the final and most conservative case, all internal attachments must be made to the base metal.

The idea that the bond between the clad and base metal isn't strong enough to support the loads is an appropriate concern when clad is purchased to only the most basic level of specification. But there is a high price to pay for allowing clad to be specified at the lowest level of production requirements. Stripping back the clad, and making attachment welds to the base metal, compared to directly welding to the clad surface is well understood to be costly, time consuming and introduces additional risk with dissimilar metal welding and inspection steps being required. If the bond between the cladding metal and the base metal can be qualified, engineers can be afforded the additional flexibility of designing internals to be welded directly to the clad without concern. It is not only engineers who can take advantage of this technology – fabricators looking for an advantage against international competition will see the use of qualified clad, and directly attaching internals as a way to remain competitive and even increase profitability. The question the remains of how to qualify clad for directly attaching internals.

NobelClad has conducted technical studies that define a clear path to qualification for most stainless steel and nickel alloys clad to carbon steel, alloy steel or stainless steel there. A combination of stringent non-destructive testing techniques coupled with very high shear strength and tensile testing of the bondzone to ductile failure when a simulated welded attachment is done is the best qualification procedure to allow confidently attaching internals to the clad surface of pressure equipment. NobelClad has written a number of papers on this topic, with a recent presentation at the European Symposium on Pressure Equipment.

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