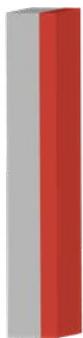




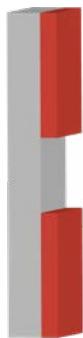
Lower Costs, Short Delivery for Fabricated Clad Equipment with Direct Attach

Fabricated equipment is a 'long lead item' for most projects and when the equipment is made from clad, it can become a schedule bottleneck. Using clad made from stock metal can save time, but comes at a significant cost. Qualified clad from NobelClad allows fabricated equipment to accept direct attachment of internals, saving owner companies significant time and money.

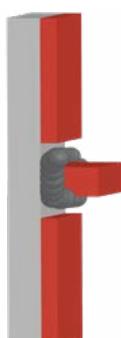
Applying rigorous specification to clad metal can allow designers to weld internal attachments directly to the clad surface. Today's equipment specifications require fabricators to remove the cladding ('strip back'), replace it with overlay and then weld the attachments to the overlay (or make a dissimilar metal weld to the steel), finished with a clad restoration overlay. The process of stripping back and redepositing overlay is both time consuming and expensive. In cases where the integrity of the clad bond is uncertain, removing the clad is a prudent course of action, even if it is expensive. What if instead, the clad material can be 'qualified' to meet exacting standards? What if the bond could be proven to meet or exceed the strength of the base metals? Then attachments could be welded directly to the clad surface without any hesitation or concern.



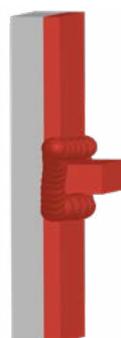
1. INSPECT MATERIAL



2. STRIP BACK



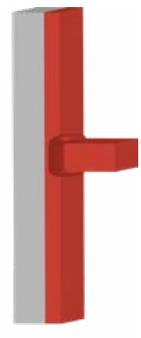
3. DISSIMILAR METAL WELD



4. CLAD RESTORATION



1. INSPECT MATERIAL



2. DIRECT ATTACH

QUALIFIED CLAD FOR DIRECT ATTACH

When engineers demand clad be produced to a higher standard, it can allow designers to consider it qualified to handle the rigors of directly attaching internals. There are four main attributes that set qualified clad apart from regular clad material - shear strength, UT coverage, UT acceptance criteria and bondzone tensile testing.

Through bondzone, welded, z-direction tensile specimens.



Left: Roll bond clad that isn't qualified – brittle failure in the bondzone at room temperature.

Right: Explosion welded clad – ductile failure in the base metal at elevated temperature after PWHT.

4 Key Requirements to Measure Clad Quality

REQUIREMENT	BASE SPECIFICATION*	QUALIFIED CLAD
Shear Testing per ASTM	20 ksi (140 MPa) minimum, only if invoked	50 ksi (345 MPa) minimum
Ultrasonic Testing Coverage	'sufficient to provide the quality level'	100% coverage
Ultrasonic Testing Acceptance	Class 1, 3, or 5 can be selected with as much as 5% of the plate unbonded	Class 1
Through Bondzone Tensile	None required	Per DMC 100 S12**

*Base specification ASTM A263, A264, or A265

**DMC 100 is available upon request

BONDZONE TENSILE SPECIMENT DESIGN

