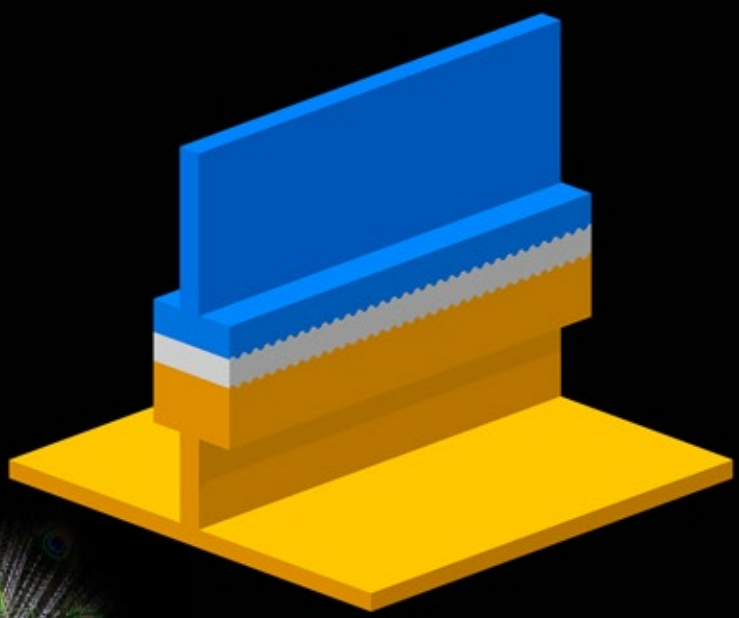
SHOCKWAVE METALWORKING TECHNOLOGIES BV

TRIPLATE®



Transition joints for "welding aluminium to steel"

Vacuum Explosive Cladding Technology

Shipbuilding and Offshore Applications

The Product:

Triplate® is a composition of three layers: steel, pure aluminium and sea water corrosion resistant aluminium.
These three layers are homogeneously bonded together in a vacuum environment, with the aid of explosives (explosion cladded, welded or plated).

Base Material:	Steel	LRA Shipplate Gr. A	or St 52-3N
Interlayer:	Pure Aluminium	Al 99,5	(Alloy 1050A)
Superlayer:	Corrosion-resistant Al	AlMg4,5Mn	(Alloy 5083)

General

The vacuum-explosion welded transition joint, called Triplate® is a high quality material for welding aluminium to steel. Shockwave, the producer and supplier of Triplate® is specialized in the manufacture of this "high-tech" transition joint.

Approval of manufacturer:

Shockwave is approved as a manufacturer of Aluminium/Steel transition joints by Lloyd's Register of Shipping and Det Norske Veritas.

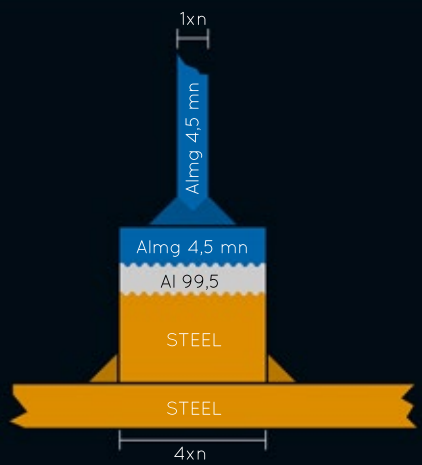
Applications:

Triplate® is most often used as a transition joint in shipbuilding and offshore for welding an aluminium superstructure to a steel hull. In the offshore it's quite common to weld aluminium living quarters to steel constructions by means of Triplate®.

Dimensions:

Standard dimensions are available from stock; custom-made sections can also be supplied quickly (including water-jet cutting). The recommended stripwidth is 4 x thickness of the aluminium plate.

Standard strip width:	variable
Standard strip length:	max. 3800 mm
Standard strip thickness:	28 mm or 34 mm



Processing:

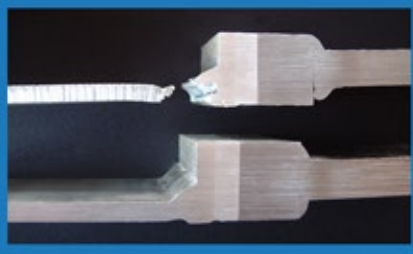
Triplate® is easy to process and replaces the conventional nut-and-bolt connection, or rivet joints. It is important that the temperature of TRIPLATE remains below the critical limit of 315° C during welding!

With reference to bending, use a standard minimum radius of 10 times the strip width or strip thickness.

Testing:

Triplate® meets the requirements of all the international standards, including the MIL-J-24445A, for Military applications.

Bend test of Triplate



Asymmetric tensile test

Tensile test of Triplate

Shear strength base material - interlayer:	> 55 N/mm2
Bend test base material in compression:	acceptable
Bend test base material in tension:	acceptable
Side bend test:	acceptable
Tensile strength (trough thickness):	> 75 N/mm2
Processing temperature:	max. 315° C

Summary of differences:

Open air cladding	Vacuum cladding
Oxides with porosity	100% dense
Oxides initiate fractures	Does not apply
Holes initiate corrosion	Does not apply
Stress relief treatment due to cold working	Not necessary since cold working is very limited
Variable weather conditions	Does not apply since it is inside
Harder to machine (sawing and bending)	Easy sawing and forming due to high ductility

Possible inspection authorities:

Lloyd's Register of Shipping, Det Norske Veritas, Germanischer Lloyd, Bureau Veritas, American Bureau of Shipping , RINA, etc.

Bending:

Triplate® could be bend in three directions:

- Sidebend: R = 10 x stripwidth
- Aluminium in tension: R = 300 mm
- Aluminium in compression: R = 300 mm

Special custom-made Triplate shapes

Welding:

The following factors are influencing the welding process: Welding speed, dimensions of the transition joint, position of the weld, dissipation of the heat into the structure.
Most important is that the temperature of Triplate® in the transition area aluminium/steel remains below the critical limit of 315° C during welding!

Preferred welding process:

The recommended welding methods are similar to those, used for the parent metals.

Aluminium:

GTAW or GMAW, TIG and MIG welding are acceptable,
Synergic pulse MIG welding is also being used.
Small diameter wires are recommended. (1.2 mm is preferable).
Argon shielding gas is recommended.
The aluminium oxide film must be wire brushed away before welding and degreased with a solvent.

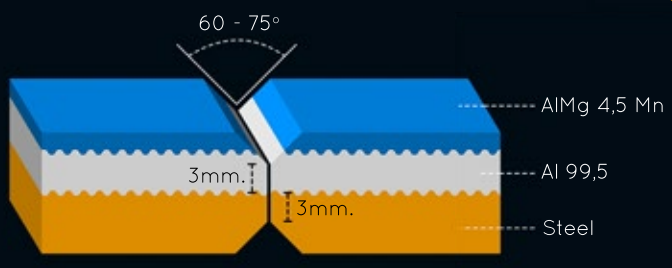
Steel:

Coated electrode, GMAW, SMAW or FCAW
Small diameters electrodes are recommended (e.g. 2.5 mm).

It's most preferable to weld first the aluminium plate on the Triplate bar after the complete tag welding in order to minimize temperature increase of the transition joint.
It is recommended to use heat sensitive paint on the transition joint in order to monitor the interface temperature.

Butt welds:

The strip ends should be chamfered on an area of 3 mm above and below the transition of aluminium and steel.
The butted strips must be clamped (see drawing).
The interface should not be welded. This unwelded area should be hammered watertight or drilled and injected with epoxy or sealant. Brazing is also an option.



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