



# Explosion Welding: A Fast Growing Process

An innovative process in the railway industry allows welders to join aluminum alloys to carbon steel



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**“Up until now and throughout the rail industry, these two elements were joined by riveting, which exposed the lower body shell to two major constraints: ineffective water tightness and premature wear of fasteners exposed to ballast impacts and cleaning agents.”**

– Stephane Roll  
Technical Manager at the Carbody Center of Excellence  
Alstom

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## EXECUTIVE SUMMARY

In France, the assembly of the Coradia Polyvalent regional trains is creating sparks. These trains were built with an innovative approach to material design and construction. Explosion welded transition joints offer superior joining and is the only solution widely used in industry for welding highly dissimilar metals. Modern aerospace, railway, automotive, and construction applications invariably require the use of lightweight materials that simultaneously provide the utmost in reliability.

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## CHALLENGES

Design engineers in the transportation industry are constantly striving to optimize their designs and eliminate excess structural weight. For over 100 years, rivets and bolts used with insulators and isolators were generally the accepted method for joining dissimilar metals. The major shortcomings of rivets and bolts are that they require holes to be drilled, need additional materials to isolate the dissimilar metals, and require regular assembly inspection. Any removal of material, such as drilling holes, weakens the metal.



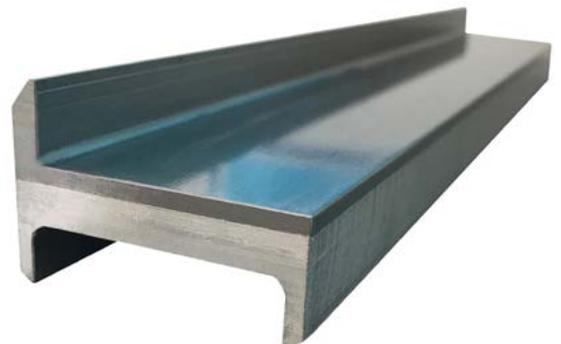
**NobelClad has a real know-how and we were perfectly satisfied with our collaboration at all stages from development to serial production. The result is a less constraining assembly process, a reduction in the amount of paint used and more waterproof cars that weigh forty kilogrammes less.”**

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## SOLUTIONS

Even though rivets and bolts have served the transportation industry for years, Alstom saw an opportunity to leverage RailClad™ transition joints while ensuring both technical and economic advantages in the long run. Alstom was introduced to this technology in early 2008. After spending a significant amount of time on research and development to pass all stages of the validation, qualification and certification, the use of explosion welding on rolling stock is now considered a better alternative.

RailClad is produced through an explosion welding process that uses explosions to weld large plates of aluminum alloy to steel. It is a solid state process where dissimilar metals are permanently welded together in a millisecond; therefore no bulk heating occurs, the metals experience no dilution, and there is no loss of mechanical strength. From those welded plates, precise strips are cut and machined into a finished profile that is directly weldable in a hybrid structure. In this instance, Alstom designed aluminum to serve as the train carbodyshell.



*Right:  
NobelClad transition joints for trains*

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## RESULTS

Alstom chose to use RailClad transition joints to benefit from the technical and economic advantages it offers. The uniqueness of the Coradia Polyvalent train structure is characterized by its lightness, strength and service life. This specific multi-material combination has reduced the weight of subassemblies used in the Regiolis carbodyshell by 20% compared to previous designs.

With a strong technical foundation, explosion welding allows Alstom to reliably and safely optimize connections compared to the traditional mechanical solutions. RailClad transition joints have limited the risk of crevice corrosion for these Alstom trains. This technology also eliminates the need to design and install protection solutions at mechanical interfaces as well as optimizes control and monitoring operations. From specification development to materials delivery, NobelClad provided clad manufacturing and design expertise to Alstom at every turn.

For Alstom, this partnership resulted in products with increased reliability and longevity, and lower production times and costs, compared using mechanical fasteners.

While the railway application is revolutionary, the technology isn't new. In the past, Alstom's Marine Division used these types of transition joints for the marine industry. It should be known that outside of the transportation and marine industry, multi-material transition joints can be leveraged for naval, automotive and aerospace applications as well.



Top:  
RailClad™ design

Bottom:  
Alstom manufacturing facility