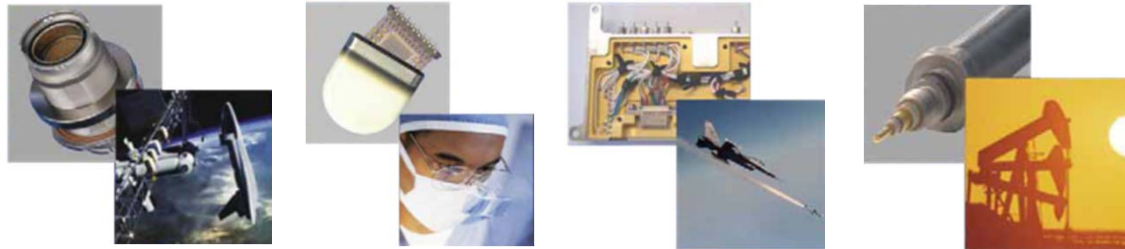


PA&E: Explosive Metal Bonding

March 2017



PA&E Bonded Metals Division:



2249 Diamond Point Road
Sequim Washington



Bonded Metals Division

Who we are:

PA&E Bonded Metals Division

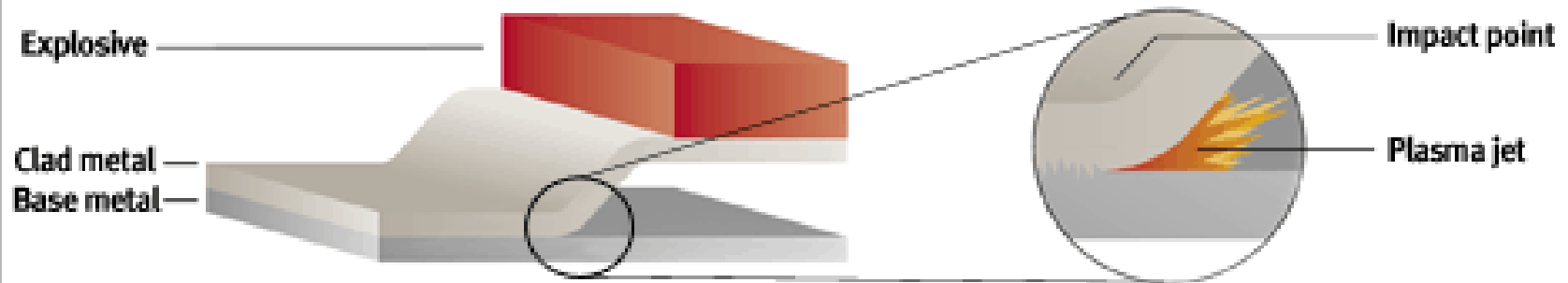
- In operation since 1970
- Formally known as Northwest Technical Industries

What we do:

We use explosives to weld or bond dissimilar metals together and to explosively form metals into exotic shapes that are difficult or impossible to do by conventional methods. Explosives are also used to compact or consolidate metal powders into near net shapes.



The Explosive Metal Bonding Process



Why Explosive Bonding?

- Perfect for meeting both heavy weight and light weight design requirements
- Much stronger than friction and diffusion welded joints
- Location of bond layers can be controlled within a design
- Weldable bi-metallic transitions (ferrous to non-ferrous)
- Eliminates galvanic corrosion (between dissimilar metals)
- Reduced need for mechanical integration (bolt-on vs. welding)
- Precious metal conservation (linings, facings, etc.)
- Markets for this technology include:
 - Chemical industries (corrosion resistance)
 - Power plants
 - Naval applications
 - Particle accelerators
 - Semiconductor production (sputter targets)
 - Space satellites



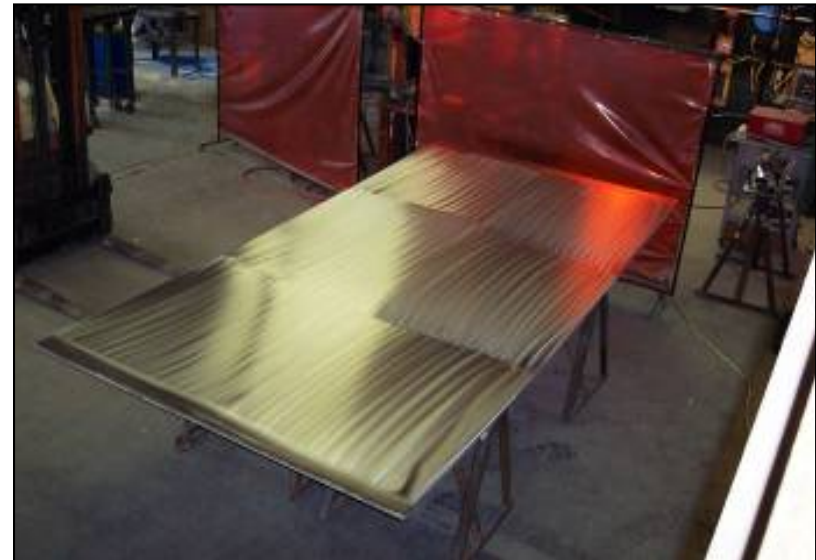
The Explosive Metal Bonding Process

Step 1: Metal Preparation

Here, copper and nickel sheets are surface prepped:



Copper Plate



Nickel Plate



The Explosive Metal Bonding Process

Step 2: Metal Preparation

PA&E employees apply shot assembly to bond Inconel to nickel



The Explosive Metal Bonding Process

Step 3: Transporting Material to Remote Blast Site

Noise created by blasts require material to be transported to a remote area for detonation



The Explosive Metal Bonding Process

Step 4: Preparing for Detonation



Final shot readied for detonation



Hoppers for pouring explosives into charge gap



The Explosive Metal Bonding Process

Step 5: Detonation



The Explosive Metal Forming Process

Step 6: Flattening



Ni/Inconel plates before flattening



Plates after flattening

Bonded Metal Examples

Aluminum/Stainless

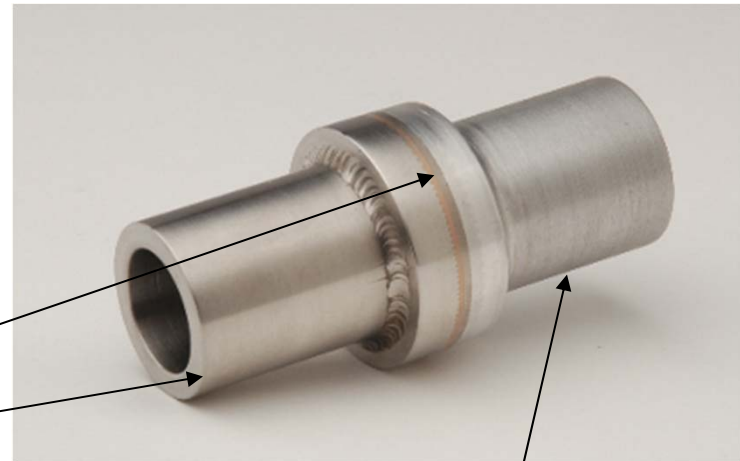


SS Rib

SS Weld

Transition Bar

Al Rib



Transition Ring

SS Pipe

Al Pipe

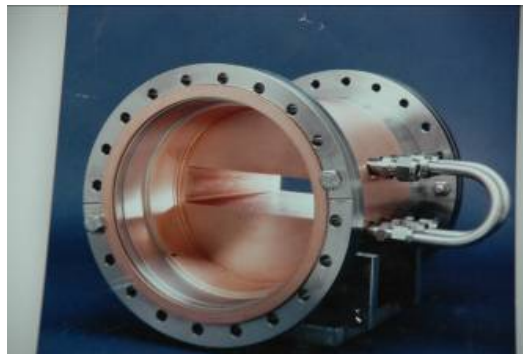
Bonded Metal Examples



Copper/stainless
UHV conflat flange



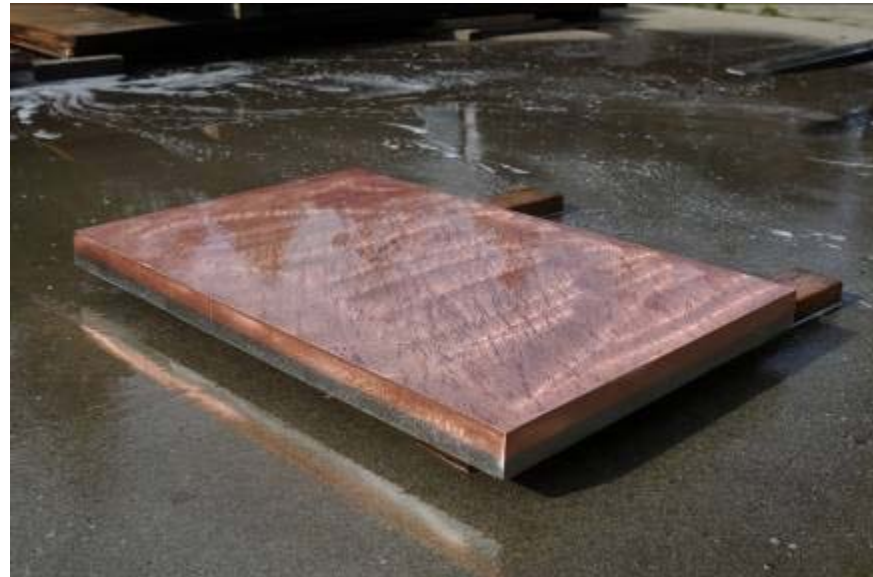
Custom 6" conflat
flange with
stainless, copper
& stainless



Cu/stainless exit slit
for UHV beam line

Bonded Metal Examples

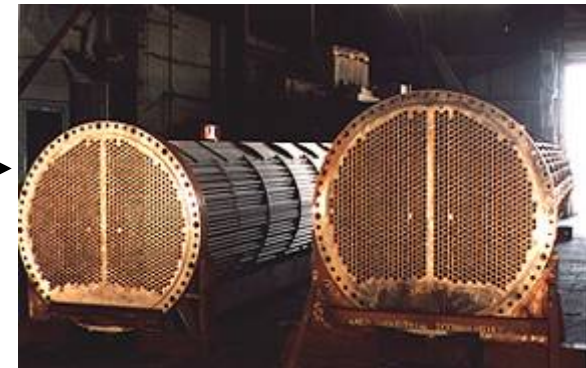
Al Tube/Steel Billet



Copper/Stainless

Bonded Metal Examples

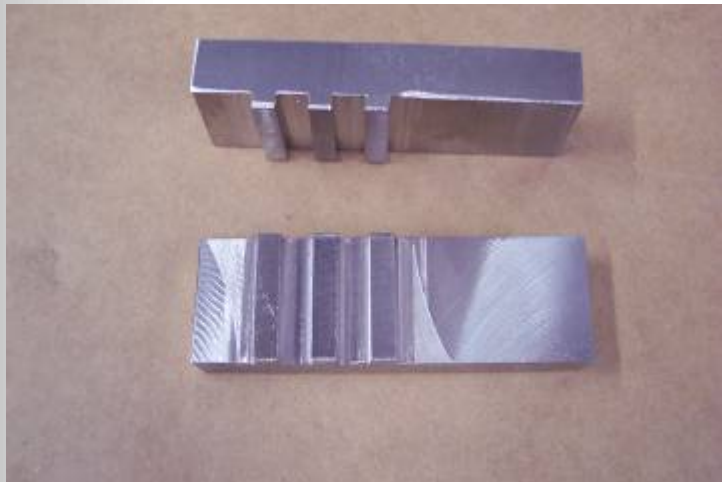
SA 240 2507 SS / SA 516 Grd 70 steel to be machined into a tube sheet in heat exchanger



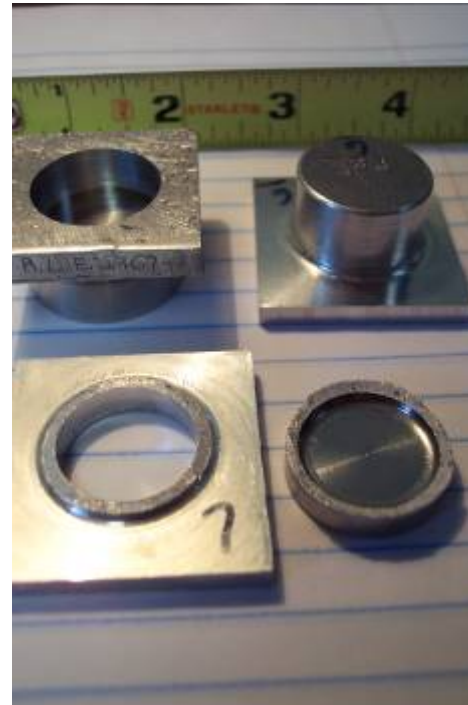
Copper/aluminum



Testing the Bond



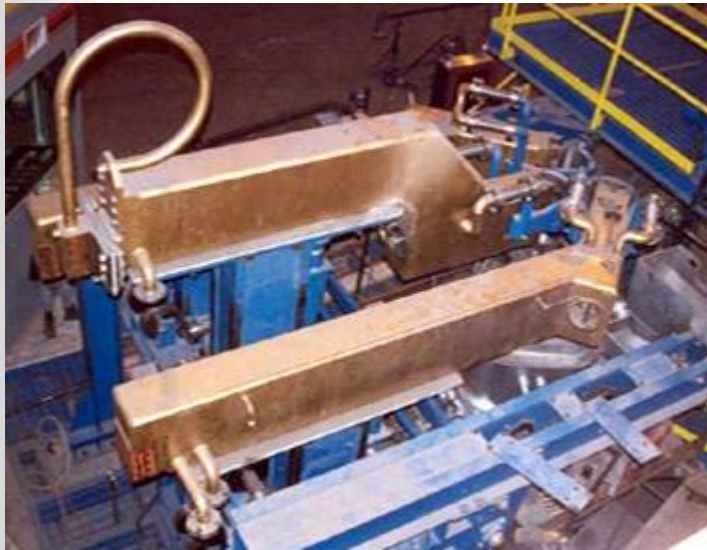
Shear lug testing



Ram tensile testing

Bonded Metal Applications

Current conducting arms made from copper/steel clad



Current conducting arms (CCA)
for Electric Arc Furnaces (EAF)



Electric Arc Furnace



Bonded Metal Applications

Clad Tubes



Copper/stainless



Aluminum/steel



Tantalum on I.D. of steel pipe



70/30 Cu-Ni/steel



Bonded Metal Applications



Alum tube/
steel billet



Deployed on US Navy aircraft carriers

Fabricated into
high-strength,
corrosion-resistant
aircraft tie-downs



Explosive Metal Bonding

Learn More

Contact PA&E's Bonded Metals Division via:

- E-mail at bondedmetals@pacaero.com
- Phone at: 360-683-4167

Or Visit:

- <http://www.pacaero.com/products/explosive-bonding.htm>

