

Inertia Welding Applications

It is possible, by using proper procedures and with proper inertia/friction welding equipment, to generate repeatable full strength weld applications.

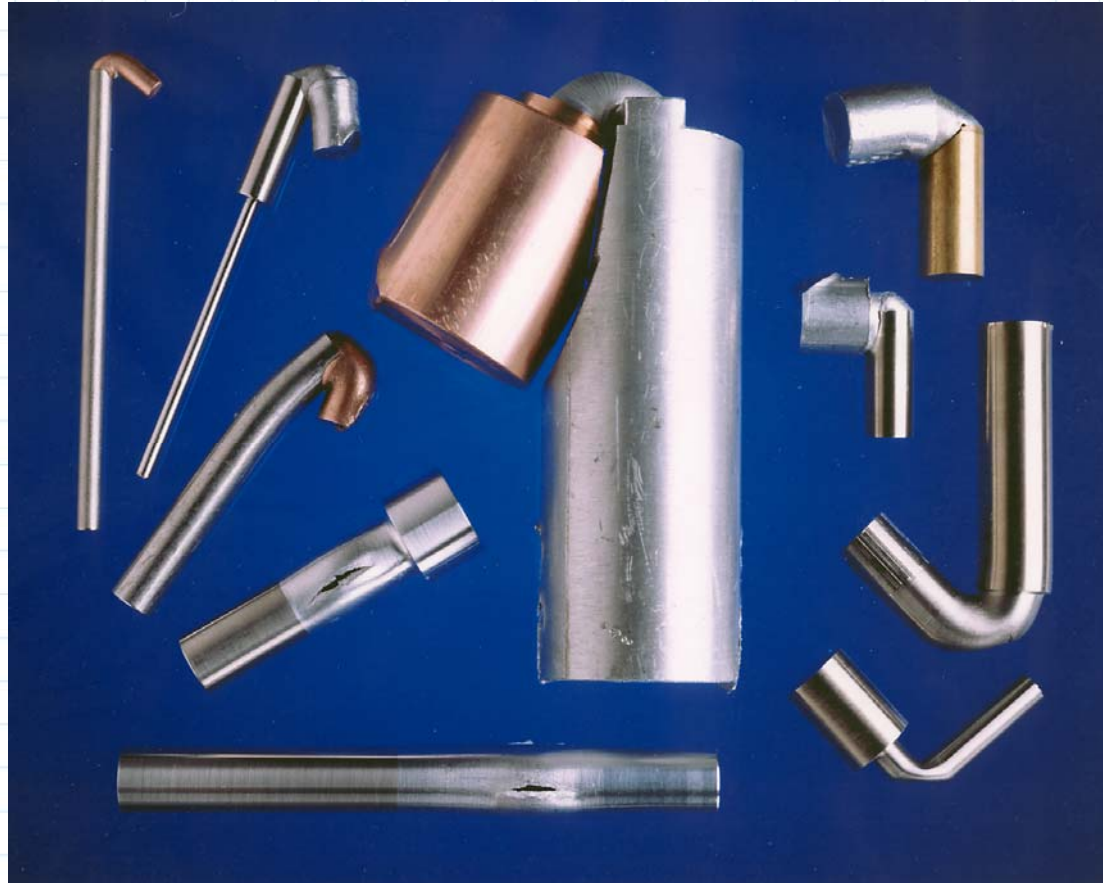
INTERFACE WELDING

Inertia Welding Specialists



INTERFACE WELDING

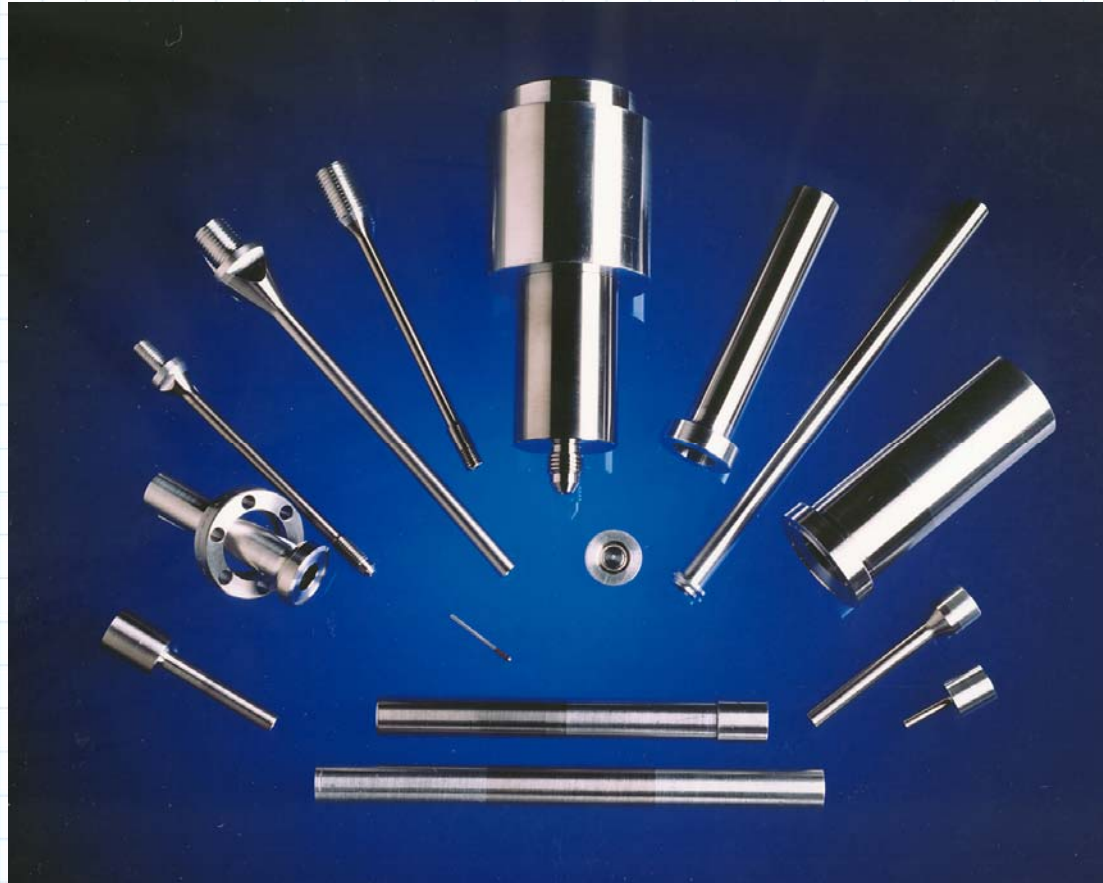
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Bend and pressure tests show the strength of Inertia Welded transitions.

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**Bi-metal fittings used in pressure vessels,
vacuum and heat pipe systems.**

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**Stainless steel to aluminum in
cryogenic applications.**

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Ordinance applications call for unique combinations.

Bi-Metal Combinations to Aluminum

| | | |
|----------------------|------------------|------------------|
| 9310 | ZIRCONIUM | NANOPHASE |
| 304 | 4140 | COPPER |
| 1018 | 4340 | INCO |
| INVAR | 6063 AL | |
| 6AL 4V TI | A286 | |
| 3 AL 2.5 V TI | TUNGSTEN | |
| MONEL | 316 SS | |
| PALLINEY | 15-5 SS | |
| MONEL | 410 SS | |



Bi-Metal Combinations to Inco

17-4 SS

NITRONIC

316 SS

4140

RENE 41

2219 AL

WASPALOY

6063 AL

MAR-M 247

6061 AL

UDIMET

TITANIUM

HASTELOY X

SILVER

ASTROLOY



Bi-Metal Combinations to Copper

INVAR

6061 AL

4140

304 SS

4043

INCO

15-5 SS

KOVAR

IRIDIUM

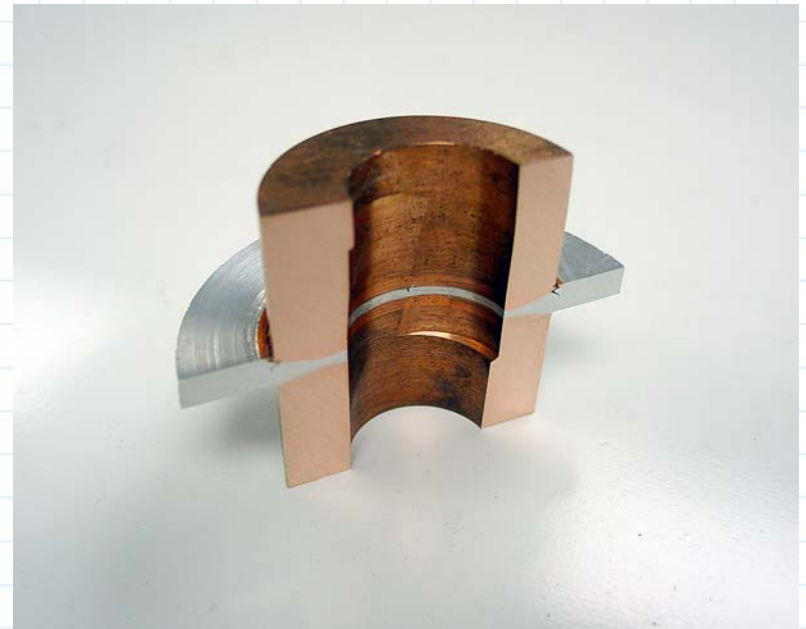
347 SS

SILVER

316 SS

5 N 5 ALUM

TITANIUM



Bi-Metal Combinations to Stainless

4130

NITRONIC

1018

C1117

LEDLOY

TUNGSTEN

ZIRCONIUM

KOVAR

9310

INCO

HAFNIUM

INVAR

TITANIUM



Bi-Metal Combinations to Titanium

MOLYBDENUM

6061 AL

321 SS

304 SS

2219 AL

NIOBIUM

ZIRCONIUM

COPPER

BRONZE

INCO



Bi-Metal Combinations of Miscellaneous Materials

MONEL **TO** VANADIUM

HIPERCO 50 **TO** AL 4750

TUNGSTEN **TO** ZIRCONIUM

PALLNEY 7 **TO** NICKEL

STELLITE 6B **TO** EVB4

TANTALUM **TO** NIOBIUM

NIOBIUM **TO** ZIRCONIUM

NIOBIUM **TO** MAR-M 247

15-5 SS **TO** MAR-M 247

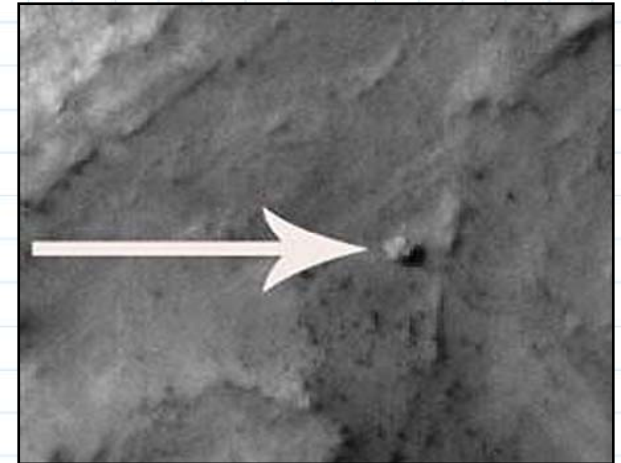
SILVER **TO** INCO



NITRALLOY "N" **TO** MARAGING 250

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**NASA's Mars Rover
Spirit**

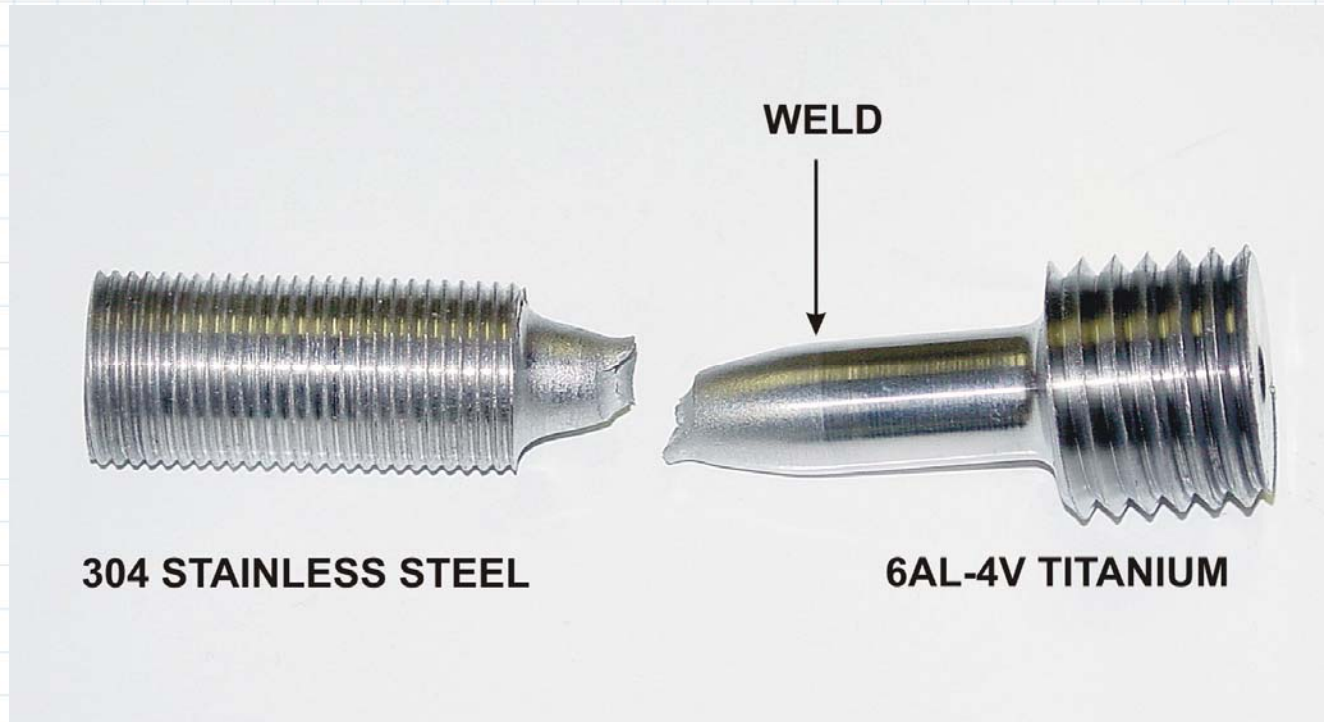
**Titanium to Aluminum NASA
Component**



Titanium to Stainless Bend Test

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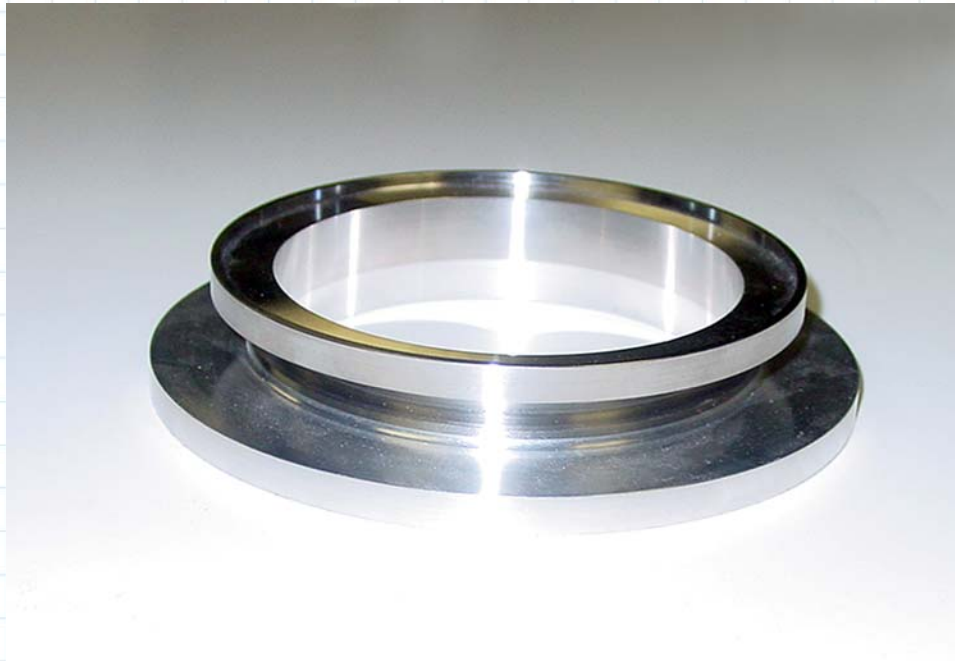
| ACTUAL AREA | YIELD LOAD @.2% | YIELD PSI @MAX | TENSILE LOAD @MAX | TENSILE PSI @MAX |
|----------------|-----------------------|----------------------|-------------------------|------------------------|
| .19644 | 11250 | 57300 | 18150 | 92400 |



Tantalum to Niobium to Zirconium Bend Test



Titanium to Aluminum to Tool Steel



Stainless to Aluminum Cryogenic Port Adapter

INTERFACE WELDING

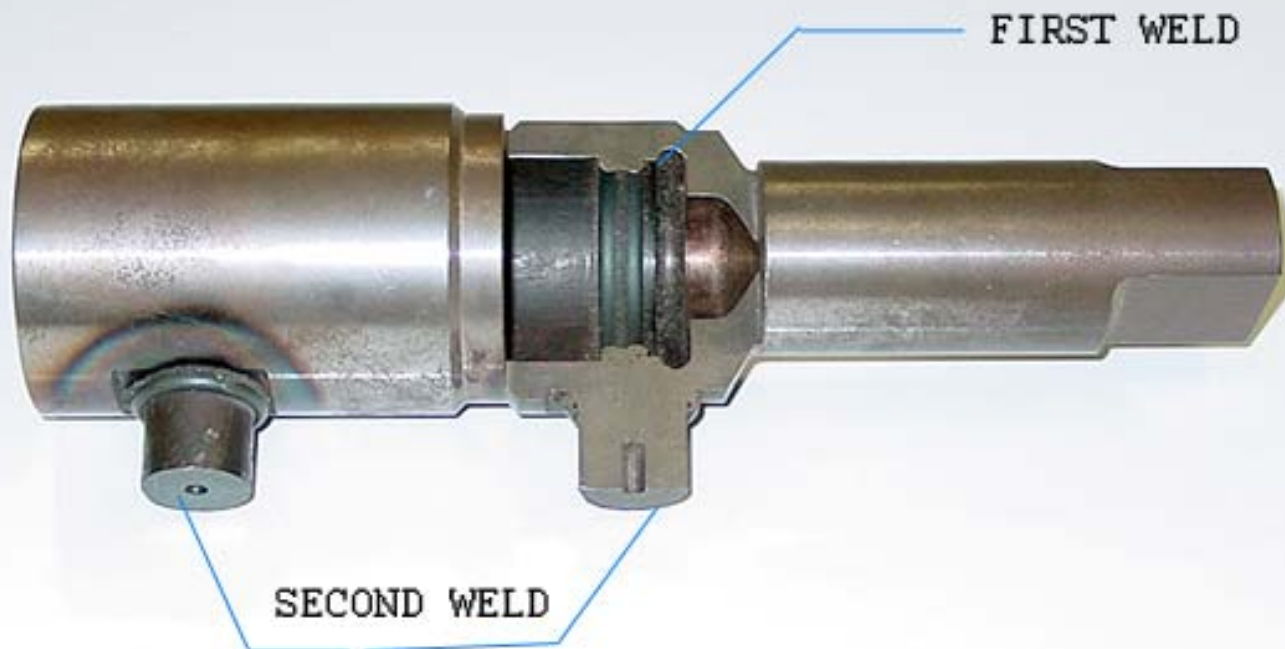
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HYDRAULICS



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AUTO PISTON

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SMALL DIAMETER BOMB



**Stainless to Aluminum Space Shuttle
Fuel Cell Cap**



Stainless to Aluminum Transition Fitting

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Control Solenoid



Aircraft Transmission Gear



Titanium to 9310 Aircraft Gear
Weight Reduction Program



Inco to 2219 Aluminum



**Titanium or Stainless to Aluminum
VCR Fitting**



Titanium to Aluminum NASA Component



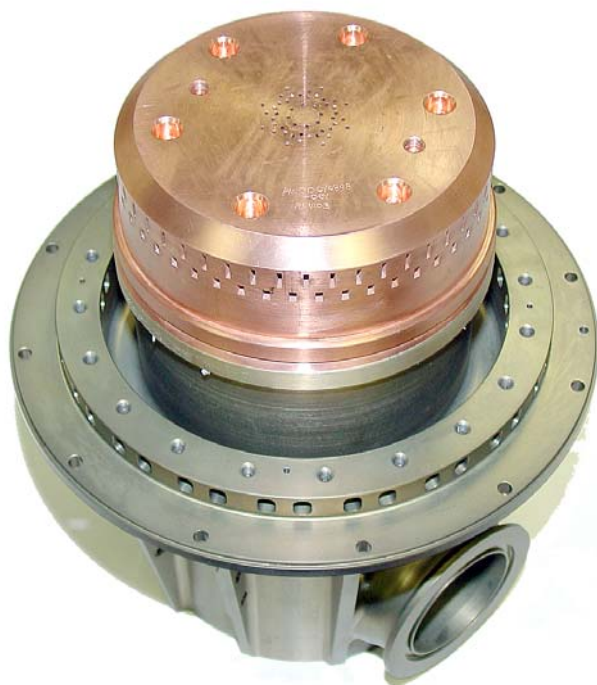
Titanium or Stainless to Aluminum Fluid Coupler



Ø3.50 Copper to Ø4.250 Aluminum
Hi-Voltage Electrical Contact



Copper to Titanium or Stainless to Copper



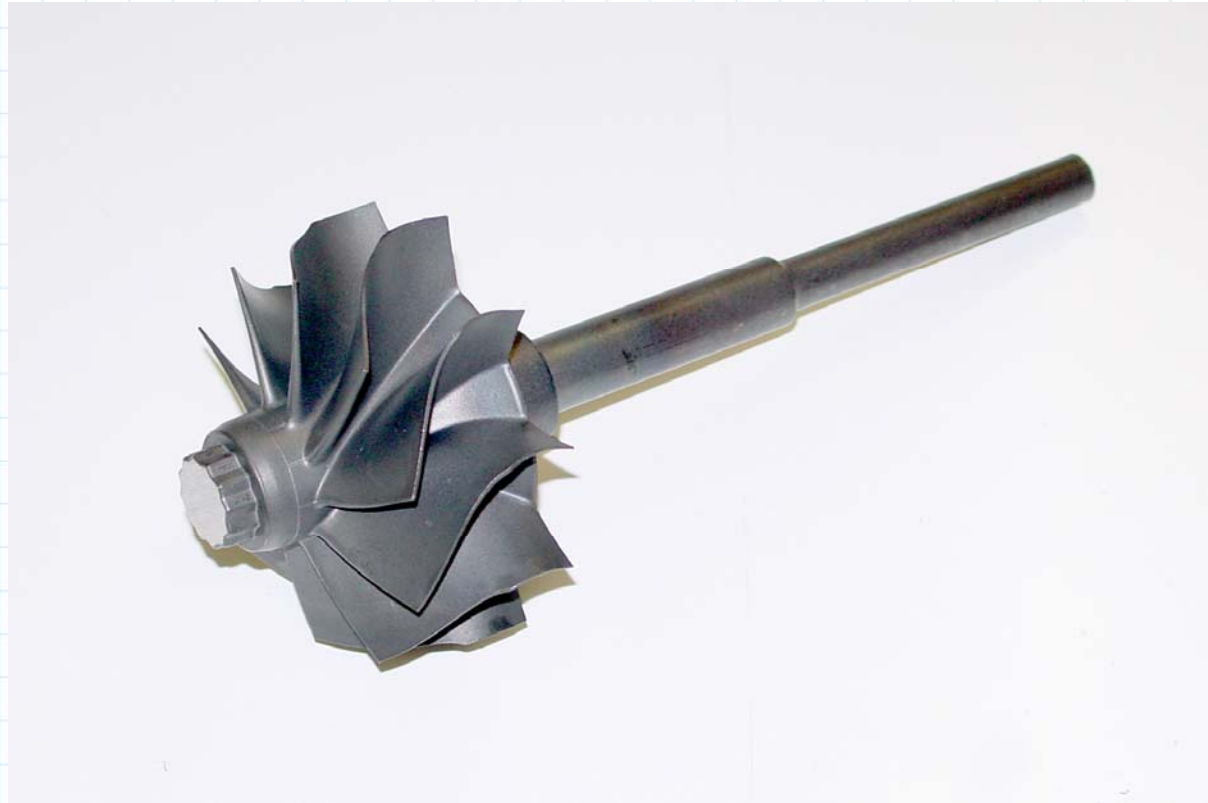
Copper to Aluminum



Titanium to Aluminum Fluid Coupler

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INCO or GMR Turbine to 4140 Shaft

INTERFACE WELDING

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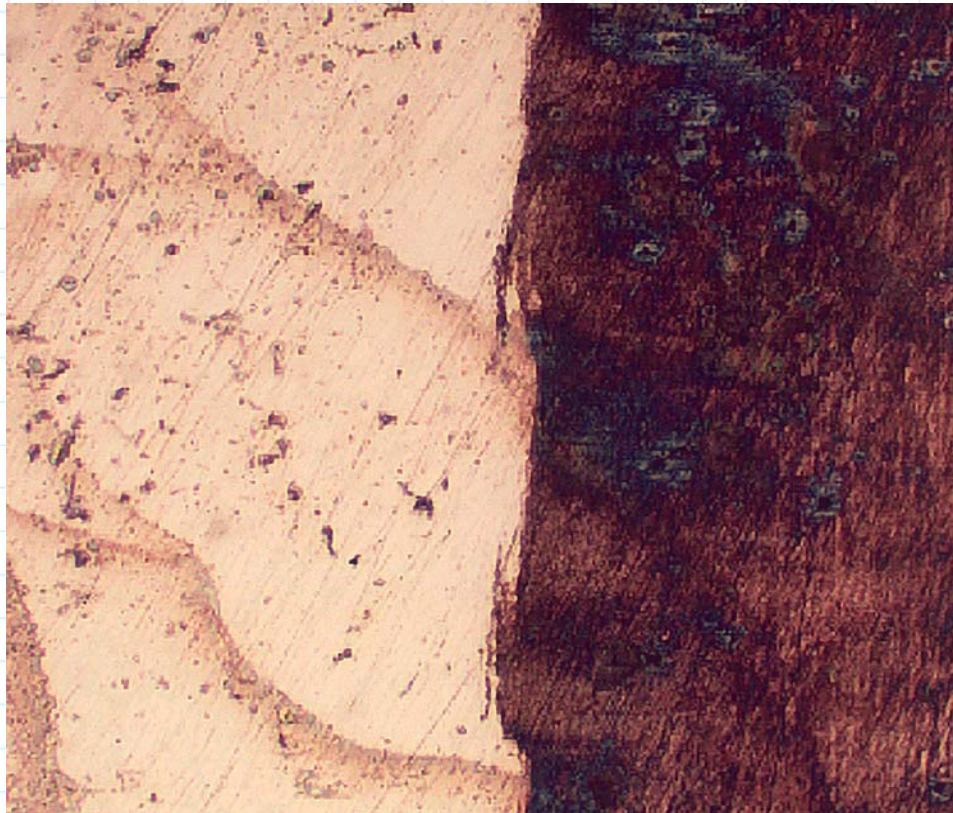
NITRALLOY "N" to MARAGING 250
Hughes (Boeing) Helicopter
Main Rotor Drive Shaft
AH64 Apache

Inertia Welding Metallurgy

Inertia/friction welding utilizes a high pressure forge force. Because of the high pressure, the metal, as it becomes heated by friction, is forged together with no melt product being produced, no chemical change and a very narrow heat affected zone. This allows for a variety of metals that have different melt or sensitive chemistries to be joined with resulting properties that are excellent and comparable to the base metal.

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Turbine Wheel Weldment MAR-M-247 TO 4140

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BI-METAL WELDMENT 8630 TO INCO 713C

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BI-METAL Zirconium to Titanium

INTERFACE WELDING

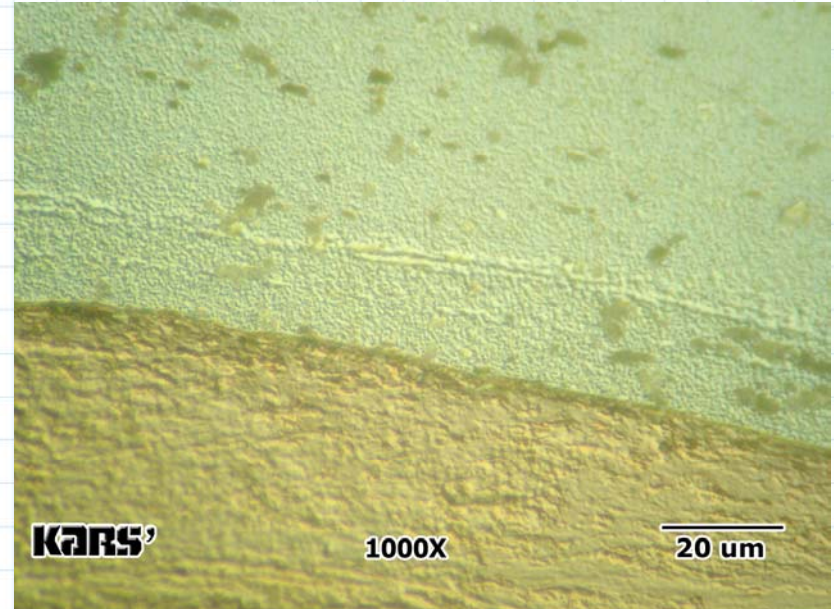
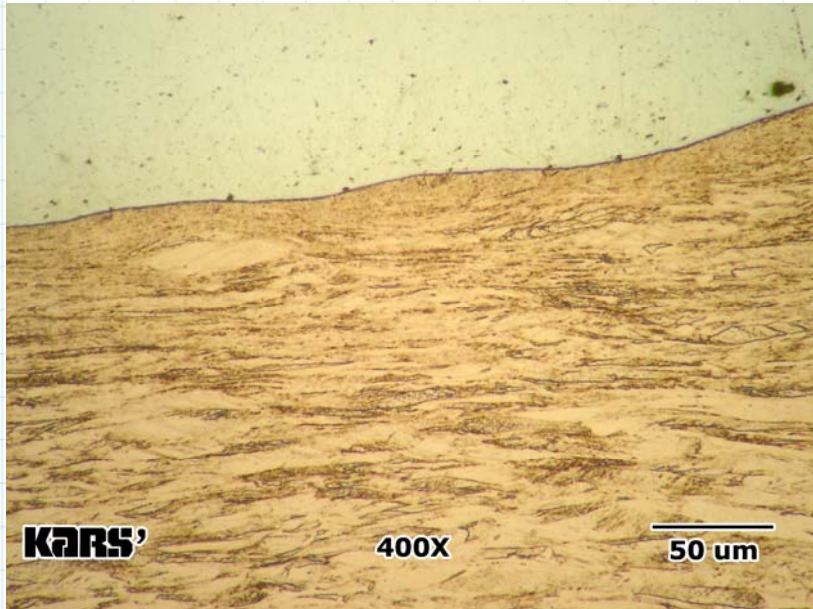
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Bi-Metal Weldment 355 Stainless to 5083 Aluminum

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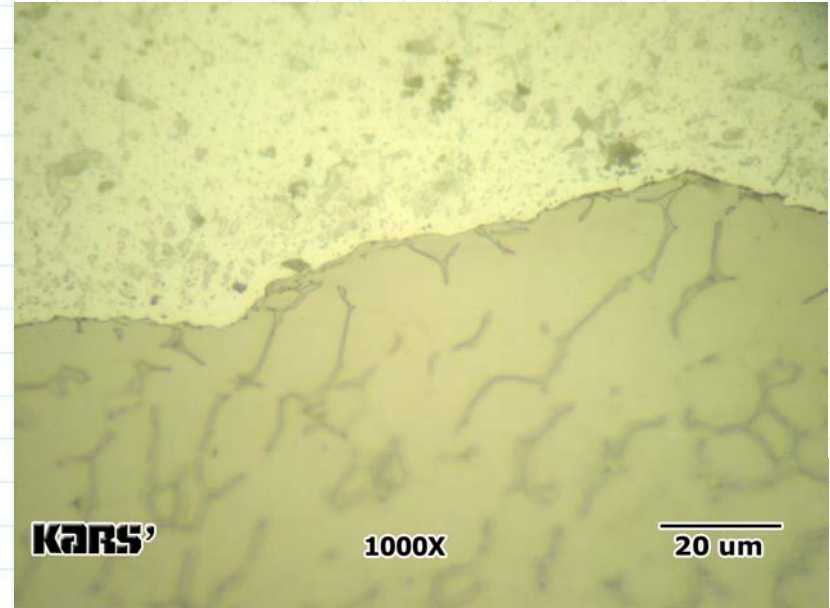
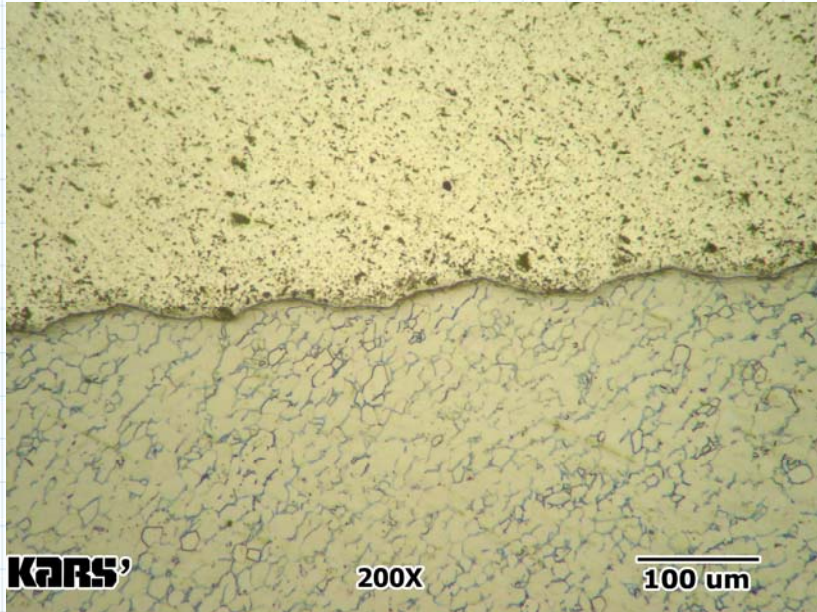
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Bi-Metal Weldment OFHC Copper to 6061-T6 Aluminum

INTERFACE WELDING

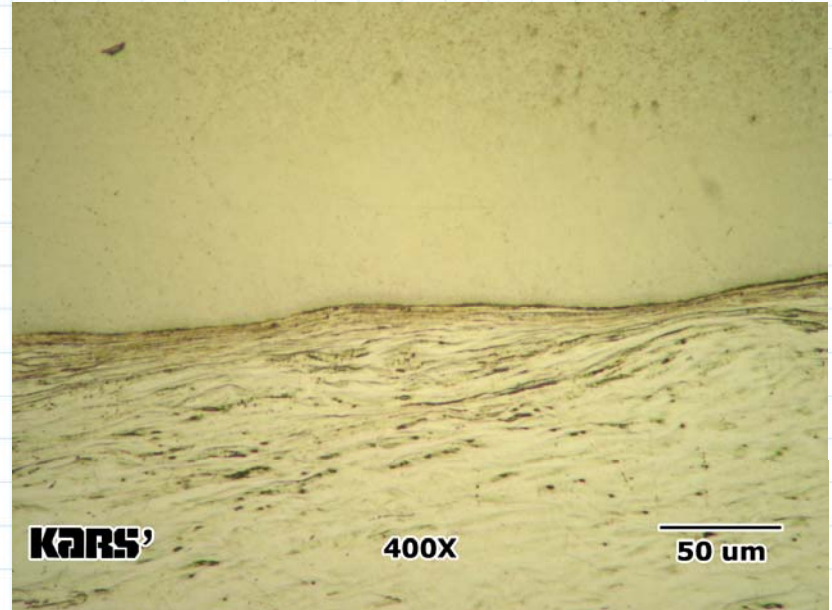
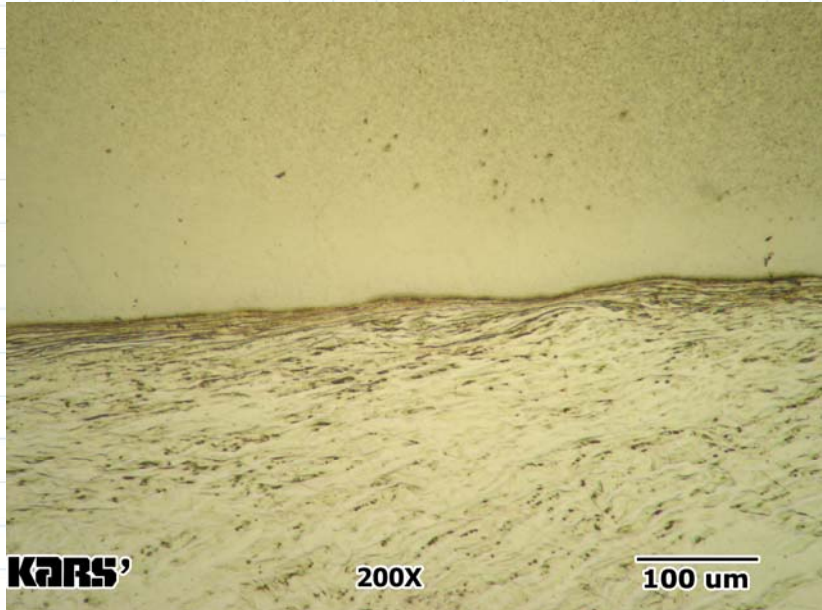
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Bi-Metal Weldment 6AL 4V Titanium to 6061-T6 Aluminum

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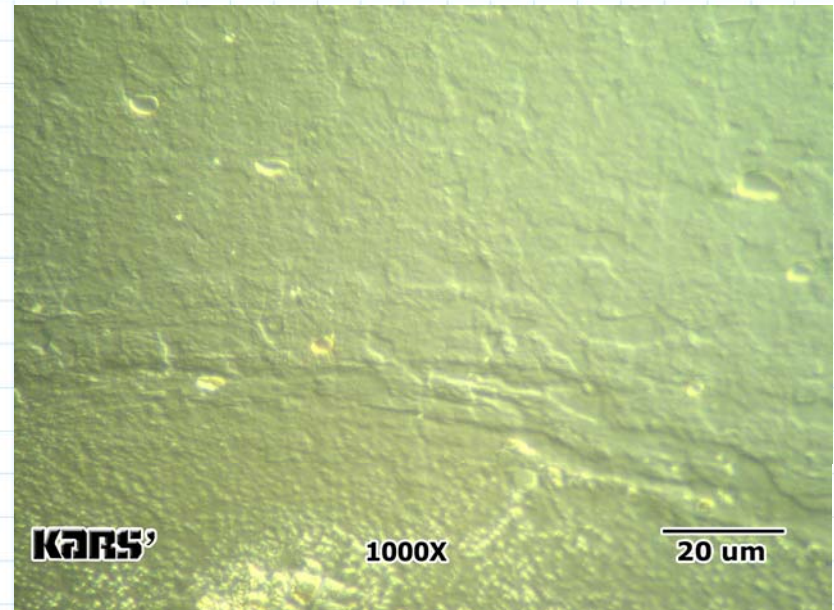
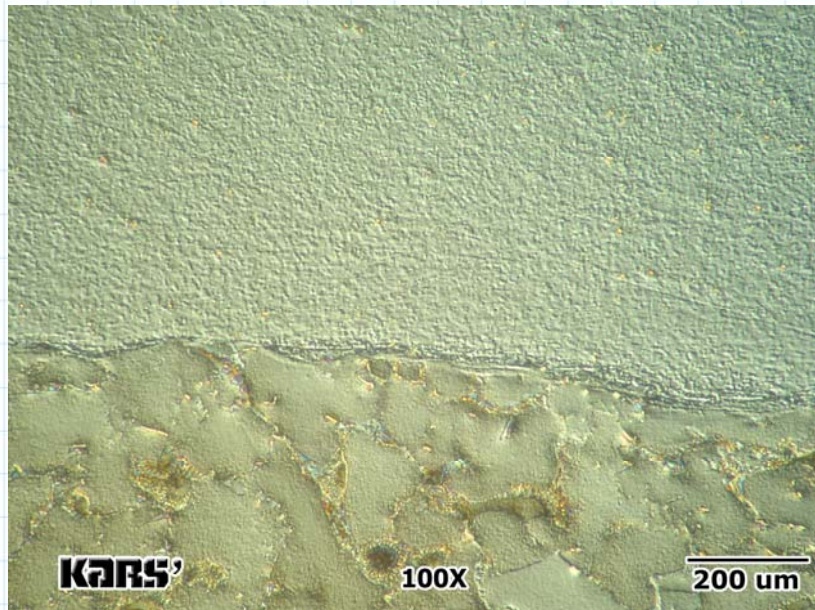
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Bi-Metal Weldment 6AL 4V Titanium to 304 Stainless

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Bi-Metal Weldment Inco 718 to Mar-M 247

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