

2022 EAA TIG WELDING WEBINAR

TIG SPORTAIR WORKSHOPS

Welding Process?

Gas

Mig

Stick

Tig (dc-)

4130 CHROME-MOLY
WYATT SWAIM

NHRA TOP FUEL DRAGSTERS



NHRA FUNNY CARS



VERIZON INDYCAR SERIES



MONSTER ENERGY NASCAR CUP SERIES



Sprints/Midgets



EXPERIMENTAL AIRCRAFT / WATERCRAFT



WHY USE 4130 TUBING?

4130 Analysis

C - .28/.33

MN - .40/.60

P Max. - .025

S Max. - .025

Si - .15/.35

CR - .80/1.10

Ni Max - .25

MO - .15/.25

Tube Sample

C - .134

MN - 1.51

P - .011

S - .004

Si - .21

CR - .04

Ni - .04

MO - .00

Plate Sample

C - .147

MN - .89

P - .012

S - .009

Si - .26

CR - 1.29

Ni - .26

MO - .82

WHY USE 4130 TUBING?

Mechanical Properties Condition (N)

Tensile Strength – 95,000 PSI

Yield Strength – 75,000 PSI

Elongation in 2% – 12% Nominal

WHY USE 4130 TUBING?

Carbon Steel Hydraulic Tubing (1018)

C - .18 Max

MN - .30/.60

P - .050 Max

S - .055

WHY USE 4130 TUBING?

Mechanical Properties (1018)

Tensile Strength - 55,000 PSI Max

Elongation - 40% Minimum

WHY USE 4130 TUBING?



Figure 1: Photograph of failed chassis received for analysis. Side 1 shown.



Figure 2: Photograph of failed chassis received for analysis. Side 2 shown.



Figure 3: Photograph of failed chassis received for analysis. Fracture face shown in photograph.

CRASH ANALYSIS-4130

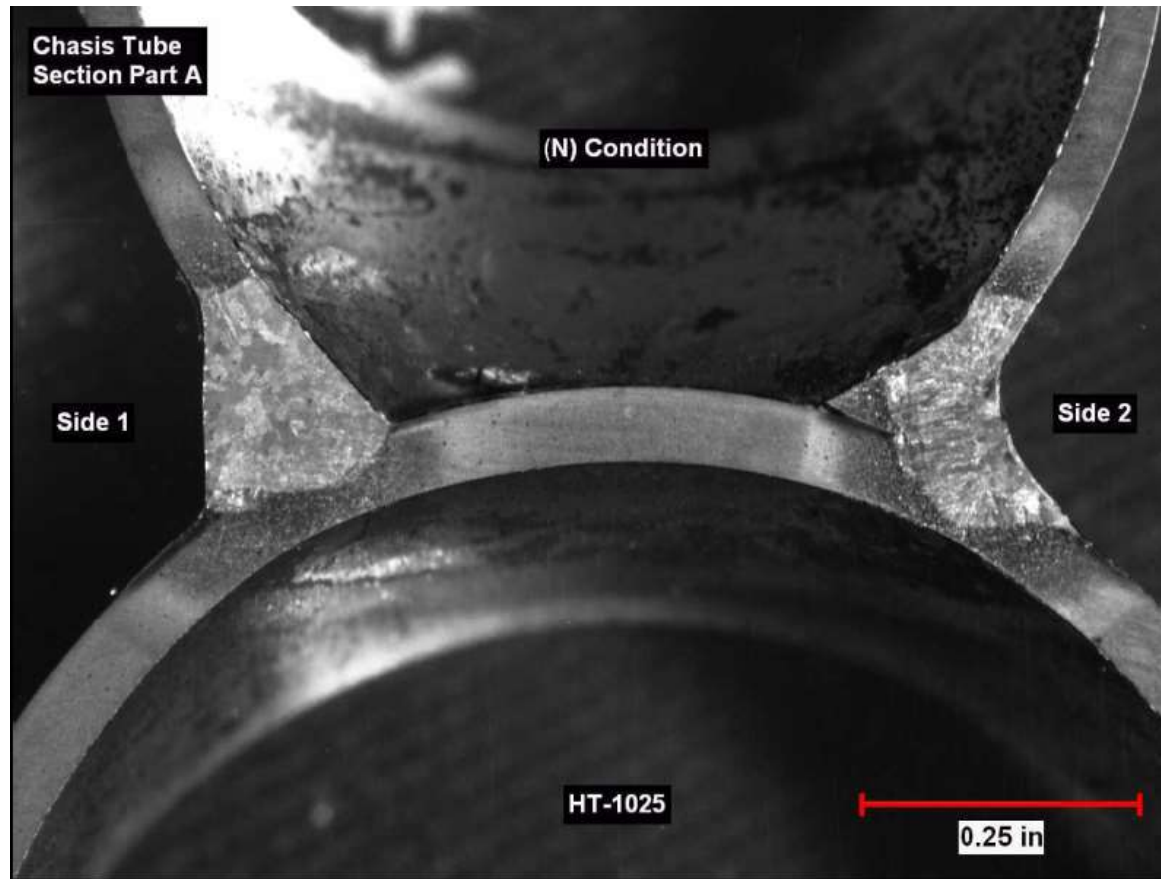


Figure 5: Macrograph of sectioned Part A.

WHY USE 4130 TUBING?

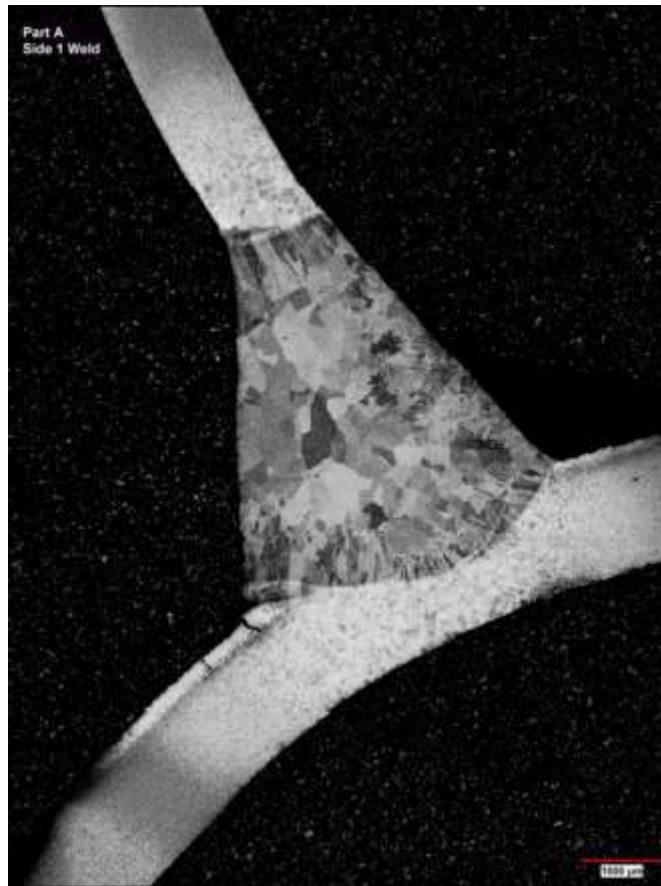


Figure 6: Mosaic image of sectioned Part A Side 1.

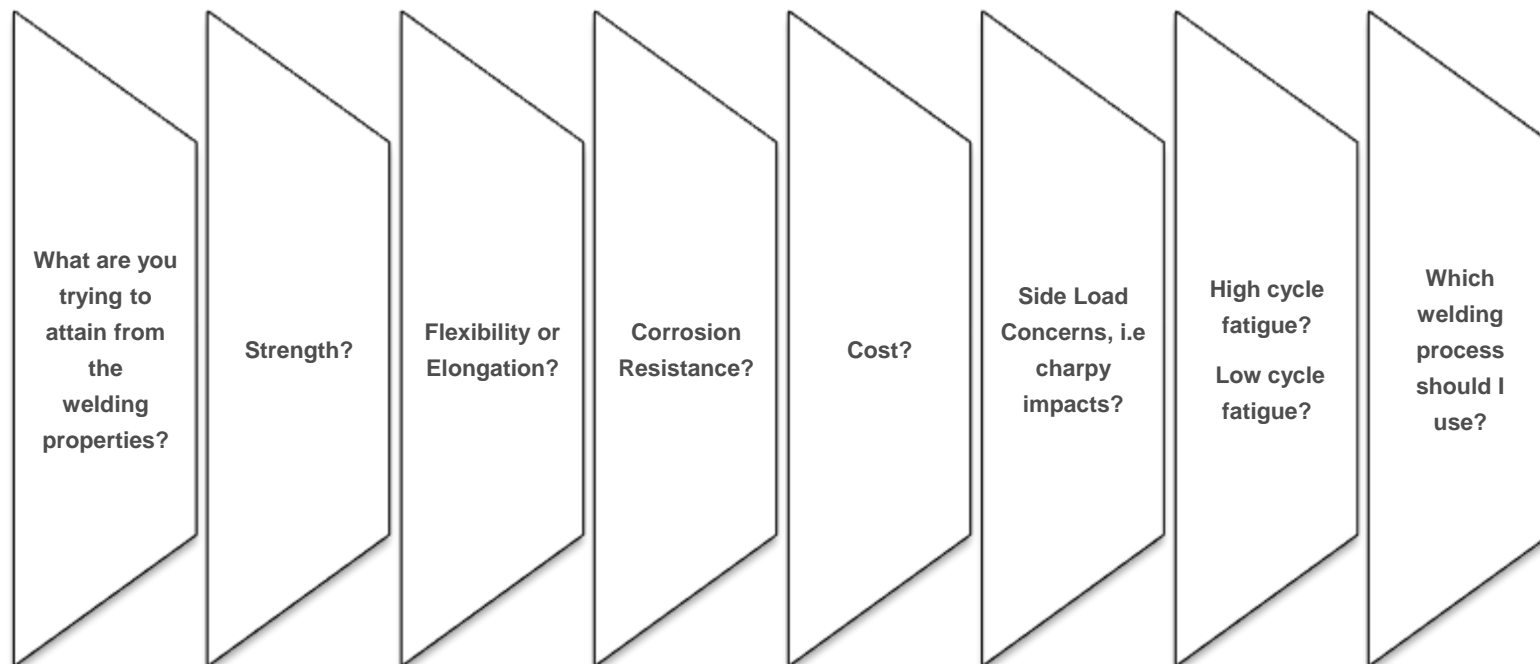
WHAT IS THE CORRECT TECHNIQUE FOR WELDING?

ASM Reference (*Does Not Reference Tubing*)

4130 Pre-Heating

Material Thickness up to .50" = 300°F	Material Thickness .60" - 1.0" = 400°F	Material Thickness 1.1" - 2.0" = 450°F
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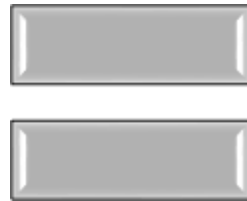
WHAT QUESTIONS SHOULD YOU ASK ABOUT THE SERVICE CONDITIONS OF YOUR PROJECT?



FAQ'S - 4130 CHROME-MOLY

CAN I WELD 4130 USING THE TIG PROCESS?

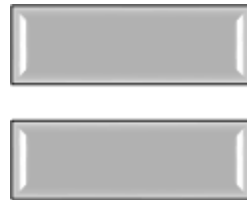
Yes –



4130 Chrome-Moly has been TIG welded in the aerospace and aircraft industries for years.

DO I NEED TO PRE-HEAT?

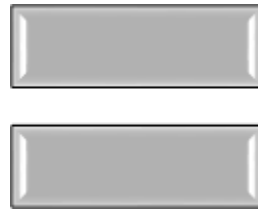
Depends



Tubing applications do not require the normal 300°F to 400°F pre-heat to obtain acceptable strength. However, it is recommended that pre-heat of 100°F to 125°F be used to remove parent material moisture.

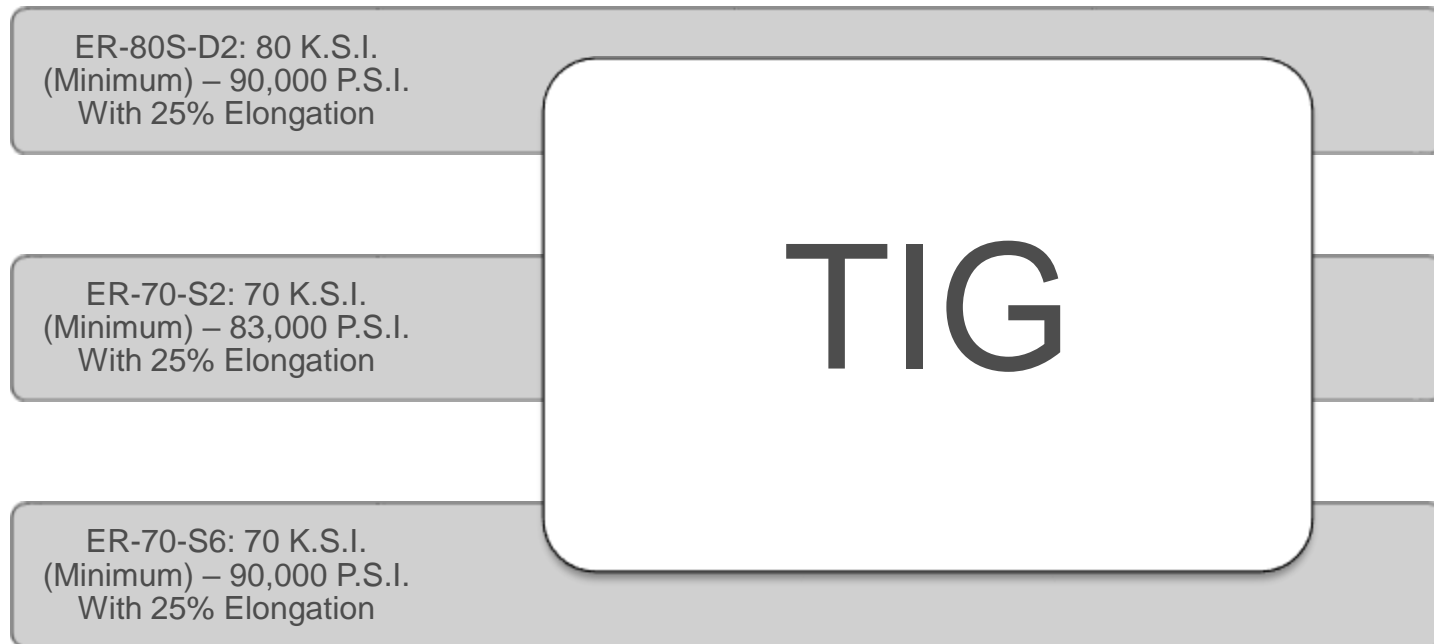
WHAT FILLER MATERIAL DO I USE?

Depends

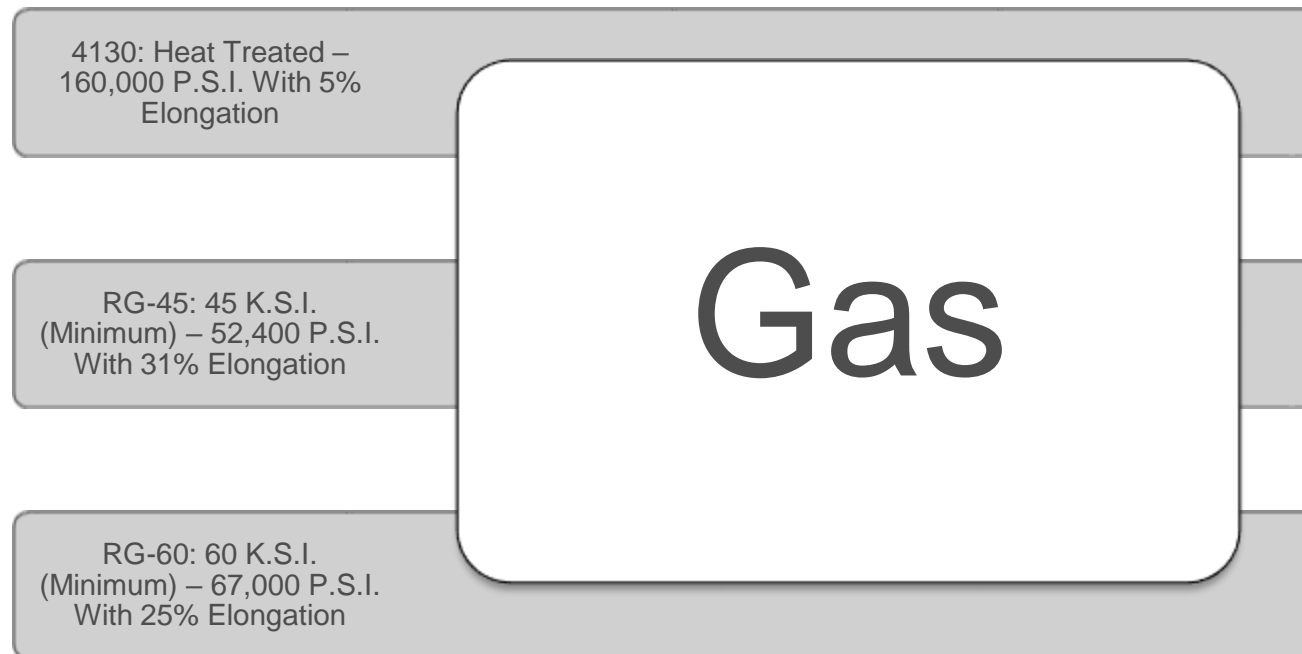


Although there are several good filler materials, my recommendation would be ER-80S-D2. This filler material will meet the strength and elongation requirements for experimental planes, racing car frames, roll cages, motorcycles and bicycle frames. Typically, you would obtain 18% elongation from this filler material after welding.

FILLER PROPERTIES TENSILE COMPARISON CHART



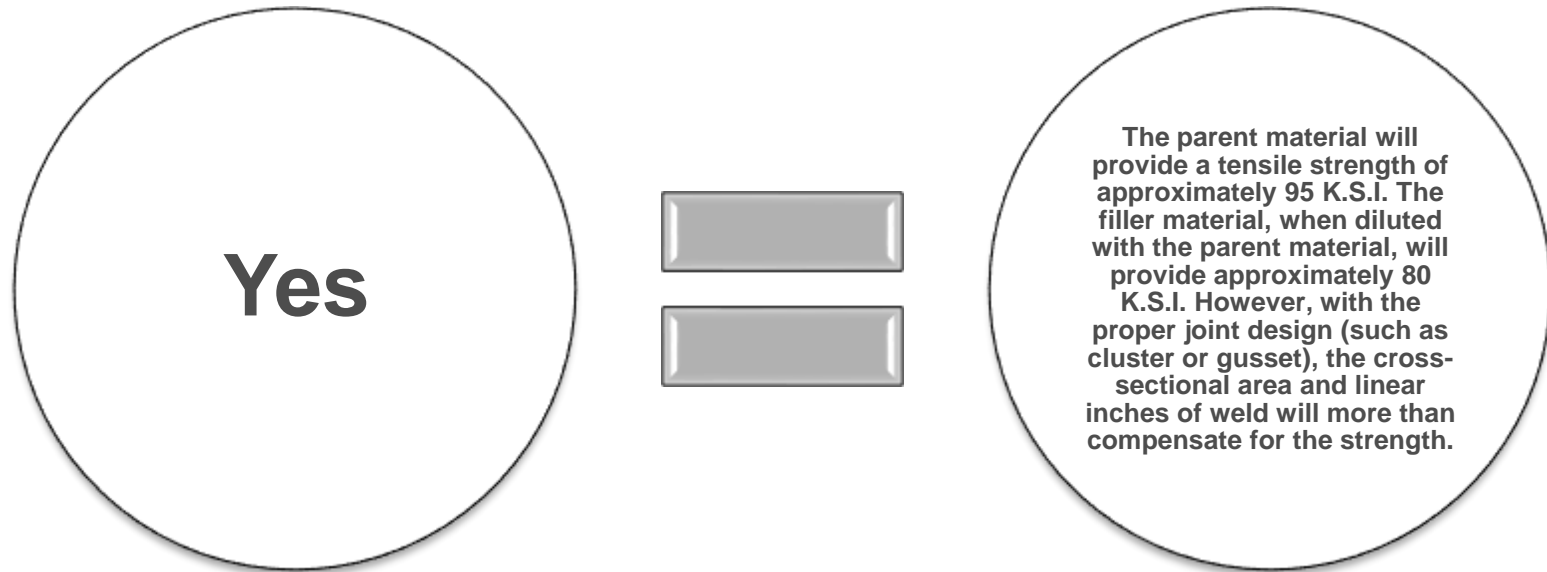
FILLER PROPERTIES TENSILE COMPARISON CHART



WHY DO I *NOT* USE 4130 FILLER?

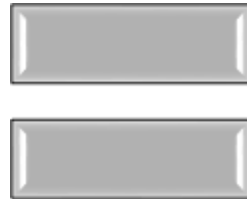
4130 filler typically is used for high strength and rigid applications. Due to its hardness or lack of elongation (flexibility), it is **NOT** recommended for sporting applications such as experimental airplanes, race car frames, roll cages, etc.

WHEN I USE ER80S-D2 FILLER MATERIAL, DO I GIVE UP STRENGTH FOR ELONGATION?



DO I HEAT TREAT 4130 AFTER WELDING?

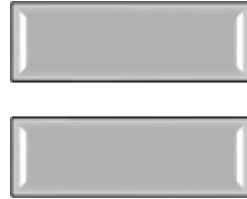
No



The term "heat treat" has been generically misused in the welding field, as has normalizing. Heat treat and normalizing operations are extremely sensitive to heat control (preferably oven-controlled) and do metallurgically change the strength value of the parent material. Stress-relieving is the recommended practice and 1,100°F is the optimum temperature for tubing applications. Use temperature crayon 900°F and mark approximately 1" away from weld areas.

DO I HAVE TO PRE-CLEAN 4130 MATERIAL?

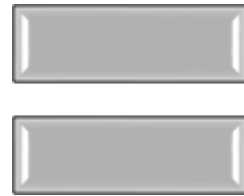
Yes



Remove surface scale and oils with mild abrasives and acetone. Wipe to remove all oils and lubricants. All burrs need to be removed with a hand scraper or burring tool.

DO I NEED TO BACK-PURGE 4130 MATERIAL?

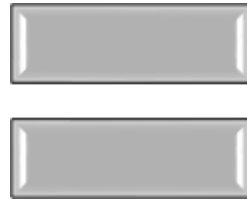
Whenever possible



It is recommended to back-purge all 4130 welds using Argon gas. However, many welds are closure welds and back purging is impractical.

DO I NEED 4130 PLATE FOR SUPPORT GUSSETS?

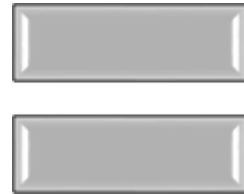
No



Mild steel will provide adequate stress and strain distribution. Most gussets are designed with more than adequate linear inches of weld.

SHOULD I COOL THE METAL AFTER I FINISH WELDING?

Absolutely
Not



Rapid quenching of the metal will create problems such as cracking and lamellar tearing. **Always** allow the weld to slow cool.

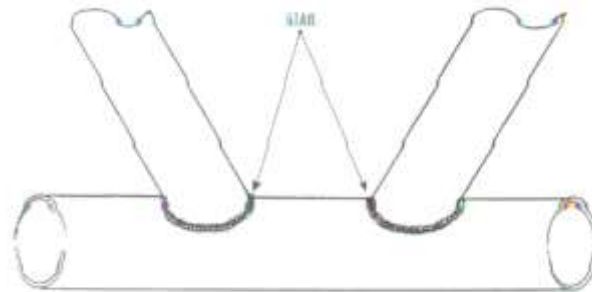
TIG WELD PROCEDURE

CUSTOMER: Hi-Tech Welding Services, Inc.

WELDING SPECIFICATION: Aircraft and Motorsports

GENERAL INFORMATION

- Remove all oxides and burrs within ¼" of weld area.
- Acetone wipe to remove all cutting oils.
- Assemble and TIG tack joint in a minimum of four (4) places.
- Preheat to 100°F to 125°F to remove moisture from parent material.
- TIG weld per parameters specified using Lincoln Precision TIG 225 or Invertec V205-T AC/DC with UltraFlex 9 Torch.



WELD SCHEDULE INFORMATION

PARENT MATERIAL: 4130

MATERIAL CONDITION: Condition (N)

MATERIAL THICKNESS: .035" Wall Thickness

FILLER MATERIAL: ER-80S-D2 .035" Dia

JOINT TYPE: (Cluster) Fillet

JOINT PREP: Abrasive Clean/Acetone Wipe

JOINT GAP: .000-.010

AMPERAGE: 0-40 Amps

TORCH TYPE: LA-9 or LW-20

CUP TYPE: Ceramic

TUNGSTEN SIZE: 1/16" Dia

TORCH GAS: Argon

BACK-UP GAS: Argon

TACKING SEQUENCE: 4-PLCS (min.)

CURRENT TYPE: D.C.E.N.

VOLTAGE: 9-12 Volts

CUP SIZE: Gas Lens 7/16" Orifice

TUNGSTEN TYPE: 2% Thoriate

TUNGSTEN SHAPE: Pointed

FLOW RATE: 15-25 C.F.H.

FLOW RATE: 5-10 C.F.H.

WELD SCHEDULE INFORMATION

NOTE: Other filler materials recommended for

TYPE APPLICATION (OPTION FILLER)	1ST	2ND	3RD	ELONGATION
NHRA/Hi-Performance Dragsters	ER80S-D2	ER70S-2	312	18%-30%
Indy/CART cars, Semi-Rigid applications	ER80S-D2	ER70S-2	ER70S-6	17%-22%
Experimental Airplanes, NASCAR, Sprints, Midgets, Go-Carts, Motorcycles, Bicycles	ER80S-D2	ER70S-2	ER70S-6	17%-22%

FOOTNOTE

Welding properties change from operator to operator. Techniques such as travel speed, filler type, filler deposition rates, amperage, gas shielding, and arc voltage (distance between tungsten and weld puddle) all have an effect towards heat input, weld strength, and elongation.

Required Approval for Release: WELD ENGINEER/WYATT SWAIM

Acute angle problem solved...



Welding Heat Input

$$\text{Amps} \times \text{Volts} \times 60 \div \text{Travel Speed} \times 1000$$

Example:

$$60 \text{ Amps} \times 9 \text{ Volts} \times 60$$

$$8 \text{ C.P.M} \times 1000$$

$$= 4.05 \text{ Joules Per Inch}$$

- ❖ Heat input controls cooling rates, grain size, notch toughness, heat affected zone (H.A.Z)

QUESTIONS ???????

NICKEL BASE & STAINLESS ALLOYS

WYATT SWAIM

SELECT AN APPLICATION

I.E. HEADERS, TAIL PIPES, EXHAUST PARTS

SERVICE CONDITIONS WANTED?

Cost?

Corrosion Resistance?

Heat Resistance?

Machinability?

Strength?

Formability?

Weldability?

Repair and modify in the field?

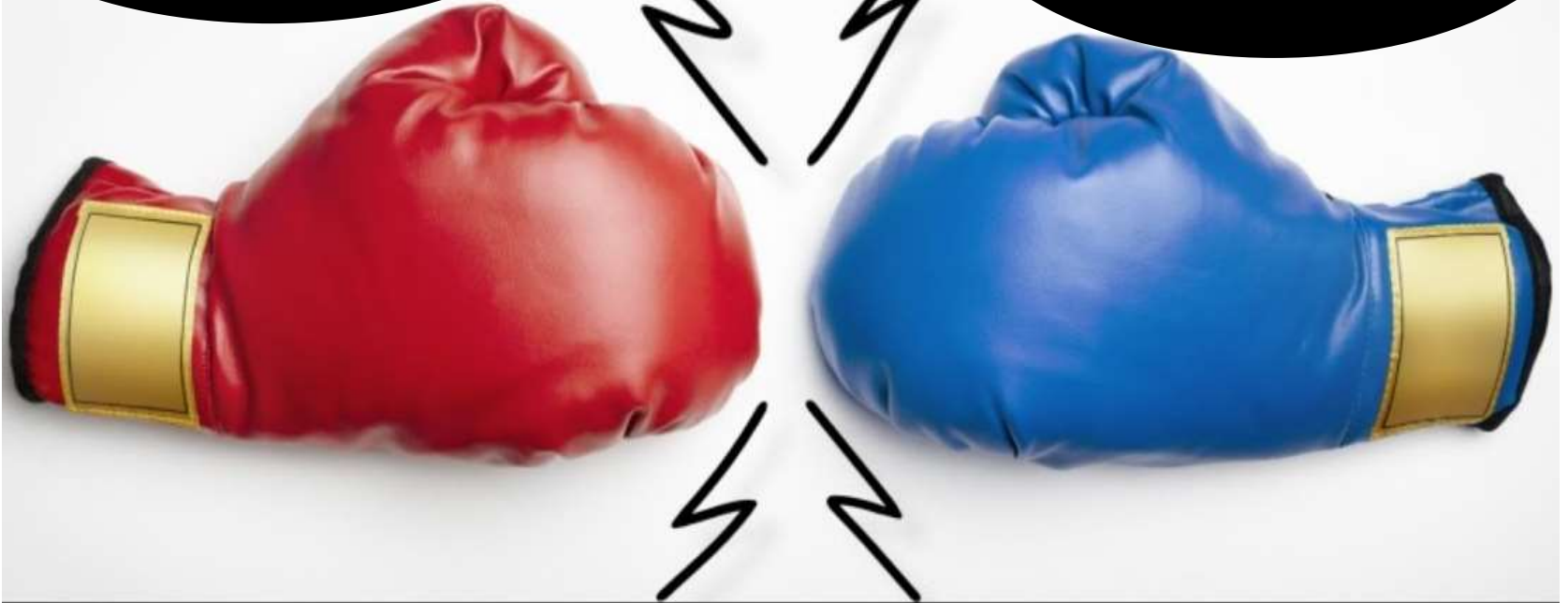
INCONEL VS. STAINLESS

	Ni	Cr	C	Elongation
Inconel 625	61.0	21.5	.05	30%
321 Stainless	13.0	20.0	.08	55%
304 Stainless	11.0	20.0	.08	55%
316 Stainless	14.0	18.0	.08	50%

304

VS

321



Tig Filler Selection

STAINLESS STEEL SELECTION CHART

304 Stainless Steel	<u>Usage</u> General Fabrication	Low temperature stabilized applications	Sustained temperature under 900 degrees F
321 Stainless Steel	<u>Usage</u> For hotter sustained temperatures (above 900 degrees) to avoid “chromium carbide precipitation”.		

STAINLESS STEEL FILLER MATERIAL RECOMMENDATIONS

321	Stainless
347	Stainless Filler
304	Stainless
3081	Stainless Filler

AVOIDING CHROMIUM OXIDES

**Always use
Argon gas**

**Always purge
(argon) backside
of welds**

**Utilize the
Tig process**



QUESTIONS ???????

**THANKS FOR
ATTENDING**

**CONTACT
INFORMATION**

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