FAQs on Welding 4130

Gas-tungsten-arc welding AISI 4130—a chromium-molybdenum alloy—isn't an everyday occurrence, but when you're called to do it, follow the guidelines offered here to assure good-quality welds.

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Noted for its high-strength properties at high temperatures, AISI 4130, a chromium-molybdenum alloy steel, finds use in a variety of sporting applications such as experimental airplanes, racing car frames, roll cages, go-carts, bicycles and motorcycle frames. Other uses include petrochemical and steam-tubing applications.

Typically, this alloy contains about 0.30 percent carbon, putting it at the high end of the low-carbon alloys—where welding begins to become difficult. The addition of about 0.75 percent chromium and 0.25 percent molybdenum provide the added strength—150 Ksi yield strength, 180 Ksi tensile strength—at temperatures of 800 to 900 F.

The following are commonly asked questions forwarded by welders who must gas-tungsten-arc weld (GTAW) this 4130 alloy for applications such as light-aircraft and motor-sport applications.

Q. Can I weld 4130 using the GTAW process?

A demonstration of GTAW welding of 4130 tubing at the Experimental Aircraft Association Show in Oshkosh, WI.

A. Yes, the aerospace and aircraft industries have welded 4130 chromium-molybdenum alloy via the GTAW process for years.

Q. Do I need to preheat material prior to welding?

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

Q. What filler material should I use?

A. Although there are several good filler materials, my recommendation would be AWS ER70S-2. This filler material will meet the strength and elongation requirements for experimental planes, racing car frames,

Weld Schedule Information

Parent material:	4130
Material condition:	Condition (N)
Material thickness:	0.035-in. wall thickness
Filler material:	AWS ER70S-2, 0.035-in. dia.
Joint type:	(Cluster) Fillet
Joint prep:	Abrasive clean/acetone wipe
Joint gap:	0.000-0.010 in.
Current type:	DCEN
Amperage:	0-40 amps
Voltage:	9-12 volts
Torch type	LA-9 or LW-20 Magnum
Cup size:	Gas lens, 7/16-in. orifice
Cup type:	Ceramic
Tungsten type:	2-percent thoriated
Tungsten size:	1/16-in. dia.
Tungsten shape:	Pointed
Torch gas:	Argon
Flow rate:	15-25 CFH
Backup gas:	Argon
Flow rate:	5-10 CFH
Tacking sequence:	4-PLCS (min.)

roll cages, motorcycles and bicycle frames. Typically, you would obtain 20 percent elongation from this filler material after welding.

Q. When should I use 4130 filler?

A. 4130 filler is used only when the weld will be preheated and post-weld heat-treated. For other applications, you should use ER70S-2 filler material.

Q. When I use ER70S-2 filler material, do I sacrifice any strength for elongation?

A. Yes, the parent material will provide a tensile strength of approximately 95 Ksi. The filler material, when diluted with the parent material, will provide approximately 80 Ksi. However, with the proper joint design (such as cluster or gusset), the cross-sectional area and linear inches of weld will more than compensate for the strength.

Q. Do I heat-treat 4130 after welding?

A. 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 will metallurgically change the strength value of the parent material. Stress-relieving is the recommended practice and 1100 F is the optimum temperature for tubing applications. Use a 900 F-temperature crayon and mark approximately 1 in. away from weld areas. Use an oxyacetylene torch with neutral flame and oscillate to avoid hot spots.

Note: Excessive stresses are induced by too much heat input, poor fitup or both. Therefore, stress relieving can be avoided by creating precision fitups and applying minimum heat input, i.e. smaller welds. GTAW welding should not require a weaving pattern in the welding technique.

Q. Do I have to preclean 4130 material?

A. Yes, remove surface scale and oils with mild abrasives and acetone. Wipe to remove all oils and lubricants. All burrs must be removed—use a hand scraper or burring tool.

Q. Do I need to backpurge 4130 material?

A. Whenever possible, it is recommended that you backpurge all 4130 welds using argon gas. However, many welds are closure welds where backpurging is impractical.

Q. Do I need 4130 plate for support gussets?

A. No, mild steel will provide adequate stress and strain distribution. Most gussets are designed with more-than-adequate linear inches of weld.

Q. Should I cool the weldment after I finish welding?

A. Absolutely not! Rapid quenching will create problems such as

Recommended Alternate Filler Materials				
Type of Application	1st option filler	2nd option filler	3rd option filler	Elongation
NHRA and/or high-performance dragsters	ER70S-2	ER70S-6	ER80S-D2	17-22%
Indy cars, CART cars, semi-rigid applications	ER80S-D2	ER70S-2	ER70S-6	17-22%
Experimental airplanes, NASCAR, sprints, midgets, go-carts, motorcycles, bicycles	ER70S-2	ER70S-6	ER80S-D2	17-22%

Tubing composed of 4130 is the structural choice for roll cages and frames in motorsports applications.

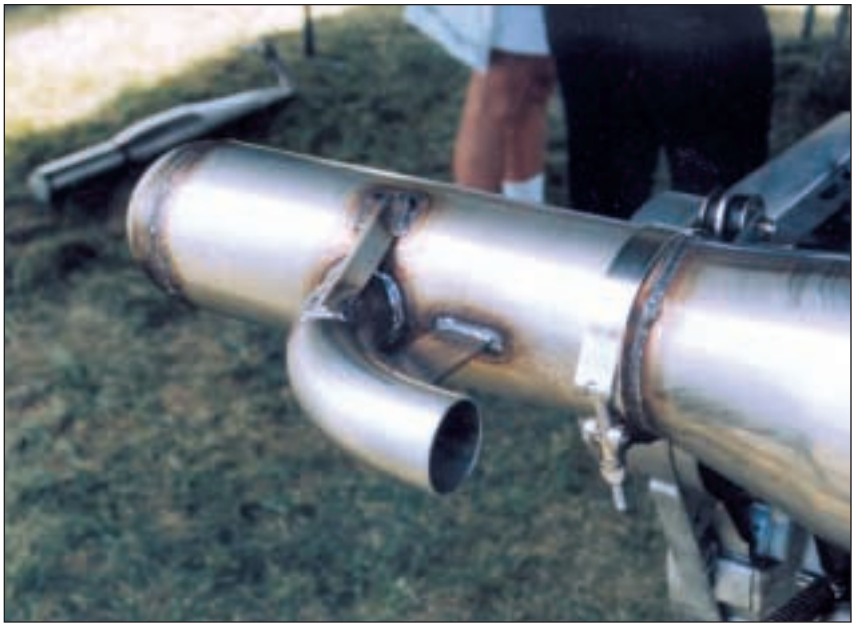
cracking and lamellar tearing. Always allow the weld to slow-cool.

Q. How should I prepare to weld this material?

A. Here is a short checklist of things to do:

- Remove all oxides and burrs within 0.25 in. of weld area.
- Use an acetone wipe to remove cutting oils.
- Assemble and GTAW tack weld the joint in at least four places.
- Preheat to 100 to 125 F to remove moisture from the parent material.

Remember: Welding properties change from operator to operator. Parameters such as travel speed, filler type, filler deposition rates, amperage, shielding gas and arc voltage (distance between tungsten and weld puddle) all effect heat input, weld strength and elongation. **MF**



Cr-Mo alloy 4130 is used on this exhaust manifold, due to its high strength as compared to mild steel.