

TECHNICAL SPECIFICATIONS FOR TIG WELDING



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CONNECTION DIAGRAMS



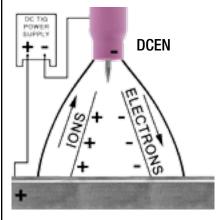
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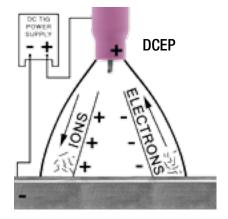
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CHARACTERISTICS OF CURRENT TYPES FOR GAS TUNGSTEN ARC WELDING

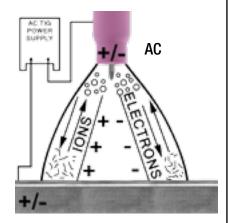
When TIG welding, there are three choices of welding current. They are: Direct Current Straight Polarity (DCSP), Direct Current Reverse Polarity (DCRP), and Alternating Current with or without High Frequency stabilization (ACHF). Each of these has its applications, advantages, and disadvantages. A look at each type and its uses will help the operator select the best current type for the job. The type of current used will have a great effect on the penetration pattern as well as the bead configuration. The diagrams below show arc characteristics of each current polarity type.



TIG WELDING DCSP Direct Current Straight Polarity produces deep penetration by concentrating heat in the joint area. No cleaning action occurs with this polarity.



TIG WELDING DCRP Direct Current Reverse Polarity produces the best cleaning action as the argon ions flowing towards the work strike with sufficient force to break up oxides on the surface.



TIG WELDING WITH ACHF Alternating Current High Frequency combines the weld penetration on the negative half cycle with the cleaning action of the positive half cycle. High frequency re-establishes the arc which breaks each half cycle on transformer based machines.

CURRENT TYPE	DCSP
ELECTRODE POLARITY	Electrode negative
OXIDE CLEANING Action	No
HEAT BALANCE IN THE ARC	70% of work end 30% at electrode end
PENETRATION PROFILE	Deep narrow
ELECTRODE CAPACITY	Excellent

CURRENT TYPE	DCRP	
ELECTRODE POLARITY	Electrode positive	
OXIDE CLEANING Action	Yes	
HEAT BALANCE IN THE ARC	30% of work end 70% at electrode end	
PENETRATION PROFILE	Shallow wide	
ELECTRODE CAPACITY	Poor	

CURRENT TYPE	ACHF	
ELECTRODE POLARITY	Alternating	
OXIDE CLEANING Action	Yes (once every half cycle)	
HEAT BALANCE IN THE ARC	50% of work end 50% at electrode end	
PENETRATION PROFILE	Medium	
ELECTRODE CAPACITY	Good	

DCSP mainly used on: Stainless Steel, Mild Steel, Nickel, Copper, Titanium

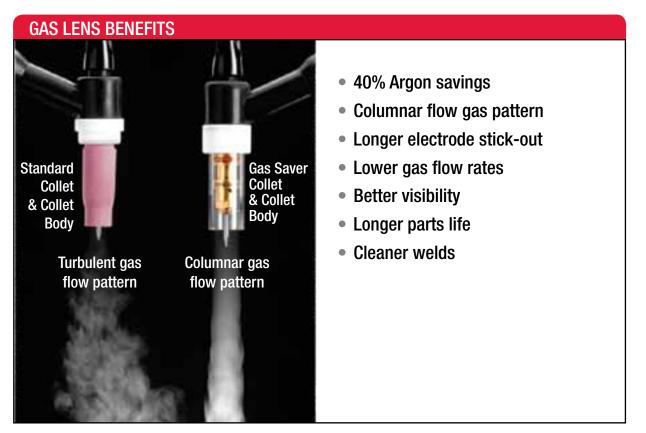
ACHF mainly used on: Aluminum, Magnesium

DCRP mainly used on: Thin Material



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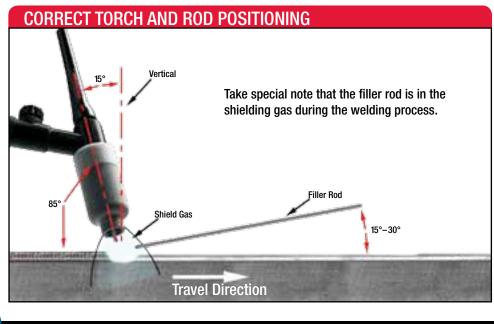
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GUIDE FOR SHIELD GAS FLOWS, CURRENT SETTINGS & CUP SELECTION									
		WELDING CURRENT (AMPS) TUNGSTEN TYPE ARGON FLOW FERROUS ME		ERROUS METALS	ARGON FLOW ALUMINUM				
Electrode Diameter	Cup Size	AC Pure	AC Thoriated	DCSP Pure	DCSP Thoriated	Standard Body CFH (L/MN)	Gas Lens Body CFH (L/MN)	Standard Body CFH (L/MN)	Gas Lens Body CFH (L/MN)
.020" (0.5mm)	3, 4, or 5	5–15	5–20	5–15	5–20	5-8 (3-4)	5-8 (3-4)	5–8 (3–4)	5–8 (3–4)
.040" (1.0mm)	4 or 5	10–60	15-80	15–70	20-80	5–10 (3–5)	5-8 (3-4)	5–12 (3–6)	5–10 (3–5)
1/16" (1.6mm)	4, 5, or 6	50–100	70–150	70–130	80–150	7–12 (4–6)	5–10 (3–5)	8–15 (4–7)	7–12 (4–6)
3/32" (2.4mm)	6, 7, or 8	100–160	140–235	150–220	150–250	10–15 (5–7)	8–10 (4–5)	10–20 (5–10)	10–15 (5–7)
1/8" (3.2mm)	7, 8, or 10	150–210	220-325	220–330	240-350	10–18 (5–9)	8–12 (4–6)	12-25 (6-12)	10-20 (5-10)
5/32" (4.0mm)	8 or 10	200–275	300–425	375–475	400–500	15–25 (7–12)	10–15 (5–7)	15-30 (7-14)	12–25 (6–12)
3/16" (4.8mm)	8 or 10	250-350	400 – 525	475–800	475-800	20–35 (10–17)	12–25 (6–12)	25–40 (12–19)	15–30 (7–14)
1/4" (6.4mm)	10	325-700	500-700	750–1000	700–1000	25–50 (12–24)	20-35 (10-17)	30–55 (14–26)	25–45 (12–21)

For pure helium shielding gas, double flow rates shown. For argon-helium mixes with below 30% helium content, use figures shown. Always adjust gas flows to accommodate best shielding results.

UNGSTEN ELECTRODE TIP SHAPES AND CURRENT RANGES

ELECTRODE	DIAMETER	DIAMETER	R AT TIP		CURRENT	PULSED CURRENT
Millimeters	Inches	Millimeters	Inches	INCLUDED ANGLE	RANGE	RANGE
1.0mm	.040"	.125mm	.005"	12°	2–15 amps	2–25 amps
1.0mm	.040"	.250mm	.010"	20°	5–30 amps	5–60 amps
1.6mm	1/16"	.500mm	.020"	25°	8–50 amps	8–100 amps
1.6mm	1/16"	.800mm	.030"	30°	10–70 amps	10–140 amps
2.4mm	3/32"	.800mm	.030"	35°	12–90 amps	12–180 amps
2.4mm	3/32"	1.100mm	.045"	45°	15–150 amps	15–250 amps
3.2mm	1/8"	1.100mm	.045"	60°	20–200 amps	20–300 amps
3.2mm	1/8"	1.500mm	.060"	90°	25–250 amps	25–350 amps

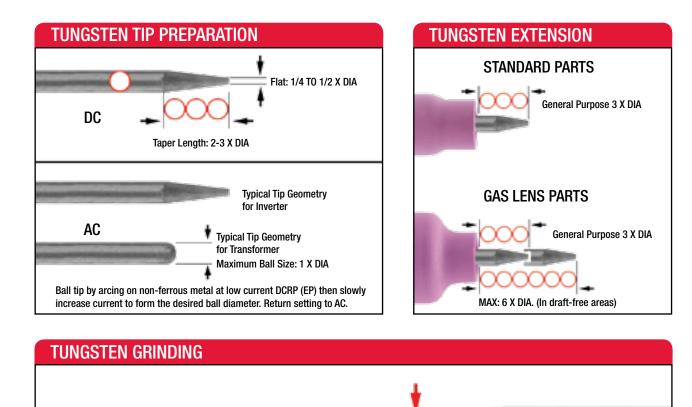




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Use a medium (60 grit or finer) aluminum oxide wheel.

- Grind longitudinally (never radially)
- Truncate (blunt) end
- Diameter of flat spot determines amperage capacity

The included angle determines weld bead shape and size. Generally, as the included angle increases, penetration increases and bead width decreases. *Refer to page 5

COLOR (CODE FOR 1	UNGSTEN ELECTRODES			
Desig	nation	Chemical Composition Impu	rities ≤0.1%		
ISO 6848	AWS A5.12	OXIDE ADDITIVE	TUNGSTEN	TIP COLOR	
WT20	EWTh-2	ThO ₂ : 1.70-2.20%	2% THORIATED	Red	
WP	EWP	~~~~~	PURE	Green	
WL15	EWLa-1.5	La0 ₂ : 1.30–1.70%	1.5% LANTHANATED	Gold	
WC20	EWCe-2	CeO ₂ : 1.80-2.20%	2% CERIATED	Gray	
WL20	EWLa-2	La ₂ O ₃ : 1.80-2.20%	2% LANTHANATED	Blue	
WZ8	EWZr-8	ZrO ₂ : 0.70–0.90%	0.8% ZIRCONIATED	White	
LaYZr™	EWG	La ₂ 0 ₃ : 1.3–1.7%; Y ₂ 0 ₃ : 0.06–0.10%; Zr0 ₂ : 0.6–1.0%	1.5% LANTHANATED 0.8% YTTRIATED 0.8% ZIRCONIATED	Chartreuse	



TUNGSTEN ELECTROD	E CHARACTE	RISTICS
Tungsten	Color Code	Characteristics
Pure	Green	Provides good arc stability for AC welding. Reasonably good resistance to contamination. Lowest current carrying capacity. Least expensive. Maintains a balled end. Used on transformer based machines only.
2% Ceriated	Gray	Similar performance to thoriated tungsten. Easy arc starting, good arc stability, long life. Possible replacement for thoriated.
2% Thoriated	Red	Easier arc starting. Higher current capacity. Greater arc stability. High resistance to weld pool contamination. Difficult to maintain balled end on AC.
1.5% Lanthanated 2% Lanthanated	Gold	Similar performance to thoriated tungsten. Easy arc starting, good arc stability, long life, high current capacity. 1.5% possible replacement for thoriated. 2% possible replacement for Pure.
.8% Zirconiated	White	Excellent for AC welding due to favorable retention of balled end, high resistance to contamination, and good arc starting. Preferred when tungsten contamination of weld is intolerable. Possible replacement for Pure.
LaYZr™	Chartreuse*	Best for use on automated or robotic applications. Runs cooler than 2% Thoriated with longer life. Low to medium amperage range.

*Substitute for Purple (Same oxide blend).

			TYPICAL CURRENT RANGE								
		Direct Current, DC		Alterna	ting Current, AC						
		DCEN	70%	Penetration	(50/50) Ba	lanced Wave, AC					
		Ceriated	Zirconiated	Ceriated	Zirconiated	Ceriated					
Tungsten Diameter in	Gas Cup (Inside	Thoriated		Thoriated	Pure	Thoriated					
inches (mm)	Diameter)	Lanthanated		Lanthanated	LaYZr™	Lanthanated					
		LaYZr™		LaYZr™		LaYZr™					
.040" (1.0mm)	#5 (3/8")	15–80 amps	20–60 amps	15–80 amps	10–30 amps	20–60 amps					
1/16" (1.6mm)	#5 (3/8")	70–150 amps	50–100 amps	70–150 amps	30–80 amps	60–120 amps					
3/32" (2.3mm)	#8 (1/2")	150-250 amps	100–160 amps	140–235 amps	60–130 amps	100–180 amps					
1/8" (3.2mm)	#8 (1/2")	250-400 amps	150–200 amps	225–325 amps	100–180 amps	160–250 amps					

equipment, and application. DCEN = Direct Current Electrode Negative (Straight Polarity)



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WELD PENETRATIO	N PROFILE		
Gas Type	30° Angle .005" FLAT	60° Angle .010" FLAT	90° Angle .020" FLAT
100Ar 100% Argon			
75Ar-25He 75% Argon 25% Helium			
50Ar-50He 50% Argon 50% Helium			
25Ar-75He 25% Argon 75% Helium			
100He 100% Helium			
95Ar-5H 95% Argon 5% Hydrogen			



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ALUN	/INUN	/I (ACHF)						
METAL	JOINT	TUNGSTEN	FILLER ROD	CUP	SHIEL	D GAS FLO	N	WELDING	TRAVEL
GAUGE	TYPE	SIZE	SIZE	SIZE	TYPE	CFH (L/MN)	PSI	AMPERES	SPEED
1/16"	BUTT	1/16"	1/16"	AEC	ARGON	15 (7)	20	60–80	12" (307.2mm)
(1.6mm)	FILLET	(1.6mm)	(1.6mm)	(1.6mm) 4, 5, 6		15 (7)	20	70–90	10" (256mm)
1/8"	BUTT	3/32"	3/32" (2.4mm) 1/8" (3.2mm)	c 7	ARGON	17 (0)	20	125–145	12" (307.2mm)
(3.2mm)	FILLET	(2.4mm)	3/32" (2.4mm) 1/16" (1.6mm)	6, 7		17 (8)	20	140–160	10" (256mm)
3/16"	BUTT	1/8"	1/8" 1/8"		ARGON/	01 (10)	00	195–220	11" (258.6mm)
(4.8mm)	FILLET	(3.2mm)	(3.2mm)	7, 8	HELIUM	21 (10)	20	210–240	9" (230.4mm)
1/4"	BUTT	3/16"	1/8"	8, 10	ARGON/	25 (12)		260–300	10" (256mm)
(6.4mm)	FILLET	(4.8mm)	(3.2mm)	0, 10	HELIUM	25 (12)	20	280–320	8" (204.8mm)

WELDING ALUMINUM

The use of TIG welding for aluminum has many advantages for both manual and automatic processes. Filler metal can be either wire or rod and should be compatible with the base alloy. Filler metal must be dry, free of oxides, grease, or other foreign matter. If filler metal becomes damp, heat for 2 hours at 250°F (121°C) before using. Although ACHF is recommended, DCRP has been successful up to 3/32" (2.4mm), DCSP with helium shield gas is successful in mechanized applications.

TITA	NIUM	(DCSP)							
METAL	JOINT	TUNGSTEN		FILLER ROD CUP		.D GAS FLO	N	WELDING	TRAVEL
GAUGE	TYPE	SIZE	SIZE	SIZE	TYPE	CFH (L/MN)	PSI	AMPERES	SPEED
1/16"	BUTT	1/16"	NONE	4, 5, 6	ARGON	15 (7)	20	90–110	10" (256mm)
(1.6mm)	FILLET	(1.6mm)	NONE	4, 3, 0	AndON	15 (7)	20	110–150	8" (204.8mm)
1/8"	BUTT	3/32"	1/16"	5, 6, 7	ARGON	15 (7)	20	190–220	9" (230.4mm)
(3.2mm)	FILLET	(2.4mm)	(1.6mm)	5, 6, 7		15 (7)	20	210–250	7" (179.2mm)
3/16"	BUTT	3/32"	1/8"	670	ARGON	20 (10)	20	220–250	8" (204.8mm)
(4.8mm)	FILLET	(2.4mm)	(3.2mm)	6, 7, 8	AndON	20 (10)	20	240–280	7" (179.2mm)
1/4"	BUTT	1/8"	1/8"	1/8" 8, 10	ARGON	30 (15)	20	275–310	8" (204.8mm)
(6.4mm)	FILLET	(3.2mm)	(3.2mm)	0,10	ANUON			290–340	7" (179.2mm)

WELDING TITANIUM

Small amounts of impurities, particularly oxygen and nitrogen, cause embrittlement of molten or hot titanium when above 500°F (260°C). The molten weld metal in the heat-affected zones must be shielded by a protective blanket of inert gas. Titanium requires a strong, positive pressure of argon or helium as a backup on the root side of the weld, as well as long, trailing, protective tail of argon gas to protect the metal while cooling. Purge chambers and trailing shields are available from CK Worldwide to assist in providing quality results.

MAGNESIUM (ACHF)

IVIAU	NLOIC		·)							
METAL	IOINIT	TUNGSTEN	FILLER ROD	CUD	SHIELI) GAS FLO	N		TRAVEL	
GAUGE	JOINT Type	SIZE	SIZE	CUP Size	ТҮРЕ	CFH (L/MN)	PSI	WELDING AMPERES	SPEED	
1/16"	BUTT	1/16"	3/32" (2.4mm)	5,6	ARGON	12 (5)	15	60	20"	
(1.6mm)	FILLET	(1.6mm)	1/8" (3.2mm)	3,0	AndON	13 (5)	15	60	(512mm)	
1/8"	BUTT	3/32"	1/8" (3.2mm)	7,8	ARGON	19 (9)	15	115	17" (435.2mm)	
(3.2mm)	FILLET	(2.4mm)	5/32" (4.0mm)	7,0	AndON	19 (9)		115		
1/4"	BUTT	3/16"						100–130	22" (563.2mm)	
(6.4mm)	FILLET	(4.8mm)	5/32" (4.0mm)	8	ARGON	25 (12)	15	110–135	20" (512mm)	
1/2"	BUTT	1/4"	3/16" (4.8mm)	10	ARGON	35 (17)	15	260	10"	
(12.8mm)	FILLET	(6.4mm)	3/10 (4.011111)	10	AndON	33 (17)	15	200	(256mm)	

WELDING MAGNESIUM

Magnesium was one of the first metals to be welded commercially by TIG. Magnesium alloys are in three groups, they are: (1) aluminumzinc-magnesium, (2) aluminum-magnesium, and (3) maganese-magnesium. Since magnesium absorbs a number of harmful ingredients and oxiodize rapidly when subjected to welding heat, TIG welding in an inert gas atmosphere is distinctly advantageous. The welding of magnesium is similar, in many respects, to the welding of aluminum. Magnesium requires a positive pressure of argon as a backup on the root side of the weld.



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DE0)	(IDIZE[) COPPE	R (DCSP))					
METAL	JOINT	TUNGSTEN	FILLER ROD	CUP	SHIELI	D GAS FLO	N	WELDING	TRAVEL
GAUGE	TYPE	SIZE	SIZE	SIZE	TYPE	CFH (L/MN)	PSI	AMPERES	SPEED
1/16"	BUTT	1/16"	" 1/16"		ARGON	18 (9)	15	110–140	12" (307.2mm)
(1.6mm)	FILLET	(1.6mm)	(1.6mm)	4, 5, 6	Andon	10 (3)	10	130–150	10" (256mm)
1/8"	BUTT	3/32"	3/32"	4, 5, 6	ARGON	10.00	15	175–225	11" (258.6mm)
(3.2mm)	FILLET	(2.4mm)	(2.4mm)		ARGON	18 (9)	10	200–250	9" (230.4mm)
3/16"	BUTT	1/8"	1/8"			36	15	190–225	10" (256mm)
(4.8mm)	FILLET	(3.2mm)	(3.2mm)	8, 10	HELIUM	(17.5)	15	205–250	8" (204.8mm)
1/4"	BUTT (2)	3/16"	1/8"	8, 10	HELIUM	36	45	225–260	9" (230.4mm)
(6.4mm)	FILLET	(4.8mm)	(3.2mm)	0, 10		(17.5)	15	250–280	7" (179.2mm)

WELDING DEOXIDIZED COPPER

Where extensive welding is to be done, the use of deoxidized (oxygen-free) copper is preferable over electrolytic tough pitch copper. Although TIG welding has been used occasionally to weld zinc-bearing copper alloys, such as brass and commercial bronzes, it is not recommended because the shielding gas does not suppress the vaporization of zinc. For the same reason zinc bearing filler rods should not be used. There is some preference of helium for the inert atmosphere in welding thickness above 1/8" (3.2mm) because of the improved weld metal fluidity. Preheating recommendations should be followed.

STAI	NLES	S STEEL	(DCSP)						
METAL	JOINT	TUNGSTEN	FILLER	FILLER CUP		SHIELD GAS FLOW			TRAVEL
GAUGE	TYPE	SIZE	ROD SIZE	SIZE	ТҮРЕ	CFH (L/MN)	PSI	WELDING AMPERES	SPEED
1/16"	BUTT	1/16"	1/16"	4.5.0	ARGON	11 (5.5)		80–100	12" (307.2mm)
(1.6mm)	FILLET	(1.6mm)	(1.6mm)	m) 4, 5, 6	AndUN	(0.0)	20	90–100	10" (256mm)
1/8"	BUTT	1/16"	3/32"	2"	ARGON	11 (F F)		120–140	12" (307.2mm)
(3.2mm)	FILLET	(1.6mm)	(2.4mm)	4, 5, 6	AKGUN	11 (5.5)	20	130–150	10" (256mm)
3/16"	BUTT	3/32" (2.4mm)	1/8"	F 0 7	, 6, 7 ARGON			200–250	12" (307.2mm)
(4.8mm)	FILLET	3/32" (2.4mm) 1/8" (3.2mm)	(3.2mm)	5, 6, 7		13 (6)	20	225–275	10" (256mm)
1/4"	BUTT	1/8"	3/16"	0 10	ARGON	12 (6)	20	275–350	10" (256mm)
(6.4mm)	FILLET	(3.2mm)	(4.8mm)	8, 10	ARGUN	ARGON 13 (6)		300–375	8" (204.8mm)

WELDING STAINLESS STEEL

In TIG welding of stainless steel, welding rods having the AWS-ASTM prefixes of E or ER can be used as filler rods. However, only bare uncoated rods should be used. Light gauge metals less then 1/16" (1.6mm) thick should always be welded with DCSP using argon gas. Follow the normal precautions for welding stainless such as: Clean surfaces; dry electrodes; use only stainless steel tools and brushes, keep stainless from coming in contact with other metals.

LOW	LOW ALLOY STEEL (DCSP)									
METAL	JOINT	TUNGSTEN	FILLER	FILLER CUP		D GAS FLOV	V	WELDING	TRAVEL	
GAUGE	TYPE	SIZE	ROD SIZE	SIZE	TYPE	CFH (L/MN)	PSI	AMPERES	SPEED	
1/16"	BUTT	1/16"	1/16"	45.6	ARGON	15 (7)	20	95-135	15" (384mm)	
(1.6mm)	FILLET	(1.6mm)	(1.6mm)	n) 4, 5, 6	AndON	15 (7)	20	95-135	15" (384mm)	
1/8"	BUTT	1/16" (1.6mm)	3/32"	4.5.0	ARGON			145-205	11" (258.6mm)	
(3.2mm)	FILLET	3/32 (2.4mm)	(2.4mm)	4, 5, 6		15 (7)	20	145-205	11" (258.6mm)	
3/16"	BUTT	3/32"	1/8"	7.0	ADCON	10 (0 5)	00	210-260	10" (256mm)	
(4.8mm)	FILLET	(2.4mm)	(3.2mm)	7,8	ARGON	16 (6.5)	20	210-260	10" (256mm)	
1/4"	BUTT	1/8"	5/32"	0.40	ARGON			240-300	10" (256mm)	
(6.4mm)	FILLET (2)	(3.2mm)	(4.0mm)	810		18 (8.5)	20	240-300	10" (256mm)	

WELDING LOW ALLOY STEEL

Mild and low carbon steels with less then 0.30% carbon and less than 1" (2.5cm) thick, generally do not require preheat. An exception to this allowance is welding on highly restrained joints. These joints should be preheated 50 to 100°F (10 to 38°C) to minimize shrinkage cracks in the base metal. Low alloy steels such as the chromium-molybdenum steels will have hard heat affected zones after welding, if the preheat temperature is too low. This is caused by rapid cooling of the base material and the formation of martensitic grain structures. A 200 to 400°F (93 to 204°C) preheat temperature will slow the cooling rate and prevent the martensitic structure.



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