SanRex

Plasma Welding Torches

PWH/M P75, P15, P22, P30

Operators Manual

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General Information

Description of Equipment

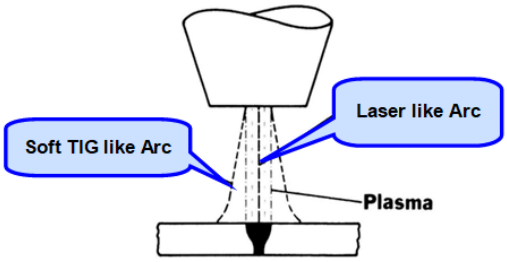
The Sanrex Plasma Welding Torches are designed for direct current plasma arc welding of ferrous metals using the transferred arc plasma process.

Features & Advantages:

- Protected Electrode - Secluded from contamination by atmosphere and base-metal, allows for many hours of non-interrupted service.
- Controllable Arc - Can use tip orifice size, electrode set-back and gas flow rates as “mini-tuners.”
- Multi-Gas Capabilities - Allows for operation of various gases for enhanced welding performance.
- Pilot Arc - Provides “absolute” arc transfer… Every time.

Plasma Welding Modes of Operation - Plasma welding is commonly used in two modes of operation, melt-in fusion welds and keyhole fusion welds.

Melt-in Fusion – Soft TIG like arc. This type weld mode is the most often used with the plasma arc welding process. It is accomplished with a softer, less constricted arc, using lower plasma gas flow rates, a reduced electrode setback, and current levels in the range of approximately 0.5 to 200 amps. This type of weld mode is very similar to that of gas tungsten arc welding with additional advantages in many applications.



Plasma Welding Arc Modes.

Keyhole – Laser like Arc. This type of weld is generally obtained by using a stiff, constricted arc. In the keyhole mode penetration is obtained by the combination of plasma and gas momentum with thermal conduction. With increased plasma gas flow rates and electrode setback, a hole known as the keyhole is pierced through the entire metal thickness at the leading edge of the weld puddle, where the forces of the plasma jet (column) displace the molten metal. As the torch travel progresses at a consistent speed, the molten metal, supported by surface tension, flows behind the keyhole to form the weld bead. Keyhole welding is almost exclusively performed in the automated mode. Typically this technique is used for square butt welds on material thickness from .093 (2.4 mm) to .250 (6.4 mm) requiring 100% penetration in a single pass. Manual keyhole welding is not recommended because of difficulties in maintaining consistent travel speeds, torch position, or filler material addition.

Microplasma Welding (typical current range 0.1 - 15A) Microplasma is used for welding thin sheets [down to 0.004” (0.1 mm) thickness], and wire and mesh sections. The needle-like, stiff arc minimizes arc wander and distortion.

Medium Current Welding in the Melt-in Fusion Mode (typical current range from 15 - 200A) This is an alternative to conventional TIG. The advantages are deeper penetration (from higher plasma gas flow), greater tolerance to surface contamination including coatings (the electrode is within the body of the torch) and better tolerance to variations in electrode to workpiece distance, without significant change in heat input.

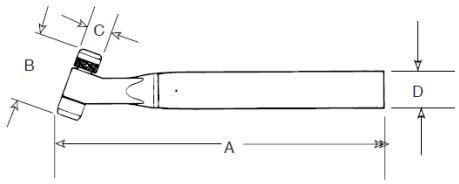
Keyhole Welding (typically over 100A) By increasing welding current and plasma gas flow, a very powerful plasma beam is created which can achieve full penetration in a material, as in laser or electron beam welding. During welding, a keyhole is formed which progressively cuts through the metal with the molten weld pool flowing behind to form the weld bead under surface tension forces. This process can be used to weld thicker materials [up to 3/8” (10 mm) of stainless steel in a single pass.

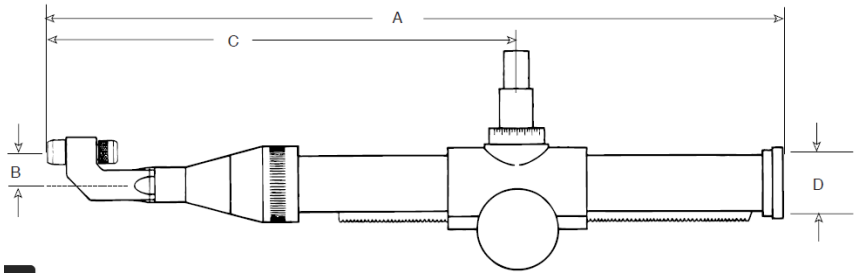
Torch Specifications

P75 (2A) Specifications

- Straight Polarity Current Rating: 75 amperes DC maximum at 60%.
- Plasma Gas: Argon (Consumption): 0.5 – 2.5 SCFH (0.24 – 1.18 lpm)
- Shield Gas/Straight Polarity: Argon or Argon/Hydrogen (Consumption: 8-15 SCFH (3.8-7.1 lpm).
- Pilot Current – 1 Amps to 5 Amps on average.
- Shipping Weight:
  - Hand torch PWH-P75: 1 lbs. (0.45 kg);
  - Machine mounted torch PWM-P75: 2 lbs. (0.9k g).
- Cooling Requirements: 2,000 BTU/hr, ¼ gpm of Torch Coolant @ 50 psi.

P75 Torch Dimensions





	A		B		C		D	
	Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)
PWH-P75 (70)	8.00	(20.32)	1.62	(4.11)	0.62	(1.57)	0.88 **1.062***	(2.24)
PWH-P75 (90)	7.75	(19.68)	1.62	(4.11)	0.62	(1.57)	0.88 **1.062***	(2.24)
PWM-P75	18.00	(47.72)	0.81	(2.06)	7.12	(18.08)	1.38	(3.50)
					15.00	(38.10)		

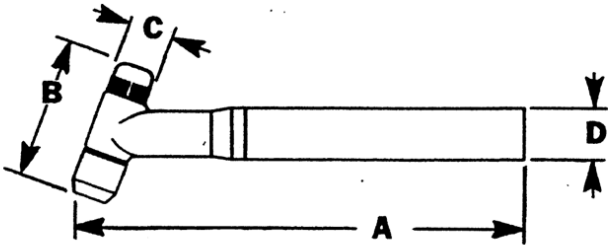
See *P75 (2A) torch replacement and Upgrade.

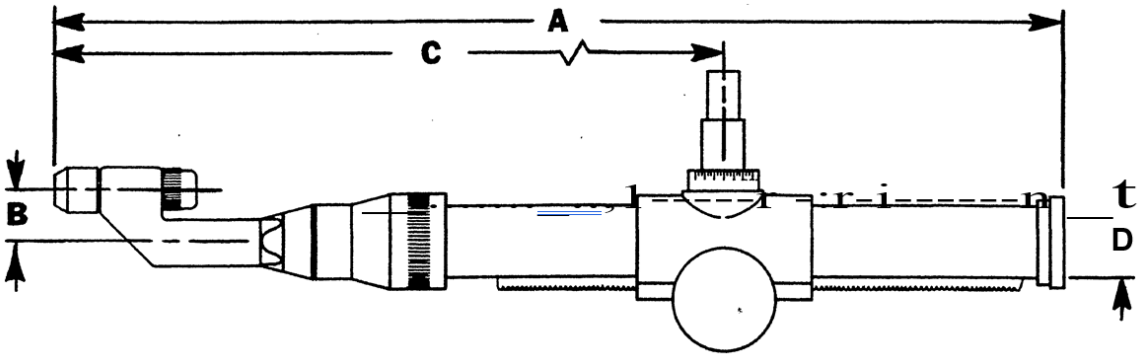
P15 (3A) Specifications

- Straight Polarity Current Rating: 150 amperes DC maximum at 60% Duty Cycle.
- Plasma Gas: Argon (Consumption): 0.5 – 3 SCFH (0.24 – 1.51 lpm)
- Shield Gas/Straight Polarity: Argon or Argon/Hydrogen (Consumption: 8-15 SCFH (3.8-7.1 lpm).
- Pilot Current – 5 Amps to 10 Amps on average.

- Shipping Weight:
  - Hand torch PWH-P15: 2 lbs. (0.9 kg);
  - Machine mounted torch PWM-P15: 3 lbs. (1.4k g).
- Cooling Requirements: 4,000 BTU/hr, 1/3 gpm of Torch Coolant @ 50 psi.

P15 Torch Dimensions



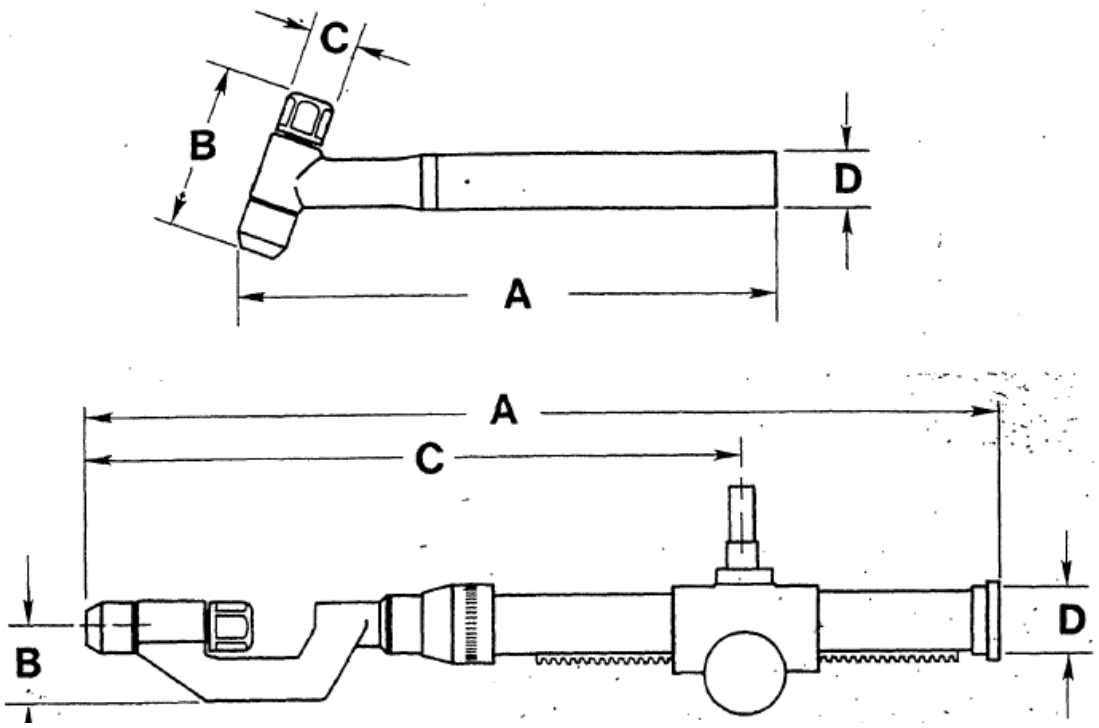


	A		B		C		D	
	Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)
PWH-P15 (70)	8.75	(22.22)	2.62	(6.65)	0.88	(2.24)	1.00	(2.54)
PWH-P15 (90)	8.50	(21.59)	2.62	(6.65)	0.88	(2.24)	1.00	(2.54)
PWM-P15	19.25	(48.90)	1.00	(2.54)	9.25	(23.50)	1.38	(3.50)
					16.75	(42.54)		

P22 (4A) Specifications

- Straight Polarity Current Rating: 220 amperes DC maximum at 60% Duty Cycle.
- Plasma Gas: Argon (Consumption): 0.5 – 7 SCFH (0.24 – 3.30 lpm)
- Shield Gas/Straight Polarity: Argon or Argon/Hydrogen (Consumption: 10-20 SCFH (4.72-9.44 lpm).
- Pilot Current – 7 Amps to 12 Amps on average.
- Shipping Weight:
  - Hand torch PWH-P22: 2 lbs. (0.9 kg);
  - Machine mounted torch PWM-P22: 3 lbs. (1.4k g).
- Cooling Requirements: 8,000 BTU/hr, 1/2 gpm of Torch Coolant @ 50 psi.

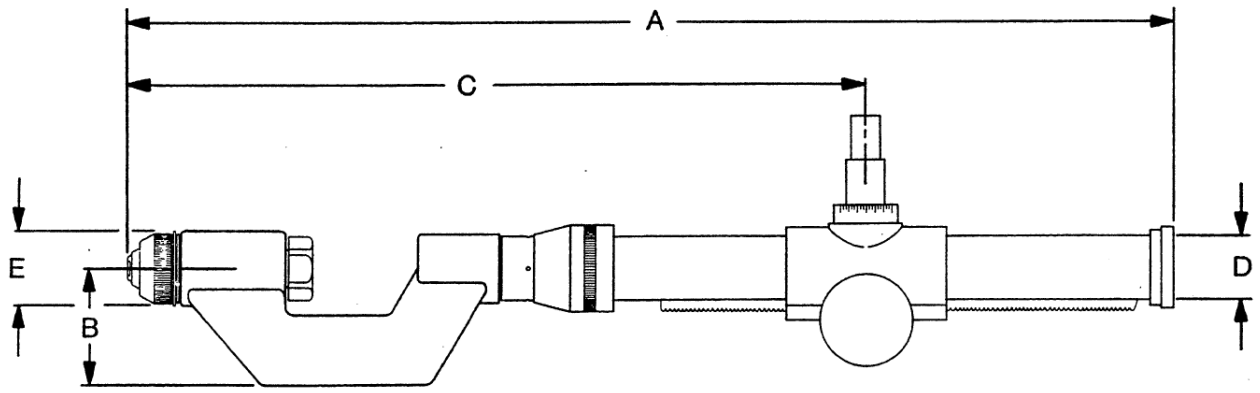
P22 Torch Dimensions



	A		B		C		D	
	Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)
PWH-P22 (70)	12.50	(31.80)	3.19	(8.1)	1.25	(2.24)	1.31	(3.3)
PWH-P22 (90)	12.25	(31.10)	3.19	(8.1)	1.25	(2.24)	1.31	(3.3)
PWM-P22	21.00	(53.30)	1.75	(4.4)	11.25	(28.6)	1.38	(3.5)
					19.00	(48.2)		

P30 (300) Specifications

- Straight Polarity Current Rating: 300 amperes DC maximum at 60% duty cycle.
- Plasma Gas: Argon (Consumption): 1.5 – 3.5 SCFH (0.71 – 1.65 lpm)
- Shield Gas/Straight Polarity: Argon or Argon/Hydrogen (Consumption: 10-20 SCFH (4.72-9.44 lpm).
- Pilot Current – 10 Amps to 15 Amps on average.
- Shipping Weight:
    - Machine mounted torch PWM-P30: 3 lbs. (1.4k g).
- Cooling Requirements: 12,000 BTU/hr, 3/4 gpm of Torch Coolant @ 100 psi.



	A		B		C		D		E	
PWM-P30	22.19	(56.4)	2.50	(6.35)	12.44	(31.6)	1.38	(3.5)	1.63	(4.14)
					20.19	(51.3)				

Parts and Assembly

Assembly Parts List

The Assembly Parts List consists of illustrated parts lists of the following:

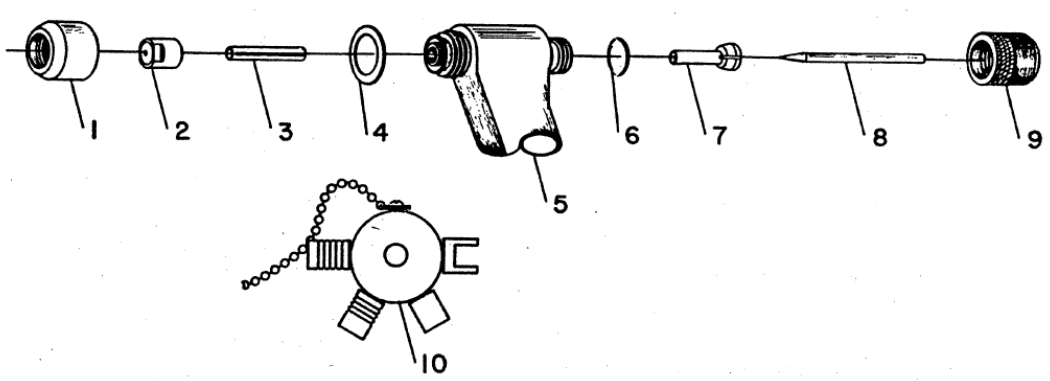
- Welding Torch
- Torch Assembly
- Torch Leads Assembly

An item number in parentheses indicates the item is located behind the item pointed to. An asterisk beside the item number indicates the part is a main assembly, not a component. Parts listed without item numbers are not illustrated but may be ordered by the catalog number shown.

ORDERING INFORMATOIN
When ordering replacement parts, order by catalog number and complete description of the part or assembly, as given in the description column of the Assembly Parts List. Address all inquiries to your authorized Sanrex distributor.

RETURNS
In the event that a Sanrex product must be returned for service, contact your Sanrex distributor. Material returned to Sanrex without proper authorization will not be accepted.

PWH/M P75 Complete Assembly Replacements



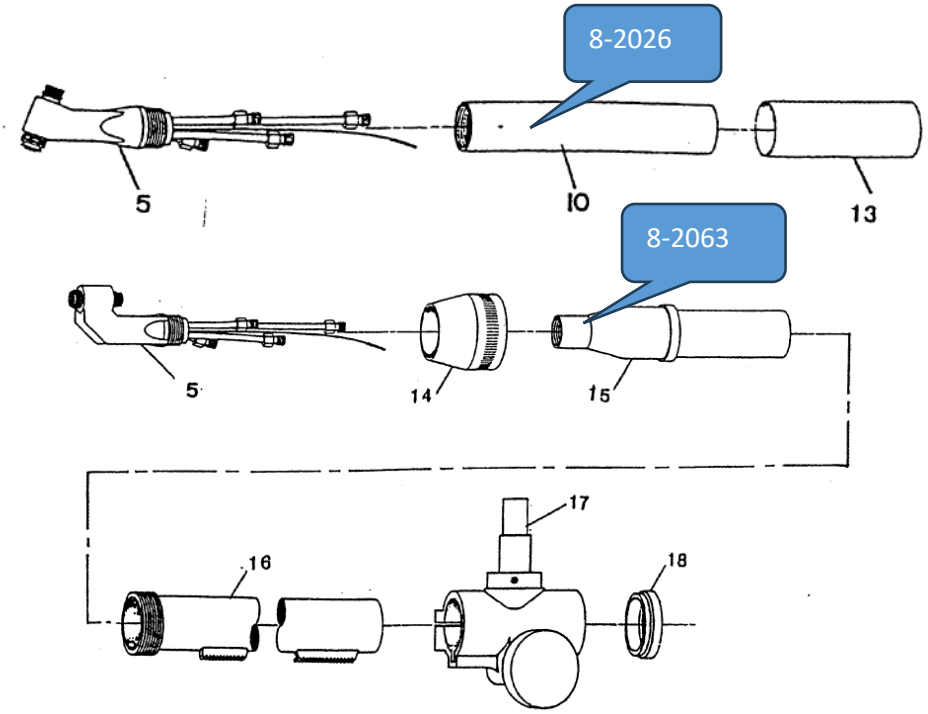
Item	Part No.	Ref. No.	Description	Std. Pkg	Item	Part No.	Ref. No.	Description	Std. Pkg.
1.	P75-3001	8-2071	Shield Cup	5	4.	P75-3015	8-2036	Gasket	5
	P75-3000	8-3236	Shield Cup, Ext.	10	5.	P75-2001	8-2027	Torch Head, 70°	1
2.	P75-3002	8-2023	Tip, .046, 35A	10		P75-2002	8-2028	Torch Head, 90°	1
	P75-3003	8-2024	Tip, .062, 55A	10		P75-2003	8-2097	Torch Head, Machine	1
	P75-3004	8-2025	Tip, .081, 75A	10	6.	P75-3016	8-2035	O-Ring	10
	P75-3005	8-2079	Tip, Long, .031	10	7.	P75-3017	8-2039	Collet	1
	P75-3006	8-2080	Tip, Long, .046	10		P75-3018	8-2041	Collet (.040)	1
	P75-3007	8-2082	Tip, Long, .062	10	8.	P75-3011	8-2044	Electrode (.040), Std.	10
	P75-3008	8-2083	Tip, Long, .081	10		P75-3010	8-2006	Electrode, Ext. (.093)	10
3.	P75-3013	8-2040	Gas Distributor	1	9.	P75-3019	8-2032	Back Cap	1
	P75-3014	8-2042	Gas Distributor (.040)	1		P75-3020	8-2030	Back Cap, Extended	1

Item	Part No.	Ref. No.	Description	Std. Pkg	Item	Part No.	Ref. No.	Description	Std. Pkg.
1.	P75-2007	**8-2026**	**Handle***	1	4.		8-5005	Mounting Tube	1
2.	P30-2005	8-4018	Nut	1	5.	P30-2008	7-2827	Pinion Assembly	1
3.	P75-2010	8-2063	**Sleeve***	1	NS	P75-2006	8-2021	Wrench/Gauge	1

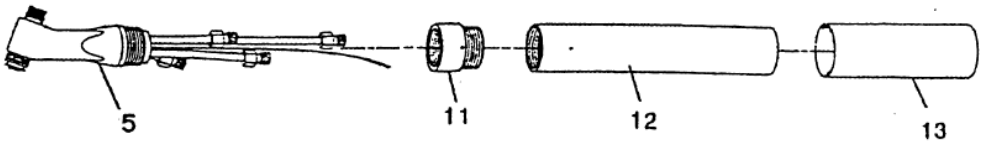
Note: * see P75 Torch obsolescence and upgrades.

The P75 (2A) torch changes.

- The 0.935” dia. Handle 8-2026 (Item 10) is no longer available and replaced with P75-3037 (9-5557) Handle adapter and P15-2010 (9-1757) 1.062 dia. 3A Handle.
- 8-2063 (Item 15) Sleeve adaptor is no longer available replaced with P75-3037 (9-5557) Handle Adaptor, (P15-2009) 9-1778 Adaptor and (P30-2006) 9-1901 Sleeve adaptor.

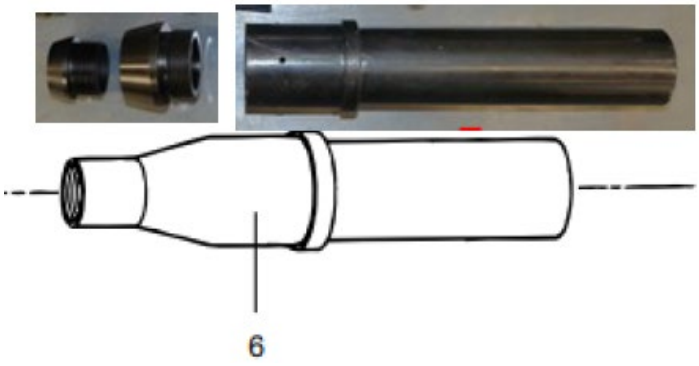


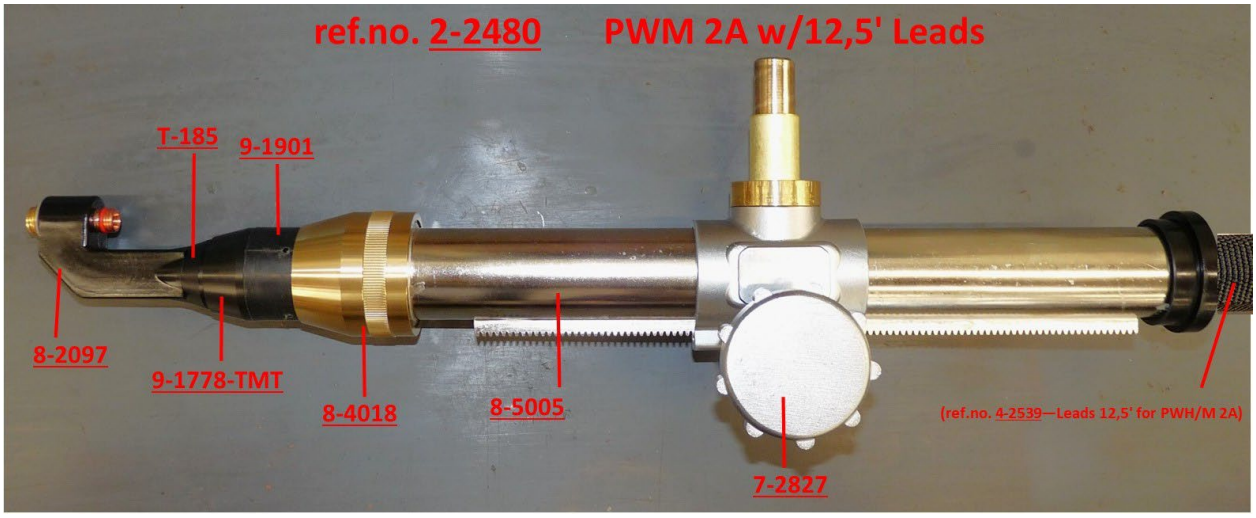
Use (Item 11) (P75-3037) 9-5557 = T-185) Handle Adaptor and (Item 12) (P15-2010) 9-1757 = 9-1775-TMT Replacement handle.



Machine Torch – Rack and Pinion mounting.

For Rack and Pinion mounting use P75-3037 (9-5557) Handle Adaptor, P15-2009 (9-1778) Adaptor and P30-2006 (9-1901) Sleeve adaptor.





P75 (2A) Torch and leads

Complete Hand Torch and leads will come with a 1.062” larger handle and larger leads. Machine torches will come with larger Leads.

Below is the Torch with leads assemblies effected with these changes.

Sanrex #	Description	REF
P75-1000	2A - Torch, 70 degree, 12.5ft, Hand	2-2443
P75-1001	2A - Torch, 70 degree, 25ft, Hand	2-2505
P75-1002	2A - Torch, 90 degree, 12.5ft, Hand	2-2444
P75-1003	2A - Torch, 90 degree, 25ft, Hand	2-2506
P75-1004	2A - Torch, 180 degree offset, Phenolic, 12.5ft	2-3002
P75-1005	2A - Torch, 180 degree offset, 12.5ft, Rack and Pinion.	2-2480
P75-1006	2A - Torch, 180 degree offset, 25ft, Rack and Pinion.	2-2594
P75-1007	2A - Torch, 180 degree offset, Phenolic, 25ft	2-2108

They will now have the larger 1.062 dia. Handle.

P75-1000-L	2A - Torch, 70 degree, 12.5ft, Hand (With Larger Handle)	2-2443
P75-1001-L	2A - Torch, 70 degree, 25ft, Hand (With Larger Handle)	2-2505
P75-1002-L	2A - Torch, 90 degree, 12.5ft, Hand (With Larger Handle)	2-2444
P75-1003-L	2A - Torch, 90 degree, 25ft, Hand (With Larger Handle)	2-2506
P75-1004-L	2A - Torch, 180 degree offset, Phenolic, 12.5ft (With Larger Handle)	2-3002
P75-1005-RP	2A - Torch, 180 degree offset, 12.5ft, Rack and Pinion. (With Larger Sleeve)	2-2480
P75-1006-RP	2A - Torch, 180 degree offset, 25ft, Rack and Pinion. (With Larger Sleeve)	2-2594
P75-1007-L	2A - Torch, 180 degree offset, Phenolic, 25ft (With Larger Handle)	2-2108

Leads Packages

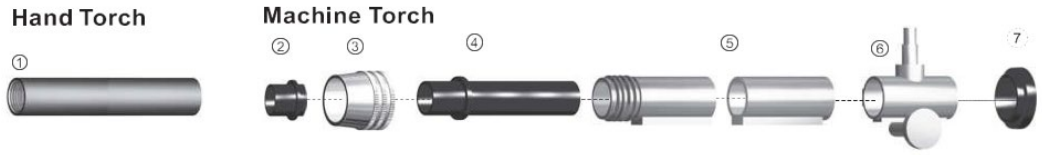
P75-2004	2A - Torch Leads w/out torch head 12.5 ft. / 3.8m	4-2539
P75-2004-L	2A - Torch Leads w/out torch head 12.5 ft. / 3.8m (Larger Handle included)	4-2539
P75-2004-RP	2A - Torch Leads w/out torch head 12.5 ft. / 3.8m (Larger Sleeve included)	4-2539
P75-2005	2A - Torch Leads w/out torch head 25 ft. / 7.6m	4-2585
P75-2005-L	2A - Torch Leads w/out torch head 25 ft. / 7.6m (Larger Handle included)	4-2585
P75-2005-RP	2A - Torch Leads w/out torch head 25 ft. / 7.6m (Larger Sleeve included)	4-2585

PWH/M P15 Complete Assembly Replacements

P15 Consumables

Item	Part No.	Ref. No.	Description	Std. Pkg.	Item	Part No.	Ref. No.	Description	Std. Pkg.
1.	P15-3001	8-3040	Shield Cup w/gas lens	1	8.	P15-2003	8-3032	**Torch Head** 180° offset	1
	P15-3000	8-3038	Shield Cup no gas lens	1		P15-2001	8-3030	Torch Head 70°	1
2.	P15-3003	8-3052	Tip, .014, 10A – Std.	10		P15-2002	8-3031	Torch Head 90°	1
	P15-3005	9-1782	Tip, .031, 30A – Std.	10	9.	P15-3020	8-0527	O-Ring Electrode Cap	10
	P15-3006	9-1783	Tip, .046, 50A – Std.	10	10.	P15-3021	9-1780	Collet	1
	P15-3007	9-1784	Tip, .062, 75A – Std.	10	11.	P15-3022	9-1779	Electrode Cap – Standard	1
	P15-3008	9-1785	Tip, .081, 100A – Std.	10	12.	P15-3023	9-1803	Electrode Cap – Extended	1
	P15-3009	9-1795	Tip, .093, 150A – Std.	10	NS	P15-2010	9-1757	PWH Handle	1
3.	P15-3010	9-1788	Tip Long, .031, 10A – Ext.	10	NS	P15-3026	9-1778	Sleeve	1
	P15-3011	9-1789	Tip Long, .046, 20A – Ext.	10	NS	P30-2005	8-4018	Nut	1
	P15-3012	9-1790	Tip Long, .062, 55A – Ext.	10	NS	P30-2006	9-1901	Adaptor	1
	P15-3013	9-1791	Tip Long, .081, 75A – Ext.	10	NS	P30-2010	8-5005	Positioning Tube	1
	P15-3014	9-1811	Tip Long, .093, 85A – Ext.	10	NS	P30-2009	8-4204	End Cap	1
4.	P15-3017	9-2240	Gas Distributor Insulating Sleeve	1	NS	P15-2006	9-1810	Gage/Wrench	1
5.	P15-3024	9-1747	Electrode	1					
6.	P15-3019	8-3059	Gas Diffuser	1					
7.	P15-3018	8-3057	Gasket – Shield Cup	5					

NS – Not shown in the picture.



P15 Common Lead Set Components

Item	Part No.	Ref. No.	Description	Std. Pkg	Item	Part No.	Ref. No.	Description	Std. Pkg.
1.	P15-3027	9-5914	Handle (Use with item 2)	1	6.	P30-2008	7-2827	Pinion Assembly	1
2.	P15-3026	9-1778	Sleeve (Use with item 1)	1	7.	P30-2009	8-4204	Bushing	1
3.	P30-2005	8-4018	Nut	1	5.	P30-2010	8-5005	Mounting Tube	1
4.	P30-2006	9-1901	Adapter	1	NS	P15-2006	9-1810	Wrench/ Gage	1

P15 Torch Lead Sets

Item	Part No.	Ref. No.	Description	Std. Pkg	Item	Part No.	Ref. No.	Description	Std. Pkg.
NS	P15-2004	4-2615	Leads 12 1/2’	1	NS	P15-2005	4-2624	Leads 25’	1

PWH/M P22 Complete Assembly Replacements

P22 Torch Consumable

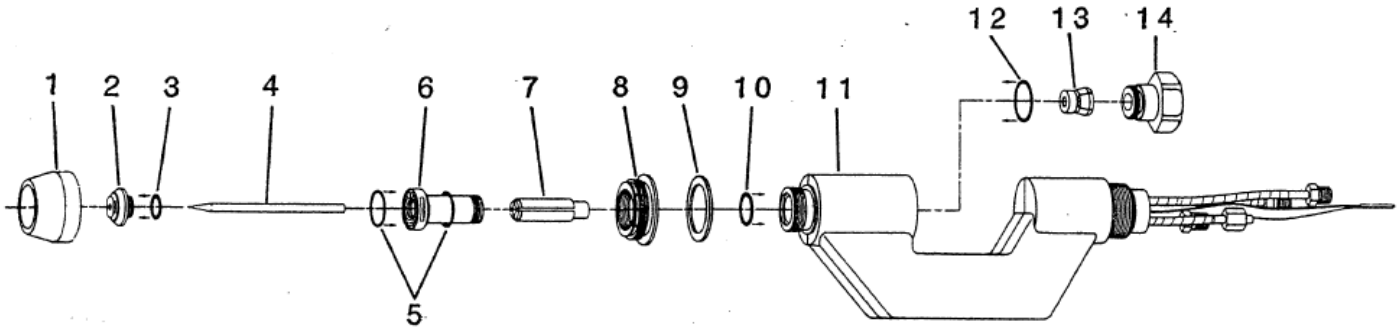
Item	Part No.	Ref. No.	Description	Std. Pkg.	Item	Part No.	Ref. No.	Description	Std. Pkg.
1.	N/A	8-4062	Shield Cup	5		P22-2002	8-4015	Torch Head Assembly 90°	1
	P22-3000	8-4064	Shield Cup with Lens	5		P22-2004	8-4054	Torch Head Assembly 180° inline	1
2.	P22-3003	9-1847	Tip, (.062), 100 A - Std.	10	11.	P22-3018	9-1876	Collet	1
	P22-3004	9-1848	Tip, (.093), 125 A - Std.	10	12.	P22-3020	9-1877	Electrode Cap Extended	1
	P22-3005	9-1849	Tip, (.125), 250 A - Std.	10					
3.	P22-3006	9-1890	Tip, (.062), 100 A - Ext.	10	NS	P30-2005	8-4018	Nut	1
	P22-3007	9-1891	Tip, (.093), 125 A - Ext.	10	NS	P30-2006	9-1901	Adaptor	1
	P22-3008	9-1892	Tip, (.125), 250 A - Ext.	5	NS	P30-2010	8-5005	Positioning Tube	1
4.	P30-3008	9-1827	Electrode (.187) - Std.	5					
	P22-3010	9-1834	Electrode (.187) - Ext.	5					
5.	P22-3011	8-4011	Liner (without Gas Distributor)	1					
6.	P22-3012	9-2204	Gas Distributor	1					
7.	P22-2005	8-4024	Collar	1					
8.	P22-3014	8-4040	Shield Gas Diffuser - Threaded	1					
9.	P22-3013	8-4069	Gasket - Shield Cup	5					
10.	P22-2001	8-4014	Torch Head Assembly 70°	1					
	P22-2003	8-4016	Torch Head Assembly 180° offset	1					

NS – Not shown in the picture.

P22 Common Lead Set Components

Item	Part No.	Ref. No.	Description	Std. Pkg	Item	Part No.	Ref. No.	Description	Std. Pkg.
1.	P22-2013	9-5914	Handle	1	5.	P30-2008	7-2827	Pinion Assembly	1
2.	P22-2005	8-4018	Nut	1	6.	P30-2009	8-4204	Bushing	1
3.	P30-2006	9-1901	Adapter	1	NS	P22-2006	4-2525	Leads 12.5’	1
4.	P30-2010	8-5005	Mounting Tube	1	NS	P22-2007	4-2544	Leads, 25’	1

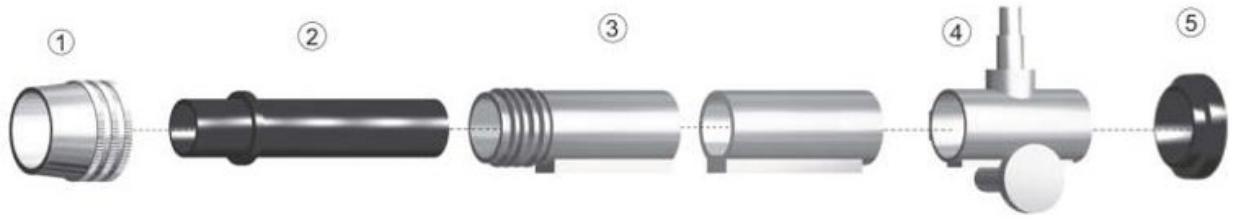
PWM P30 Complete Assembly Replacements



P30 Consumables

Item	Part No.	Item No.	Description	Std. Pkg.
1	P30-3001	8-4373	Shield Cup	1
2	P30-3005	8-4370	Tip, 0.093, 200A	5
	P30-3006	8-4371	Tip, 113, 250A	5
	P30-3007	8-4372	Tip, 125, 300A	5
3	P30-3016	9-2863	O-Ring	10
4	P30-3008	9-1827	Electrode	5
5	P30-3017	9-2956	O-Ring	10
6	P30-3009	8-6509	Liner, Includes O-Rings	1
7	P30-3010	8-6651	Gas Distributor	1
8	P30-3012	8-6652	Shield Cup Diffuser	1
9	P30-3011	8-6512	Gasket	5
10	P30-3018	8-0531	O-Ring	10
11	P30-2001	8-6649	Torch Body	1
12	P30-3013	8-0534	O-Ring	10
13	P30-3014	8-6650	Collet	1
14	P30-3015	8-6654	Electrode Cap	1

P30 Lead Set Components



Item	Part No.	Ref. No.	Description	Std. Pkg.
1	P30-2005	8-4018	Nut	1
2	P30-2006	9-1901	Adapter	1
3	P30-2010	8-5005	Mounting Tube	1
4	P30-2008	7-2827	Pinion Assembly	1
5	P30-2009	8-4204	Bushing	1
NS	P30-2002	4-2525	Torch Leads 12.5ft.	1
NS	P30-2003	4-2544	Torch Leads 25ft.	1
NS	P30-2011	8-6517	Wrench	1

Folks…Plasma Welding is not TIG! Do not treat the Plasma Welding Torch as a TIG Torch. The Geometry of the Plasma Welding Torch components are set to a very tight tolerance. Altering the Geometry in anyway will result in damage and/or failure of the torch and poor welds.

Coolant Systems – Do not use TIG Water Coolers! TIG coolers are not built with components that resist corrosion or have the cooling capacity required for plasma welding. The coolant reservoir may state noncorrosive but will leach contaminates into the coolant that is conductive. In TIG applications this does not matter. Water coolers such as would be used for Plasma Cutting or Laser are recommended. An example would be the Dynaflux R2000.

Coolant system rated IEC standard cooling capacity is based on a 25° Celsius (77° F) environment at a flow of one liter per minute with a 40° Celsius (72° F) coolant temperature rise.

Torch Coolant – Never use TIG Coolant or tap water. Always use Coolant intended for Plasma Welding or Plasma Cutting Water cooled systems. The resistance of the coolant must be within the Acceptable Green range. See Chart below.

Sanrex Torch rating.

P75 – 2000 btu/hr., ¼ gpm, (1.2 qt/min,) 50 psi.

P15 – 4000 btu/hr., 1/3 gpm (1.3 qt/min.), 50 psi.

P22 – 8000 btu/hr., ½ gpm (2 qt./min.), 50 psi.

P30 – 12000 btu/hr., 3/4 gpm (3qt/min.), 100 psi.

Comparison Chart
Resistivity/Conductivity

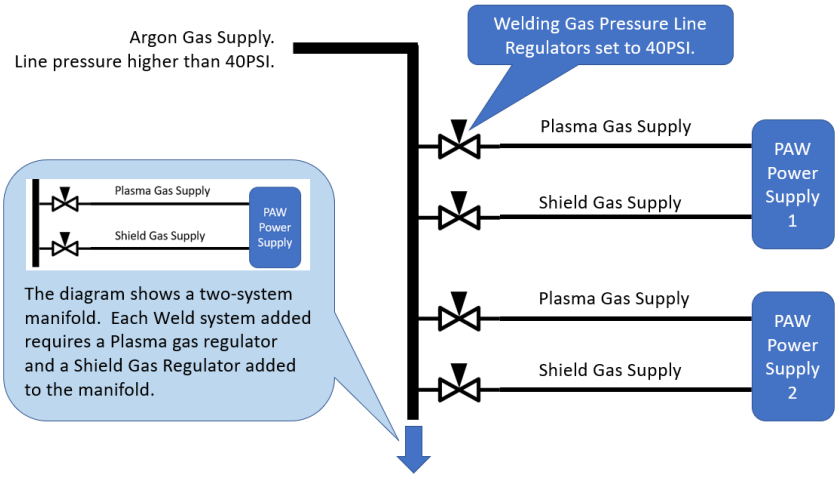
	Resistivity Ohms/cm @ 25°C (77°F)	Resistivity Megohms/cm @ 25°C (77°F)	Conductivity Micromhos/cm @ 25°C (77°F)
Acceptabl	3,000,000	3.0	.333
	1,000,000	1.0	1.00
	900,000	.90	1.11
	750,000	.75	1.35
	500,000	.50	2.00
	400,000	.40	2.75
	300,000	.30	3.33
	200,000	.20	5.00
Minimu	100,000	.10	10.0
Not Acce ble	90,000	.090	11.1
	75,000	.075	15.0
	50,000	.050	20.0
	25,000	.025	42.5
	10,000	.010	100.0

Damage and failure of the torch will occur if Coolant is in the Red Not Acceptable range.

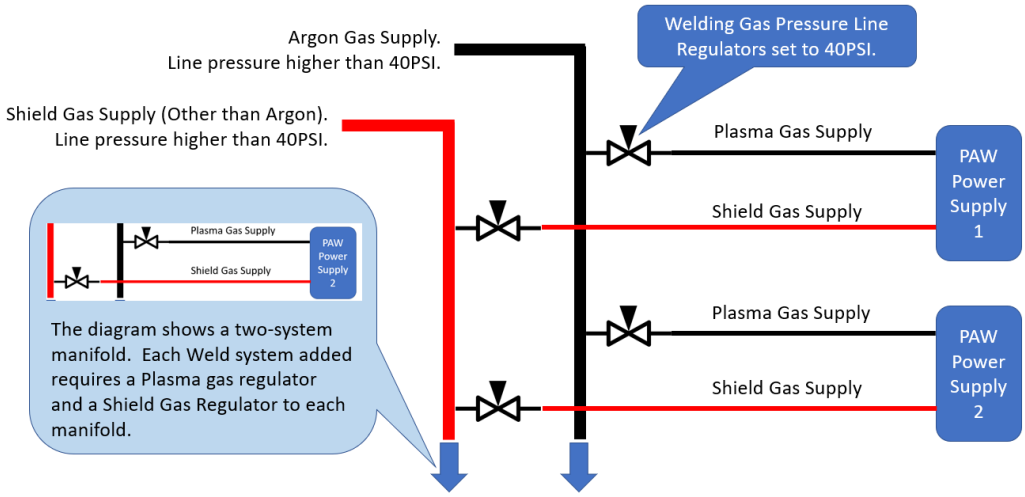
We recommend a De-ionized water Propylene Glycol mixtures. This nonconductive mix with added Propylene Glycol improves heat transfer from the torch. The Propylene Glycol is also biodegradable making it environmentally safe.

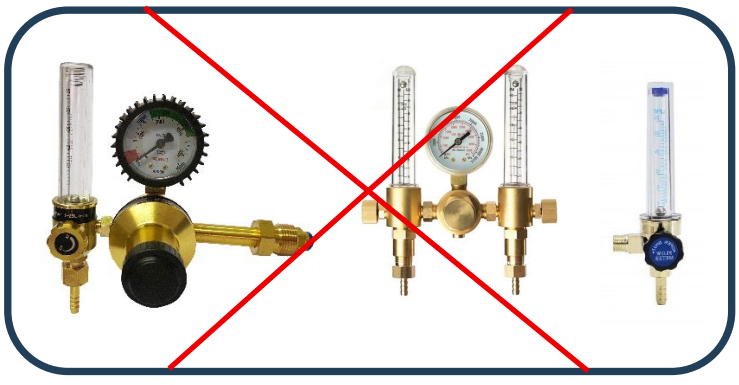
Gas supply options – Always use two dedicated Supplies. One supply for Plasma Gas and one supply for the shield Gas. Each supply with their own Pressure Regulator set to 40 psi. Never use Regulator/Flowmeters and never "Y" off one regulator.

Plasma Welding Gas Manifold



Dissimilar Plasma Welding Gas Manifold

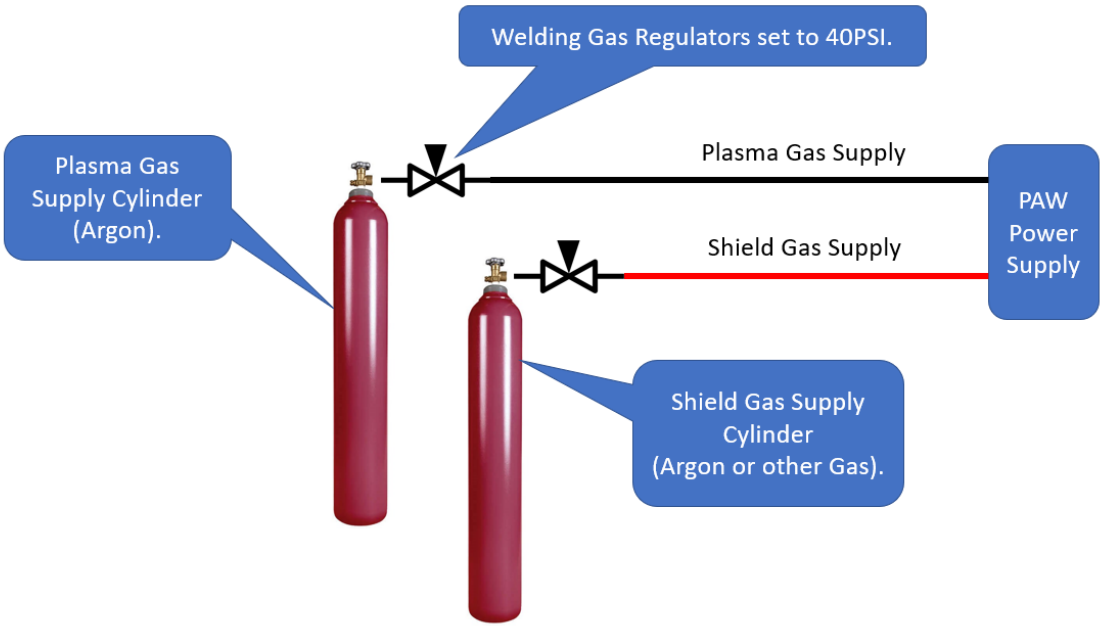




DO NOT USE REGULATOR/FLOWMETERS or FLOWMETERS!

Always use Pressure or Line regulators.

Plasma Welding with Cylinder Gas

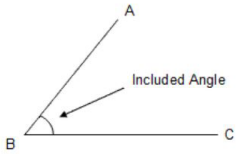


Electrode – Do not under any circumstances grind the Tungsten Electrode by hand on a bench grinder. Damage or failure of the torch will occur. The diameter and angle of the Tungsten Electrode point Geometry must match precisely the inside Geometry of the Welding TIP and be perfectly centered. Always use factory ground Tungsten Electrodes.

Not recommended, but if you must grind your own Tungsten Electrode a Precision dedicated Tungsten Grinder set to Sanrex Factory settings must be used. Electrode point sharpened to a 20° included Angle, surface finish minimum 32 Microinch. Removal of the sharp point (.015” - .025” flat) may increase electrode life at higher welding amperages. Tungsten Electrode quality is paramount with the diameter tolerance less than +/- .005”. 2% Thoriated is preferred, Lanthanated, ceriated, Zirconiated, Rare Earth Mix are acceptable but may have reduced lifetime. ***Do not use Pure Tungsten!***

Included angle

Definition: The angle made by two lines with a common vertex



When two lines meet at a common point (vertex) the angle between them is called the included angle. The two lines define the angle. So for example in the figure above we could refer to the angle ∠ABC as the "included angle of BA and BC".

Or we could refer to "BA and BC and their included angle".

Sharpened WRONG!

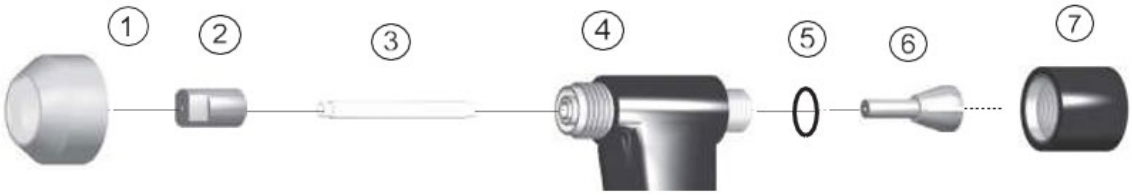
Sharpened Correctly at 20° Included Angle.

Welding TIP – The orifice diameter designates the maximum current the tip can carry. The maximum current is the pilot current plus the welding current.

Maximum Current rating of each tip is established using maximum electrode setback at the maximum plasma gas flow rates. Lower plasma gas flow rates can be used with maximum current rating of the tip if electrode setback is set to minimum.

- Pilot Arc Ignition – Never ignite the pilot arc without pre-purge of the plasma gas for at least 1 minute. More so if in a dusty and humid environment. Any contamination in the plasma stream during arc ignition will cause electrode and tip deterioration and cause poor welds. This also holds true when turning off the pilot arc. Always post purge for at least a minute after turning off the pilot arc.
- Always leave the pilot Arc on for the duration of the welding shift. Each pilot ignition causes electrode deterioration.

P75 Torch Assembly.



P15 Torch Assembly.

P22 & P30 Torches

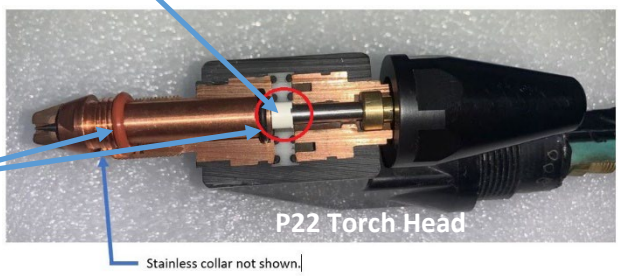
The P22 & P30 Torches have an internal liner. There are two O-Rings inside the torch that seal the liner in the torch. The welding Tips thread into the liner. (See P22 Torch assembly picture.)

If an O-ring becomes damage coolant will leak into the plasma gas stream causing failure of the consumables and eventually the torch head. A black residue on the internal components is a good indication of a coolant leak, most likely caused by faulty O-Rings.

Good practice when replacing the tips is to always support the liner from turning with a wrench when removing or installing tips. Excessive movement of the liner during tip replacement will cause pre-mature O-Ring failure.

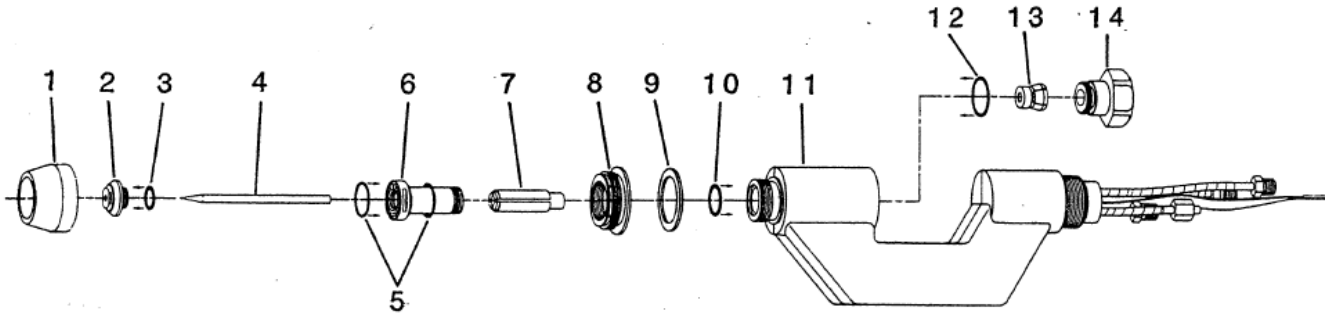
P22 Torch Assembly.

1. Cup
2. Standard Tip (Keyhole Process)
3. Extended Tip (Melt-in Process)
4. Electrode
5. Liner (Red and Black O-Ring inside of Torch).
   Note: NO liner in P75 or P15 Torch.
6. Gas Distributor
7. Collar
8. Shield Gas Diffuser
9. Cup Gasket
10. Torch Head
11. Collet
12. Back Cap



P30 Torch Assembly.

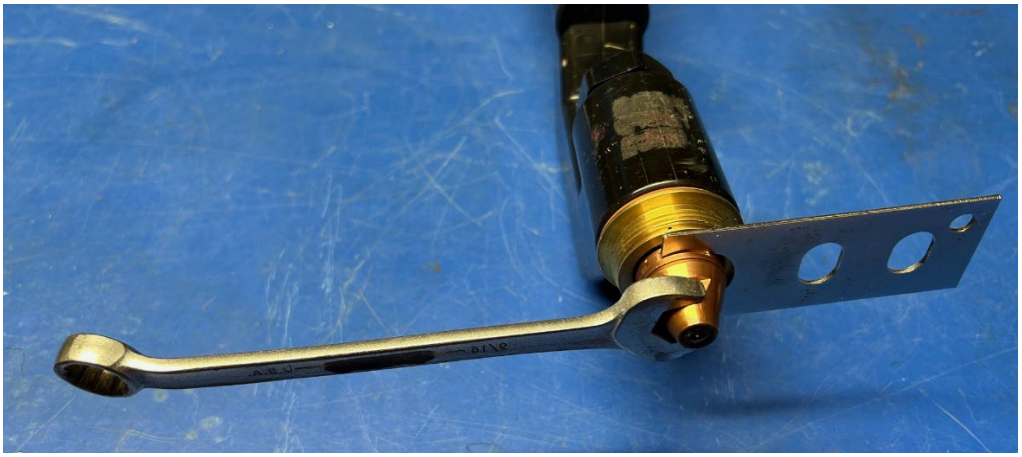
Simular assembly as the P22 Torch.



1.	Shield Cup	8.	Gas Difuser
2.	Tip	9.	Gasket
3.	Tip O-Ring	10.	Liner Inner O-Ring
4.	Electrode	11.	Torch Body
5.	Tip O-Ring & Liner outer O-Ring	12.	Back Cap O-Ring
6.	Liner	13.	Collet
7.	Gas Distributor	14.	Back Cap

P22 and P30 Welding TIP removal

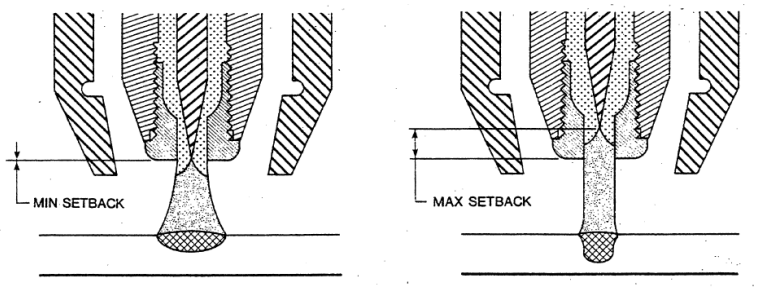
Always support the liner from turning when removing or installing the welding Tip. Excesive turning of the liner while removing or installing the welding tip will cause the inner O-rings to fail causeing coolant leak in the torch. Never over tighten the TIP. Snug fit is recommended.



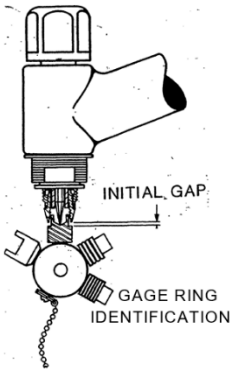
Picture of the P30 torch. The P22 torch is simular in design. No liner in the P75 or P15 Torch.

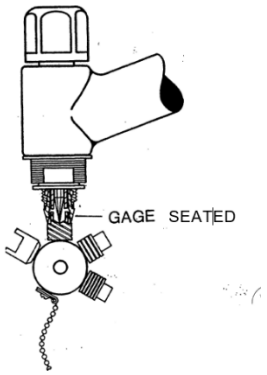
Electrode Setback using OEM Electrode Gauge: P75-2006, P15-2006, P22-3021, P30-2010.

Minimum setback is defined as the electrode set flush with the end of the Welding Tip. For any other setback use setback gauge. Minimum setback will give you a TIG like Arc.



If a stiff columnated arc is desired, insert the electrode gage into the front of the torch and loosen the electrode cap slightly. Push back on the electrode with the gage until the shoulder of the gage seats against the front of the torch. Tighten the electrode cap while holding the gauge in this position. Insert the proper tip into the liner assembly and tighten moderately.





If a soft arc is desired, insert the proper tip into the liner assembly. Loosen the back cap slightly, allowing the electrode point to protrude through the orifice opening. Using a flat surface, push the electrode back until it is flush with the tip face. Tighten the back cap.

How to measure electrode setback without Gauge.

1. Remove the **shield cup** so the nozzle/orifice face is exposed.
2. Fully seat the **electrode** in its holder (do not partially tighten).
3. Use **calipers or a depth gauge**:
    - Reference surface: **flat face of the orifice/nozzle**
    - Measurement point: **electrode tip**
4. Record the **recess distance** (not overall electrode length)

   Measurement is always from the **outer face of the constricting nozzle**, not from shield cups or caps.

2. Typical Sanrex electrode setback ranges

Sanrex does **not** use a single universal number—setback depends on **weld mode, current, and torch size**. However, the following ranges are consistently recommended across Sanrex-style plasma torches:

A. Melt-in (soft arc / TIG-like plasma welding)

- **Typical setback: 0.5 – 1.0 mm (0.020 – 0.040 in)**
- **Use when:**
  - Low to medium current
  - Manual or semi-automatic welding
  - Thin material
- Produces a **less constricted, softer arc**

Melt-in welds use a **reduced electrode setback** to soften arc force and heat density

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B. Medium-current plasma welding

- **Typical setback: 1.0 – 1.5 mm (0.040 – 0.060 in)**
- **Use when:**
  - 15–200 A range
  - Deeper penetration than TIG but not keyhole
- Improves **arc stability and electrode life**

Increased setback improves arc constriction and electrode protection at higher current levels.

C. Keyhole plasma welding (automated only)

- **Typical setback: 1.5 – 2.5 mm (0.060 – 0.100 in)**
- **Use when:**

    - High current
    - High plasma gas flow
    - Full-penetration keyhole welding
- Creates a **stiff, high-velocity plasma jet**

  Keyhole welding requires **increased electrode setback and plasma gas flow** to achieve full penetration.

Pre-weld

- Always purge Plasma Gas for at least 1 minute prior to turning on the Pilot arc. Pilot arc must start in an inert atmosphere.
- Once pilot arc is on, best to leave on even when not welding.
- The pilot may dance around a little like a flame on a candle pending air currents around the application. This is OK and is expected.
- Use Argon for Plasma and Shield gas.
    - Welding SS, titanium and other exotic metals can use 95/1-5% Argon/Hydrogen for Shield gas. This will brighten the weld color and remove any surface tension.
- Use pressure regulators, set at 40 psi.
- Always use separate Gas supplies.
- Do not use Regulator/Flowmeters.
- Shield gas set at 15 –30 scfh.

Troubleshooting

Common causes of Poor Pilot, poor Tip life, poor Welding Arc ignition.

- Improper grinding of electrode.
    - Follow proper electrode sharpening instructions.
- Electrode discolored, Bluing in color, blue-black appearance.
    - Cause - atmosphere in contact with the electrode when hot. This can be lack of preflow and postflow gas and/or aspirating atmosphere into the plasma stream.
- Black residue on electrode and other consumables.
    - This is caused by coolant entering the plasma stream. Most likely an internal coolant leak. The black residue is carbon build up.
- Coolant conductive. Resistivity of the coolant must be within the Acceptable Green range. Damage and failure of the torch will occur if Coolant is in the Not Acceptable range.

Comparison Chart
Resistivity/Conductivity

	Resistivity Ohms/cm @ 25°C (77°F)	Resistivity Megohms/cm @ 25°C (77°F)	Conductivity Micromhos/cm @ 25°C (77°F)
Acceptabl	3,000,000	3.0	.333
	1,000,000	1.0	1.00
	900,000	.90	1.11
	750,000	.75	1.35
	500,000	.50	2.00
	400,000	.40	2.75
	300,000	.30	3.33
	200,000	.20	5.00
Minimu	100,000	.10	10.0
Not Acce ble	90,000	.090	11.1
	75,000	.075	15.0
	50,000	.050	20.0
	25,000	.025	42.5
	10,000	.010	100.0

Check List of Contaminated Electrode and Dirty Weld Nozzles.

1. A dark blue or black tungsten (Figure B) is a sign of moisture or oxygen getting into the plasma gas line (also called the pilot gas line). If the gas is good quality and the gas lines are leak free the tungsten should remain a gray color (Figure A) not dark blue or black. Moisture and oxygen in the gas lines deteriorate the tungsten electrode and thus the number of arc starts that the tungsten electrode can produce is reduced. This cuts down on the number of arc starts in production and decreases production.
2. Any leaks in the gas lines or fittings can allow air to be sucked into the gas system which adds oxygen and moisture to the welding gases being used. Levels of oxygen and water should be less than 5ppm. The most important gas in plasma welding is the pilot gas, also called plasma gas, most cases argon gas. The grade of argon being used should be at least 99.998% pure argon. In plasma welding if the gas is not pure it will contaminate the tungsten electrode and turn the tungsten electrode a dark blue and black color. If the problem is very severe the discoloration will run all the way to the point of the tungsten electrode and the nozzles on the torch will clog up.

3. If your welding system is shut down overnight air with oxygen and moisture will get up inside the plasma torch. Before starting to weld on the next day you need to purge the gas lines approximately 5 to 10 minutes before starting to weld. You may want to turn the pilot gas down to a very low flow such as 0.1 liters per minute and let the gas run all night to keep the gas line clean. It will be such a low flow that it will not be of any economic importance.
4. When the pilot arc is turned off let the gas continue to flow for at least 10 to 15 seconds before turning off main power. The gas flow will keep the tungsten electrode from oxidizing until it cools down.
5. Whenever thinking about electrode life, electrode contamination, ease of arc starting and arc stability you should not forget that the exchange of ions takes place within the plasma column in both directions which is from the electrode to the work piece and from the work piece to the electrode. If impurities such as lead, sulfur, aluminum, magnesium, copper,

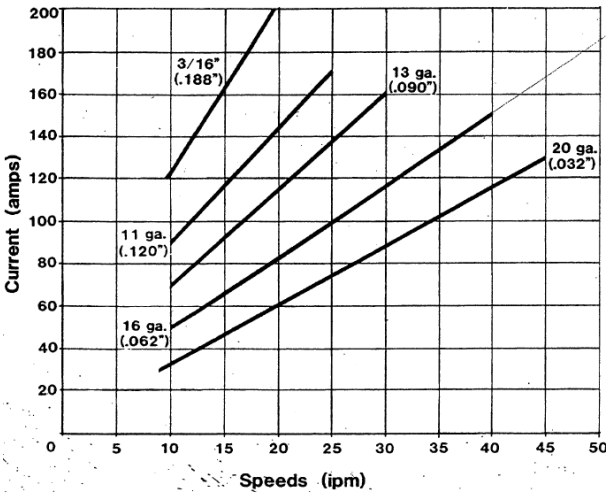
zinc, brass, oil, grease or any other dirty elements are on or in the material being welded they will contaminate the tungsten electrode and nozzle. You then cannot count on a maximum number of welds before replacing the tungsten electrode and weld nozzle.

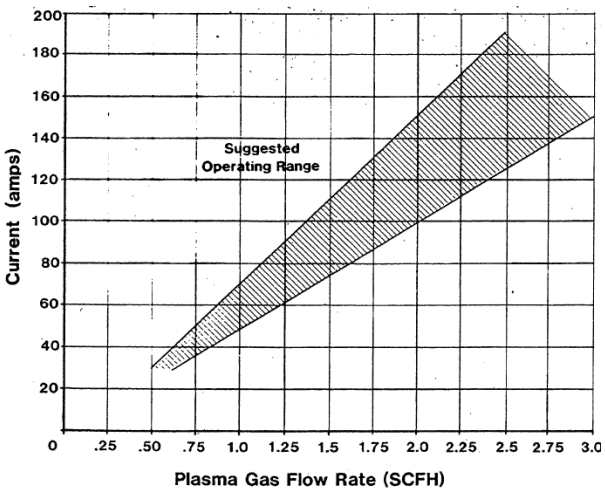
6. Clean the nozzle orifice with acetone or alcohol and a Q-tip. A round wooden toothpick can be used to clean the orifice of the nozzle. Weld nozzles trap contamination during welding and will need to be cleaned every time the tungsten is re-ground.
7. The pilot arc should be bright white with a light blue tint color. If the color changes to orange or purple that is a sign of contamination. Also, the pilot arc will draw back into the nozzle, which is a sign that the tungsten electrode has deteriorated.
8. The type of hose material that the pilot gas and shield gas are passed through is very important. All plastics can have moisture and oxygen that diffused through the walls of the hose material. Do not use petroleum or rubber base hoses.

Starting Parameters

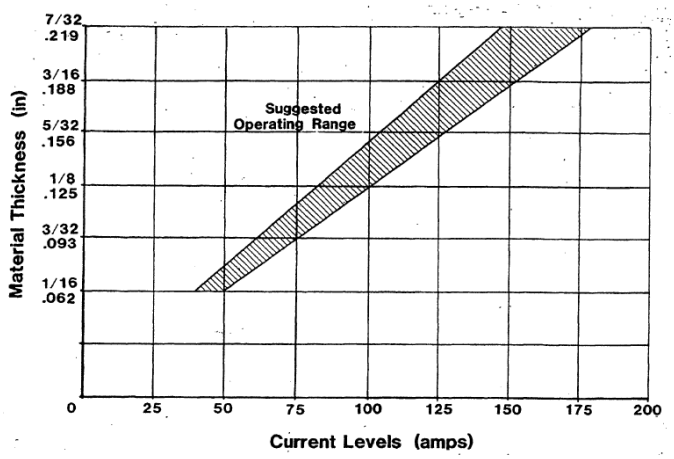
Suggested general Current, Speed, Plasma Gas Flow settings.

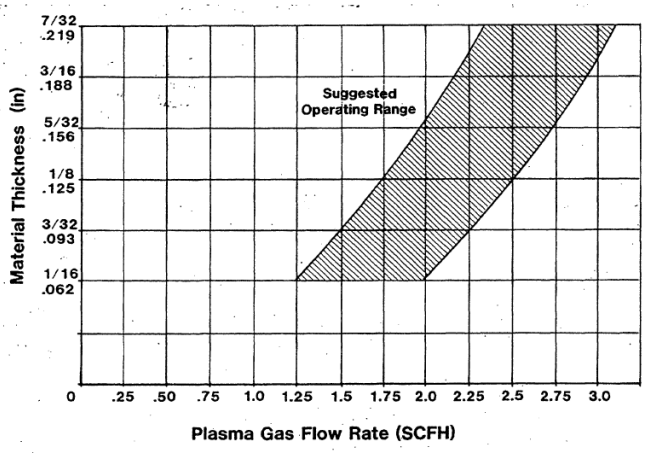
Melt-In Fusion



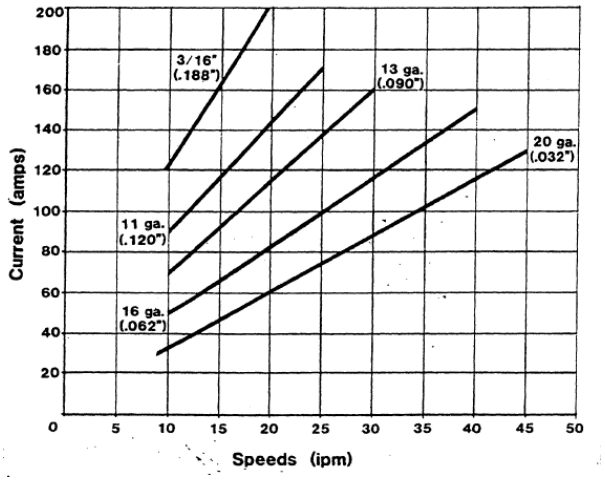


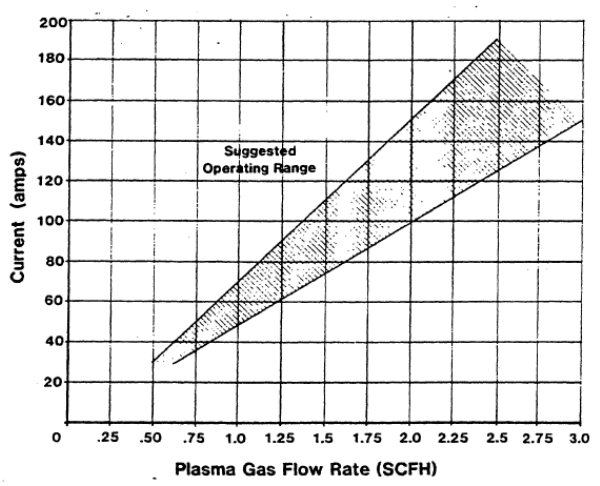
Keyhole



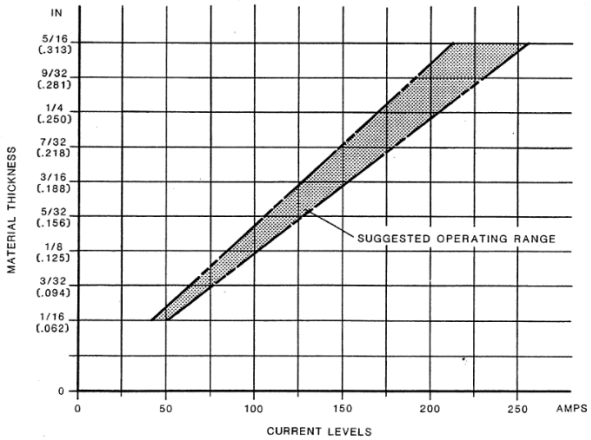


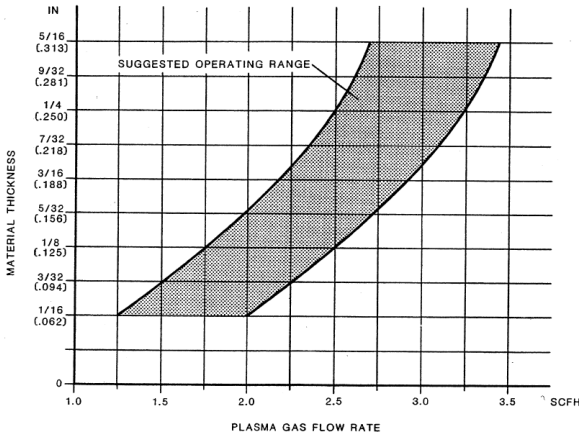
P30 Melt-In Fusion





P30 Keyhole





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