HYPERTHERM®
A Hypertherm Associates Brand

Mechanized Gouging

For MAXPRO200® and Powermax125® systems

White Paper

Introduction

The adoption of plasma gouging has been rising for years due to a variety of productivity, safety, and environmental drivers. Although most of the growth has been in handheld applications, now more customers are automating the process so that they can get repeatable plasma gouges. For example, customers may mechanize by putting the torch on a track-mounted carriage, a stationary manipulator, a tripod, or a custom-made fixture.

But to automate *correctly,* knowledge of the gouge process parameters and a high level of integration skills are necessary. Only then can you get all of the equipment to function together to provide the necessary gouge contour.

This document is intended to make the demonstration and adoption of mechanized gouging easier and more successful. This document is specific to integrating a MAXPRO200 or Powermax125 plasma power supply on a stationary manipulator or track-mounted carriage.

- A stationary manipulator is used in cylindrical gouging applications where the workpiece is in motion, such as with a rotating pressure vessel.
- A track-mounted carriage is used in applications where the workpiece is stationary, such as for removing welds that did not pass inspection or for back-gouging root welds.

Applications for this type of setup and operation vary greatly, as do the desired gouge contours. Thus, this document focuses on providing information for a common application: producing high-quality single-pass gouges using air or O_2/air on mild steel.

The information provided includes the following:

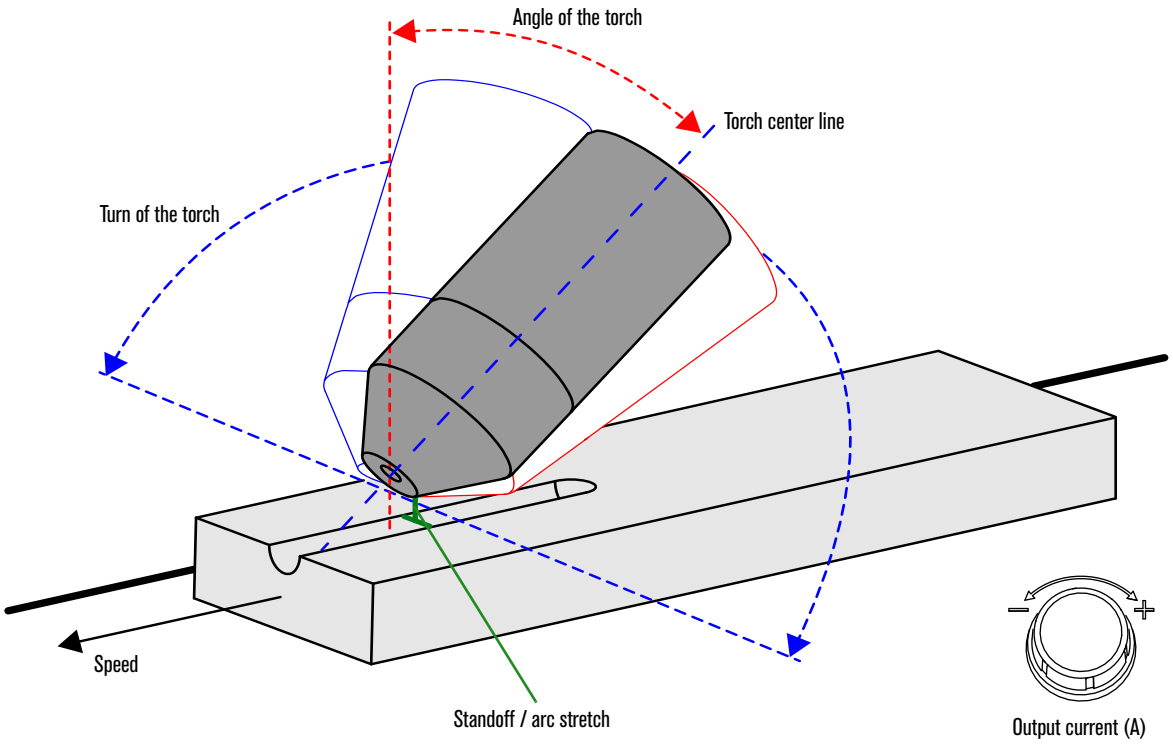
- Minimum hardware requirements for mechanizing gouging
- Factors that change gouge contours
- Powermax125 single-pass gouging consumables and process chart
- MAXPRO200 single-pass extended gouging consumables and process chart
- Installation guide: cylindrical gouging using a stationary manipulator
- Installation guide: gouging using a track-mounted carriage
- System diagrams
- Recommendations for proper PPE
- Links to operator manuals and drawings

Minimum hardware requirements for mechanizing gouging

- A Powermax125 with a CPC connector installed *or* a MAXPRO200 with a VDC3 board installed
- A machine torch
- Gouging consumables
- Clean, dry compressed or bottled air and O2
- A remote pendant for start / stop
- Various cables
- For stationary manipulator applications: a mounting fixture that is stable and safely holds up to 11.5 kg (25 lb)
- For track-mounted carriages: a carriage capable of traveling up to 1,270 mm/min (50 in/min) and a vertical carry capacity of 23 kg (50 lb)

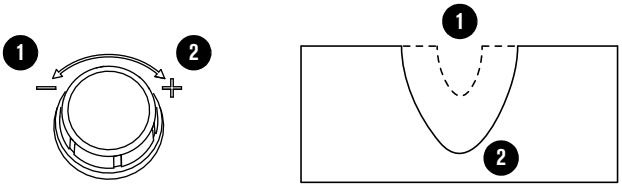
Factors that change gouge contours

The width and the depth of the gouge contour are a result of the following factors. Adjust these factors in combination to get the gouge that you want.



Output current (A) of the plasma power supply

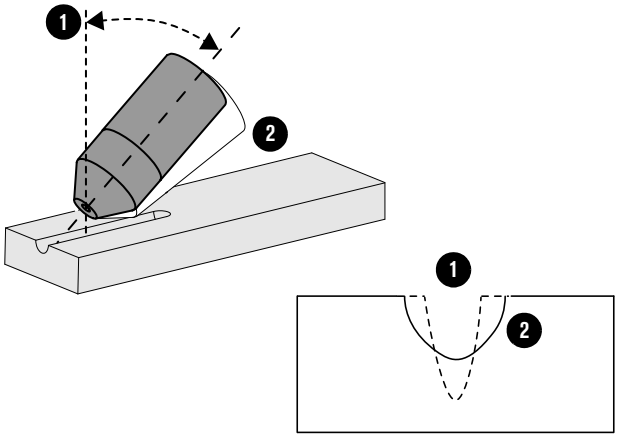
Decrease the amperage on the front panel to make the gouge narrower and shallower ❶. Increase the amperage to make the gouge wider and deeper ❷.



- Arc stretch is related to the amperage of the plasma power supply. The higher the amperage, the longer that you can stretch the arc. Hypertherm recommends that you keep amperage and arc stretch consistent.
- The lowest and highest possible amperage settings are related to the plasma power supply and the Hypertherm consumables.

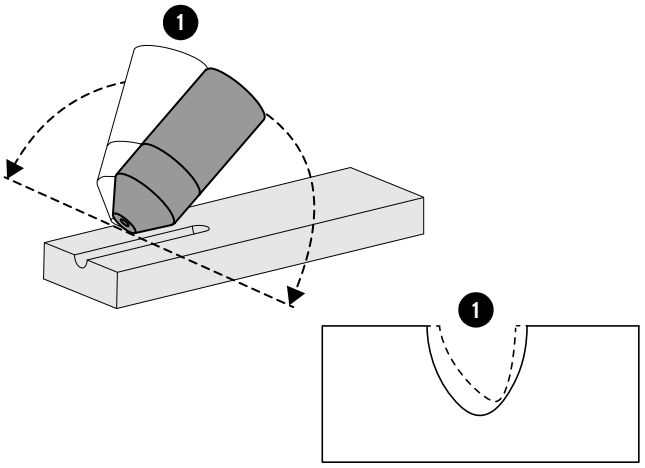
Angle of the torch to the workpiece

Put the torch in a more upright position to make the gouge narrower and deeper ❶. Tilt down the torch so that it is closer to the workpiece to make the gouge wider and more shallow ❷.



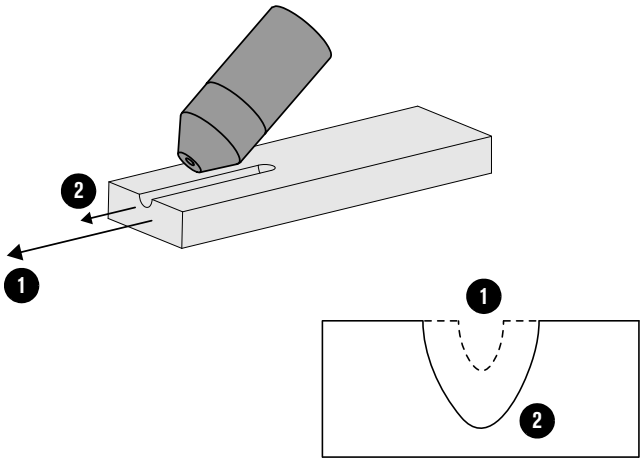
Turn of the torch

Turn the torch relative to the torch center line to make the gouge flatter and steeper on one side ❶.



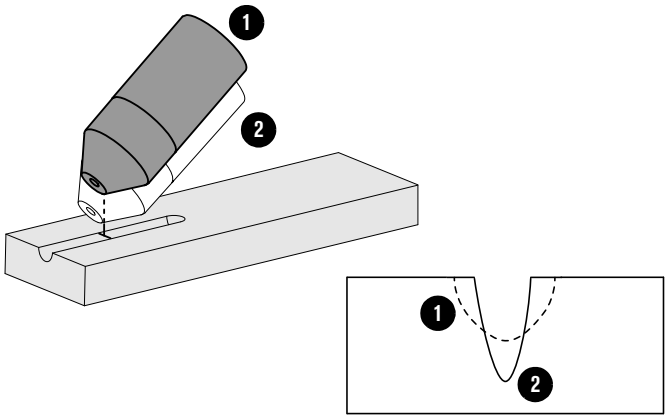
Speed of the torch

Increase the speed of the torch to make the gouge narrower and more shallow ❶. Decrease the speed of the torch to make the gouge wider and deeper ❷.



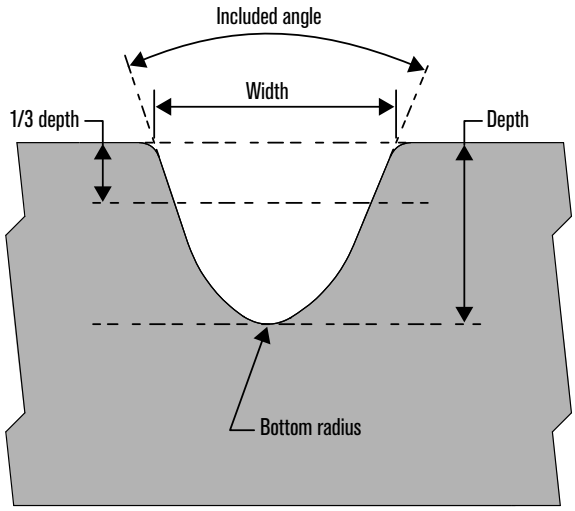
Cut height / arc stretch

Move the torch away from the workpiece to make the gouge wider, shallower, and smoother on the bottom ❶. Move the torch closer to the workpiece to make the gouge narrower and deeper ❷.



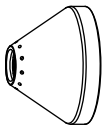
- Arc stretch is related to the amperage of the plasma power supply. The higher the amperage, the longer that you can stretch the arc. Hypertherm recommends that you keep amperage and arc stretch consistent.
- Keep at least a small distance between the torch tip and the molten metal to increase consumable life and prevent damage to the torch.

Aspects of a gouge contour

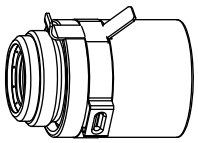


Powermax125 single-pass gouging consumables and process chart

125 A Air - Maximum Control



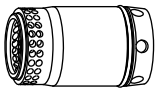
420509



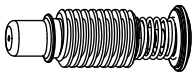
420156



420001



220997



220971

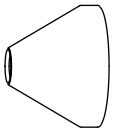
Metric

Operating Parameters						Gouge Contour				
Torch Angle	Gas Pressure (psi)	Speed (mm/min)	Standoff (mm)	Arc Voltage (V)	Motion Delay (seconds)	Width (mm)	Depth (mm)	Included Angle	Bottom Radius (mm)	Metal Removal Rate (kg/hour)
57.5°	Nominal	381	14.9	209	0.6	11.7	7.79	47°	2.87	11.3
		508	16.1		0.5	9.75	6.04			9.9
		635	16.9		0.4	9.47	5.08	59°		
		762	17.5		0.3	9.22	4.64	64°		
		889	19.0		0.2	9.34	3.96	75°		
		1016	19.2		0.2	9.11	3.58	79°		
		1143	19.9		0.1	8.99	3.07	89°		
		1270	20.2		0	8.76	2.92	91°		

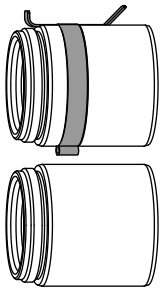
English

Operating Parameters						Gouge Contour				
Torch Angle	Gas Pressure (psi)	Speed (in/min)	Standoff (inches)	Arc Voltage (V)	Motion Delay (seconds)	Width (inches)	Depth (inches)	Included Angle	Bottom Radius (inches)	Metal Removal Rate (lb/hour)
57.5°	Nominal	15	0.590	209	0.6	0.461	0.307	47°	0.113	25
		20	0.637		0.5	0.384	0.238			22
		25	0.669		0.4	0.373	0.200	59°		
		30	0.691		0.3	0.363	0.183	64°		
		35	0.749		0.2	0.368	0.156	75°		
		40	0.758		0.2	0.359	0.141	79°		
		45	0.786		0.1	0.354	0.121	89°		
		50	0.797		0	0.345	0.115	91°		

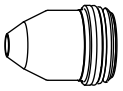
200 A Gouging – O_2 Plasma / Air Shield



420885



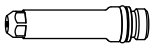
420794 / 420793



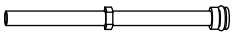
420886



420883



420887



420881

Metric

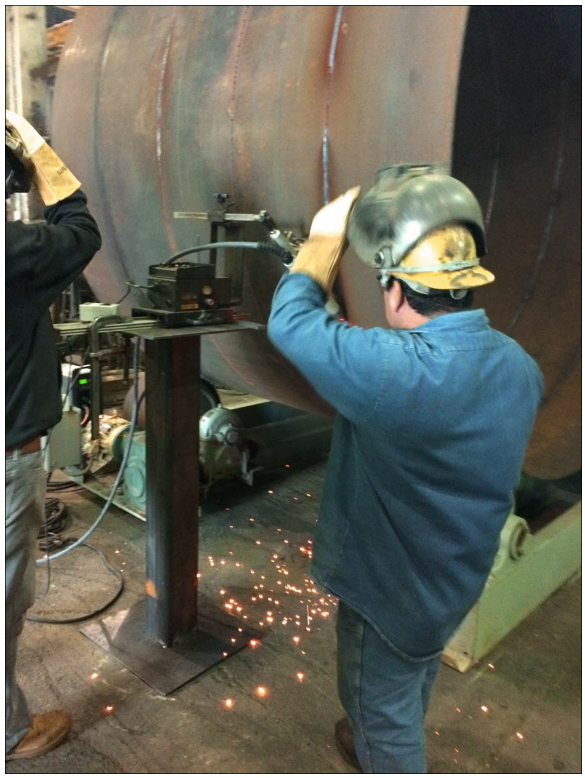
Operating Parameters							Gouge Contour				
Torch Angle	Plasma Pressure (psi)	Shield Pressure (psi)	Arc Voltage (V)	Speed (mm/min)	Standoff (mm)	Motion Delay (seconds)	Width (mm)	Depth (mm)	Included Angle	Bottom Radius (mm)	Metal Removal Rate (kg/hour)
57.5°	68	48	165	508	5.59	1.2	14.48	9.65	55°	2.79	21.3
				635	7.37	1.1	13.21	7.87	64°	2.54	19.5
				762	7.87	1.0	12.19	7.11	64°	2.28	19.5
				889	7.87	0.9	11.68	6.35	68°	2.28	19.5
				1016	7.87	0.8	10.41	5.58	68°	2.28	18.1
				1143	8.89	0.7	9.91	5.33	68°	2.03	18.1
				1270	8.89	0.6	9.39	5.08	68°	2.03	18.1

English

Operating Parameters							Gouge Contour				
Torch Angle	Plasma Pressure (psi)	Shield Pressure (psi)	Arc Voltage (V)	Speed (in/min)	Standoff (inches)	Motion Delay (seconds)	Width (inches)	Depth (inches)	Included Angle	Bottom Radius (inches)	Metal Removal Rate (lb/hour)
57.5°	68	48	165	20	0.22	1.2	0.57	0.38	55°	0.11	47
				25	0.29	1.1	0.52	0.31	64°	0.10	43
				30	0.31	1.0	0.48	0.28	64°	0.09	43
				35	0.31	0.9	0.46	0.25	68°	0.09	43
				40	0.31	0.8	0.41	0.27	68°	0.09	40
				45	0.35	0.7	0.39	0.21	68°	0.08	40
				50	0.35	0.6	0.37	0.20	68°	0.08	40

Back-gouging applications in which the torch is stationary and the cylindrical workpiece is in motion are common in the fabrication of rail cars, large-diameter poles or towers, and pressure vessels that are used in a variety of industries.

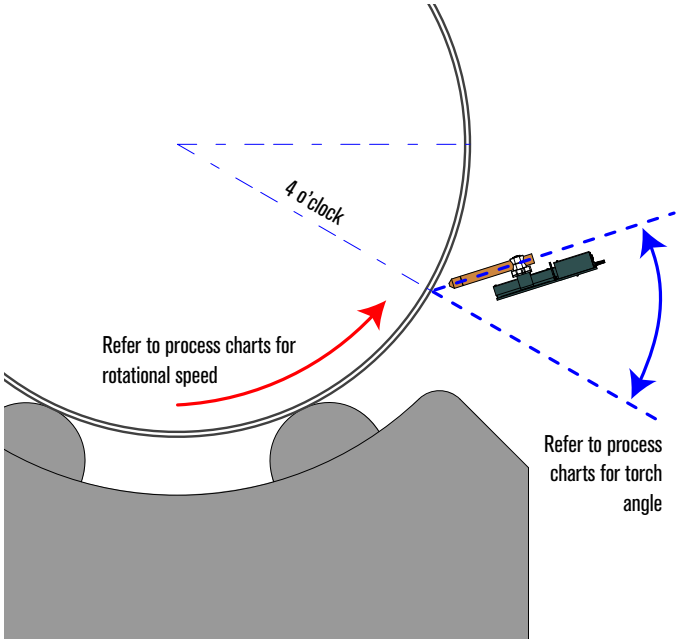
An essential component of this type of installation is a fixture to hold the torch. This fixture can be as simple as an industrial-grade tripod that is durable enough to hold the weight of the torch, or customers can fabricate a fixture that is like the one shown.



One of the challenges with mechanized gouging is setting the torch at the best angle for gouging and then transferring the arc, and doing so without causing an undesirable initial gouge.

The MAXPRO200 is unable to start reliably at the recommended torch angle for gouging. Customers may need a device that, after arc transfer, automatically moves the torch from a position that is more perpendicular to the plate to the recommended torch angle for gouging. A system integrator may need to design and make this mechanical device since there is not currently an off-the-shelf solution for this type of application.

Refer to the following illustration for help with the setup of the torch with optional OEM standalone Torch Height Control (THC) for a cylindrical gouging application. The illustration intentionally does not show a mounting fixture, tripod, or manipulator. Depending on the application, the torch may need to be manually adjusted from left to right during the gouging process to follow a seam, weld, or scribe line.



Links to fixture options:

- Bug-O Systems Torch Supports
- HarBach Positioning

Back-gouging applications in which the torch is mounted on a carriage with or without a track are common in the fabrication of long structural beams, ships, and large cylinders.

Not all carriages on the market today are suited for mechanized gouging. Many carriages don't have the motion control accuracy, forward-motion speed, torch stability, or vertical-load carrying capacity necessary to make gouge contours that customers want. We have provided links to select OEM carriages from several larger OEMs that serve the North American market and are most suitable for mechanized gouging.

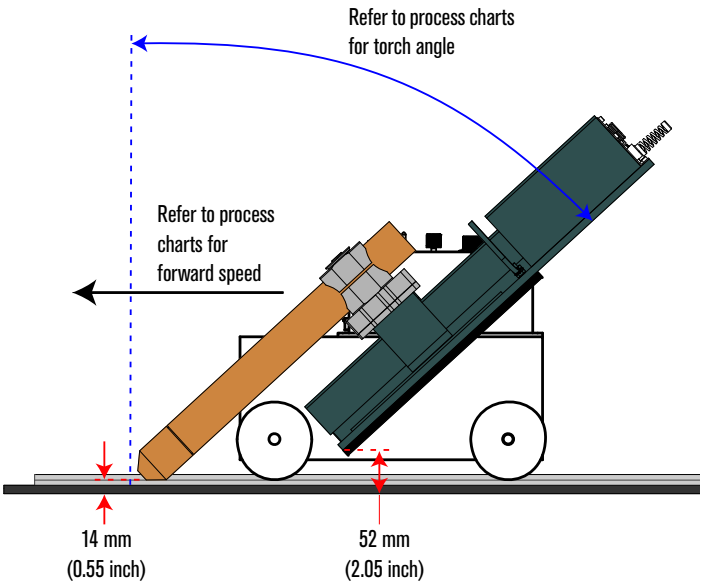
Some of these carriages offer oscillation capability which, with some experimentation, can provide wider and deeper gouge contours as compared to a single-pass gouge. With the correct oscillation settings for moving the torch from left to right and dwell time, customers can make gouges with minimal ripple in the contour.

> Note: This white paper does not provide guidance on how best to set up the carriage to get these types of results using torch oscillation.

We recommend that customers use an OEM automatic THC to keep the proper cut height. When using an OEM automatic THC, proper mounting onto the carriage arm is essential. This makes sure that the carriage arm is stable and provides the necessary torch motion for arc transfer and starting, and then the proper standoff for the gouging process.

Depending on the carriage brand, there may be some flexibility in how it attaches and travels down the track. This flexibility is amplified when the torch and height controller are mounted on an arm that is several feet from the carriage.

When it comes to mounting a torch and height controller, make sure that all fasteners are tight. The less flexibility the better for eliminating variation in the gouge contour as the carriage travels down a track or plate.



Links to select OEM carriages:

- Bug-O Modular Drive System
- Servo-Robot MWR-100/350E™ Mobile Welding and Cutting Robot
- Gullco® KAT® Welding and Cutting Automation Carriage
- Koike IK-12 NEXT Welding and Cutting Carriage
- Steelmax® Rail Runner II Modular Welding and Cutting Carriage

Plasma systems

Part Number	Description
059539	Powermax125 System, 480 V 3-PH, CSA, Plus CPC Connector, 180° Machine Torch with Consumables, 7.6 m (25 foot) Lead, Remote
059540	Powermax125 System, 480 V 3-PH, CSA, Plus CPC Connector, 180° Machine Torch with Consumables, 15.2 m (50 foot) Lead, Remote
059552	Powermax125 System, 600 V 3-PH, CSA, Plus CPC Connector, 180° Machine Torch with Consumables, 7.6 m (25 foot) Lead, Remote
059553	Powermax125 System, 600 V 3-PH, CSA, Plus CPC Connector, 180° Machine Torch with Consumables, 15.2 m (50 foot) Lead, Remote

Plasma power supplies

Part Number	Description
059488	Powermax125 Power Supply, 480 V 3-PH, CSA, Plus CPC Connector
059509	Powermax125 Power Supply, 600 V 3-PH, CSA, Plus CPC Connector

Work leads

Part Number	Description
223292	Kit: 125 A Work Lead with Hand Clamp, 7.6 m (25 foot)
223293	Kit: 125 A Work Lead with Hand Clamp, 15.2 m (50 foot)
223294	Kit: 125 A Work Lead with Hand Clamp, 22.9 m (75 foot)
223737	Kit: 125 A Work Lead with Hand Clamp, 45.7 m (150 foot)

Machine torches

Part Number	Description
059519	Duramax Hyamp Machine Torch, 180°, 4.5 m (15 foot) Lead
059520	Duramax Hyamp Machine Torch, 180°, 7.6 m (25 foot) Lead
059521	Duramax Hyamp Machine Torch, 180°, 10.7 m (35 foot) Lead
059522	Duramax Hyamp Machine Torch, 180°, 15.2 m (50 foot) Lead
059523	Duramax Hyamp Machine Torch, 180°, 22.8 m (75 foot) Lead

Consumables

Part Number	Description
220971	Electrode, Duramax Hyamp, 30 A – 125 A
420001	Nozzle, Duramax Hyamp, 65 A – 125 A, Gouging
420509	Shield, Duramax Hyamp, 65 A – 125 A, Max Control Gouging
220997	Swirl Ring, Duramax Hyamp, 30 A – 125 A
420156	Retaining Cap, Duramax Hyamp, 30 A – 125 A, Mechanized Ohmic

Plasma power supplies

Part Number	Description
078609	MAXPRO200 480 V, 3-PH, 60 Hz
078610	MAXPRO200 200 V/208 V, 3-PH, 50 Hz – 60 Hz
078611	MAXPRO200 220 V, 3-PH, 50 Hz – 60 Hz
078612	MAXPRO200 240 V, 3-PH, 60 Hz
078613	MAXPRO200 380 V, 50 Hz – 60 Hz
078616	MAXPRO200 440 V, 3-PH, 50 Hz – 60 Hz
078617	MAXPRO200 600 V, 3-PH, 60 Hz

Machine torches

Part Number	Description
228937	MAXPRO200 Torch Assembly with 45 mm (1-3/4 inch) Diameter Sleeve
428024	MAXPRO200 Torch Assembly with 50 mm (2 inch) Diameter Sleeve
428027	MAXPRO200 Quick Disconnect Torch Assembly with 50 mm (2 inch) Diameter Sleeve
428028	MAXPRO200 Quick Disconnect Torch Assembly with 45 mm (1-3/4 inch) Diameter Sleeve

Torch leads

Part Number	Description
229477	Shielded Leads, 7.5 m (25 foot)
229478	Shielded Leads, 15 m (50 foot)
229479	Shielded Leads, 22 m (75 foot)
229480	Shielded Leads, 30 m (100 foot)

Torch mounting brackets

Part Number	Description
020522	Mounting Bracket, 45 mm (1-3/4 inch) Diameter Sleeve
020046	Mounting Bracket, 50 mm (2 inch) Diameter Sleeve

Work cables

Part Number	Description
223335	Work Cable Assembly with Lugs, 7.5 m (25 foot)
223336	Work Cable Assembly with Lugs, 15 m (50 foot)
223337	Work Cable Assembly with Lugs, 22 m (75 foot)
223338	Work Cable Assembly with Lugs, 30 m (100 foot)
008539	Work Cable Ground Clamp

Remote pendants

Part Number	Description
428624	Remote Start / Stop Switch, 3m (10 foot)

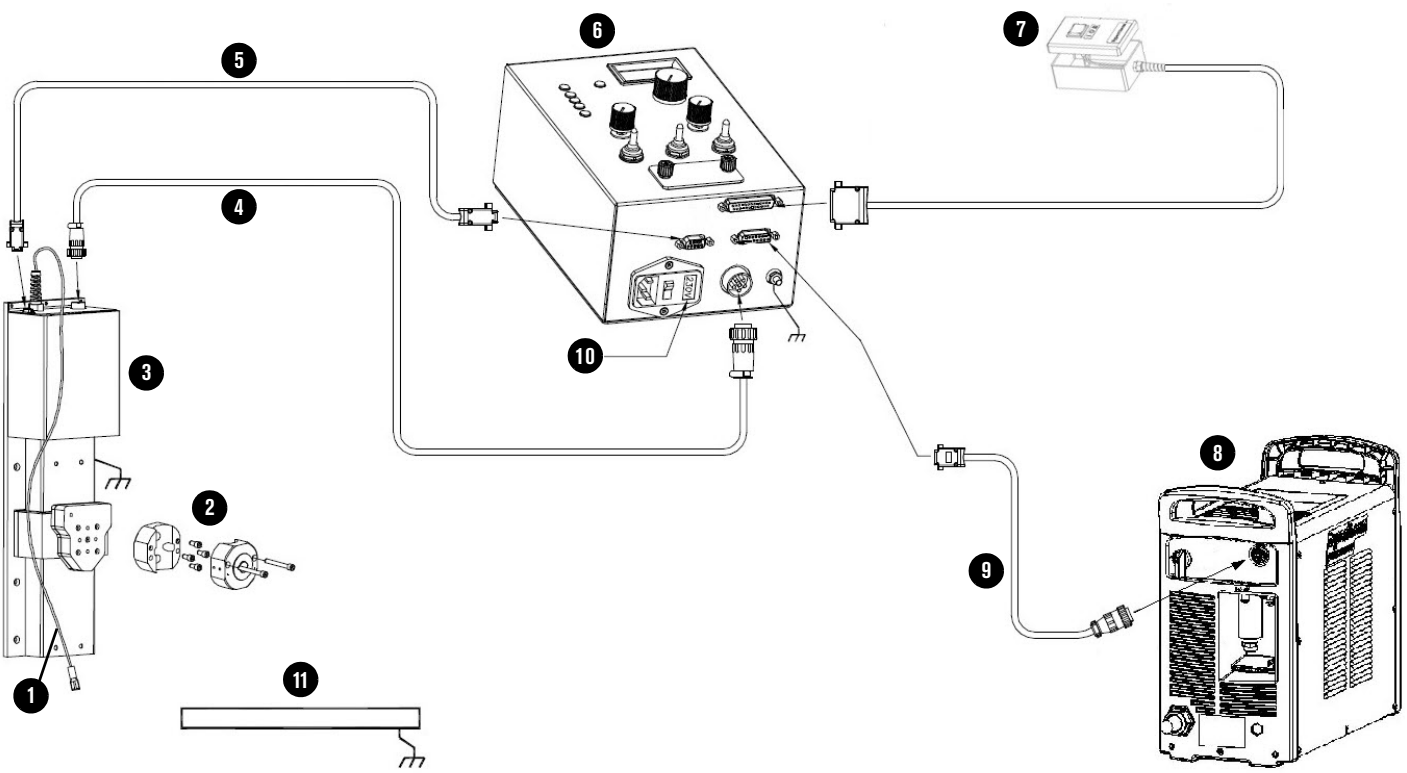
Interface cables

Part Number	Description
223327	Interface Cable, Power Supply To CNC/THC, 1.5 m (5 foot)
223328	Interface Cable, Power Supply To CNC/THC, 3 m (10 foot)
223329	Interface Cable, Power Supply To CNC/THC, 7.5 m (25 foot)

Consumables

Part Number	Description
420885	Gouging Shield
420793	Retaining Cap, without initial height sense (IHS) tab
420794	Retaining Cap, with initial height sense (IHS) tab
420886	Nozzle
420883	Swirl Ring
420887	Electrode
420881	Water Tube

Powermax125 with OEM standalone THC



1 Ohmic contact wire (connect to torch shield)

2 Torch mounting block kit (optional)

3 OEM lifter (with motor / brake and magnetic breakaway)

4 Lifter motor power / brake cable

5 Lifter interface cable

6 OEM control module

7 Remote pendant (for start / stop)

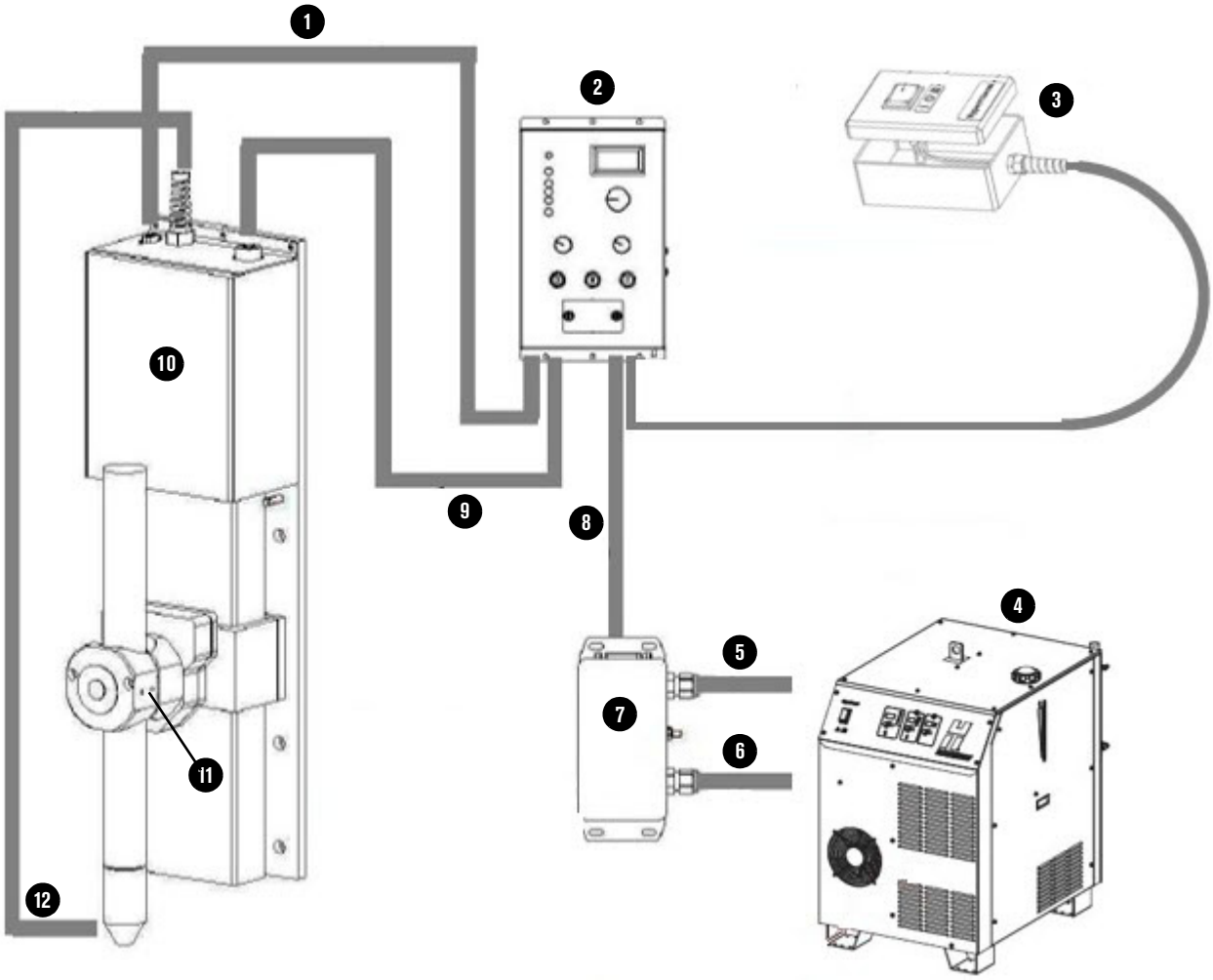
8 Powermax125 (with built-in voltage divider board)

9 Plasma interface cable

10 Input power range-select:
Low: 100 VAC to 130 VAC, 50/60 Hz
High: 200 VAC to 260 VAC, 50/60 Hz

11 Workpiece / cutting table

MAXPRO200 with OEM standalone THC



1 Lifter interface cable
2 OEM control module
3 Remote pendant (for start / stop)
4 MAXPRO200 plasma power supply
5 Plasma signal wiring (customer-supplied)
6 High-voltage wiring (customer-supplied)
7 OEM plasma interface module
8 Plasma interface cable
9 Lifter motor power / brake cable
10 OEM lifter (with motor / brake and magnetic breakaway)
11 Torch mounting kit (optional)
12 Tip touch sense high-voltage cable

Recommendations for proper PPE

Plasma gouging with the MAXPRO200 and Powermax125 creates intense ultraviolet light and very loud noise when compared to arc welding. Protect operators and spectators from these hazards.

In addition to PPE (personal protective equipment) for operators and spectators, make sure that the radiant heat and ejected molten material from the plasma gouging process does not cause damage to nearby equipment. Proper shielding should be used.

For mechanized plasma gouging, the following PPE should be used:

- Welding hood with shade #12 lens. We recommend models with a leather neck guard.
- Hearing protection, either earmuffs and / or ear plugs.
- Full-length sleeves to protect skin from ultraviolet radiation.

Links to operator manuals and drawings

For more information, refer to the following documents:

- 0Powermax125 Operator Manual (808080)
- MAXPRO200 Instruction Manual (807700)

All Hypertherm technical documentation is available at www.hypertherm.com/docs.

Note: The Hypertherm Light Industrial Business team is working on technology projects that in the future will make creating larger gouge structures possible and repeatable. We are not currently in the position to advise on the best methods to achieve these types of results.

Find additional information on True Bevel at www.hypertherm.com/truebevel

Sensor™, MAXPRO200®, Powermax125®and Hypertherm are trademarks of Hypertherm, Inc. and may be registered in the United States and/or other countries. All other trademarks are the property of their respective holders.

Environmental stewardship is one of Hypertherm's core values.
www.hypertherm.com/environment

100% Associate-owned

© 8/2024 Hypertherm, Inc. Revision 4

810730

HYPERTHERM ASSOCIATES®