How to improve plasma cut quality

The following reference guide offers several solutions to help improve cut quality. It is important to try and work through the suggestions provided – as often there are many different factors to consider:

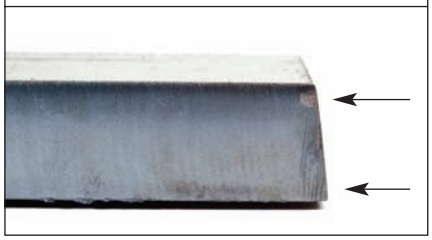
- Type of machine (example: XY table, punch press)
- Plasma cutting system (example: power supply, torch, consumables)
- Motion control device (example: CNC, torch height control)
- Process variables (example: cutting speed, gas pressures, flow rates)
- External variables (example: material variability, gas purity, operator experience)

It is important to consider all of these factors when attempting to improve the appearance of a cut.

Cut quality issues

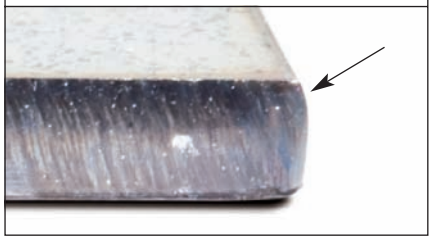
Angularity

Positive cut angle
More material was removed from the top of the cut surface than from the bottom.



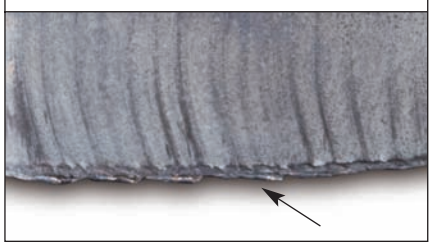
Negative cut angle
More material was removed from the bottom of the cut surface than from the top.

Top edge rounding
Slight rounding along the top edge of the cut surface.

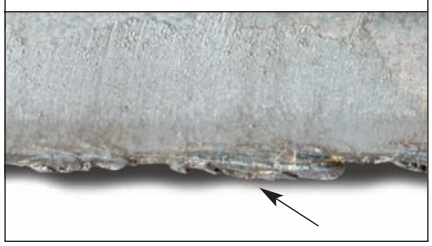


Dross

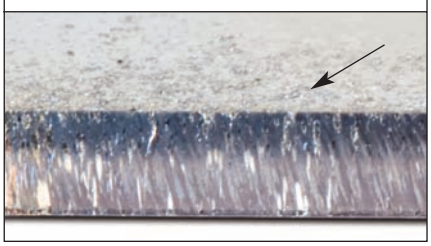
High-speed dross
Small, linear bead of molten material that attaches and hardens along the bottom edge of the cut ("S" shaped laglines present; dross difficult to remove, requires grinding).



Low-speed dross
A bubbly or globular accumulation of molten material that attaches and hardens along the bottom edge of the cut (vertical laglines may be present; dross easy to remove, flakes off in large chunks).



Top spatter
Light spatter of molten material that collects on the top edges of the cut (typically inconsequential, most common with air plasma).



Cut quality issues continued

Surface finish

Roughness
Depending on the type of metal being cut, some roughness is to be expected; “roughness” describes the texture of the cut face (the cut is not smooth).

Aluminum

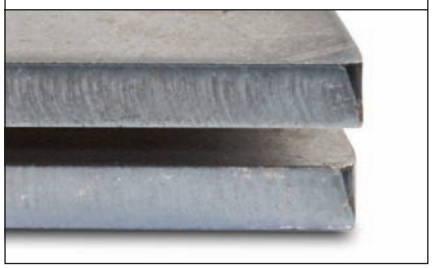
Top: Air/Air
- Best for thin material under 3 mm

Bottom: H35/N_2
- Excellent edge quality
- Weldable edge

Mild steel

Top: Air/Air
- Clean cut
- Nitrided edge
- Increased surface hardness

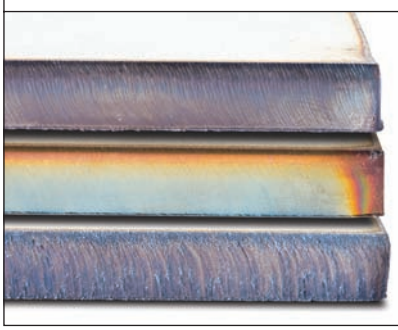
Bottom: O_2
- Exceptional edge quality
- Weldable edge



Color

Color results from a chemical reaction between a metal and the plasma gas used to cut it; color changes are to be expected (color varies most dramatically with stainless steel).

Top: **N_2/N_2**
Middle: **H35/N_2**
Bottom: Air/Air



Basic steps to improve cut quality

Step 1

Is the plasma arc cutting in the appropriate direction?

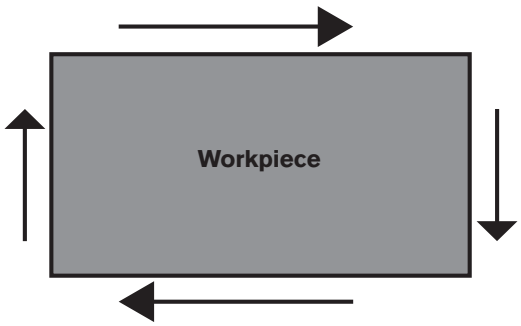
The squarest cut angles are always to the right side, with respect to the forward motion of the torch.

- Check direction of the cut
- Adjust the cutting direction, if needed

The plasma arc typically spins clockwise with standard consumables.

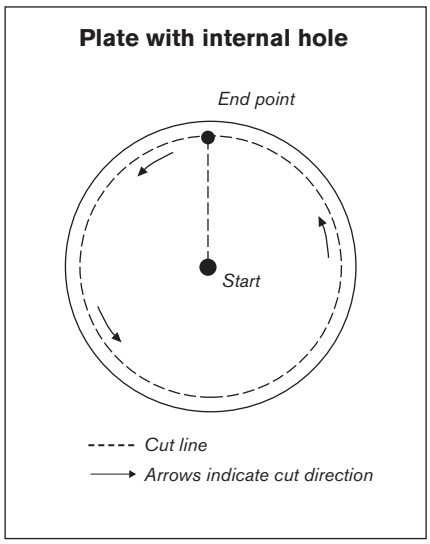
Contour:

- Torch travels clockwise
- Good side of the cut is to the right side of the torch, as it travels forward.



Internal feature (hole):

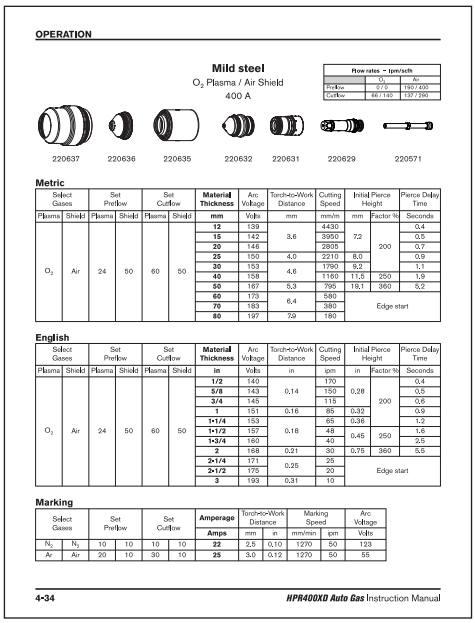
- Torch travels counter-clockwise
- Good side of the cut is to the right side of the torch, as it travels forward.



Step 2

Was the correct process selected for the material and thickness being cut?

Refer to the cut charts in the Operation section of the Hypertherm Instruction Manual.



OPERATION

Mild steel
O_2 Plasma / Air Shield
400 A

Flow rates – lpm/scfh		
	O_2	Air
Preflow	6/13	190/400
Cutflow	66/140	137/290

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Metric

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	mm	Volts	mm	mm/m	mm	Factor %	Seconds
O_2	Air	24	50	60	50	12	139	3,6	4430	7,2	200	0,4
						15	142		3950			0,5
						20	146		2805			0,7
						25	150	4,0	2210	8,0		0,9
						30	153	4,6	1790	9,2		1,1
						40	158		1160	11,3	250	1,9
						50	167	5,3	795	19,1	360	5,2
						60	173	6,4	580	Edge start		
						70	183		380			
						80	197	7,9	180			

English

Select Gases		Set Preflow		Set Cutflow		Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Pierce Height		Pierce Delay Time
Plasma	Shield	Plasma	Shield	Plasma	Shield	in	Volts	in	ipm	in	Factor %	Seconds
O_2	Air	24	50	60	50	1/2	140	0,14	170	0,28	200	0,4
						5/8	143		150			0,5
						3/4	145		115			0,6
						1	151	0,18	85	0,32		0,9
						1-1/4	153		65	0,36		1,2
						1-1/2	157		48	0,45	250	1,6
						1-3/4	160		40			2,5
						2	168	0,21	30	0,75	360	5,5
						2-1/4	171	0,25	25	Edge start		
						2-1/2	175		20			
						3	193	0,31	10			

Marking

Select Gases		Set Preflow		Set Cutflow		Amperage	Torch-to-Work Distance		Marking Speed		Arc Voltage
						Amps	mm	in	mm/min	ipm	Volts
N_2	N_2	10	10	10	10	22	2,5	0,10	1270	50	123
Air	Air	20	10	30	10	25	3,0	0,12	1270	50	55

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Be sure to follow the specifications in the cut charts:

- Select the appropriate process for:
  - Material type
  - Material thickness
  - Desired cut quality
  - Productivity goals
- Select correct plasma and shield gas
- Select correct parameters for:
  - Gas pressures (or flow rates)
  - Torch-to-work distance and arc voltage
  - Cutting speed
- Confirm the correct consumables are being used (verify the part numbers)

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Note: Generally, lower amperage processes offer better angularity and surface finish; however, cutting speeds will be slower and dross levels will be higher.

Step 3

Are the consumables worn?

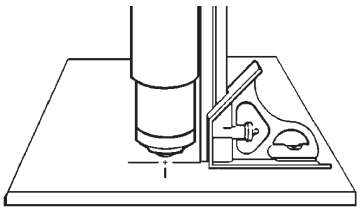
- Inspect consumables for wear
- Replace worn consumables
- Always replace the nozzle and electrode at the same time
- Avoid over-lubricating o-rings

Note: Use genuine Hypertherm consumables to ensure maximum cutting performance.

Step 4

Is the torch square to the workpiece?

- Level the workpiece
- Square the torch to the workpiece (both from the front and side of the torch)



Note: Check to see if material is bent or warped; in extreme cases this limitation cannot be corrected.

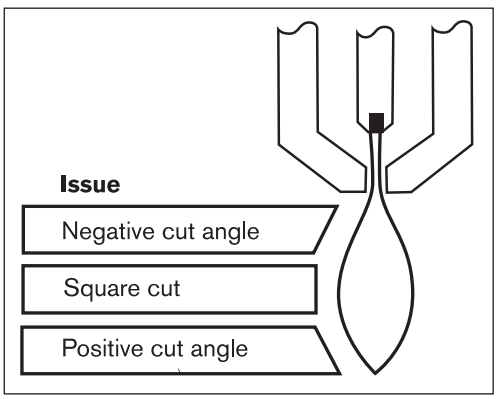
Step 5

Is the torch-to-work distance set at the proper height?

- Adjust torch-to-work distance to the correct setting
- If using arc voltage control, adjust voltage

Note: As consumable parts wear, arc voltage settings need continual adjustment to maintain torch-to-work distance.

Torch-to-work distance can impact angularity



Negative cut angle: torch too low; increase torch-to-work distance

Positive cut angle: torch too high; decrease torch-to-work distance

Note: A slight variation in cut angles may be normal, as long as it is within tolerance.

Step 6

Is the cutting speed set too fast or too slow?

- Adjust cutting speed, as needed

Note: Cutting speed may also impact your dross levels.

High-speed dross: Cutting speed too fast (arc lags behind), reduce cutting speed

Low-speed dross: Cutting speed too slow (arc shoots ahead), increase cutting speed

Top Spatter: Cutting speed too fast, reduce cutting speed

Note: In addition to speed, both material chemistry and surface finish can impact dross levels; as workpiece heats up, more dross may form on subsequent cuts.

Step 7

Are there problems with the gas delivery system?

- Identify and repair any leaks or restrictions
- Use properly sized regulators and gas lines
- Use pure, high-quality gas
- If manual purge required, such as with the MAX200, confirm purging cycle was completed
- Consult the gas distributor

Step 8

Is there torch vibration?

- Make sure that the torch is secure to the table gantry
- Consult OEM; table may require maintenance

Step 9

Does the table need to be tuned?

- Check and ensure that the table is cutting at specified speed
- Consult OEM; table speed may need tuning

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