

# 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.



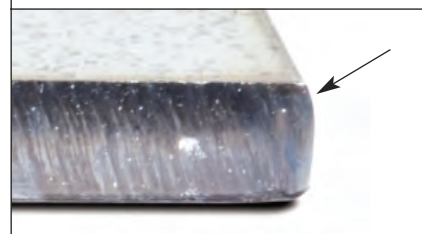
#### Negative cut angle

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



#### Top edge rounding

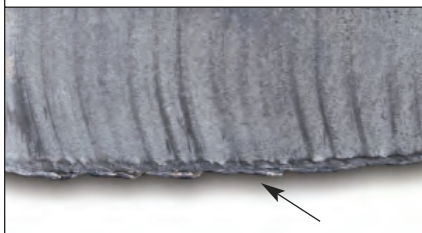
Slight rounding along the top edge of the cut surface.



### Dross

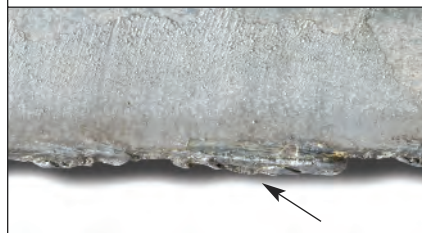
#### High-speed dross

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).



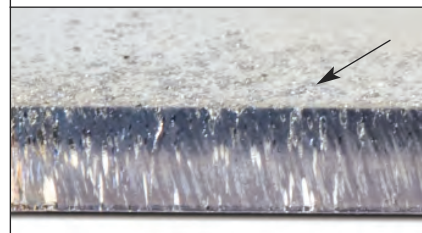
#### Low-speed dross

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).

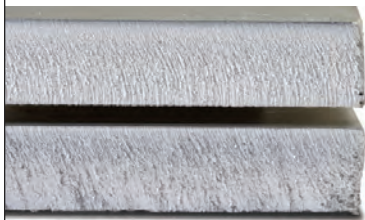
#### Aluminum

##### Top: Air/Air

- Best for thin material under 1/8" (3 mm)

##### Bottom: H35/N<sub>2</sub>

- Excellent edge quality
- Weldable edge



#### Mild steel

##### Top: Air/Air

- Clean cut
- Nitrided edge
- Increased surface hardness

##### Bottom: O<sub>2</sub>

- Exceptional edge quality
- Weldable edge



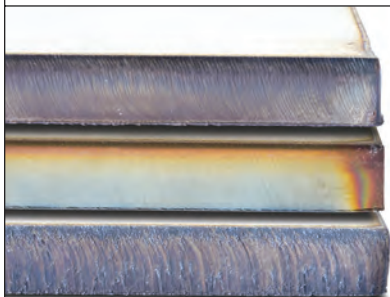
### Color

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<sub>2</sub>/N<sub>2</sub>

##### Middle: H35/N<sub>2</sub>

##### Bottom: Air/Air



# Basic steps to improve cut quality

## Step 1

### Is the plasma arc cutting in the appropriate direction?

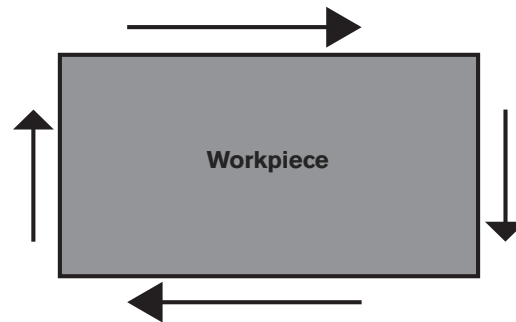
The squarest cut angles are always to the right side, with respect to the forward motion of the torch.

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

The plasma arc typically spins clockwise with standard consumables.

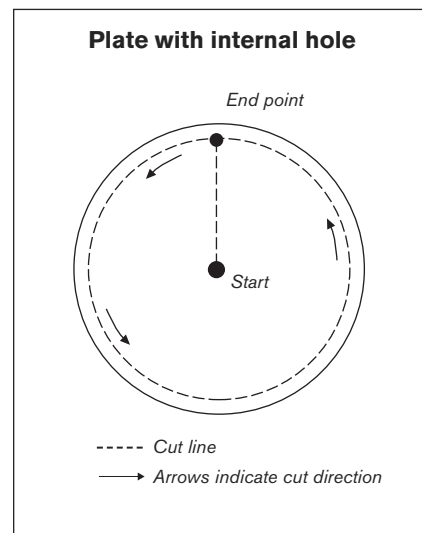
#### Contour:

- 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<sub>2</sub> Plasma / Air Shield  
400 A

Flow rate - liter/min	O <sub>2</sub>	Air
Preheat	0.75	100/100
Cut	0.75	100/100

**Metric**

Shield Gases	Set Preflow	Set Cutflow	Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Piece Height	Pierce Delay Time			
Plasma	Shield	Plasma	Shield	mm	Volts	mm/min	mm	Seconds			
O <sub>2</sub>	Air	34	50	60	50	12	139	4450	0.4		
						15	142	3.6	3850	7.0	0.5
						20	148		2300		0.7
						25	150	4.0	2210	8.0	0.9
						30	153	4.6	1990	9.2	1.1
						40	158		1160	11.5	2.0
						50	167	5.3	795	19.1	3.0
						60	173		580		5.2
						70	183	6.4	380		Edge start
						80	197	7.9	180		

**English**

Shield Gases	Set Preflow	Set Cutflow	Material Thickness	Arc Voltage	Torch-to-Work Distance	Cutting Speed	Initial Piece Height	Pierce Delay Time			
Plasma	Shield	Plasma	Shield	in	Volts	ipm	in	Seconds			
O <sub>2</sub>	Air	34	50	60	50	1/2	140	170	0.4		
						5/8	143	0.14	150	0.28	0.5
						3/4	145		115		0.8
						1	151	0.16	85	0.32	0.9
						1 1/4	153		65	0.38	1.2
						1 1/2	157	0.18	48	0.45	1.6
						1 3/4	160		40		2.5
						2	168	0.21	30	0.75	3.0
						2 1/4	171	0.25	25		Edge start
						2 1/2	175		20		
3	183	0.31	10								

**Marking**

Shield Gases	Set Preflow	Set Cutflow	Amperage	Torch-to-Work Distance	Marking Speed	Arc Voltage					
N <sub>2</sub>	N <sub>2</sub>	Ar	Amps	mm	in	Volts					
N <sub>2</sub>	N <sub>2</sub>	Ar	10	10	10	22	2.5	0.10	1270	50	123
Ar	Ar	Ar	20	10	30	28	3.0	0.12	1270	50	55

4-34 HPR400XD Auto Gas Instruction Manual

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)



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?

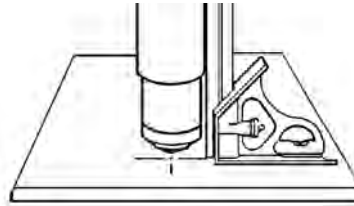
- Inspect consumables for wear
- Replace worn consumables
- Always replace the nozzle and electrode at the same time
- Avoid over-lubricating o-rings

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.

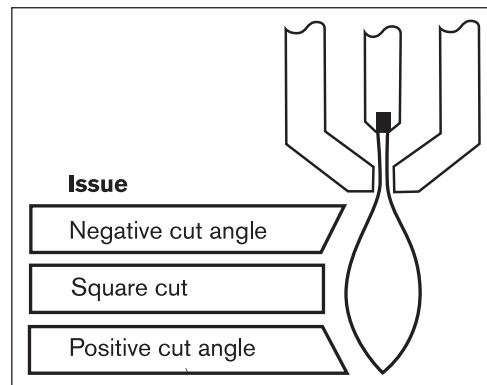
## Step 5

### 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
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## 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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