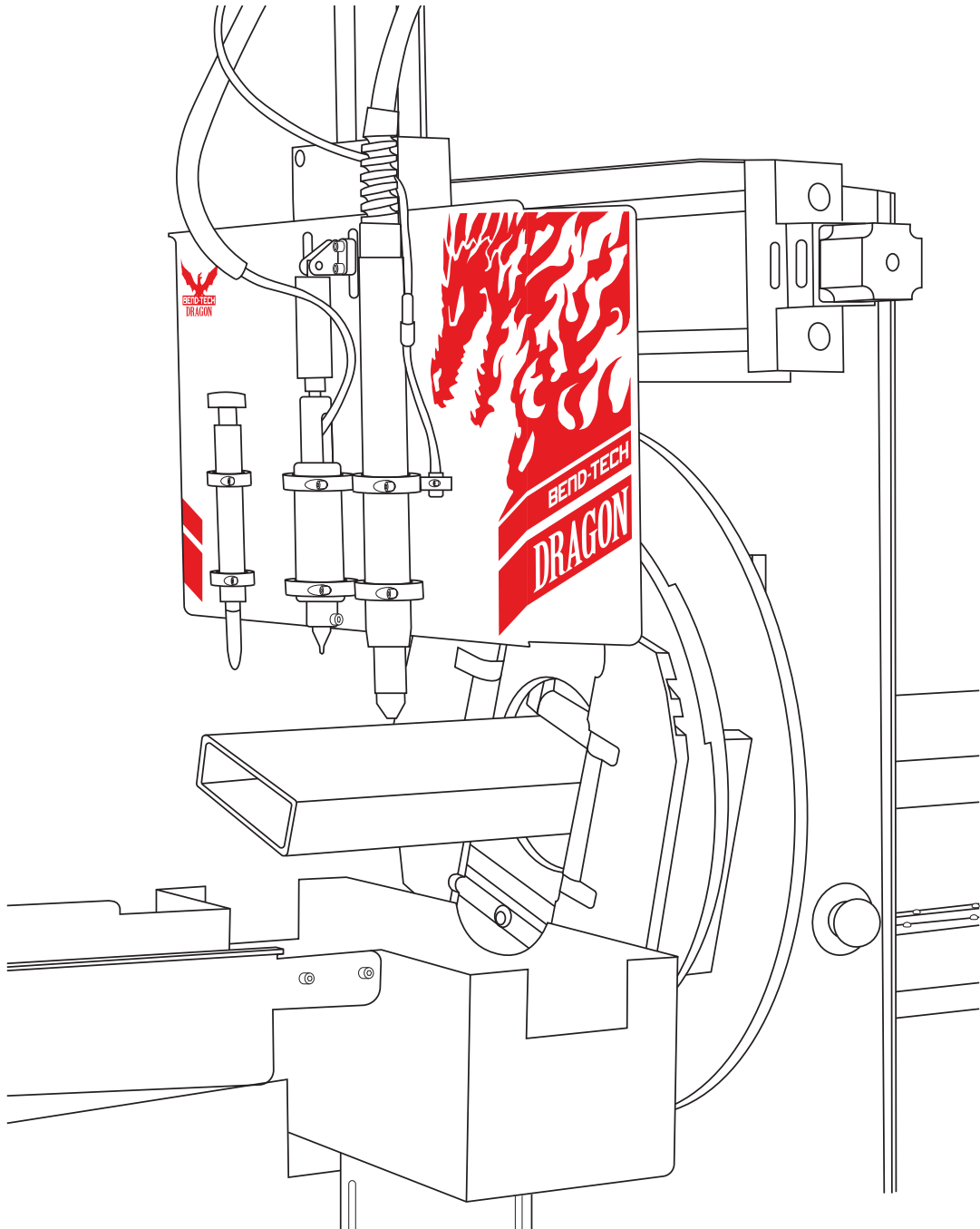


Part 1 of 1

# BEND-TECH DRAGON A400

## Plasma Cutting Guide



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# **Dragon A400**

## **Plasma Cutting Guide** Version 1.3

English  
Original Instructions

March 2020

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# Limited Warranty

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## Covering Bend-Tech Dragon

Bend-Tech, LLC provides a limited warranty on all new Dragon machines that are manufactured directly or under license by Bend-Tech, LLC, and sold by Bend-Tech, LLC or its approved distributors.

## Warranty Coverage

Each Bend-Tech Dragon machine is warranted by the manufacturer against defects in material workmanship for 12-months. The warranty period commences upon delivery of the Dragon machine to the customer's facility.

## Repair or Replacement Only

The Manufacturer's sole liability, and the Customer's exclusive remedy under this warranty shall be limited to repairing or replacing the defective part. Repair or replacement of parts is at the sole discretion of the manufacturer. The Customer is responsible for warranty parts installation. Bend-Tech does not provide warranty service labor.

## Limits

This warranty does not cover components subject to wear due to normal use of the machine such as belts, lights, tooling etc. This warranty is void if Bend-Tech, LLC has determined any failure is the result of mishandling, abuse, misuse, improper installation, improper storage, improper maintenance or unauthorized modification of the machine. The warranty does not cover damage due to natural disasters, fire, flood or other external factors.

## Software

Dragon software is covered by a 2-year maintenance plan from the purchase date of the Dragon A400 machine. After the 2-year maintenance plan is expired, the Customer can purchase a maintenance plan. A maintenance plan will ensure the customer always has the newest version of Dragon software. The maintenance plan is critical to keeping Dragon software updated with the newest capabilities possible, and is critical to the servicing of the machine. Bend-Tech, LLC will contact the Customer regarding updates to the maintenance plan within 1-month of expiration. Contact Bend-Tech Support to ensure software is up to date: [support@bend-tech.com](mailto:support@bend-tech.com).

# Customer Service

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Any questions or concerns regarding this manual can be directed to Bend-Tech, LLC representatives via the Dragon website, [www.bend-tech.com](http://www.bend-tech.com). Click Contact in the menu bar for communication options and send your comments to the Dragon Customer Service department.

## Online Resources

- <https://www.youtube.com/user/bendtech2020>
- <http://www.bend-tech.com/wiki7>
- <http://www.bend-tech.com>
- <https://www.facebook.com/2020ssi>
- [https://www.instagram.com/bend\\_tech](https://www.instagram.com/bend_tech)

# Customer Satisfaction Commitment

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Congratulations on your purchase of the world's best CNC plasma tube and pipe cutting machine, the Dragon A400. Bend-Tech, LLC places great pride in customer satisfaction and it is our promise to offer you the best support available for your Dragon A400. We recognize that our support is a key factor in your success.

## Contact Us

You can contact Bend-Tech, LLC customer service at 651-257-8715. Our support hours are Monday-Friday, 8:30-5:00 CST. E-mail Bend-Tech, LLC sales at: [support@bend-tech.com](mailto:support@bend-tech.com). Our mailing address is: Bend-Tech LLC, 729 Prospect Ave., Osceola, WI 54020, U.S.A..

# Warnings

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This manual contains important statements that are called out from the regular text with an associated signal word: “Danger,” “Warning,” “Caution,” or “Note.” Each of these signal words is accompanied by its own icon. These signal words and icons indicate the severity of the condition and the warning. The machine operator should familiarize themselves with these warnings and read the statements before operating the machine.

## Definitions & Examples

### Danger

Danger indicates a serious condition that could cause severe injury or death to the operator or bystanders if the instructions are not followed.

#### Example

## ! Danger !



Exceeding the material weight limit of the Dragon A400 can result in serious injury to the operator and/or bystanders.

### Warning

A Warning indicates there is a possibility for minor injury if the instructions are not followed correctly.

#### Example

## ! Warning !



Due to the extreme temperatures that result from the plasma cutting process, parts cooled in water in the parts catcher can still be extremely hot. Always use caution when handling newly-cut parts.

## Caution

Caution warns the operator that minor injury or machine damage could occur if instructions are not followed. It could also mean that not following directions could affect the overall procedure being performed.

### Example

## ! Caution !



Exceeding the material weight limit can affect performance and possibly damage the Dragon A400.

## Note

A Note gives clarification or focuses on information that is critical or unique to an operation.

### Example



*Water Cooling system greatly reduces smoke and vapor emitted by the machine. Bend-Tech recommends use of the Water Cooling system whenever possible.*

# Glossary

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### **A400**

Indicates machine with 400-lb weight limit.

### **Axis**

A fixed reference line used by the Dragon A400.

### **Bend-Tech 7X**

Machine design software - CAD.

### **BOB**

Breakout Board.

### **Material Support Lifter**

The Material Support Lifter supports material to reduce sag.

### **Chuck**

Located on the Trolley, the Chuck holds the material so it can be moved forward, backward and rotated.

### **Control Box**

Connects Dragon Software Suite to the Dragon A400.

### **Coolant Tray**

Cools cut parts as they are produced.

### **Drive Belt**

The X Motor uses the Drive Belt to power the Trolley along the Rail. The Drive Belt is mounted stationary along the length of the machine.

### **Drive Belt Pulley**

Located on the X Motor, it works in conjunction with the Drive Belt to power the Trolley along the Rail.

### **E-Stop**

Emergency stop.

### **ESS**

Ethernet Smooth Stepper (Control Board).

### **Ethernet**

System for connecting multiple computers via a Local Area Network.

### **Front Gate**

The Gate supports the material at the front of the machine. It consists of two sets of self-centering roller jaws.

### **Gate Lead Screw**

Controls operation and adjustment of the Gate.

### **Interface**

Any particular screen display generated by Bend-Tech software.

### **Mach3**

Machine driver software.

### **Parts Catcher**

The parts catcher is placed at the front of the machine to catch parts as they are cut.

### **Rail**

The Rail is the main structure of the Dragon A400. The Trolley rides on the Rail.

### **Tail**

The Tail is located at the opposite end of the Head of the machine. The Tail arrives pre-assembled. The X Axis homing sensor, Drive Belt Adjustment Block and E-Stop are located at the Tail of the machine.

### **Toolhead**

Operates the Marker, Engraver and Torch.

### **Trolley**

The Trolley rides on the Rail, and carries the Chuck forward and backward along the length of the Rail Support Beam.



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# Consumables

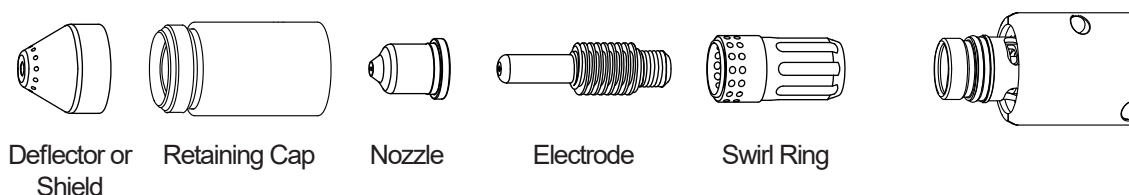
## Overview

Bend-Tech recommends reading the Hypertherm Operator Manual (or operator manual for whatever brand plasma cutting machine is being used with the Dragon machine) and using the consumables recommended for mechanized cutting. The Hypertherm unit comes with shielded consumables. Shielded consumables protect the nozzle and minimize any damage that can result from slag during the piercing process. Bend-Tech recommends using shielded consumables with the Dragon A400 whenever possible.

Ensure plasma machine settings are correct for the type of cutting being performed.

Consumables will typically last 3-5 hours of “arc on” time in a mechanized cutting setting. Consumable life can vary depending on the type of cutting being performed, quality of air supply, machine settings, type of material being cut and numerous other factors. It is important to inspect consumables on a regular basis.

## Consumables in order of assembly

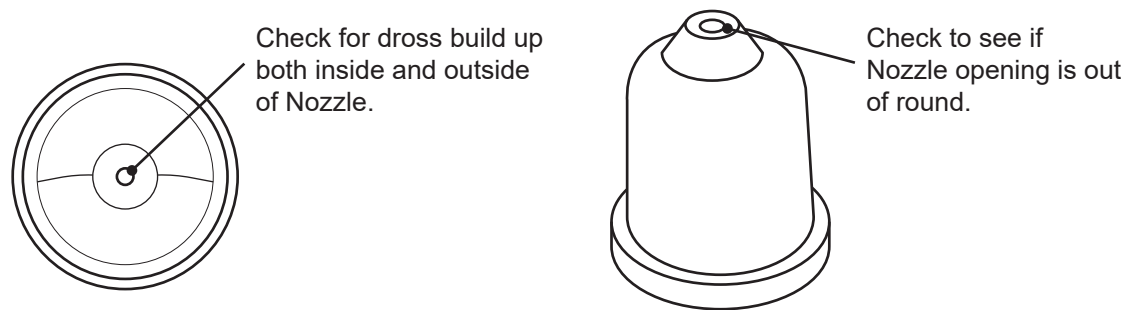


## Inspecting and Changing Consumables

It is recommended the Operator change the electrode and nozzle at the same time. This ensures optimal orifice and pit depth.

### Nozzle

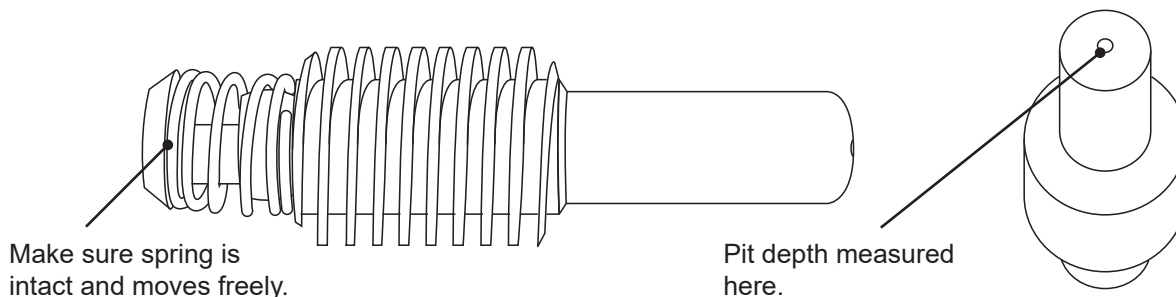
The nozzle focuses the arc by funneling gas flow. If the nozzle is out of round it will result in an uneven cut. Often the Operator can conduct a visual inspection of the nozzle to determine if it is worn out. Also check the cuts for excessive slag and dross. Inspect the nozzle to ensure it is free of slag. Inspect the inside of the nozzle for out of round or inconsistencies, nicks or notches, or rounded edges. Improper gas flow will cause premature nozzle failure.



### Electrode

The Operator can determine electrode life by measuring pit depth. Pit depth is the distance from the surface of the copper electrode piece to the hafnium located at the center of the electrode. When new, the hafnium will be flush with the surface of the nozzle, and will deteriorate as the Torch is used. Once pit depth reaches .040-.045 in. the electrode and nozzle should be replaced. To determine pit depth, measure the distance from the surface of the electrode to the bottom of the pit of the electrode. Use a quality pit depth gauge. Follow the manufacturer's recommendations for pit depth.

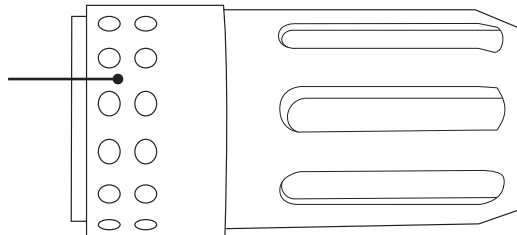
In the case of a spring electrode ensure the spring is intact and moves freely.



## Swirl Ring

Inspect the swirl ring for cracks, deformations and clogged holes. The swirl ring does not wear like the electrode and nozzle, but it can become cracked from heat cycling or from some sort of physical damage. The swirl ring will only need to be replaced if there is evidence of physical damage.

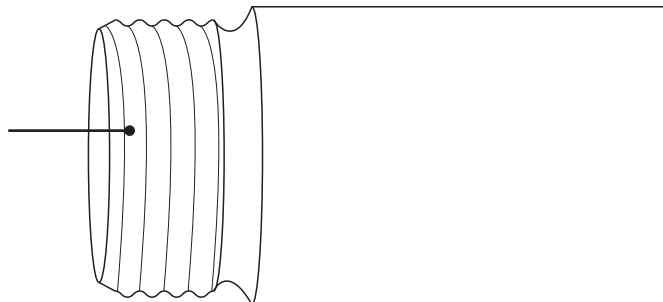
Make sure the swirl ring has no cracks or deformations, and that the holes are clear.



## Retaining Cap

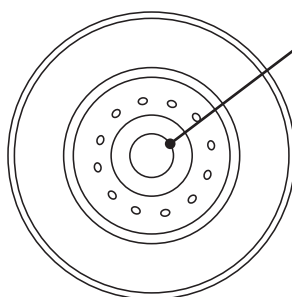
Ensure the retaining cap is free of slag and not cracked, and that the threads are intact. Dirt can damage the retaining cap threads. Heat can damage the retaining cap.

Make sure the threads are clean and intact.

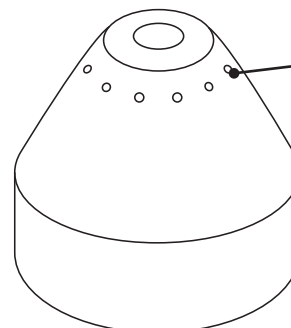


## Shield Cap

Inspect the shield cap to ensure all of the holes are clean and not plugged. If the shield cap cannot vent gas properly it will result in uneven or imprecise cuts. The shield cap will only need to be replaced if there is evidence of physical damage and/or if hole is out of round. If there is spatter on the Shield it may still be usable. However, it may also be an indication that the Torch is set too close to the material, especially in regard to materials thinner than .25 in. Typically the shield cap will last up to 15-times as long as the electrode and nozzle.



Make sure the opening is not out of round.



Check that the holes are clean.



*Do not judge consumables by their color. Staining or discoloration do not necessarily indicate worn consumables.*

## Signs that Consumables Need Replacing

---

### Signs of a Bad Electrode

- Torch not cutting at required speed
- Green discoloration of the arc
- Excessive dross
- Arc is misfiring or difficult to start

### Signs of a Bad Nozzle

- Kerf too wide
- Operator needs to slow the Torch down because the Torch is not cutting well at desired speed
- Oblong holes

## Maximizing Consumables

---

### Normal vs. Fine Cut Consumables

For most fabricators normal consumables will perform excellent when used in the Dragon A400. However, fabricators working with thinner gauge metals may get better results using fine cut consumables. Fine cut consumables cut with a narrower kerf and stiffer arc which is ideal for thinner material, typically  $\frac{3}{16}$  in. and smaller.

- Fine cut consumables will perform more intricate cuts and produce sharper corners and angles when used with thinner gauge metals.
- Hypertherm recommends using a shield rather than a deflector when using fine cut consumables.
- Ensure the torch is clean and free of spatter when using fine cut consumables. Wipe the torch clean for best results.
- Refer to the cutting charts in this manual vs. the ones provided by Hypertherm. The Dragon A400 typically requires different settings than Hypertherm recommends.



*Recommended gas pressure setting for Hypertherm units is 90-135 psi.*

## Cutting Speed

- Ensure cutting speed is set properly for the material thickness and amperage being used.
- Cutting too slow will result in a larger kerf. Cutting too slow will also cause the arc to start to travel out to the sides of the material as it looks for ground. This can damage the shield.
- Cutting too fast, or cutting too high, can cause slag to build up on the consumables because the plasma arc will not be able to force the slag through the kerf.

## Gas Supply

- Too much gas pressure can make it difficult for the Torch to fire. Also, too much gas pressure will cause rapid deterioration of the electrode.
- It is important to keep the air supply for the plasma system clean and free of moisture and oil.

## Torch Mounting

- Torch collision can cause physical damage to the consumables. Torch collision can damage the Torch and lead to complete Torch replacement. Always ensure Torch height is set correctly. Ensure Torch is mounted on the machine correctly.
- Ensure the Torch is tight in the Toolhead and not vibrating during the cutting process. If the Torch is not secured properly and moves even slightly during the cutting process it can result in poor cut quality.

## Cut Settings

- Best cut quality is usually achieved when amperage is set to 95-percent of the nozzle's rating. If the amperage is too low the cut will be sloppy. If the amperage is too high it will shorten the nozzle lifespan.
- Ensure the Torch does not pierce too low. Optimum pierce height is 1.5 to 2-times the cut height. Piercing too low can cause molten metal to spatter on the nozzle and shield.
- Program Lead-in and Lead-out properly to avoid stretching the arc. If the Torch tries to arc and it is not centered over the material the arc will cut into the sidewall of the nozzle and damage it.
- Moving the Torch to the right results in the squarest cuts. The majority of swirl rings spin the

plasma stream clockwise. However, Torch cutting direction depends on the project and the cut desired by the Operator.

- Ensure the consumables match the amperage set for the plasma cutting machine.

### **Kerf Width**

Kerf is the width of the material that is removed during the plasma cutting process. The Operator can adjust Kerf Width settings in Bend-Tech Dragon software in Tube Library > Machine > Basic Settings > Kerf Width.

- Bend-Tech recommends setting Kerf Width at 0.06. However, for most accurate cutting, it is recommended that the Operator make a test cut and measure the Kerf Width and adjust the Kerf Width setting accordingly.

### **Torch Maintenance**

- Bend-Tech recommends the Operator keep a log of Torch consumables. Record the lifespan of consumables as well as amperage, material thickness and type of material. A log will help the Operator keep track of consumables and optimize their lifespan.
- When assembling the Torch it is important that all the consumables are assembled properly, that everything fits together snug and nothing is crooked. When lubricating o-rings always use o-ring lubricant. Apply just enough to make the o-ring shiny. Do not use grease - this can cause uncontrolled arcing within the Torch and ultimately Torch failure.
- Keep Torch consumables clean. Remove any excess slag, dirt or grease and wipe clean with electronic contact cleaner or hydrogen peroxide on a regular basis.



## Cut Charts

Follow specifications in the cut charts provided by the manufacturer.

### Select the appropriate settings for:

- Material type
- Material Thickness
- Desired cut quality
- Productivity goals
- Type of gas being used
- Gas pressure
- Torch distance or arc voltage
- Cutting speed
- Consumables being used

### Cutting Speed

<b>High-speed dross</b>	Cutting speed too fast - arc is lagging behind. Usually uniform buildup that is difficult to remove.
<b>Low-speed dross</b>	Cutting speed too low - arc jumping ahead. Large droplets that are easier to remove than high-speed but not ideal
<b>Top spatter</b>	Cutting speed too fast



# Cutting Charts



## Before Using these Charts

---

The cutting charts in this guide have been compiled based on Hypertherm recommended settings as well as Bend-Tech experience in using and testing the Dragon A400. Bend-Tech is providing these charts as a baseline. These settings may need to be adjusted based on Operator preference to optimize machine performance.

The Dragon A400 is programmed with preset cut values. These values are a baseline that will get the Operator up and running. Cut settings can be adjusted in the Tube Library in the Machine, Lead In/Out and NRC interfaces.

## 45 AMP: Mild Steel

45 Amp: Mild Steel					
Material Thickness	Cutting Height	Pierce Height	Dwell Time	Cutting Feed Rate	Cutting
(in.)	(in.)	(in.)	(sec)	(ipm)	AMPs
0.0625	0.06	0.09	0	80	30-34
0.125	0.07	0.1	0	65	32-36
0.1875	0.08	0.11	0	50	35-40
0.25	0.09	0.12	0.25	35	42-45
0.375	0.09	0.12	0.5	25	45

45 Amp: Mild Steel - <i>Fine Cut Consumables</i>					
Material Thickness	Cutting Height	Pierce Height	Dwell Time	Cutting Feed Rate	Cutting
(in.)	(in.)	(in.)	(sec)	(ipm)	AMPs
0.0625	0.05	0.09	0	80	30-34
0.125	0.06	0.1	0	65	32-36
0.1875	0.07	0.11	0	50	35-40
0.25	0.08	0.12	0.25	35	42-45
0.375	0.08	0.12	0.5	25	45



*Re-do the Torch Mount when changing between fine cut consumables and regular consumables.*

## 65/85 AMP: Mild Steel

65/85 Amp: Mild Steel					
Material Thickness	Cutting Height	Pierce Height	Dwell Time	Cutting Feed Rate	Cutting
(in.)	(in.)	(in.)	(sec)	(ipm)	AMPs
0.0625	0.06	0.09	0	80	30-34
0.125	0.07	0.1	0	65	32-36
0.1875	0.08	0.11	0	60	42-45
0.25	0.09	0.12	0.25	60	55-60
0.375	0.09	0.12	0.5	60	65

65/85 Amp: Mild Steel - <i>Fine Cut Consumables</i>					
Material Thickness	Cutting Height	Pierce Height	Dwell Time	Cutting Feed Rate	Cutting
(in.)	(in.)	(in.)	(sec)	(ipm)	AMPs
0.0625	0.05	0.09	0	80	30-34
0.125	0.06	0.1	0	65	32-36
0.1875	0.07	0.11	0	60	42-45
0.25	0.08	0.12	0.25	60	55-60
0.375	0.08	0.12	0.5	60	65



*Re-do the Torch Mount when changing between fine cut consumables and regular consumables.*

**Additional Cutting Feed Rates for 65/85 Amp: Mild Steel**

<b>65/85 Amp: Mild Steel - Fine Cut Consumables</b>					
<b>Material Thickness</b>	<b>Cutting Height</b>	<b>Pierce Height</b>	<b>Dwell Time</b>	<b>Cutting Feed Rate</b>	<b>Cutting</b>
(in.)	(in.)	(in.)	(sec)	(ipm)	AMPs
0.0625	0.05	0.09	0	80	30-34
				100	35-38
				120	38-45
				140	45-55
0.125	0.06	0.1	0	65	32-36
				80	36-40
				100	40-45
				120	45-50
0.1875	0.07	0.11	0	60	42-45
				80	45-55
				100	55-60
0.25	0.08	0.12	0.25	60	55-60
				80	65
0.375	0.08	0.12	0.5	60	65

# Troubleshooting

## Diagnosing Cutting Issues

Symptom	Cause	Corrective Action
Cope at both ends of the tube are not the same rotation	Material not properly secured in the Chuck	Ensure material is tight in Chuck. If using spacers for the material ensure the measurements are correct.
	Settings in Nesting Project not correct	Check the part in Edit Flat.
	Y Motor Backlash incorrect	Remove Trolley Cover and observe backlash on Y motor. If incorrect adjust on machine. Use zero backlash in Dragon software.
	Y motor loose/Drive Gear loose	Remove Trolley Cover and perform visual and physical check of Y motor and Y Motor Drive Gear.
	Y motor skipping steps	Check Ethernet connectivity; Check to ensure Breakout Board is seated in Motor Drivers properly; Ensure consistent power to machine. If Y motor is skipping steps, it is most likely Y acceleration or RPM is set too high. Adjust in Dragon software.

Symptom	Cause	Corrective Action
Cut quality issues	Torch consumables worn out	Inspect Torch consumables, measure pit depth of electrode.
	Incorrect Torch height settings	Check settings in software and Torch height on machine.
	Incorrect cutting speed	Ensure cutting speed is correct in regard to amperage and material thickness.
	Incorrect cutting amperage	Ensure consumables match the amperage settings on the machine. Set cut speed appropriately.
Round holes are coming out oval	Cutting speed	Adjust material feed rate.
	Material loose in Chuck	Ensure material is secure in Chuck.
	Gate too tight or too loose	Ensure material moves freely in Gate with no play.
	Backlash	Perform a Backlash Test in Machine Library > Mechanical Settings. Remove the Trolley cover and perform a visual inspection of backlash. Ensure all motors are tight.



*In some cases, on thicker material, round holes may appear oval. However, while the hole may appear oval on the OD of the material, the hole will be round on the ID of the material. This is part of the normal cutting process of the Dragon A400.*

Symptom	Cause	Corrective Action
Machine cutting and then returning to previous engraving	Order of actions incorrect in software settings	Change order of actions Machine Library > Basic > Default Process Order.
Off center holes in rectangular material	Gate out of position	Check homing sensors, re-home, load material with Gate in home position and perform side offsets calibration.
	Machine not homed properly	In the Machine Control interface click Home All Axis



Symptom	Cause	Corrective Action
Jagged Cuts	Material feed rate too high	Ensure consumables match the amperage settings on the machine. Set cut speed appropriately.
	Amperage incorrect	Ensure amperage is set to cutting charts in this manual. It is possible the amperage may need to be adjusted by the Operator to achieve best results.
	Gate too tight on material	Ensure material moves freely in Gate with no play.
Torch Not Firing	Hypertherm not powered on	Check Hypertherm power switch; check power cable; check cable to Control Box.
	Torch set too high	Check Torch height with feeler gauge; perform Torch Mount procedure.
	Improper air supply	Check air supply, check air pressure.
	Consumables	Remove and inspect Torch consumables. Refer to Consumables Guide.
	Bad ground	Ensure ground clamp is connected; ensure ground cable is secured on Trolley; ensure alligator clamp is securely connected to ground cable on Dragon A400.
Torch Colliding With Material	Torch wand not switched on	Check switch on Torch wand.
	Material selected in software does not match material loaded into machine	Check to ensure material chosen in software matches material loaded in the machine.
	Material dimensions entered incorrectly in Tube Library	Confirm material dimensions are accurate with those entered in Tube Library.
	Torch set improperly	Perform Torch Mount procedure.
	Side Offsets calibration not performed	Perform Side Offsets calibration for the given material.
Gate out of position	Perform Gate homing procedure.	

# Plasma System Gas Supply

## Plasma System Gas/Air Supply

Proper gas or air supply for the plasma cutting process is critical to achieving precise, consistent cuts in material as well as for maximizing the life of the consumables and Torch. Plasma systems use pressurized gas/air to create the plasma jet, initiate the arc and maintain the plasma jet during the cutting process, as well as to cool the unit after cutting. For the Powermax45, Hypertherm recommends a gas/air supply that can maintain 6 cfm at 90 psi. For larger machines such as the Powermax65 and Powermax85, these number may vary slightly but are in the same ballpark. This equates to a significant gas/air flow that must be maintained for extended periods. This can be a challenge.

### **Some simple rules to follow include:**

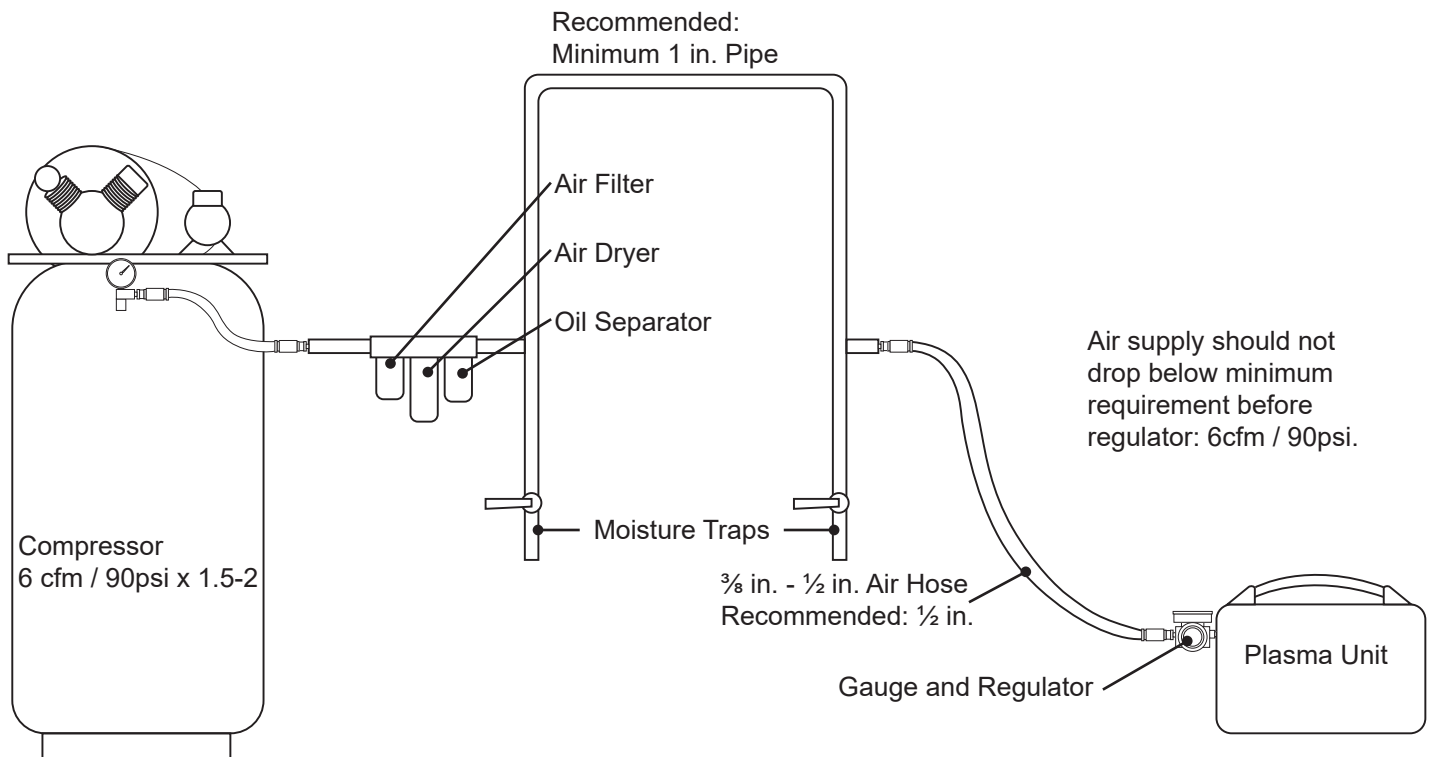
- Use as short a line as possible between the compressor and the plasma unit.
- Minimize junctions and fittings
- If the compressor can handle it, raise the pressure and use a larger line to the plasma unit, then control the pressure at the plasma unit with a secondary pressure regulator.

It is important to note that an air compressor may have a manufacturer rating of 6 cfm at 90 psi, but that does not necessarily mean the compressor can maintain those figures during extended use. For example, approximate pressure loss for a 100 ft. run of ½ in. pipe at 100 psi gauge pressure would be 44 psi. Even if the compressor shows the specified numbers at the compressor outlet, a plasma unit at the end of that 100-foot run would only see 56 psi. To

maintain 100 psi at the end of the 100 ft. run the compressor would be required to have a 134 psi gauge pressure. This is assuming a straight run with no fittings.

For high-volume cutting it is recommended that the user have a compressor that is 1.5-2 times the minimum system requirements. Optimum air supply setup for the Dragon A400 using a Hypertherm unit is a compressor that can maintain 180 psi and 12 cfm.

Bend-Tech recommends filtering gas/air to ISO 8573.1 Class 1.4.1 standards for plasma cutting operations. Filter systems that meet these requirements are readily available online and from many commercial outlets.



### **Proper gas delivery is critical to maximizing the life of consumables:**

- Ensure there are no leaks or restrictions
- Ensure all regulators and gas lines are sized properly
- For best results, use pure gas, or gas that has been processed through a filter, dryer and oil separator
- Ensure gas pressure is set correctly







**Bend-Tech, LLC**

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