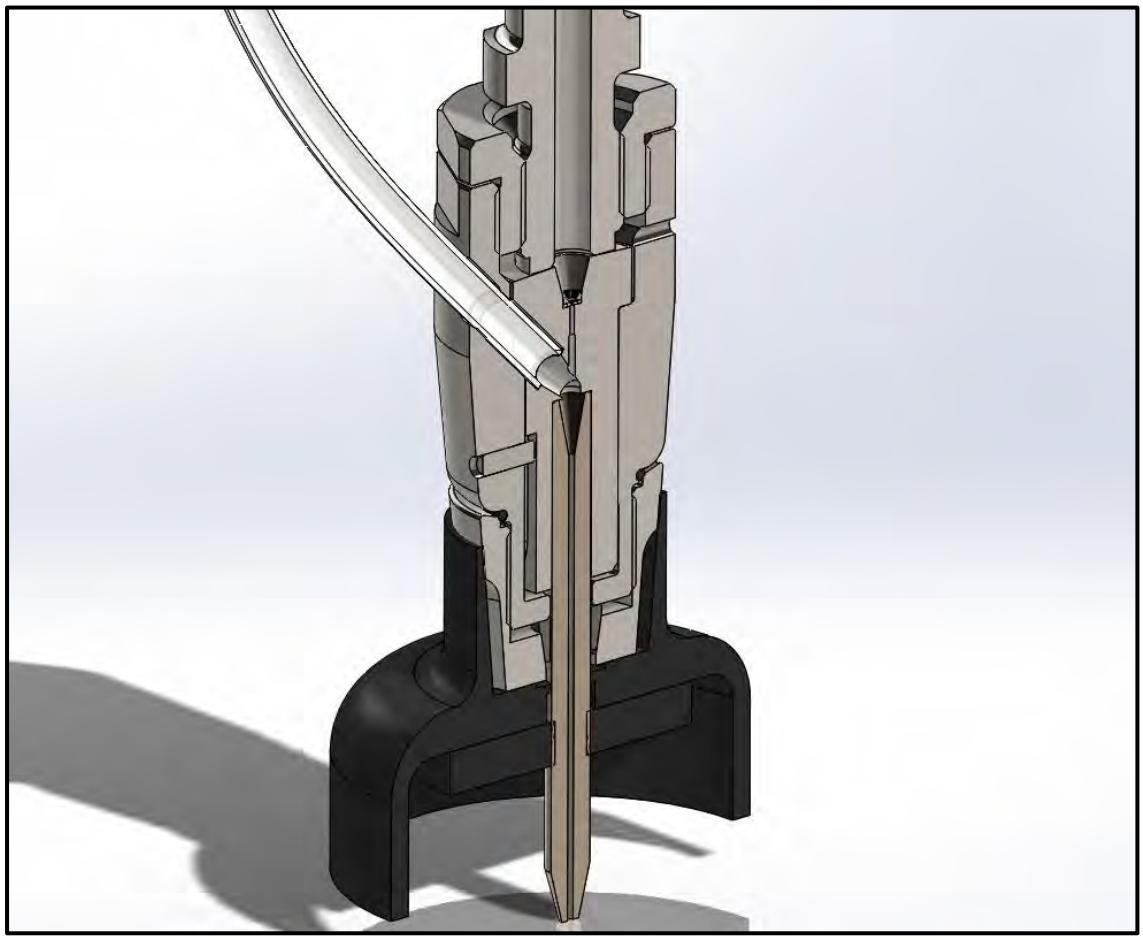
International Waterjet Parts, Incorporated

Designed Precision - Evolution Abrasivejet Cutting Head

User Manual



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1 Introduction

1.1 Overview

International Waterjet Parts, Inc. is proud to offer the **Designed Precision - Evolution** ("**DP-Evolution**" or "**DP-E**" for short) as the next step in the evolution of abrasivejet cutting technology. This cutting head provides the maximum flexibility for your needs while maintaining high quality and value.

1.1.1 Design Concept

The DP-E is designed to minimize the exposure of the cutting head body from abrasive media by extending the feed tube interface all the way in to the mixing chamber, as shown in Figure 1:

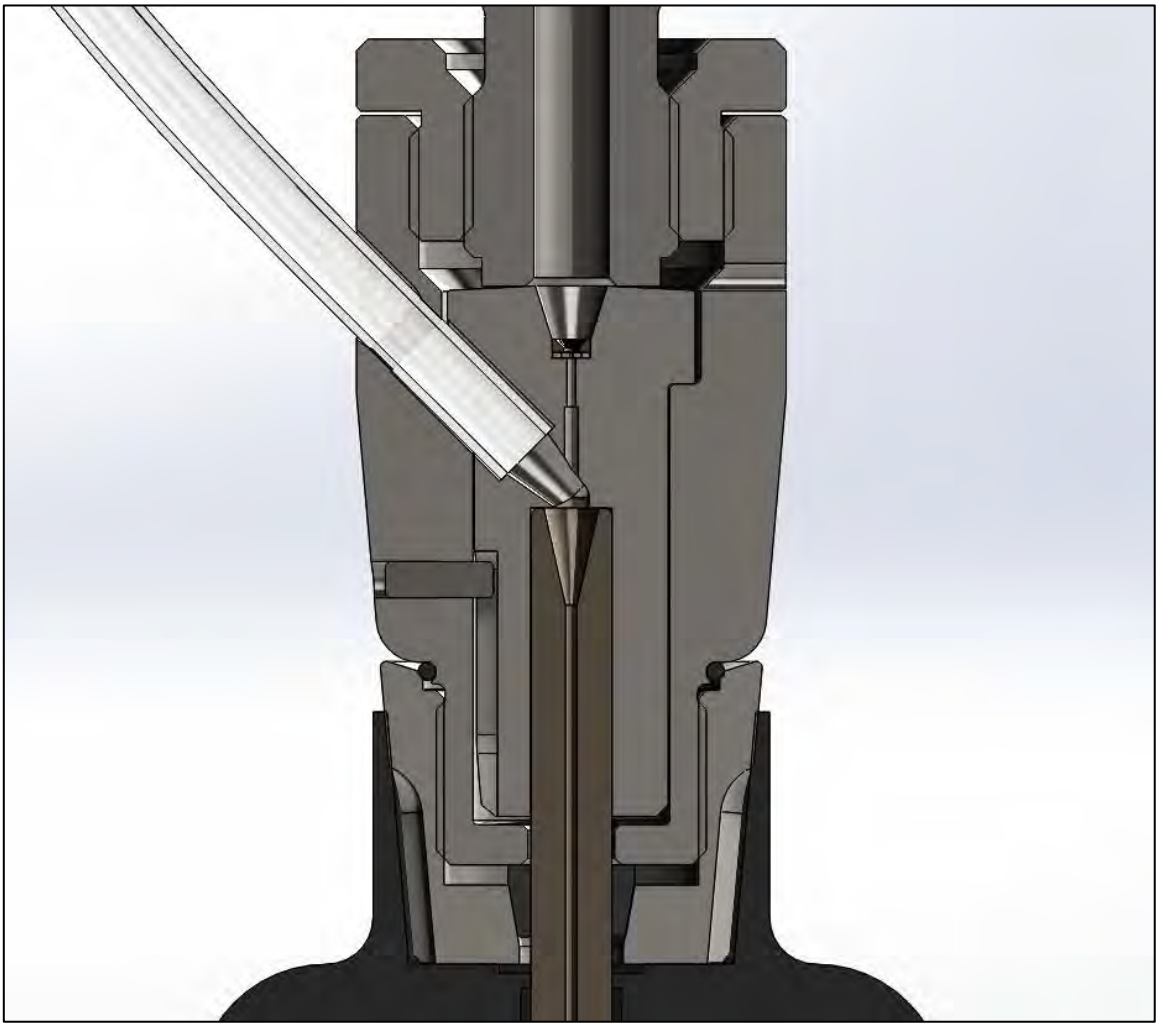

Fig. 1 – Section view of the DP-E with a sapphire/ruby cartridge, standard Flow-style extension tube, and a 0.281" diameter abrasive nozzle

Notice how the feed tube seat is fully enclosed inside the cartridge. This interface is IWP's **patent-pending** technology that revolutionizes how cutting heads operate. The internal geometry is modeled after IWP's DP3000 insert design, proven in the industry for over a decade to maximize abrasive efficiency so you can use less abrasive media or cut faster.

The DP-E body is **fully compatible** across sapphire, ruby, and diamond cartridges. This gives you flexibility if you have a short job that you don't want to put hours on your diamond, just install a sapphire/ruby, and save the diamond for the long jobs to minimize downtime and tool changeover.

The cartridges are designed to provide all alignment of the waterjet stream from the orifice to the abrasive nozzle in one part, eliminating stacked tolerances of multiple part assemblies. IWP was the first in the waterjet industry to bring this concept to market with the iDP3000 Integrated Diamond Abrasive Cutting Head. Now, you have this precision alignment for sapphire, ruby, and diamond options for the first time.

The DP-E is fully index-able with respect to the orientation of your abrasive feed tube. You will not need any additional parts to be able to orient the abrasive inlet whichever way you need.

1.2 DP-Evolution Features and Options

1.2.1 Sapphire/Ruby

When you purchase a Sapphire or Ruby DP-E Kit, you receive two free sapphire or ruby cartridges of any available size. Each cartridge is manufactured and tested to ensure precise stream alignment.

1.2.2 Diamond

In a Diamond DP-E Kit, you receive a diamond cartridge covered under warranty to last at least 500 hours at 60,000psi operating pressure when used in conjunction with a short stop filter assembly (p/n F300-H0034-0000). In order for the cartridge to live up to its full potential, it is imperative that your system's water quality be excellent.

1.3 Operational Overview

This section explains briefly the general concept of the DP-Evolution. Later sections go more in depth with each component.

1.4 Safety

When operating your waterjet system and working around the cutting head, please be careful since even a water-only stream can pierce flesh very easily. Always use a hand valve to isolate the high pressure water from the cutting head even if the On/Off Valve actuator is in the "water off"

position. Ideally, the pump should be off and the system relieved of stored energy via a bleed down valve or opening the On/Off Valve to let excess pressure escape through the cutting head.

1.4.1 Emergencies

If a person or animal is injured by a waterjet stream, special precautions must be taken to reduce the instance of life-threatening infections. Since a waterjet stream can penetrate organic flesh very easily and very deep, the patient may encounter microbes and bacteria that are not normally exposed to different regions of the body. Seek immediate medical care in the event of an accident.

1.5 Technical Support

IWP is committed to provide superior technical support to its customers. If you have any issues with your DP-Evolution, don't hesitate to contact us via phone, email, video chat, or whatever you need to get it fixed. We are available Monday through Friday from 7:00am to 4:00pm (Pacific Time Zone).

Phone – 1-866-302-3284 or 1-208-666-6000

Fax – 1-208-667-7595

Email – lwilliamson@optaminerals.com

Web – www.iwpwaterjet.com

Address – 3884 North Schreiber Way, Suite 204
Coeur d'Alene, ID 83815
United States of America

1.6 Spare Parts

If you need any spare parts for the DP-Evolution, IWP carries well-stocked inventory available on demand. Please call us or visit our website for more information.

2 Installation

2.1 Overview

There are many conditions that must be met in order for the DP-Evolution to be installed properly. It is important to have personnel who are knowledgeable about, and capable of working on, waterjet systems to perform the installation of the DP-E.

2.2 Installation Summary

Before installing the DP-E, ensure that your On/Off Valve and Actuator are in good working order. Also, ensure that your extension tube has good sealing surfaces and thread appearance. Look for signs of galling and pitting. If you are installing a brand new head, we recommend replacing the old extension tube with a new one if it hasn't been done in a while.

2.2.1 Assembly

When assembling the DP-E, refer to Figures 2 and 3:

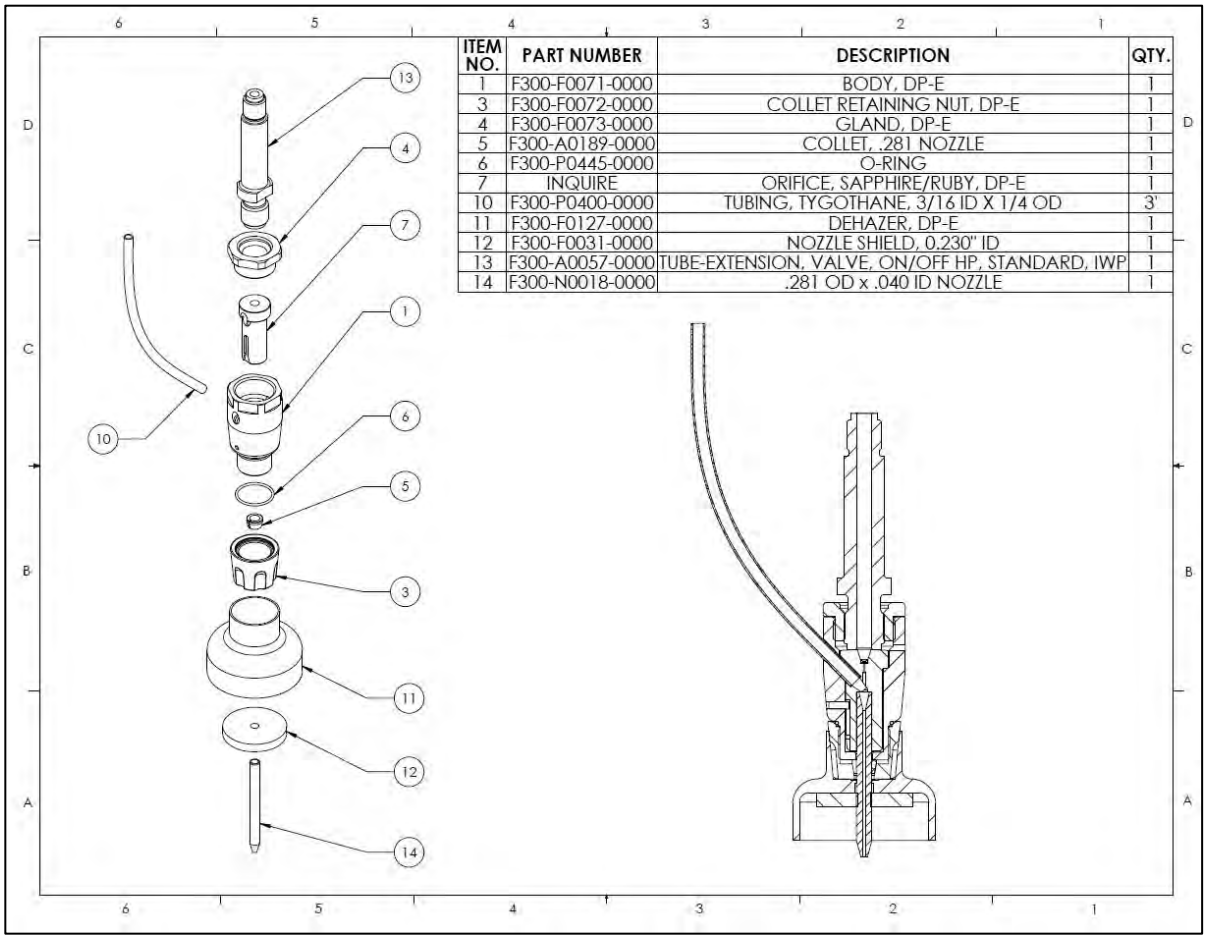

Fig. 2 – Assembly view of the DP-E with Flow-style Extension Tube and typical abrasive nozzle

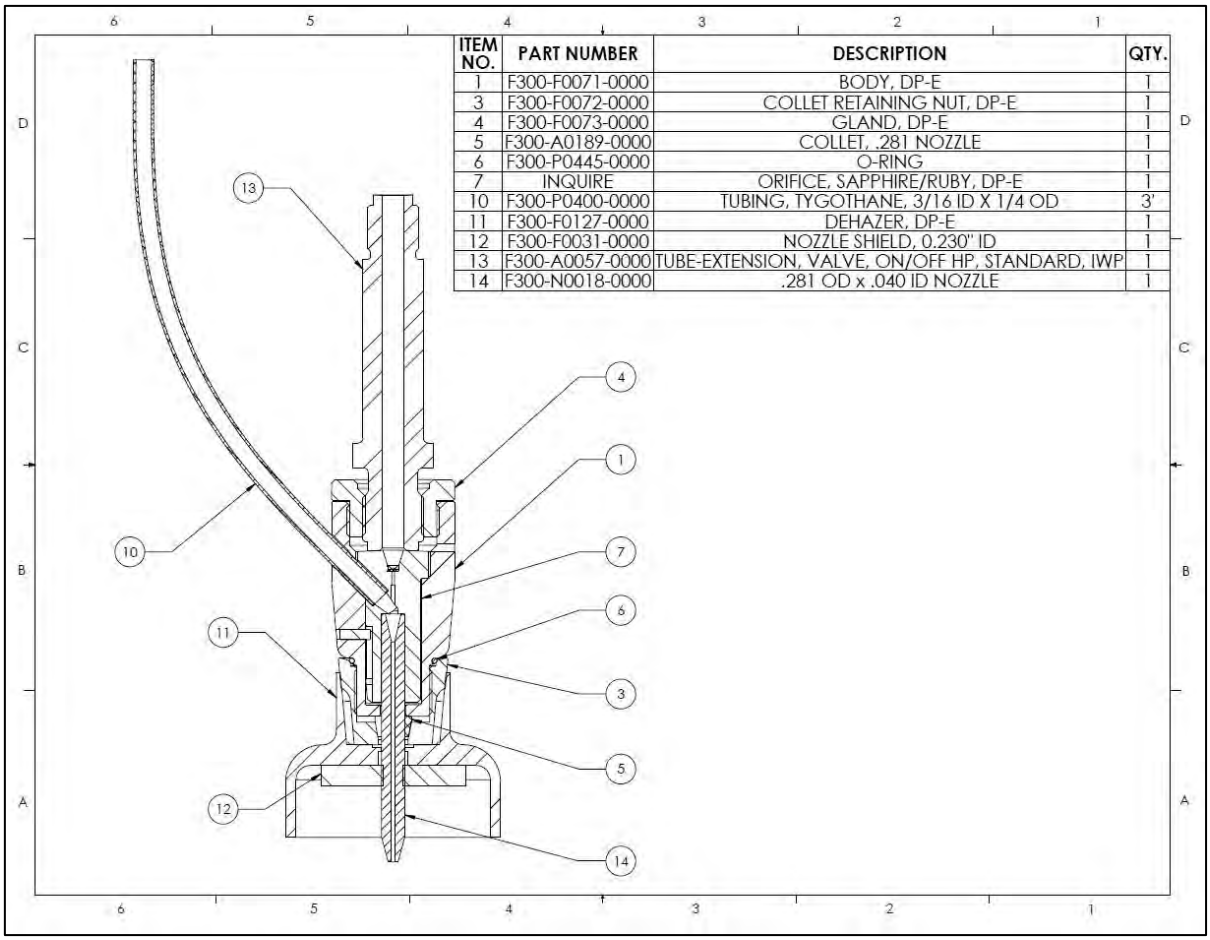

Fig. 3 – Section view of the DP-E with Flow-style Extension Tube and typical abrasive nozzle

1) Insert the Cartridge (7) in the DP-E Body (1) by first aligning the slot in the Cartridge (7) to the locating pin in the Body (1). Make sure there is no debris on the surfaces where the Cartridge (7) contacts the Body (1).
2) Apply Blue Goop to the external threads on the Gland (4), and screw into the Body (1) until it bottoms out. Back off the Gland (4) until the hex flats are aligned with the Body (1). This is the base orientation of the abrasive inlet.
3) Apply Blue Goop to the Extension Tube (13) threads and the sealing surface, and screw the Body (1) and Gland (4) together onto the Extension Tube (13). The hex flats on the Body (1) and Gland (4) are sized such that a single 1-3/8" wrench can span across both parts.
4) Tighten the Body (1) + Gland (4) onto the Extension Tube (13) 1/8th of a turn past hand tight, corresponding to no more than 50ft-lbs. If you need a different orientation of your abrasive inlet, back off the Gland (4) by one hex (1/6th of a turn) at a time and re-tighten the Gland (4) and Body (1) onto the Extension Tube (13). Do not exceed a maximum spacing of 0.150" between the Gland (4) and the Body (1).
5) Install the O-Ring (6) onto the Body (1).

6) Place the Collet (5) in the Collet Retaining Nut (3) and screw onto the Body (1) until the Collet (5) just contacts the Body (1).
7) Slide your Abrasive Nozzle (14) into the collet until it contacts the Cartridge (7).
8) While holding the Abrasive Nozzle (14) with upward pressure against the Cartridge (7), tighten the Collet Retaining Nut (3) with your hand until the Abrasive Nozzle (14) is secure.
9) Slide the Dehazer (11) onto the Abrasive Nozzle (14).
10) Slide the Blast Disk (12) onto the Abrasive Nozzle (14) and seat it against the bottom surface of the Dehazer (11).
11) Insert the Feed Tube (10) into the Body (1). Make sure the end of the tube is cut perpendicular as square as possible. Push the end of the Feed Tube (10) into the Body (1) until it seats against the Cartridge (7). The Feed Tube (10) should extend about 3/4" into the assembly.

2.2.2 Adjustment

In order to take advantage of the **patent-pending** built-in ability to index the cutting head, refer to the following figures to orient the abrasive inlet to whatever direction you require. Note that the Body and Gland hex flats are sized so one wrench can span both parts.

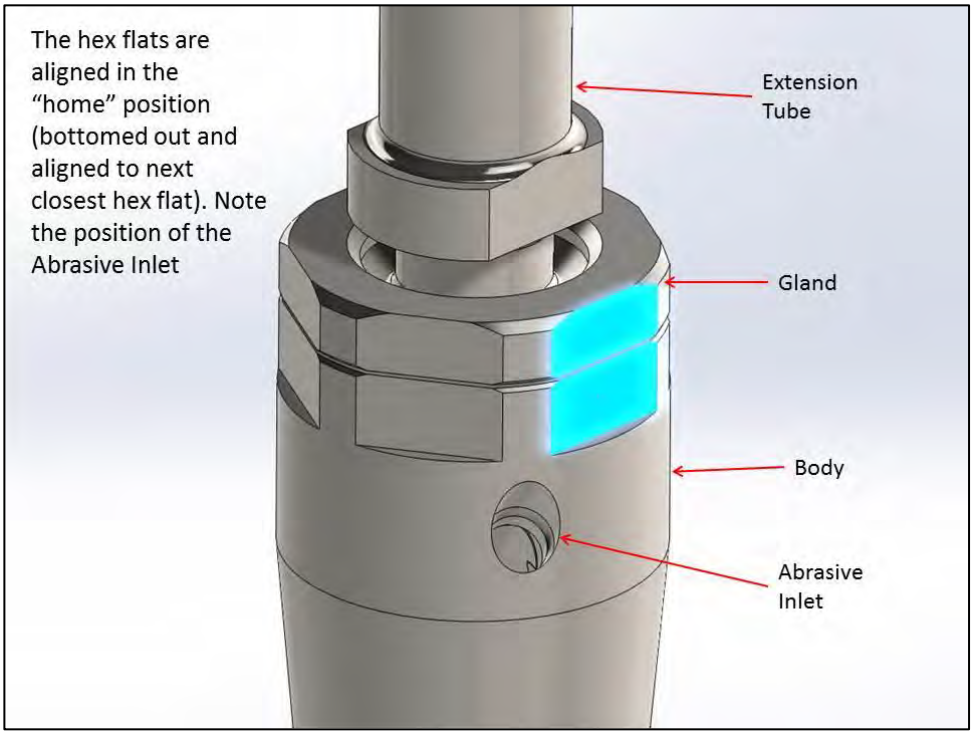

Fig. 4 – DP-E "home" position

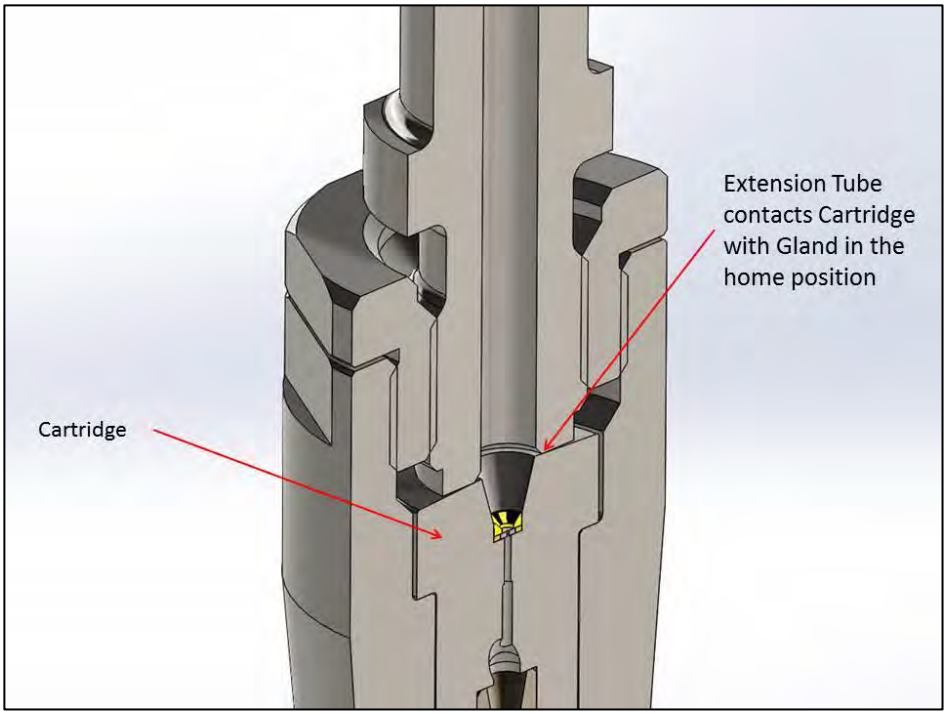

Fig. 5 – Section view of "home" position

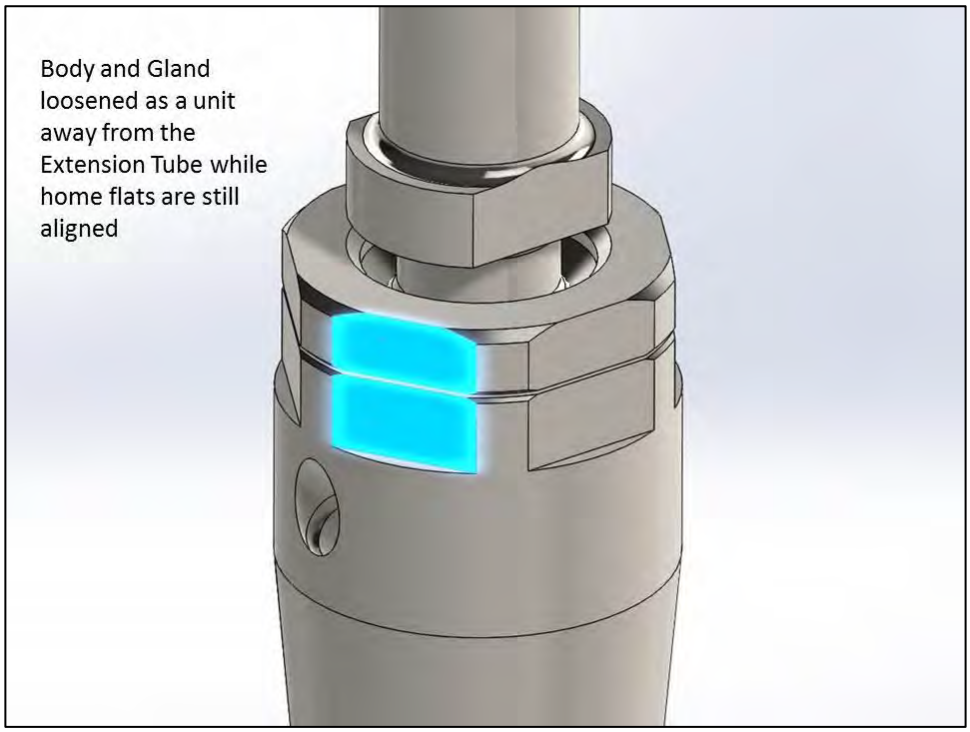

Fig. 6 – DP-E in "home" position loosened from Extension Tube

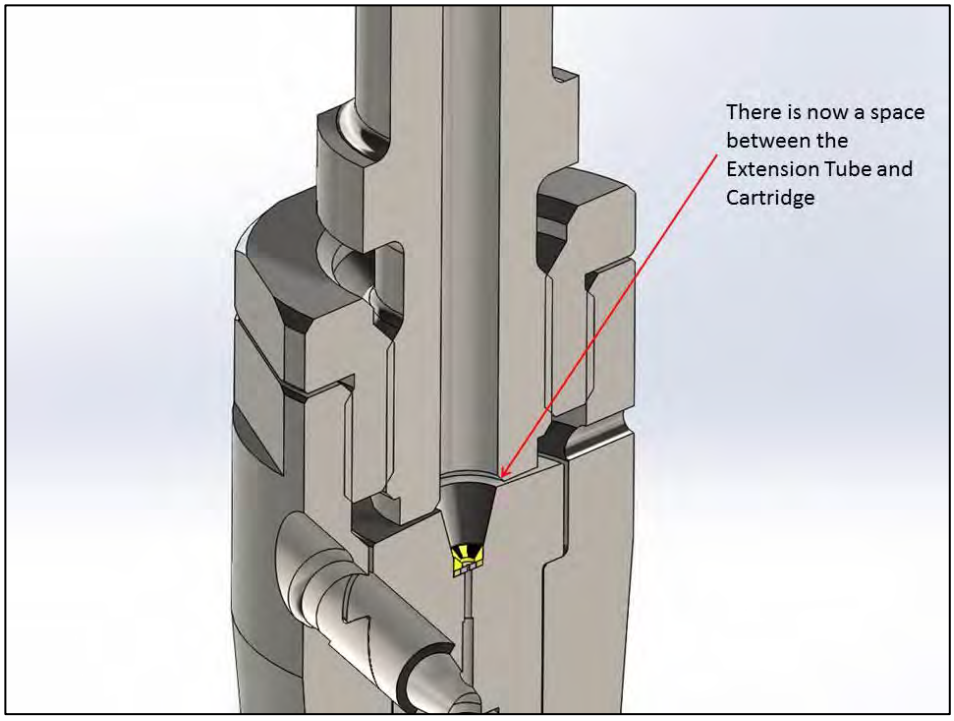

Fig. 7 – Section view of DP-E in "home" position loosened from Extension Tube

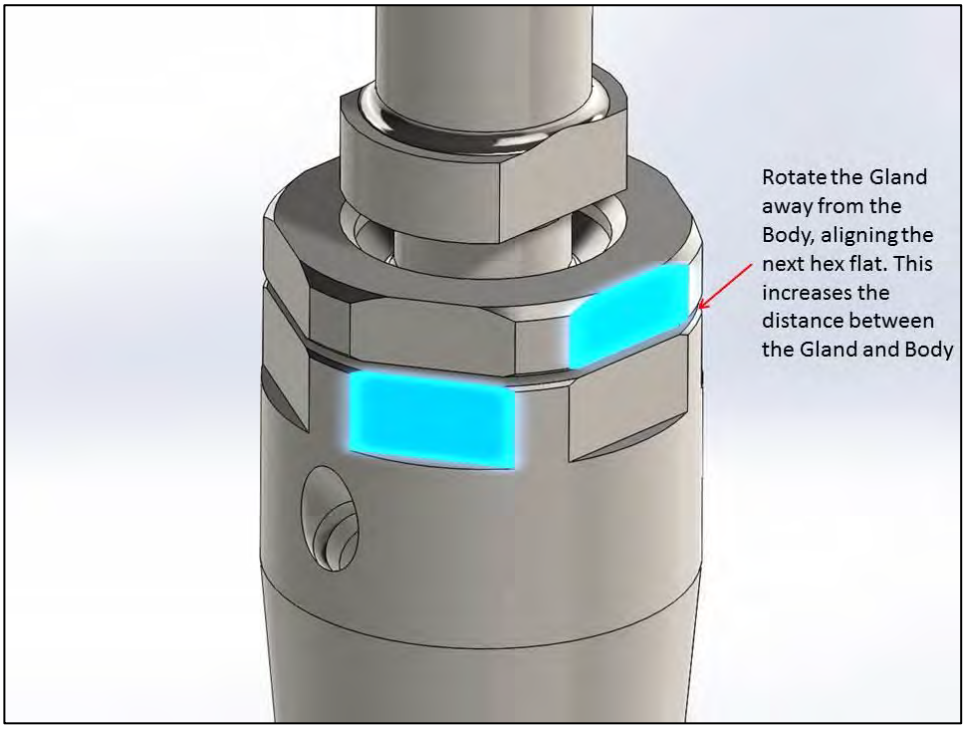

Fig. 8 – Gland loosened from Body

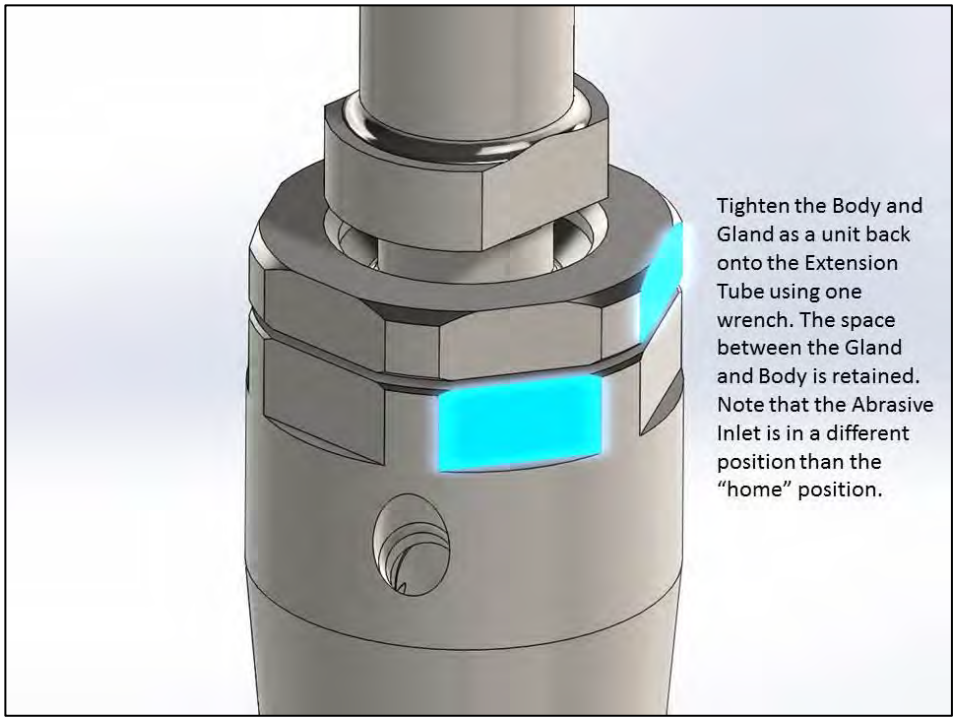

Fig. 9 – Body+Gland tightened together onto Extension Tube in new abrasive inlet orientation

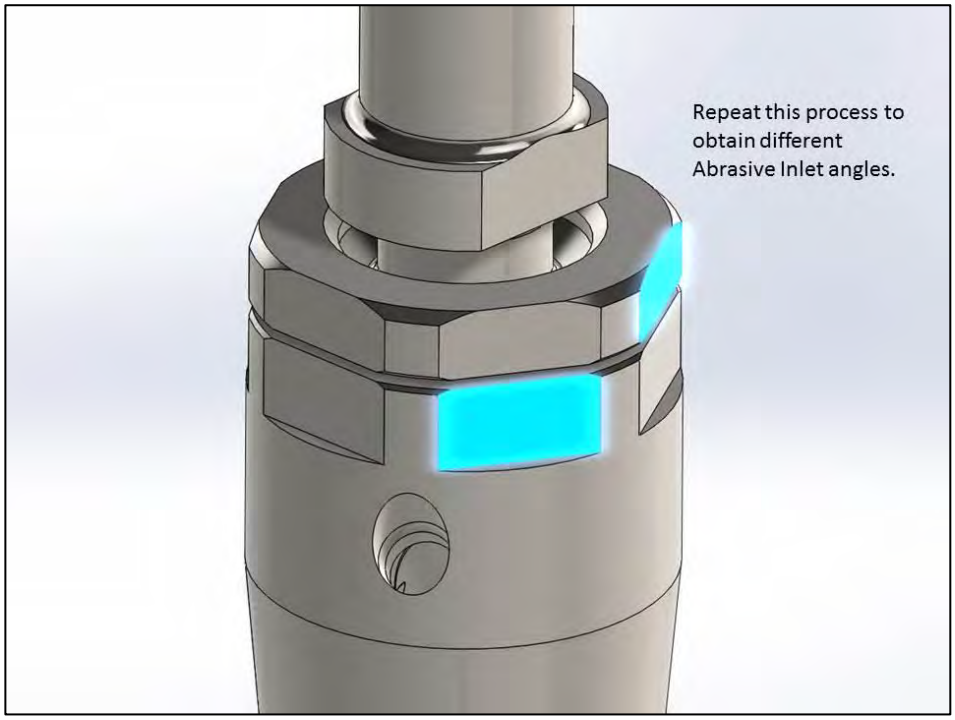

Fig. 10 – New abrasive inlet orientation

2.3 Site Requirements

2.3.1 Waterjet System Components

Certain components in your waterjet system will contribute to how long your cutting head lasts. Water quality is an important factor contributing to cutting head and jewel life. Ensure that all filters are in good condition. We recommend that even if you are using sapphire and ruby cartridges, that you use a short stop filter. This takes the place of the 1/4" Female to 3/8” Male adapter that most On/Off Valves use to interface with the tubing. Replacement filter elements are readily available. Refer to section 5.2.2 for more details.

2.3.1.1 High Pressure Tubing

Another source of premature jewel failure comes from particulates fragmenting from internal high pressure tubing surfaces. Although the material used for tubing is stainless steel, it is only *resistant* to corrosion in the presence of water. Over time, particulates can flake off and settle inside the tubing, and the system must be purged to remove the built-up debris. IWP recommends that the system be purged every time an orifice is changed out. This is especially important when using diamond cartridges, since the life of a diamond is much longer than ruby/sapphire (and thus, the initial investment). In order to purge the system, install an old orifice (with the jewel intact) and run the pump with water on for a few seconds. Then, change out the cartridge and continue cutting.

3 Maintenance

3.1.1 Daily Inspection

Every day, you should verify that the cutting head is tightened sufficiently onto the extension tube before cutting. Whenever you put wrenches on the cutting head and extension tube, ensure all water pressure is bled from the system via a bleed down valve or by turning the water on with the pump **off**. Close the hand valve and test the actuator to ensure it does not leak before changing the cartridge. If you are using a normally closed actuator, make sure your air compressor is on and all air lines are connected. Switch the actuator to the “water on” position before servicing the cutting head. This removes pressure from the On/Off Needle and will prevent any rotation from destroying the On/Off Needle and Seat.

3.1.2 Periodic Inspection

Every so often, check the cutting head for leaks, and keep an eye on the waterjet stream exiting the nozzle. Refer to the Troubleshooting Guide in section 4 for tips on how to diagnose and correct performance issues.

3.1.3 High Pressure System Maintenance

As discussed in the Installation section, all high pressure water components must be in good condition for the cutting head to last as expected. A failure in the high pressure section of your pump can send debris through the high pressure water circuit and damage or destroy your orifice. Minimize this risk by keeping your pump maintained regularly.

4 Troubleshooting

4.1 Troubleshooting Guide

Table 1 shows various fault conditions with the DP-E. Correct as needed.

Troubleshooting Table		
Symptom	**Cause**	**Solution**
Water leak from weep hole	Extension Tube is not seated against cartridge	Tighten Extension Tube or replace.
	Extension Tube and/or Cartridge sealing surface is galled	Remove burrs or resurface the Extension Tube and/or Cartridge sealing faces. Replace worn parts as needed.
	Extension Tube Body is fractured	Replace Extension Tube
Water leak from abrasive inlet hole/Water backing up into feed tube	Abrasive Nozzle is plugged	Remove nozzle, clear obstruction with air or pick, and reinstall.
Water leak at end of nozzle when On/Off Valve is shut	On/Off Valve Seat is leaking	Inspect and replace the appropriate On/Off Valve parts
Stream misaligned	Damaged jewel	Replace cartridge
	Mixing chamber worn	Replace cartridge
	Nozzle worn	Replace nozzle
Improper wear in mixing chamber	Damaged jewel	Replace cartridge
	Worn insert (diamond)	Replace cartridge
	Feed tube is not seated in mixing chamber	Push the feed tube into the head until the end of the tube is seated against the mixing chamber. Make sure the feed tube is cut as square as possible.
Garnet not feeding	Flow rate exceeds DP-E capacity	Adjust your mini hopper so garnet does not collect in the feed tube
	Water backwashed into feed tube/mini hopper, causing clumping	Clean mini hopper and feed tube. Ensure they are completely dry before reinstalling.

Table 1 – DP-E fault symptoms, causes, and corrective actions

5 Specifications

5.1 Overview

In order to achieve the longest life out of the DP-E (and thus minimize operating costs), certain criteria must be met. Every waterjet system is different, and some components may not operate in their ideal state. If you follow these specifications, you will reduce the risk of premature component failure.

5.2 Installation Specifications

5.2.1 Equipment Dimensions

Refer to Figure 4 for the overall dimensions of the cutting head:

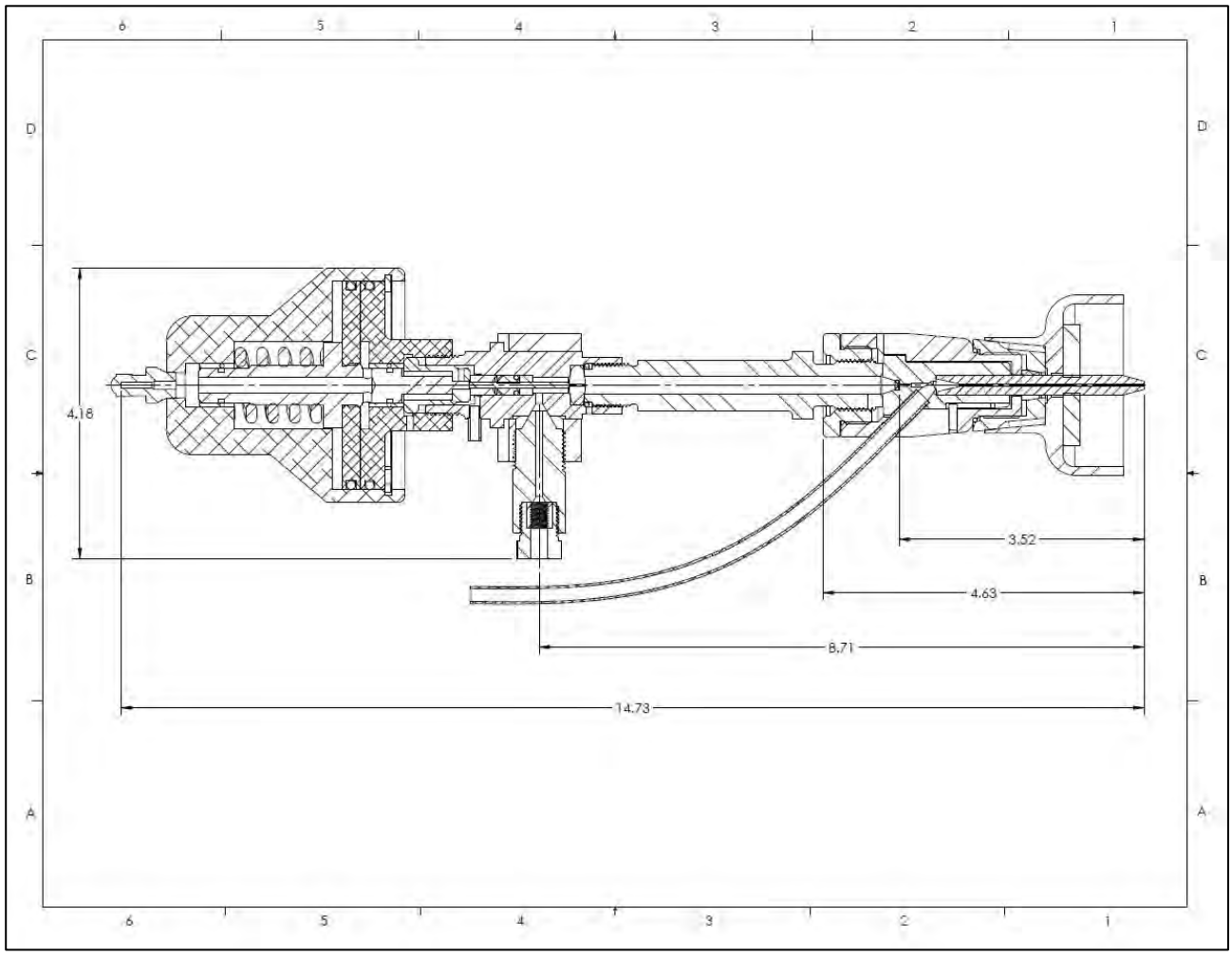

Fig. 11 – Overall dimensions of a DP-E with Flow-style Extension Tube, On/Off Valve, and Actuator Assembly

5.2.2 Service Connections

Flow-style extension tubes used widely throughout the industry have 3/4-16 threads. IWP has chosen to adopt this thread as the standard connection for cutting heads. Adapters for other threads are readily available to fit a variety of On/Off Valve bodies.

Most On/Off Valves use a 1/4" Female to 3/8" Male adapter, assuming you are using 1/4" tubing to supply the cutting head with water. We highly recommend using a short stop filter assembly (p/n F300-H0034-0000) to protect not only your cutting head components, but also your On/Off Valve components. Refer to Figure 5 for more details:

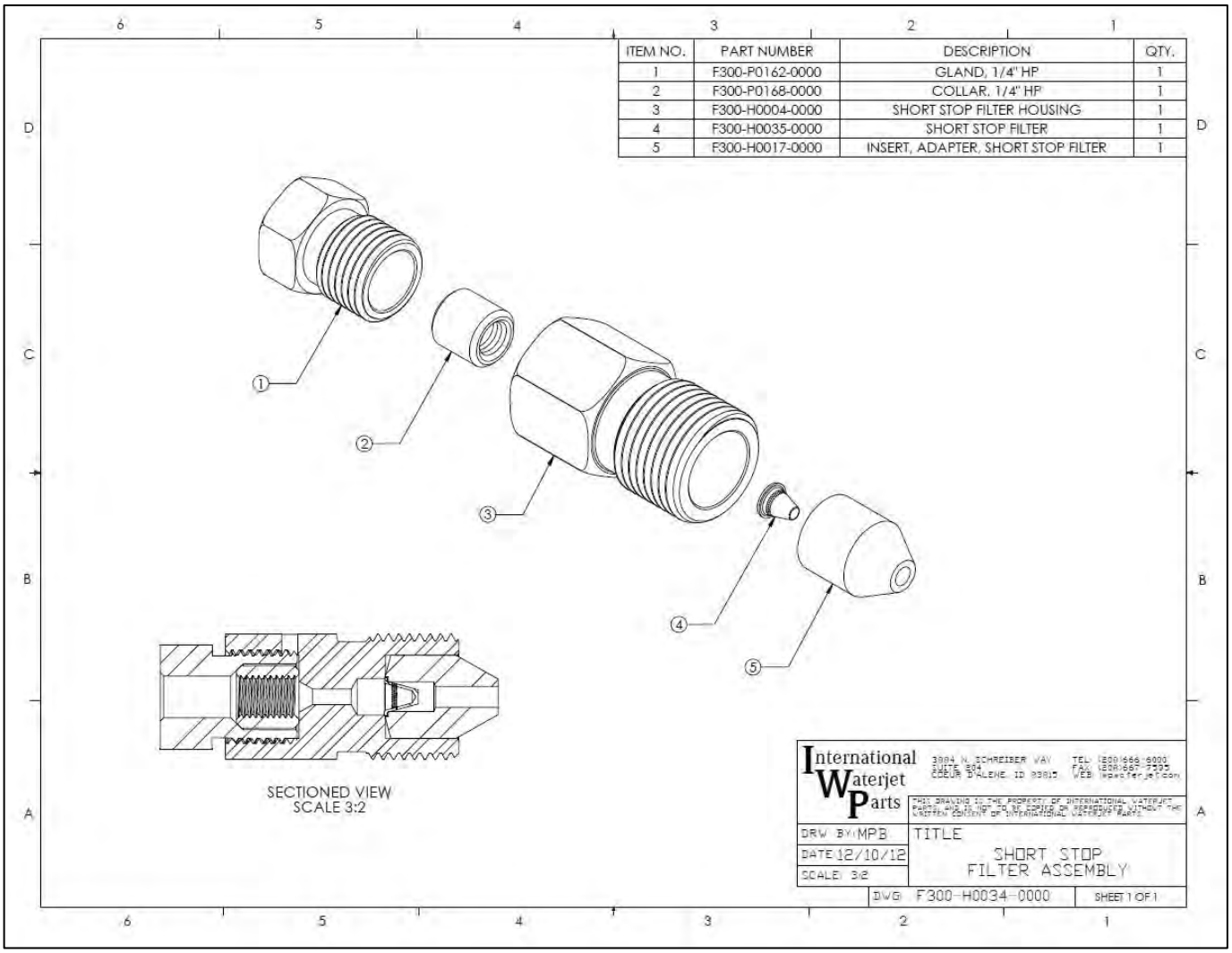

Fig. 12 – Short Stop Filter Assembly

5.3 Water Quality Specifications

Most waterjet pumps provide an internal filter bank to filter the inlet water supply down to 0.5 micron. We recommend that the final level of filtration be no greater than 1 micron. Filters should be checked periodically for blockages and general wear, and should be changed regularly. Poor water quality is the leading cause of premature jewel failure, even in diamonds.

5.4 Orifice Capacity

IWP can supply orifices from 0.003" [0.08mm] up to 0.024" [0.61mm]. Common sizes between 0.010" [0.25mm] and 0.018" [0.46mm] are readily available; any uncommon size in ruby/sapphire can be assembled with a short lead time. Uncommon diamond sizes have a longer lead time.

Choose an orifice size that will provide the optimal cutting power to your work piece. Refer to Table 2 to select the appropriate orifice size for the flow rate of your pump. Note that these values are for one cutting head. As a reference, most 50hp pumps can provide between 1 to 1.1 gallons per minute of water at 55,000 to 60,000psi.

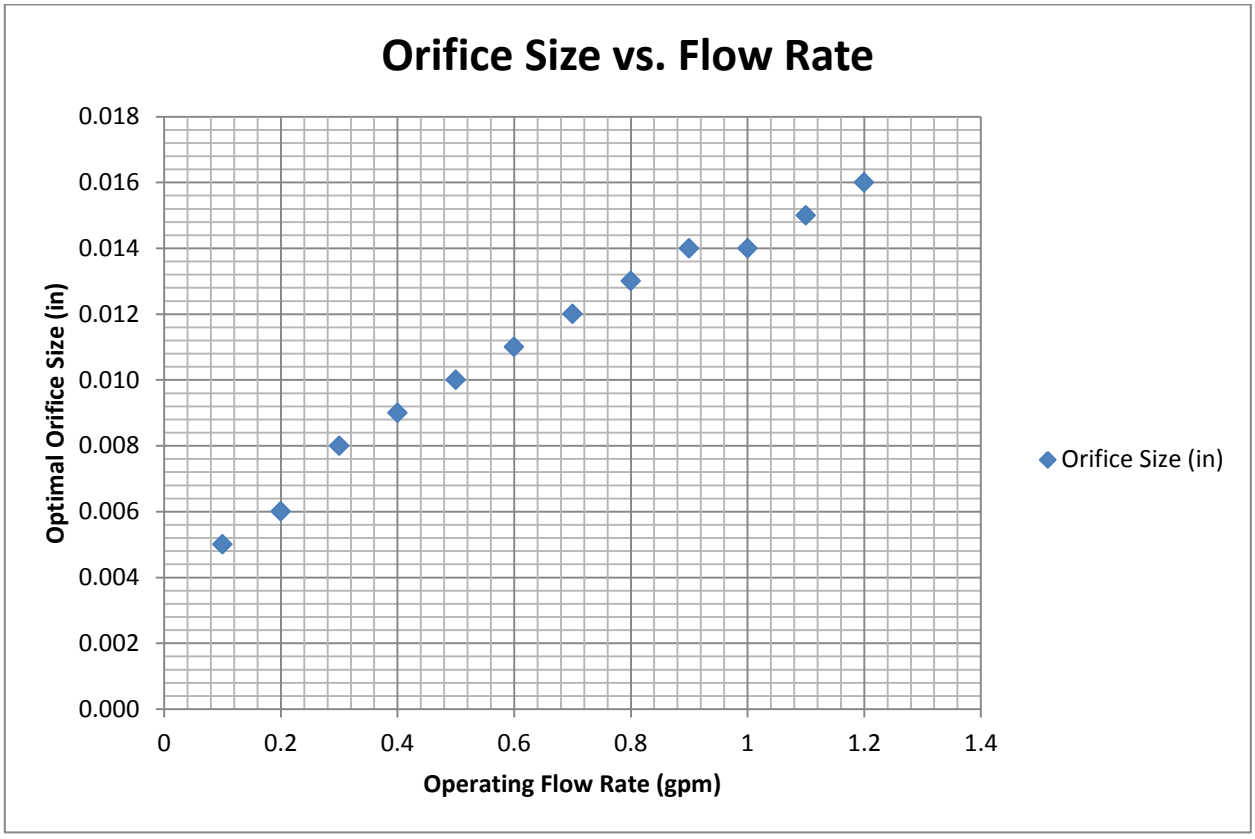

Table 2 – Optimal orifice sizes at a specified flow rate

5.5 Torque Specifications

Follow these guidelines when installing the DP-E. Always apply anti-seize compound to all stainless steel threads. You can use Blue or Pure Goop to protect stainless steel threads and sealing surfaces.

5.5.1 Gland to Cutting Head Body

The gland, p/n F300-F0073-0000, does not need to be tightened onto the body (F300-F0071-0000). Run the gland all the way down until it bottoms out on the body, then back it off until the hex flats line up. The widths of the body and gland hex flats are sized to fit one 1-3/8" wrench when tightening the cutting head to the extension tube. If you need a different orientation of your abrasive inlet, back off the gland by one hex (1/6th of a turn) at a time and re-tighten the gland and body onto the extension tube (or adapter). Do not exceed a maximum spacing of 0.150" between the gland and body.

5.5.2 Extension Tube to Cutting Head

This connection requires at least 40 ft-lbs, but no more than 50 ft-lbs (about 1/8th of a turn past hand tight) of torque to seal properly. Do not over-tighten the connection between the extension tube and cutting head. Over-tightening will gall (cold-weld) the sealing surfaces of the extension tube and cartridge, rendering them useless. They will never obtain a good seal after they have been galled.

Sometimes, extension tubes that have been galled can be refurbished by using a lathe to remove a very small amount of material from the galled sealing surface. While in the lathe, using 300 and 600 grit sandpaper can restore a sealable surface. Since the sealing surface on the cartridge is slightly tapered, you can cut the sealing surface of the extension tube straight.

5.5.3 Collet Retaining Nut to Body

The collet retaining nut (F300-F0072-0000) is designed to be hand-tightened onto the body. The interface between the abrasive nozzle and nut does not provide alignment for the stream. All alignment is obtained within the cartridge. The knobbed ridges on the nut are not meant for any wrench, just your hand.

6 Parts List

6.1 Part Index

Refer to Table 3 for a breakdown of the parts for the DP-E:

DP-Evolution Parts List	
IWP p/n	**Description**
F300-F0124-0000	Cutting Head Assembly
F300-F0071-0000	Body
F300-F0072-0000	Collet Retaining Nut
F300-F0073-0000	Gland
F300-F0127-0000	Dehazer, for 0.281" Nozzle
F300-F0031-0000	Blast Disk, for 0.281" Nozzle
F300-F0152-0000	Carbide Insert
Inquire for size	Cartridge Assembly, Sapphire, 0.0XX"
Inquire for size	Cartridge Assembly, Ruby, 0.0XX"
Inquire for size	Cartridge Assembly, Diamond, 0.0XX"
Inquire for size	DP-E Cutting Head, Sapphire/Ruby, .0XX"
Inquire for size	DP-E Cutting Head, Diamond, .0XX"
F300-A0189-0000	Collet, for 0.281" Nozzle
F300-P0400-0000	Tubing, Tygothane, 1/4" OD x 3/16" ID
F300-P0445-0000	O-Ring

Table 3 – DP-Evolution Parts List

7 Material Safety Data Sheets (MSDS)

7.1 Blue Goop

Please refer to the attached MSDS sheet.