DE HAVILLAND AIRCRAFT OF CANADA LIMITED

PPS 10.20

PRODUCTION PROCESS STANDARD

PROPRIETARY INFORMATION

SET-UP AND OPERATION OF THE WATERJET

Issue 6
- This standard supersedes PPS 10.20, Issue 5.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS related questions to christie.chung@dehavilland.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

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PPS Group

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M&P Engineering

Issue 6 - Summary of Changes (over the previous issue)

The following summaries are not detailed and are intended only to assist in alerting PPS users to changes which may affect them; refer to the applicable sections of this PPS for detailed procedure and requirements.

- Specified that this PPS is categorized as a controlled special process according to PPS 13.39.

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1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the set-up and operation of the waterjet (Flow Systems “Waternife”).

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS shall be followed to ensure compliance with all applicable specifications. In general, if this PPS conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

1.1.2 Refer to PPS 13.26 for the subcontractor provisions applicable to this PPS.

2 HAZARDOUS MATERIALS

2.1 Before receipt at De Havilland Aircraft of Canada Limited (DHC), all materials shall be approved and assigned Material Safety Data Sheet (MSDS) numbers by the DHC Environment, Health and Safety Department. Refer to the manufacturer’s MSDS for specific safety data on any of the materials specified in this PPS. If the MSDS is not available, contact DHC Environment, Health and Safety Department.

3 REFERENCES

3.1 DHC Laboratory Drawing, LAB 074.

3.2 PPS 13.13 - Personal Protective Respiratory Equipment.

3.3 PPS 13.26 - General Subcontractor Provisions.

3.4 PPS 13.39 - DASH 8 & Lear 45 Critical and Special Processes PPS Index.

3.5 PPS 16.23 - Handling and Protection of Aircraft Parts.

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 Household cleaner (e.g., Mr. Clean).

4.1.2 Stainless steel balls, 0.25" diameter.

4.1.3 Garnet abrasive, Garlite, 100 mesh (Industrial Garnet Extractives, Inc.).

4.2 Equipment

4.2.1 Waterjet cutting system - Flow Systems Inc., consisting of the following components:

- Model G-411-A Stationary Waterjet Cutting Machine
- Model 401 Articulated Boom “Waterouter” Cutting Machine
- Model 408 Universal Waterjet Cutting Machine
- Model 425 Stationary Waterjet Paser Abrasive Jet Delivery System (may be used with either Model G-411-A or Model 408 Waterjet Cutting Machine)
- Model 230 Catcher (for use with Model 425 Paser)
- Model 163 Water Intensifier Pump
- Model 9X Water Intensifier Pump
- Aqua Cleer Series C Reverse Osmosis Filtration Unit
- Model 889 Vacuum and Waste Handling System

4.2.1.1 Refer to Figure 1 for a general description of the waterjet.

4.2.1.2 It is acceptable to use alternative waterjet cutting equipment provided the requirements of the engineering drawing and section 6 of this PPS are met. Set-up and operate alternative waterjet cutting equipment according to the equipment manufacturers instructions.

4.2.2 Nozzle nuts to TS.897.04.11, TS.897.04.12 and TS.897.04.13.

4.2.3 Orifice assemblies to TS.897.04.32 and TS.897.04.33.

4.2.4 Waste water catchers (see Figure 3).

4.2.5 Yokes for Model 401 cutting machine (see Figure 5).

4.2.6 DHC approved safety glasses or face shields.

4.2.7 DHC approved hearing protectors.

4.2.8 Waterjet templates to TS.897.22.11 and TS.897.22.12.

4.2.9 Open-ended wrenches (3/4" and 1 1/16" sizes), Allen wrenches and adjustable wrench.

4.3 Facilities

4.3.1 This PPS has been categorized as a Controlled Special Process according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform waterjet cutting according to this PPS.

4.3.2 Subcontractors shall direct requests for approval to DHC Quality.

4.3.3 Facility approval shall be based on a facility report, a facility survey and completion of a qualification test program, if required. The facility report shall detail the materials and equipment to be used, the process sequence to be followed and the laboratory facilities used to show compliance with the requirements of this PPS. Any deviation from the procedure or requirements of this PPS shall be detailed in the facility report. Based upon the facility report, DHC Engineering may identify additional qualification and/or process control test requirements. During the facility survey, the facility requesting qualification shall be prepared to demonstrate their capability. Once approved, no changes to subcontractor facilities may be made without prior written approval from DHC Quality.

4.3.3.1 For approval of subcontractor facilities to perform waterjet cutting according to this PPS, completion of a test program and submission of suitable test samples representative of production parts is required. Test samples shall meet the requirements specified in section 6.

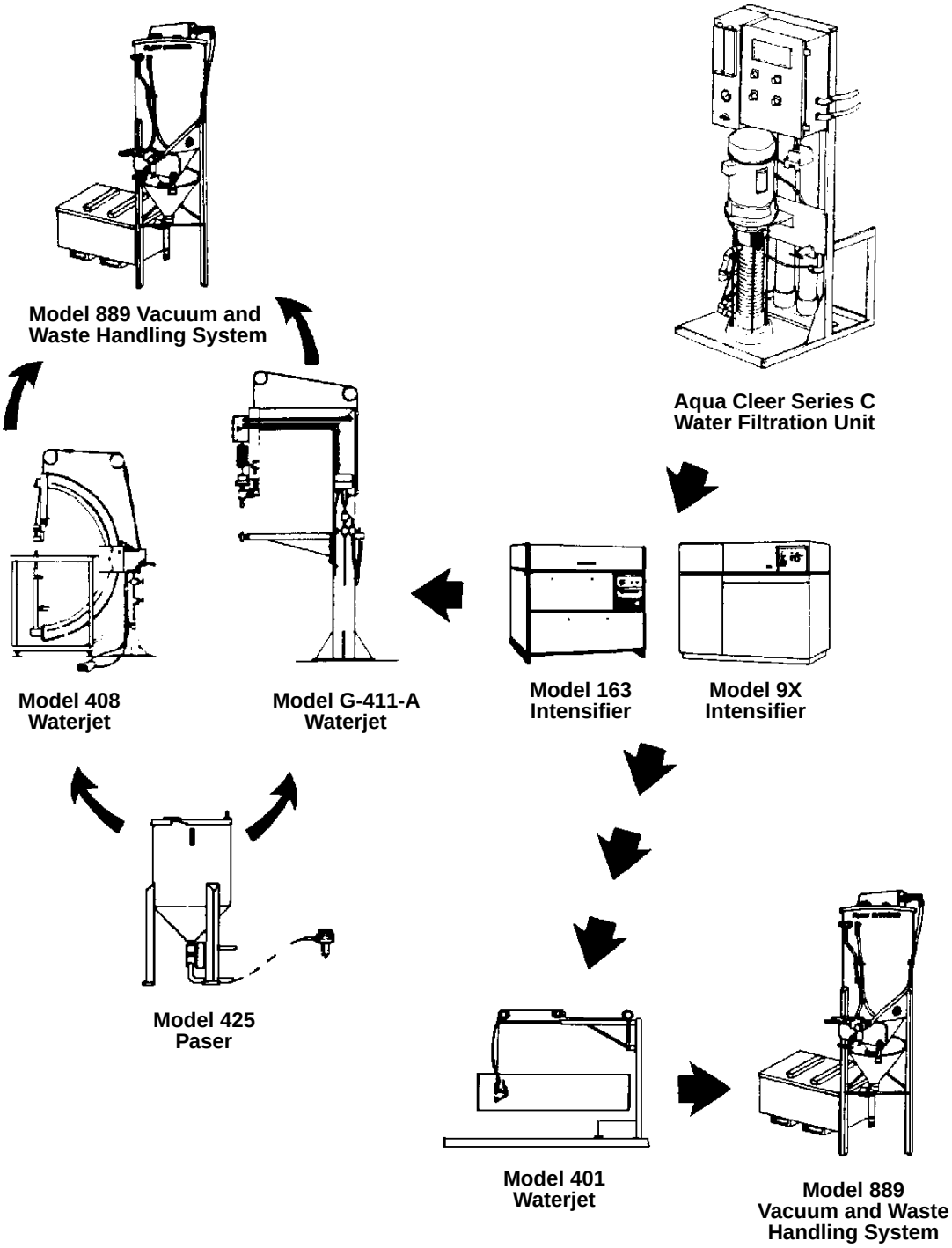


FIGURE 1 - GENERAL DESCRIPTION OF WATERJET CUTTING SYSTEM

5 PROCEDURE

5.1 General

5.1.1 The waterjet cutting system cuts by concentrating a small diameter, high velocity stream of water on the material being processed. The Model 425 Paser Abrasive Jet Delivery System may be attached to the Instajet nozzle bodies of the Model G-411-A and Model 408 cutting machines to mix garnet abrasive material with the high pressure water stream (see Figure 2). Refer to section 5.2 for a description of the basic operation of the Model 425 Paser.

5.1.2 The waterjet cutting system consists of a reverse osmosis water filtration system, an intensifier pump (Model 163 or Model 9X), the cutting machines (Models 408, G-411-A and 401) and vacuum and waste handling systems.

5.1.2.1 The reverse osmosis water filtration system provides a 40 psig supply of filtered water to the intensifier pump.

5.1.2.2 The intensifier unit consists of an electric motor driven hydraulic pump, with a maximum pressure of 2750 psig, which provides hydraulic pressure for a double acting intensifier pump. The intensification ratio is 20:1 for the Model 9X and 13:1 for the Model 163, thus providing a maximum water pressure of 55,000 psig and 35,750 psig, respectively.

5.1.2.3 The high pressure water is piped to the cutting stations where it is discharged through a small orifice (0.003" to 0.018" diameter) in a sapphire nozzle. This high energy stream of water provides the cutting action. A catcher (see Figure 3) collects the waste water and debris for disposal.

5.1.2.4 Process water, cutting debris and, if applicable, spent garnet and pulverized catcher balls are disposed of through the Model 889 Abrasivejet Vacuum and Waste Handling System (see Figure 4). Refer to section 5.3 for a description of the basic operation of the Model 889 vacuum system.

5.2 Basic Operation of Model 425 Paser Abrasive Delivery System

5.2.1 The Model 425 Paser Abrasive Delivery System may be used to add abrasive garnet material to the high pressure cutting water for the Model G-411-A or Model 408 cutting stations.

5.2.2 The Model 425 Paser consists of a nozzle body for mixing the abrasive garnet with high pressure water and a material hopper with a material flow control valve (see Figure 4).

5.2.3 Abrasive garnet material is supplied to the nozzle body and the flow is controlled by the adjustable flow control valve at the hopper.

5.2.4 The intensifier unit supplies the high pressure water to the Instajet nozzle valve, providing the carrier medium for the abrasive garnet.

5.2.5 Once the high pressure water and garnet are combined, the abrasive jet exits through the orifice toward the material being cut.

5.2.6 Use Model 230 catcher to catch the abrasive cutting stream generated by the Model 425 Paser. Fill the catcher with stainless steel balls (see paragraph 4.1.2) to within 0.5" of the bottom of the catcher top. As the balls act as an energy dissipating medium, they will become pulverized and require replacing. The level of the balls in the catcher shall never drop below 3" before being replaced. Draw the expended garnet, water, cutting debris and pulverized balls out of the catcher by means of the Model 889 vacuum through an outlet on the bottom of the catcher.

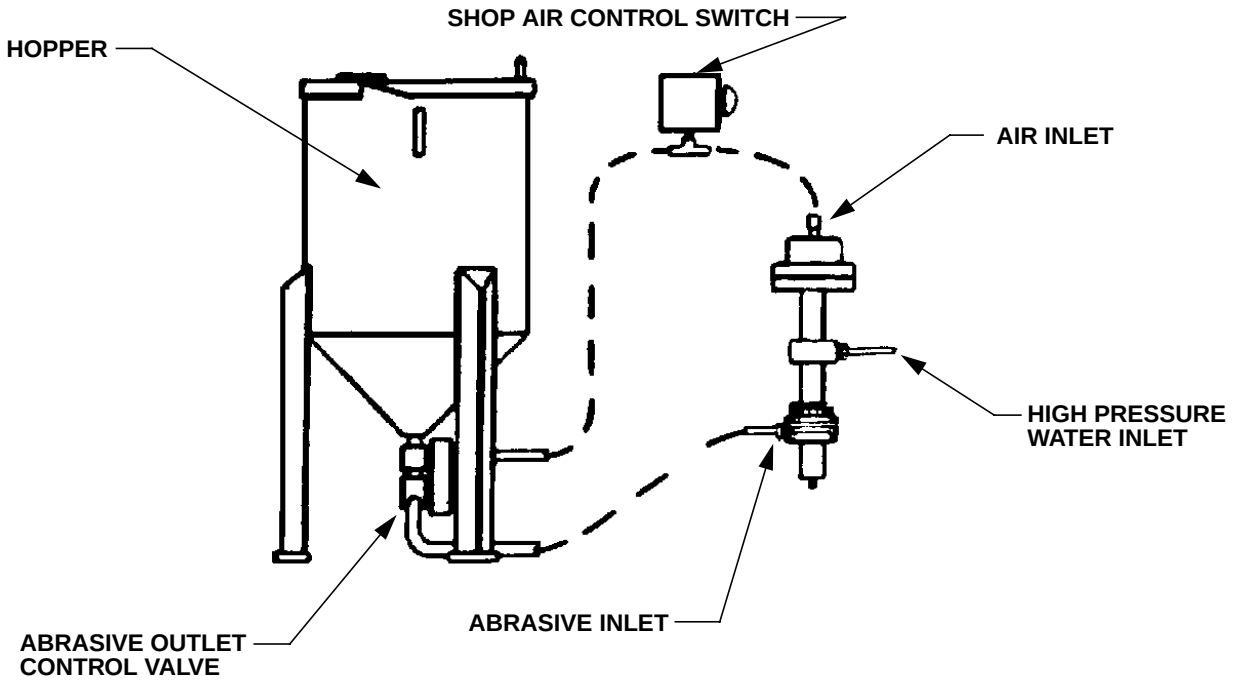
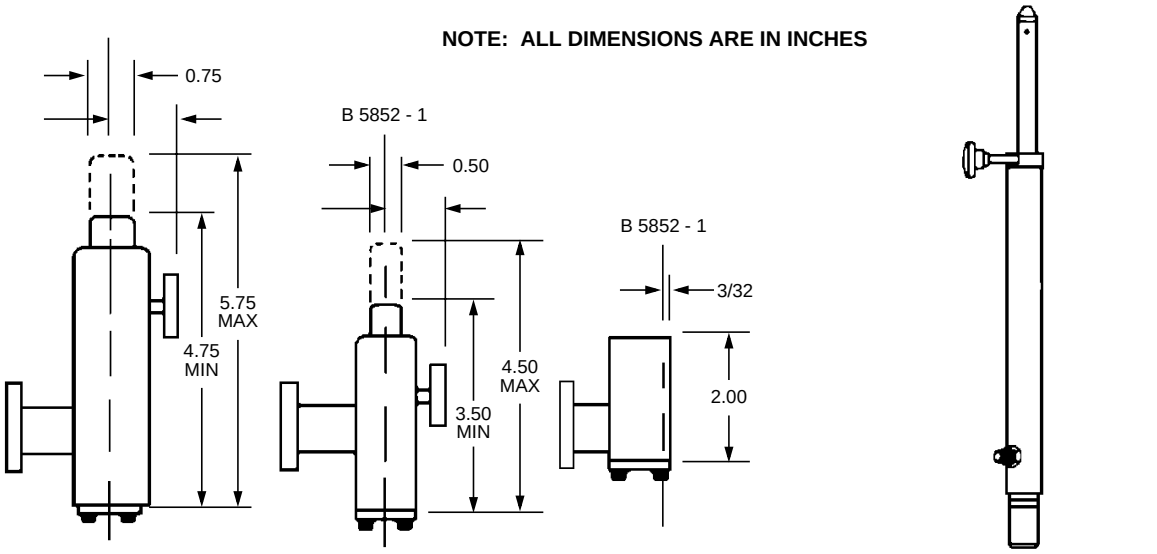


FIGURE 2 - GENERAL DESCRIPTION OF MODEL 425 PASER



FOR USE WITH MODELS G-411-A AND 401

FOR USE WITH MODEL 408

FIGURE 3A - CATCHER TIPS FOR NON-ABRASIVE CUTTING STREAM

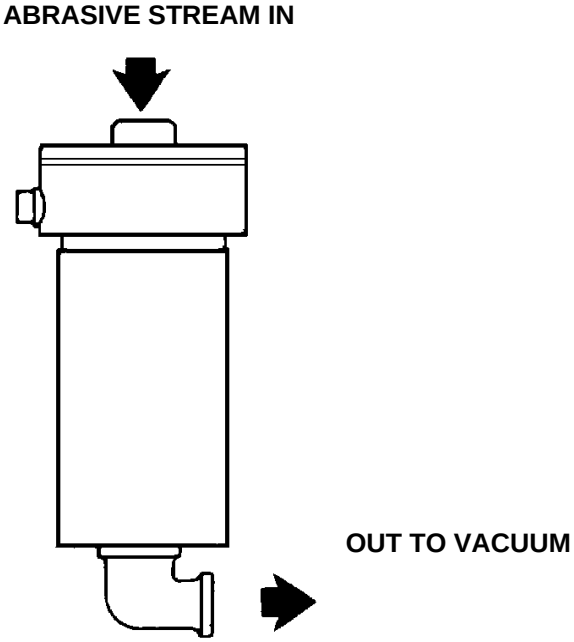


FIGURE 3B - MODEL 230 CATCHER FOR ABRASIVE CUTTING STREAM

FIGURE 3 - CUTTING STREAM WASTE WATER CATCHERS

5.3 Basic Operation of Model 889 Vacuum and Waste Handling System

5.3.1 The Model 889 Abrasivejet Vacuum and Waste Handling System basically consists of a vacuum drum, a receiving cone and a weir tank.

5.3.2 Shop air, reduced in pressure by a regulator, enters the unit and creates a vacuum at the throat of the venturi. This region is connected to the interior of the drum causing the entire drum to become a region of vacuum. Process waste from the cutting operation is captured by the air flow through the catcher neck and is sucked into the drum.

5.3.3 When shop air to the vacuum is removed, the interior of the drum returns to atmospheric pressure, the outlet check valve opens and the collected waste drains into the receiver cone located directly below the drum outlet. The waste flows through the cone and to the weir tank.

5.3.4 As the waste water passes through the weir tank, the solid portions settle out of the flow and collect in the compartments of the tank. As a result, the water exiting the tank is basically free of suspended solids and can be appropriately disposed.

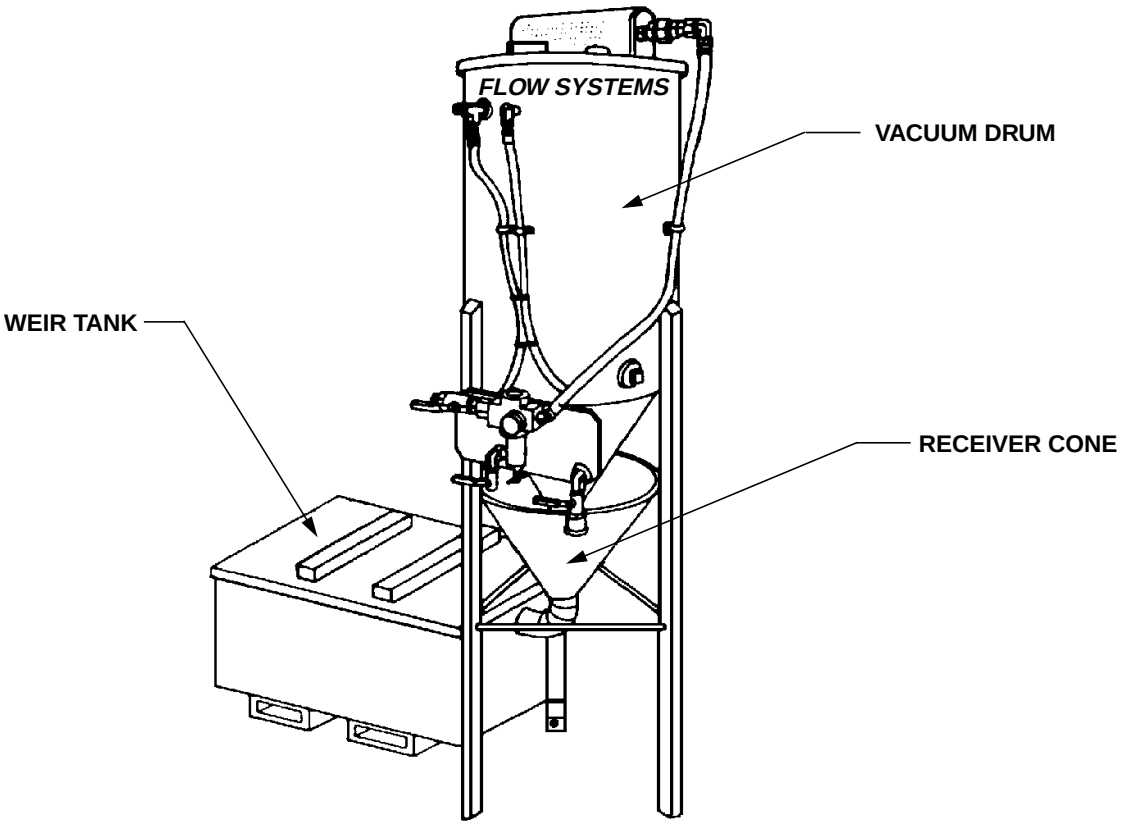


FIGURE 4 - GENERAL DESCRIPTION OF MODEL 889 VACUUM AND WASTE HANDLING SYSTEM

5.4 Set-Up of Equipment

5.4.1 Reverse Osmosis Water Filtration System

5.4.1.1 The pump for the water filtration system is turned on by a wall switch to pump water to the intensifier unit. If repair or replacement of component parts for the filtration system is required, notify Plant Engineering.

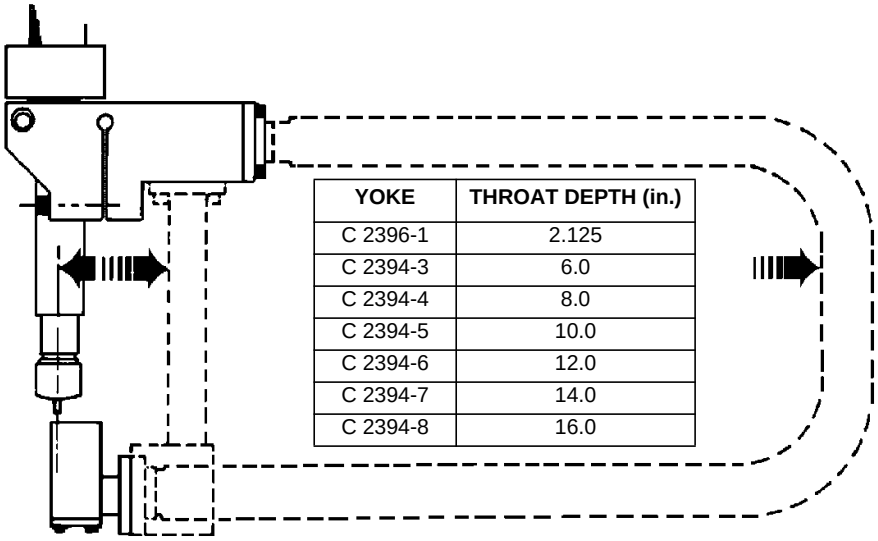
5.4.2 Intensifier Pump

5.4.2.1 No special set-up is required before the actual pump start-up as specified in section 5.6. If repair or replacement of component parts for the intensifier pumps is required, notify Plant Engineering.

5.4.3 Cutting Stations (Models G-411-A, 401 and 408 Cutting Machines)

5.4.3.1 Set-up of the cutting stations and the Model 425 Paser to suit the particular part to be cut shall be performed by the operator as shown in Figure 1 through Figure 3. The following component parts are replaceable:

- *Orifices assemblies* - in order to change the orifice size or replace worn orifices.
- *Nozzle nuts* - in order to change the guide tip size or nozzle style.
- *Waste water catcher* - in order to change the catcher style.
- *Yoke for Model 401 (See Figure 5)* - in order to change yoke size (before changing yokes, operators shall consult their supervisor).



YOKE	THROAT DEPTH (in.)
C 2396-1	2.125
C 2394-3	6.0
C 2394-4	8.0
C 2394-5	10.0
C 2394-6	12.0
C 2394-7	14.0
C 2394-8	16.0

FIGURE 5 - YOKES FOR MODEL 401 ARTICULATED BOOM “WATEROUTER”

5.5 Templates

5.5.1 Templates are used to guide the waterjet cutter so as to produce the desired part contour. Templates also provide support to the part during the cutting process. Templates may be of metal or composite material, as well as being flat, curved or compound curved, and may be made to fit the outer or inner contour of the part (although the outer contour is typically used).

5.5.2 The standard template used at DHC are Tool Types 248 and 285 (TS.897.22.11). Tool Type 248 templates have a 1/16" set-back on all edges to be cut by the waterjet while Tool Type 285 templates have a 3/32" set-back. These templates require nozzle nuts with matching 1/16" and 3/32" set-back guides. The 3/32" set-back edges on Tool Type 285 templates are identified by a red line. Refer to Figure 1 for tool selection. The templates to be used when abrasive waterjet cutting with the Model 425 Paser are Tool Type 257 (TS.897.22.12), with a 1/8" set-back on all edges to be cut by the abrasive waterjet. If the component thickness is less than 0.063", a sub-template is normally supplied in order to provide additional support in the areas of locating, clamping and cutting. The sub-template is clamped to the reverse side of the component.

5.5.3 On some edges of the component, it may not be possible or desirable to use the waterjet. These edges are marked on the template by a yellow line and are identified “SCRIBE ONLY - NO SET-BACK”. These edges shall not be cut, but the profile shall be scribed only and shall be cut at a later time.

5.5.4 In addition to the Type 248 templates, a number of older Type 76, 173 and 225 templates have been modified to be used for waterjet cutting by incorporating a 1/16" set-back. These templates have been re-numbered as Type 248 and can be used with the standard 1/16" set-back nozzle nut guides. Some of these reworked templates have protruding drill bushings set close to the edges which may interfere with the waterjet nozzle. Use special stepped nozzle nuts with these templates. Refer to Figure 1 for tool selection.

5.5.5 Align templates on the part using the locating holes provided and securely clamp them using clecos, toggle clamps or other suitable means. The distance between clamping joints shall not exceed 4". Remove and replace clamps as cutting progresses, as necessary, to clear the waterjet nozzle.

5.6 Operation of Equipment

5.6.1 Start-Up

5.6.1.1 Start-up procedures for the reverse osmosis water filtration system, intensifier pump, and cutting stations are shown in Figure 4 through Figure 6.

5.6.2 Operating the Waterjet Cutters

5.6.2.1 The following procedure outlines equipment operation at DHC. Subcontractors shall operate equipment according to the manufacturer's instruction manuals. Subcontractors cutting metallic sheet for DHC shall set-up and operate equipment according to their DHC approved Technique Sheet. Materials suitable for waterjet cutting are shown in Table II. Table II also specifies the maximum thickness for each material as well as the recommended orifice diameter, water pressure and feed rate.

5.6.2.2 Other types of non-metallic materials or other thicknesses of non-metallic materials may be cut on the waterjet cutter provided trial samples have been cut and approved by Plastic Shop Inspection.

5.6.2.3 If the machine settings are critical to produce an acceptable part, record the set-up details on a Set-Up Data Sheet against the particular component part number. If cutting parts containing wire screen or sheet metal inserts, apply the requirements specified in paragraph 5.6.2.2 and paragraph 5.6.2.3. If cutting parts containing sheet metal inserts, use the Model 425 Paser.

5.6.2.4 Except when cutting holes, ensure that the waterjet is on before bringing a part up to the jet to start a cut. Do not start the jet with the part under the nozzle. When cutting holes, start the jet in the middle of the hole so that the delamination which occurs around the starting hole will be removed with the plug.

5.6.2.5 Do not cut edges if the template is marked with a yellow line and identified "SCRIBE ONLY - NO SET-BACK".

5.6.2.6 Except when making bevel cuts, ensure that the cuts are at 90° to the surface of the part. Bevel cuts may be made on the Model 408 universal waterjet by using the hand crank to rotate the semi-circular track to the desired position.

5.6.2.7 Move clamps, if necessary, to clear the nozzle. Replace the clamps once the cut has been made.

5.6.2.8 If the following conditions are encountered, adjust the water pressure, orifice diameter or feed rate as follows:

- *Serrations on cut edge* - decrease orifice diameter or decrease feed rate.
- *Cutting speed too slow* - increase water pressure or increase orifice diameter.
- *Delamination* - decrease feed rate.

5.6.2.9 The waterjet shall produce a coherent stream, with very little misting, for the following distances. If the stream breaks up before the distance specified, replace the orifice as shown in Figure 1.

- 0.003" diameter orifice - 3/4" long.
- 0.012" diameter orifice - 3/8" long.

5.6.2.10 If the waterjets will be idled for more than 10 minutes, shut down intensifier pumps according to Figure 10 to avoid overheating.

5.6.3 Shut-Down

5.6.3.1 Shut-down procedures for the water filtration system, intensifier pump, cutting stations and Model 425 Paser are shown in Figure 7 through Figure 10.

6 REQUIREMENTS

6.1 General

6.1.1 All waterjet cut edges shall meet the dimensional requirements of the applicable engineering drawing.

6.2 Metallic Parts

6.2.1 Parts surfaces shall be cleaned, thoroughly dried and free of all contaminants before wrapping or bagging according to PPS 16.23.

6.2.2 There shall be no evidence of grit entrapment along the cut edge. The cut edge shall appear smooth, uniform, and have a maximum surface roughness of 125 Ra.

6.2.3 Prepare Technique Sheets for waterjet cutting for each combination of sheet gauge and material type. The Technique Sheet shall include the material specification, sheet thickness, maximum stack height, nozzle details, work piece feed speed, operating pressure, distance from cutting plane to nozzle, abrasive type mesh size and feed rate.

6.2.4 Qualify waterjet cutting facilities cutting metallic parts according to paragraph 6.2.4.1 through to paragraph 6.2.4.2.

6.2.4.1 Using the appropriate Technique Sheet, cut test specimens from the maximum and minimum sheet gauges for each material to be qualified. One test specimen is required from each layer within the stack. The test specimens shall be cut by stacking the sheets to the maximum stack height the facility wishes to be qualified. The test specimens shall be labelled with the following information:

- Test specimen number
- name of facility
- Material specification
- Sheet thickness
- Stack height
- Technique Sheet number
- Location of the test specimen within the stack

6.2.4.1.1 Use LAB 074 test panel as the qualification test specimen. The as-cut test specimen shall meet the dimensional requirements of the engineering drawing. For test specimen material, refer to Table I.

6.2.4.2 There shall be no evidence of grit entrapment along the cut edge. The cut edge shall appear smooth, uniform, and have a maximum surface roughness of 125 Ra.

TABLE I - TEST SPECIMEN MATERIAL

MATERIAL	TEST SPECIMEN MATERIAL
Aluminum	QQ-A-250/5, 2024-T3/T4
Aluminum (laminated)	MIL-S-22499, Comp 1 (AMS-DTL-22499) Type II, Class 2
Titanium	MIL-T-9046, CP-1/AMS 4901 Commercially Pure Annealed 70 ksi
CRES	AMS 5519 Type 301 Full Hard
	AMS 5518 Type 301 1/2 Hard
DHMS M2.22 Copper	DHMS M2.22

6.2.5 The processing facility shall be re-qualified annually by DHC Quality. Re-qualification of individual Technique Sheets will be required if there are any changes to their content.

6.3 Composite Parts

6.3.1 Ensure composite edges are free of delamination.

7 DHC SAFETY PRECAUTIONS

7.1 The safety precautions specified herein are specific to DHC to meet Canadian Federal and Provincial government environmental, health and safety regulations. It is strongly recommended that other facilities consider these safety precautions; however, suppliers, subcontractors and partners are responsible for ensuring that their own environmental, health and safety precautions satisfy the appropriate local government regulations.

7.2 Observe standard plant safety precautions when performing the procedure specified herein.

7.3 Before starting or returning the waterjet to operation, ensure that all personnel are clear of the equipment.

7.4 Wear DHC approved safety glasses or face shields when operating the waterjet.

7.5 Wear protective respiratory equipment according to PPS 13.13 when operating the waterjet.

7.6 The waterjet is a high-energy cutting system capable of high speed cutting of a multitude of materials. Do not subject any part of your body to the waterjet stream.

7.7 Do not remove protective shields from the high pressure tubing.

7.8 Do not step or lean on the high pressure tubing.

7.9 Some of the fittings on the equipment contain weep holes. Do not touch these holes with bare hands or try to stop dripping by clogging the holes.

7.10 High pressure water will remain in the system for a prolonged period after shut-down of the high pressure water source (i.e., intensifier pump). Ensure that the system pressure is bled down as part of the shut-down procedures specified in Figure 7 through Figure 10.

7.11 Ensure that the equipment is shut down as specified in Figure 1, including the electrical power, before any maintenance is attempted.

7.12 Immediately report any leaks observed in the hydraulic system of the intensifier pump or the high pressure water system to Plant Engineering.

8 PERSONNEL REQUIREMENTS

8.1 Personnel responsible for the set-up and operation of the waterjet shall have a good working knowledge of the applicable procedure and requirements as specified herein and shall have exhibited their competency to their supervisor.

8.2 Train personnel working with the waterjet with regard to the correct and safe use of the equipment.

9 MAINTENANCE OF EQUIPMENT

9.1 Periodically check the Model 425 Paser hopper and add garnet abrasive (see paragraph 4.1.3), as required.

9.2 If C 5030-1 handles on the Model 401 waterjet become worn, replace them by pulling back on the knurled fitting, removing the old handles and inserting the new ones.

9.3 Once per shift, check the mixing tube in the Model 425 Paser and the impingement discs in the applicable catchers and replace them, if necessary, according to Figure 13.

9.4 Perform routine checks according to Figure 11 and daily checks according to Figure 12.

9.5 Clean and replace orifices according to Figure 14, as necessary.

9.6 Maintain alternative waterjet cutting equipment according to the manufacturer’s instruction.

TABLE II - MATERIALS FOR WATERJET CUTTING

MATERIALS SUITABLE FOR ABRASIVE AND NON-ABRASIVE WATERJET CUTTING			MATERIAL SUITABLE FOR ABRASIVE WATERJET CUTTING ONLY (Note 1)		
Part Shape - Flat, Curved, Compound Curved **Part Edge - Straight, Curved, Circular** **Cutouts - Any shape** **Holes - Over 5/8" diameter** **Materials - As shown below** **Maximum Thickness - As shown below**			**Assemblies With Sheet Metal Inserts**		
MATERIAL GROUP	**MATERIAL**	**THICKNESS (Note 2)**	**WATER PRESSURE**	**ORIFICE DIAMETER**	**FEED RATE**
Composites (Laminates)	Kevlar/Epoxy	0.020" 0.125" max.	45 - 55 ksi	0.005" 0.010"	60 fpm 3 fpm
	Glass/Epoxy	0.020" 0.125" max.	45 - 55 ksi	0.005" 0.008"	60 fpm 4 fpm
Composites (Sandwich)	Honeycomb Core	0.250" max.	50 - 55 ksi	—	—
	Foam Core	0.500" max.	50 - 55 ksi	—	—
Rubber (Solid)	Neoprene	1.00" max.	50 - 55 ksi	0.011"	20 fpm
	Silicone				
	Urethane				
Rubber (Foam)	Polyurethane	2.00" max.	50 - 55 ksi	0.005"	200 fpm
	Silicone				
Plastic	Acrylic/PVC (Kydex)	0.062" 0.125" max.	40 - 50 ksi	0.004" 0.005"	6 fpm
	Polycarbonate (Lexan)	0.062" 0.125" max.	50 - 55 ksi	0.005" 0.008"	15 fpm 3 fpm
	PTFE (Teflon)	0.062" 0.125" max.	45 ksi	0.004"	100 fpm
	Nylon (Zytel)	0.062" max	—	—	—
	PVA/PVC/PVF/Vinyl	0.125" max.	40 ksi	—	—
Miscellaneous	Leather	0.125" 0.250" max.	55 ksi	0.006" 0.006"	18 fpm 12 fpm
	Carpet	0.187" 0.500" max.	40 - 50 ksi	0.005" 0.008"	125 fpm 15 fpm
	Balsa Wood	3.00" max.	40 ksi	—	—
Metallic	Aluminum	See applicable technique sheet			
	Steel				
	Titanium				

Note 1. If cutting materials containing wire screen or sheet metal inserts, apply the requirements specified in paragraph 5.6.2.2 and paragraph 5.6.2.3. If cutting materials with sheet metal inserts, use the Model 425 Paser.

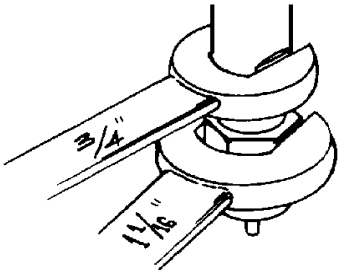
Note 2. If 2 thicknesses are shown, the lesser thickness is shown as a guide for selecting pressure, orifice and feed.

FLOW CHART 1 - SET-UP OF CUTTING STATIONS FOR NON-ABRASIVE WATERJET CUTTING

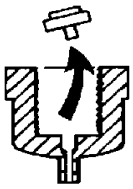
Step 1. Shut down cutting station according to section 5.6.3.

Step 2. Shut down intensifier pump according to section 5.6.3.

Step 3. Loosen and remove nozzle nut using 2 wrenches (3/4" & 1 1/16").



Step 4. Remove orifice assembly from nozzle nut.

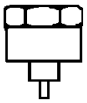


Step 5. Select appropriate nozzle nut.

TS.897.04.11
MK 1 (1/16" SET-BACK)
MK 2 (3/32" SET-BACK-RED)

TS.897.04.12
(NO TEMPLATE FOLLOWER)

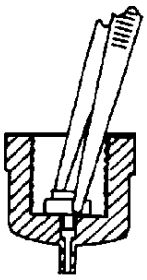
TS.897.04.13
(1/16" SET-BACK)



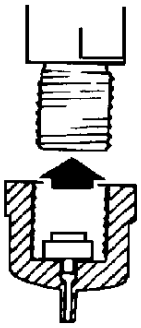
Step 6. Select appropriate orifice assembly.

ORIFICE DIAMETER	TS.897.04.32 ORIFICE ASSEMBLY
0.003"	MK 3
0.004"	MK 4
0.005"	MK 5
0.006"	MK 6
0.007"	MK 7
0.008"	MK 8
0.009"	MK 9
0.010"	MK 10
0.011"	MK 11
0.012"	MK 12
0.013"	MK 13
0.014"	MK 14
0.015"	MK 15
0.016"	Mk 16

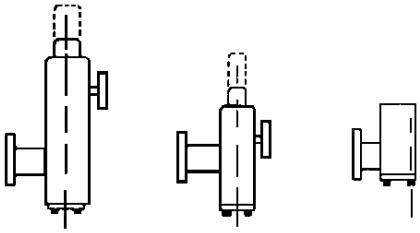
Step 7. Install orifice assembly in nozzle nut using tweezers.



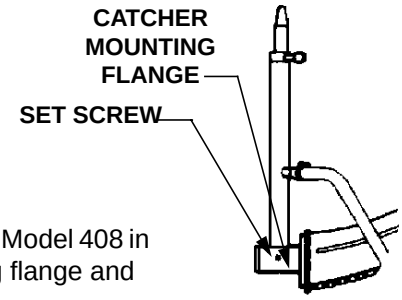
Step 8. Install nozzle nut on nozzle body.



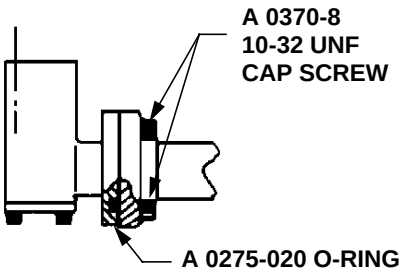
Step 9. Tighten nozzle nut using 2 wrenches (3/4" & 1 1/16") (maximum torque - 50 ft. lbs.).



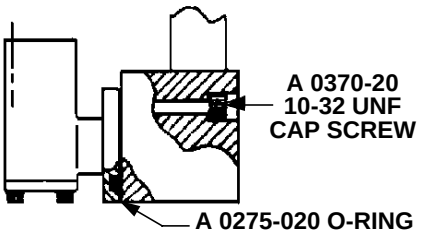
Step 10. Select appropriate catcher (see Figure 3 for dimensions).



Step 11. Install catcher for Model 408 in catcher mounting flange and tighten set screw.

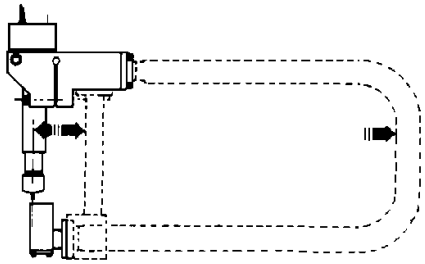


Step 12. Install catcher for Model G-411-A or Model 401 using O-Ring and cap screws.

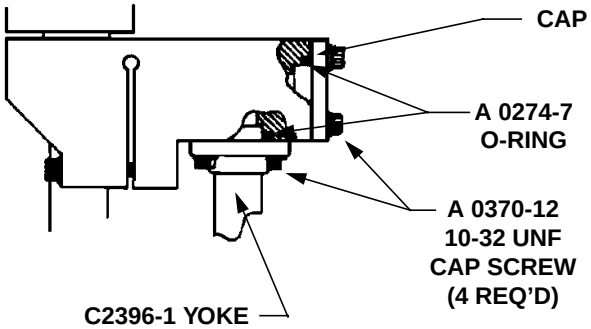


FLOW CHART 2 - SET-UP OF YOKE ON "WATEROUTER" (MODEL 401) WATERJET

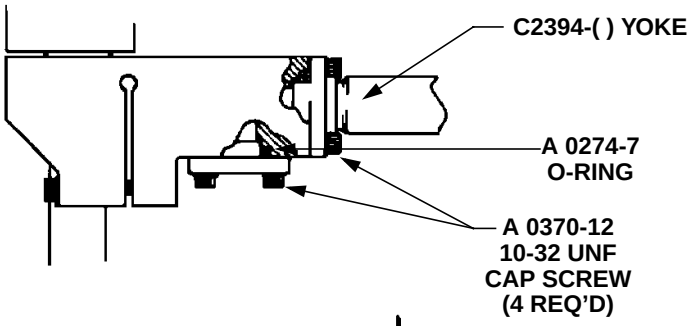
Step 1. Select the appropriate yoke (see Figure 5 for throat depths of various yokes).



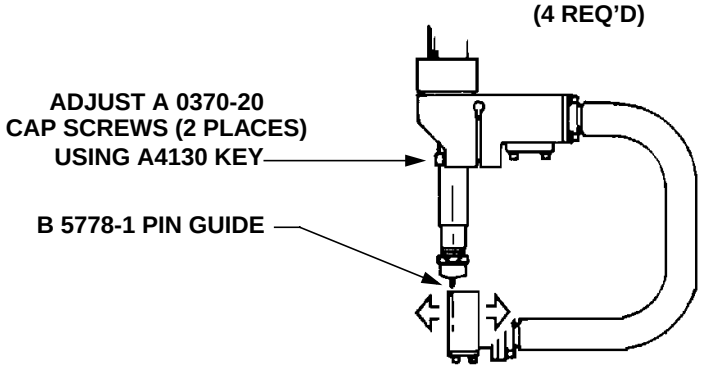
Step 2. Install yoke into the appropriate opening using 2 cap screws, and cap other opening using O-Ring and 2 cap screws



OR



Step 3. Align waterjet with catcher (replace orifice assembly with pin guide and adjust 2 cap screws until pin guide point is in the centre of the catcher hole).



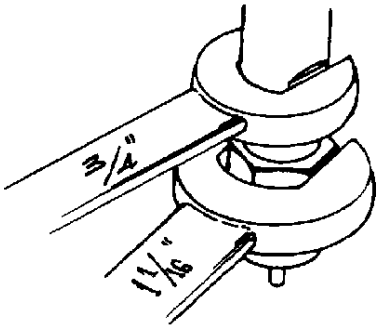
FLOW CHART 3 - SET-UP OF MODEL 425 PASER FOR ABRASIVE WATERJET CUTTING

Step 1. Shut down cutting station according to section 5.6.3.

Step 2. Shut down intensifier pump according to section 5.6.3.

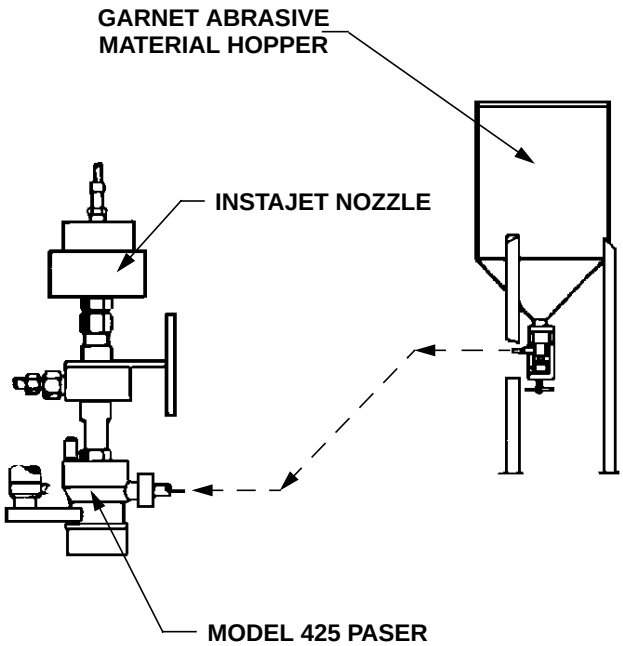
Step 3. Ensure that on/off shop air control box is in off position.

Step 4. Loosen and remove nozzle nut using 2 wrenches (3/4" & 1 1/16").



Step 5. Install Model 425 paser on instajet nozzle body.

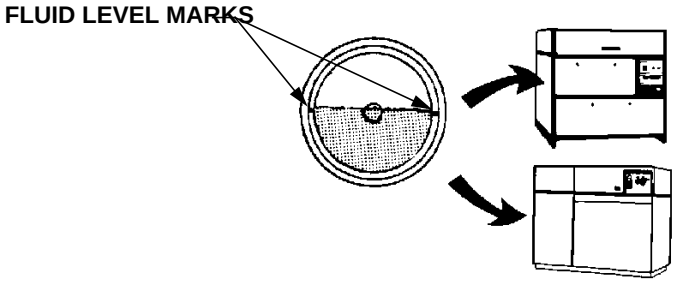
Step 6. Ensure that the tubing carrying garnet abrasive is connected between the hopper material flow control and the Model 425 paser.



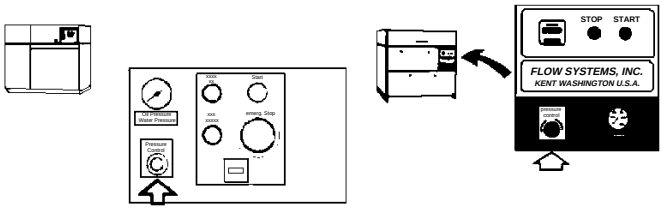
FLOW CHART 4 - START-UP PROCEDURE FOR HIGH PRESSURE WATER DELIVERY

Step 1. Switch on reverse osmosis water filtration system according to paragraph 5.4.1.1.

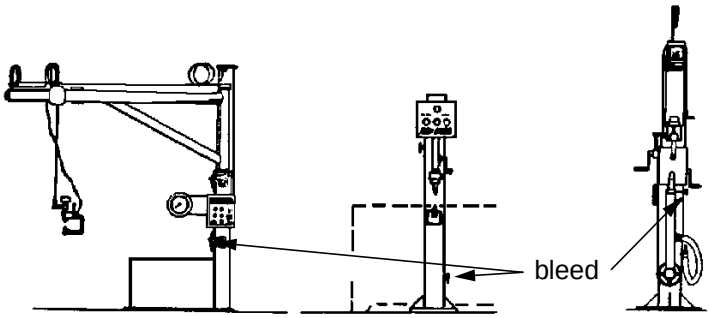
Step 2. Ensure that hydraulic fluid level in applicable intensifier pump (model 9x or 163) is up to fluid level marks.



Step 3. Set the pressure control on the applicable intensifier pump to the lowest setting.



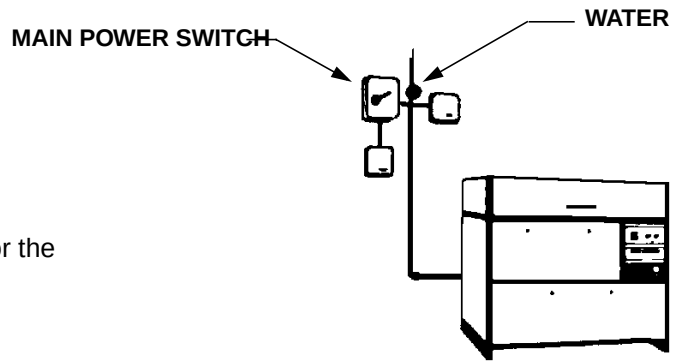
Step 4. Ensure that all bleed valves are closed on applicable cutting machines.



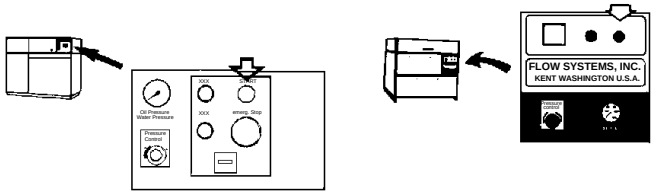
Step 5. Ensure that nozzles are clear of work and tools, and that no personnel are working on the waterjet equipment.

Step 6. Turn the water supply from the intensifier pump on.

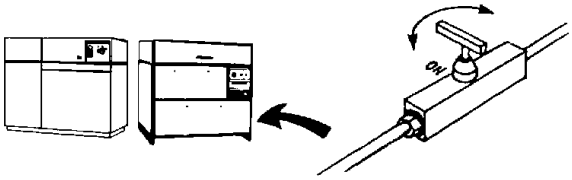
Step 7. Turn on the main power switch for the intensifier pump.



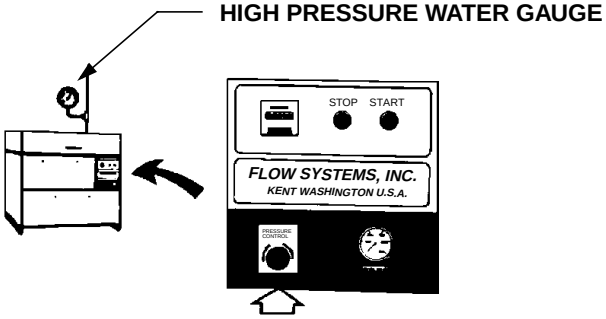
Step 8. Push the start button on the applicable intensifier pump.



Step 9. Open the high pressure water valve at the rear of the intensifier pump. Ensure that the valve is fully on or water stream will wear away valve needle.



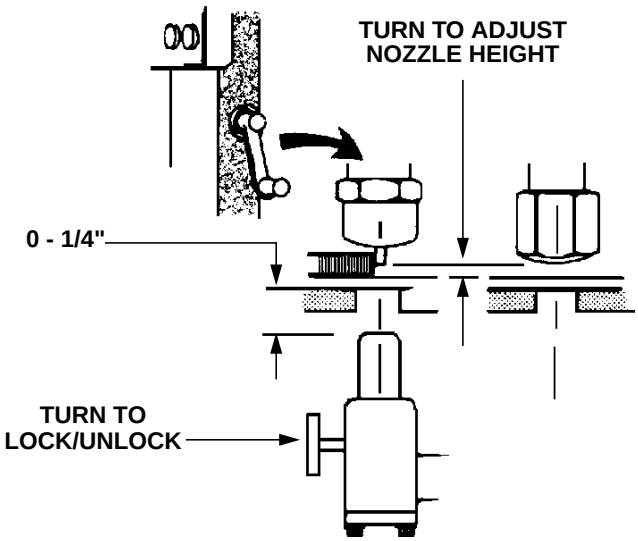
Step 10. Read the water pressure on the gauge at the rear of the intensifier pump. Refer to Table II for the recommended pressures. If necessary, adjust the water pressure.



FLOW CHART 5 - -START UP PROCEDURE FOR STATIONARY (MODEL G-411-A) AND UNIVERSAL (MODEL 408) WATERJET

Step 1. Adjust nozzle height.
- Rotate vertical adjustment handle to adjust nozzle to the required height.
- Minimum height is equivalent to nozzle diameter and maximum height is 1/8".

Step 2. Adjust catcher tip height.
- Unlock.
- Slide tip to provide the required clearance.
- Lock.
- Minimum clearance is zero and maximum is 1/4".



Step 3. Close bleed valve.

Step 4. Open high pressure water valve.

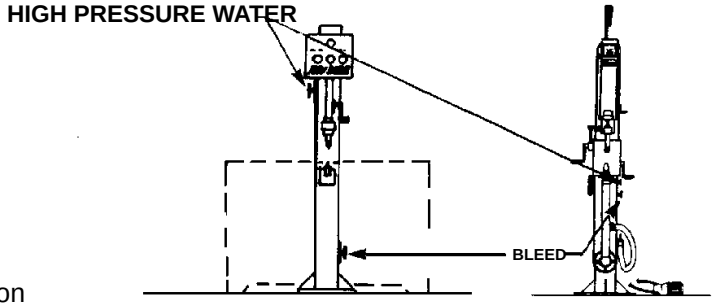
Step 5. model 408 is operated by depressing the foot pedal.

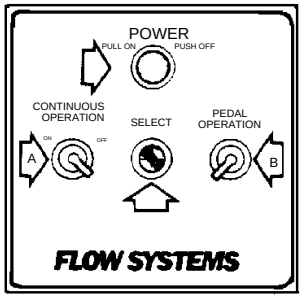
Step 6. pull “power pull/on - push/off” button (button illuminates red) (Model G-411-A only).

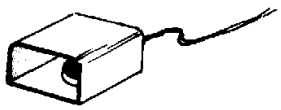
Step 7. Turn select switch to instajet (Model G-411-A only).

a. Continuous operation (Model G-411-A only)
- Turn CONTINUOUS OPERATION switch to “ON”.
- Waterjet is operating.

b. Foot pedal operation (Models 408 & G-411-A)
- Turn PEDAL OPERATION switch to “ON” (Model G-411-A only).
- Waterjet operates when foot pedal is depressed.



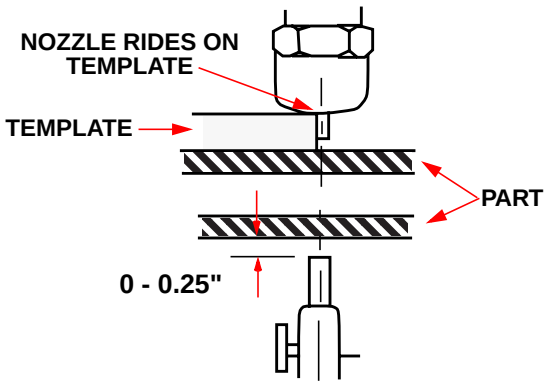




FLOW CHART 6 - START-UP PROCEDURE FOR "WATEROUTER" (MODEL 401) WATERJET

Step 1. Set nozzle height.

- Nozzle height is not adjustable as such. Since the nozzle rides on the template, the nozzle height above the part is determined by the template thickness and the nozzle guide tip length.

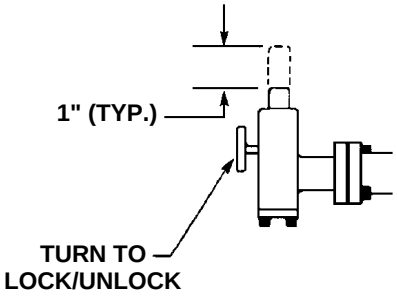


Step 2. Adjust catcher height.

- Minimum clearance is zero and maximum is 1/4".
- Adjust clearance according to A, B, or C as shown below.

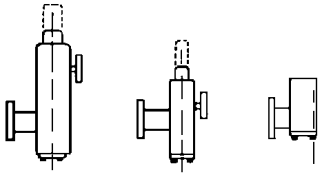
A. Adjust catcher tip height.

- Unlock.
- Slide tip to provide required clearance.
- Lock.



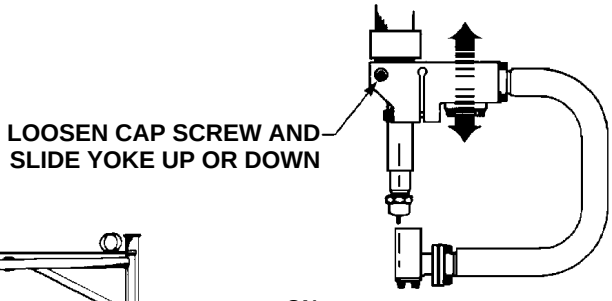
B. Change catchers.

- Install catcher shown in Figure 1.
- Align waterjet with catcher as shown in Figure 2.

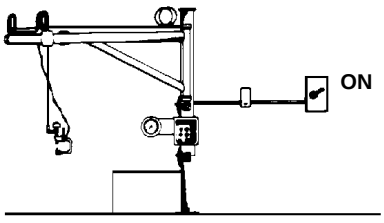


C. Slide yoke up or down.

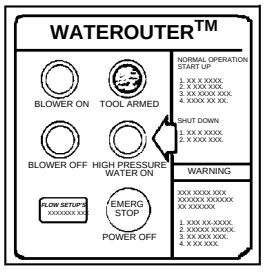
- Loosen cap screws.
- Slide yoke to provide required clearance.
- Tighten cap screws.
- Align waterjet with catcher as shown in Figure 2.



Step 3. Turn power switch to "on".

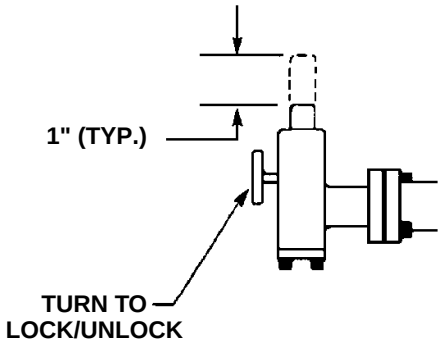


Step 4. Depress "high pressure water on" button.

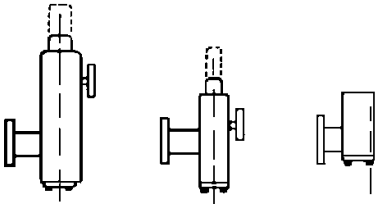


FLOW CHART 6 - START-UP PROCEDURE FOR "WATEROUTER" (MODEL 401) WATERJET CON'T

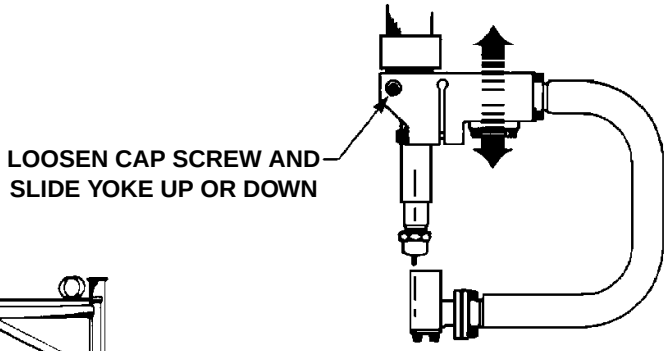
A. Adjust catcher tip height.
- Unlock.
- Slide tip to provide required clearance.
- Lock.



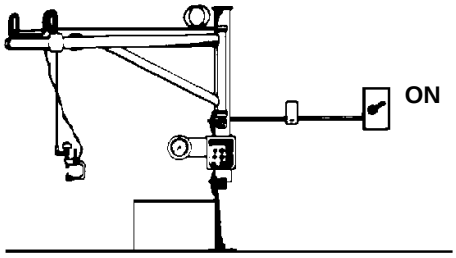
B. Change catchers.
- Install catcher shown in Figure 1.
- Align waterjet with catcher as shown in Figure 2.



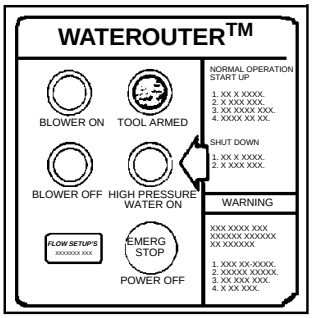
C. Slide yoke up or down.
- Loosen cap screws.
- Slide yoke to provide required clearance.
- Tighten cap screws.
- Align waterjet with catcher as shown in Figure 2.



Step 3. Turn power switch to "on".

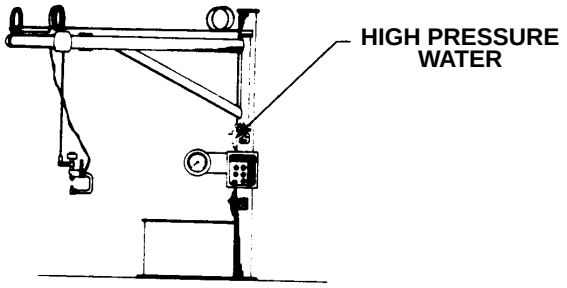


Step 4. Depress "high pressure water on" button.



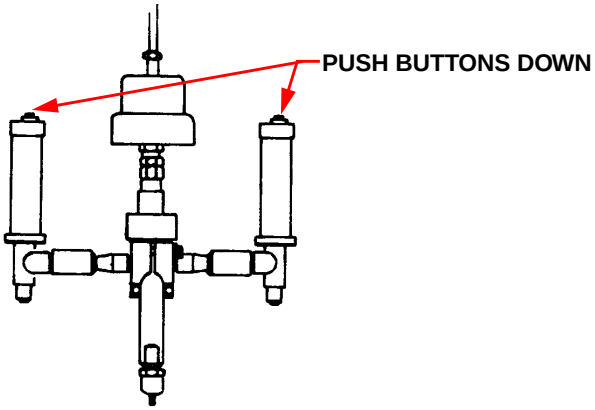
FLOW CHART 6 - START-UP PROCEDURE FOR "WATEROUTER" (MODEL 401) WATERJET CON'T

Step 5. Open high pressure water valve.



Step 6. Operate.

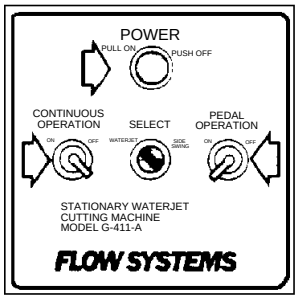
- Push buttons down.
- Both buttons shall be depressed.
- Waterjet operating.



FLOW CHART 7 - SHUT DOWN OF STATIONARY (MODEL G-411-A) AND UNIVERSAL (MODEL 408) WATERJETS

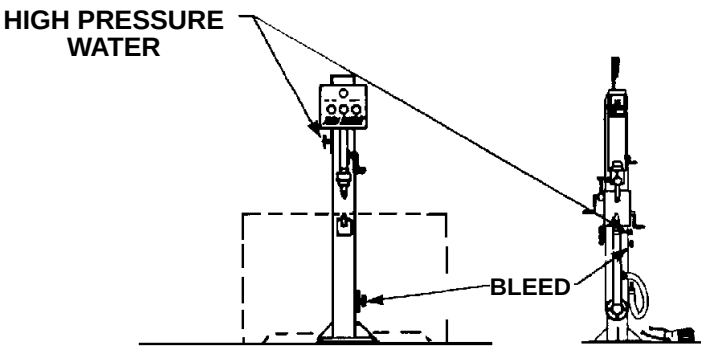
Step 1. Model 408 is de-activated by releasing the foot pedal. Set "continuous operation" or "pedal operation" switch to "off" (Model G-411-A only).

Step 2. Depress power pull/on - push/off button (model G-411-A-only).



Step 3. Close high pressure water valve.

Step 4. Open bleed valve to completely release pressure in the machine.



FLOW CHART 8 - SHUT DOWN OF MODEL 425 PASER

Step 1. Push air control valve off.

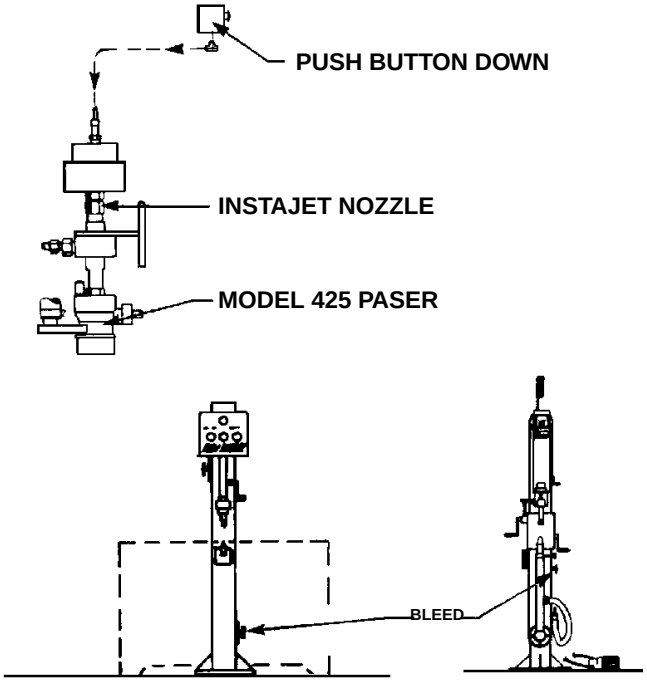
Step 2. Close high pressure water valve.

Step 3. Close inlet air pressure valve.

Step 4. Shut off vacuum system.

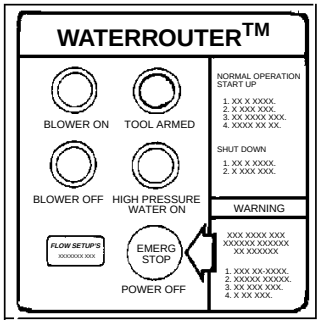
Step 5. Open bleed valve to completely release pressure in applicable cutting machine.

Step 6. Close bleed valve.



FLOW CHART 9 - SHUT DOWN OF "WATEROUTER" (MODEL 401) WATERJET

Step 1. Depress "emergency stop/power off" button.

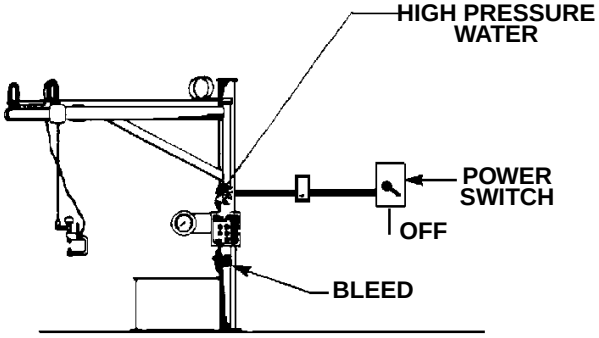


Step 2. Turn power switch to "off".

Step 3. Close high pressure water valve.

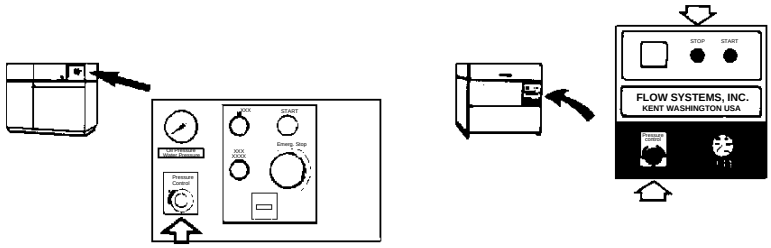
Step 4. Open bleed valve completely to release pressure in the machine.

Step 5. Close bleed valve.

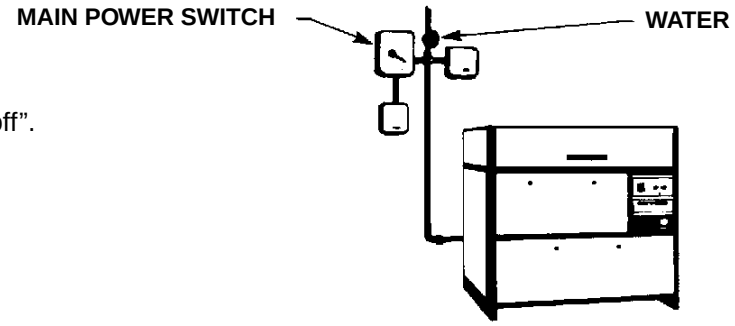


FLOW CHART 10 - SHUT DOWN OF INTENSIFIER PUMPS AND WATER FILTRATION UNIT

Step 1. Set pressure control to lowest setting.



Step 2. Push “stop” button.

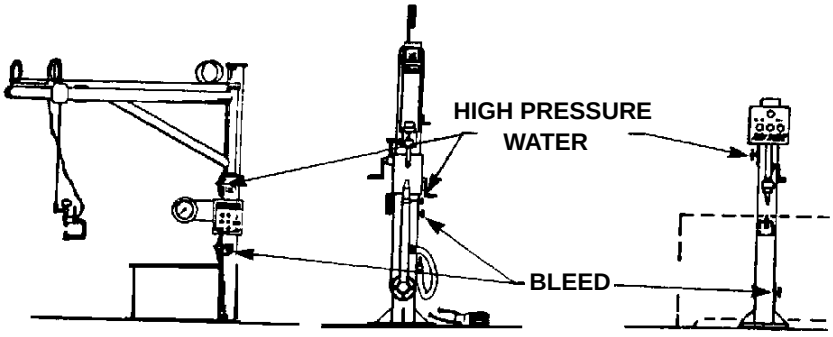


Step 3. Turn main power switch to “off”.

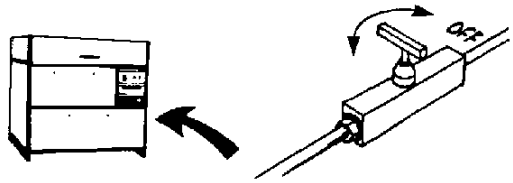
Step 4. Turn water supply valve off.

Step 5. Bleed intensifier pump and high pressure water lines

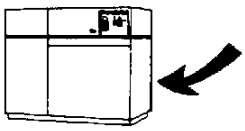
- Open high pressure water valve and bleed valve on appropriate cutting machine.
- Allow pressure to escape.
- Close both valves.



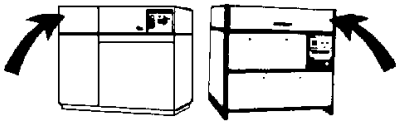
Step 6. Turn off (close) high pressure water valve at rear of intensifier pump. Ensure valve is fully closed or water stream will wear away valve needle.



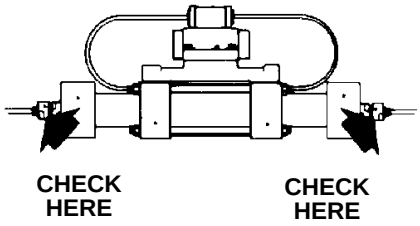
Step 7. Turn off wall switch for reverse osmosis filtration unit.



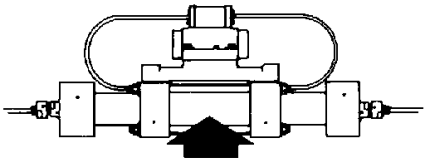
FLOW CHART 11 - ROUTINE CHECKS



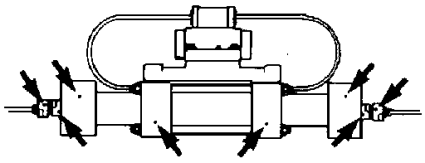
Step 1. Check temperature of intensifier pump check valves.
- Shall be cool.



Step 2. Check temperature of intensifier pump hydraulic fluid.
- Check cylinder temperature.
- Shall be no more than hand warm.

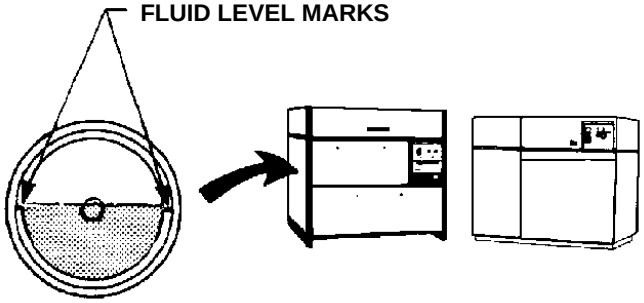


Step 3. Check leakage at intensifier pump weep holes.
- Check at end bell, end cap and check valves.
- Maximum leakage is 1 teaspoon per machine stroke.



Step 4. Check entire system for water leaks.
- No leaks allowed.

FLOW CHART 12 - DAILY CHECKS



Step 1. Check hydraulic fluid level of intensifier pumps.
- Fluid shall be up to fluid level marks.

FLOW CHART 13 - OPERATOR SERVICING

Step 1. Remove 2 cap screws.

Step 2. Remove cover.

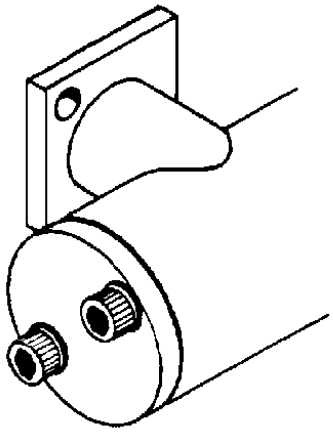
Step 3. Remove 2 rubber disks and 2 impingement disks.

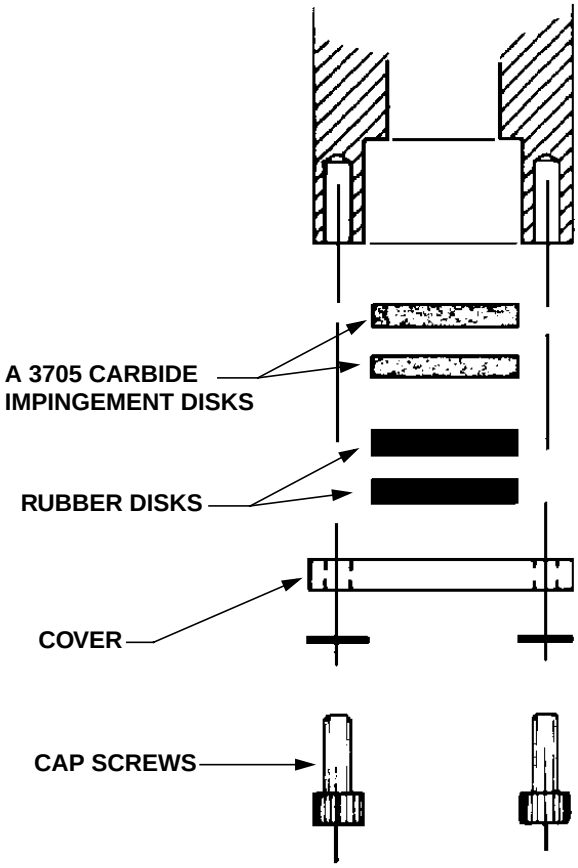
Step 4. Install 2 new impingement disks.

Step 5. Install 2 new rubber disks.

Step 6. Replace cover.

Step 7. Install 2 cap screws.





FLOW CHART 13A - SERVICING OF CATCHER IMPINGEMENT DISKS

FLOW CHART 13 - OPERATOR SERVICING CON'T

Step 1. Using an adjustable wrench, remove nozzle guard.

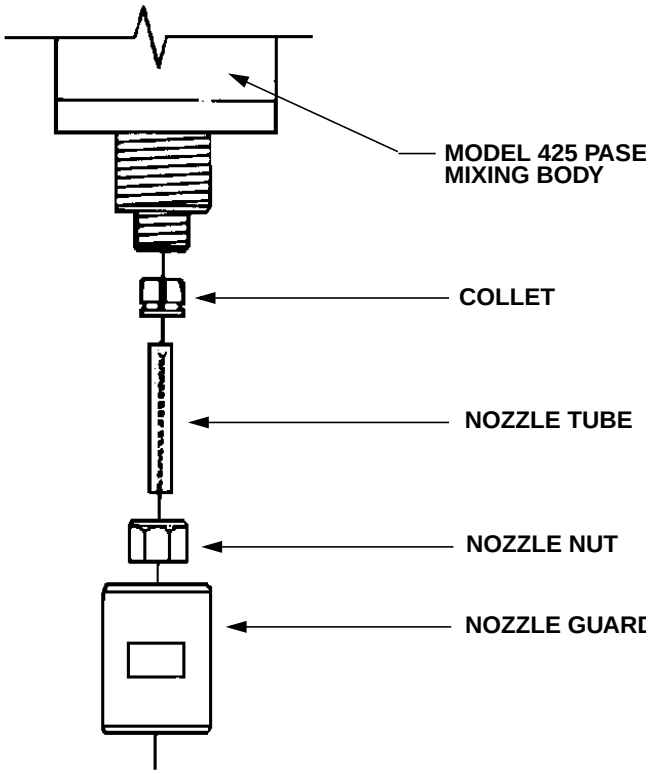
Step 2. Remove nozzle nut.

Step 3. Remove tube and collet will slide downward.

Step 4. Remove nozzle tube from collet and insert new nozzle tube in collet, ensuring that flared end of nozzle tube is pointing upward.

Step 5. Slide nozzle tube and collet upward into paser mixing body until nozzle tube seats firmly.

Step 6. Replace nozzle nut and nozzle guard.



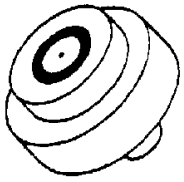
FLOW CHART 13B - SERVICING OF MODEL 425 PASER NOZZLE TUBE

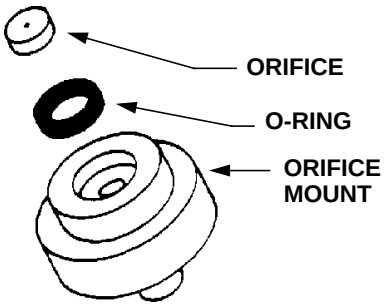
FLOW CHART 14 - CLEANING AND ASSEMBLY OF ORIFICES

Step 1. Remove orifice from orifice mount.
- Use a blunt pointed object (e.g. dental pick).

Step 2. Discard O-Ring.

Step 3. Soak orifice in cleaning solution.
- Place in beaker containing household detergent (see paragraph 4.1.1) and water.
- Keep orifices of the same diameter together. Do not mix diameters.





FLOW CHART 14 - CLEANING AND ASSEMBLY OF ORIFICES CON'T

Step 4. Ultrasonically clean orifices for 15 minutes.
- Place beaker containing orifices and cleaning solution in the ultrasonic cleaner. Do not place orifices directly into ultrasonic cleaner.

Step 5. Remove orifices from cleaning solution.
- Use tweezers.

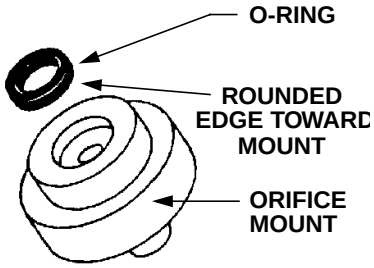
Step 6. Place orifices in beaker of distilled water.

Step 7. Ultrasonically clean orifices for 15 minutes.
- Place beaker containing orifices and distilled water in the ultrasonic cleaner.

Step 8. Remove orifices from distilled water.
- Use tweezers.

Step 9. Place orifices on lint free paper and allow to dry.

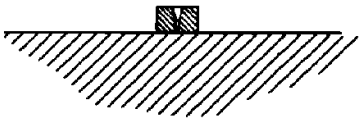
Step 10. Ultrasonically clean orifice mounts.
- Use same procedure as shown in Step 3 through Step 9 above.



Step 11. place cleaned or new orifice mount under 20x stereo microscope.
- To ensure proper cleaning and no damage.

Step 12. press new O-Ring into orifice mount counterbore.
- Use tweezers.
- If O-Ring has rounded edge, this edge faces the orifice mount.

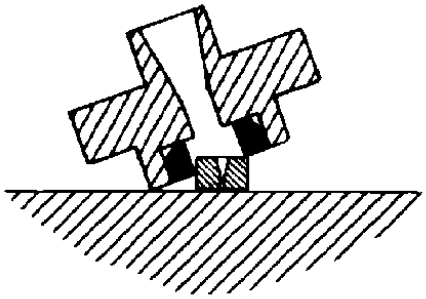
Step 13. Place orifice on a flat surface.
- Ensure large hole (water exit side) is up.



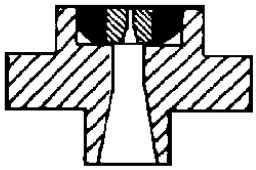
FLOW CHART 14 - CLEANING AND ASSEMBLY OF ORIFICES CON'T

Step 14. Push orifice mount onto orifice.

- Rock the mount onto the orifice.

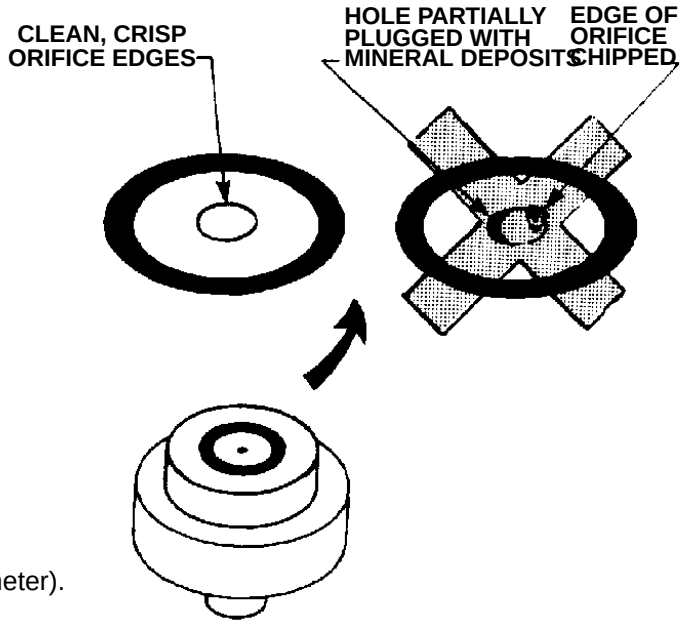


SMALL HOLE UP **FLAT SIDE UP**



Step 15. Inspect orifice.

- Use 50X magnification.
- Check for proper installation:
  Orifice - small hole up.
  O-Ring - flat side up.
- Check for orifice damage.
- Orifice entry hole shall have clean, crisp edges.
- Shall be no evidence of mineral deposits, chipping or erosion of entry hole.



Step 16. Store orifices.

- Organize by size (orifice diameter).