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Installation, Operating, and Maintenance Instructions for the BETE HydroWhirl[®]S Series Tank Washing Nozzles



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1. Introduction

Congratulations on your purchase of a BETE HydroWhirl S series tank washing nozzle! The HydroWhirl S series nozzles are driven by liquid pressure only. There are no electrical parts or motors of any kind, making for a simple yet effective product for washing tanks, drums, containers, and vessels. The HydroWhirl S series nozzles are a precision product which are designed to have a minimum service life of 300 hours under normal operating conditions (see Section 4). Environmental conditions such as high temperature or the presence of chemicals may shorten the lifetime of the HydroWhirl S.

2. Safety and Precautions

2.1. Handling

HydroWhirl S nozzles should be handled carefully, paying special attention to the slots, which have sharp edges and can cut. The use of work gloves when handling the nozzles is recommended.

2.2. Nozzle Connection

Prior to startup, the nozzle connection should be checked to ensure it is securely attached to the pipe. If the nozzle is loose it can detach from the pipe at a high velocity and cause personal injury or damage to nearby objects. Personnel should not be near the nozzle when it is starting up or running.

2.3. General Safety

General safety rules and guidelines of the facility where the nozzle is being installed should be followed at all times. In the event of conflicting directives between facility safety rules and guidelines and this manual, the facility safety rules and guidelines shall take precedence. If a conflict interferes with installation, use, or maintenance of the HydroWhirl S nozzle, please consult your local representative or the factory.

2.4. Tanks Larger than 3500 ft³ (100m³)

For tanks with a volume larger than 3500 ft³ (100 m³) dangerous electrical charges of the liquid sprayed can occur. Additional safety precautions must be taken!

2.5. Cleaning Solution

Environmental condition (temperature, pressure, atmosphere, etc.) must be maintained such that the cleaning solution will remain in liquid form prior to exiting the nozzle.

2.6. Tank Drain

When cleaning the tank, a drain large enough to accommodate at least the flow rate of the nozzle must be in operation in order to prevent the accumulation of liquid which can cause an insulating condition.

2.7 Environments

HydroWhirl S nozzles can be used safely in combustible gas environments **OR** combustible dust environments but cannot be used in a hybrid mixture of both.

2.8 Sprayed Components

All components that could be charged by contact with the nozzle spray must be grounded.

3. Installation

3.1. Identifying Connection Type

There are three types of connections available for the HydroWhirl S series tank washing nozzles:

- a) Female threaded (NPT or G/BSP)
- b) Clip-on (pipe, tube or DIN pipe)
- c) Welded (pipe, tube or DIN pipe)

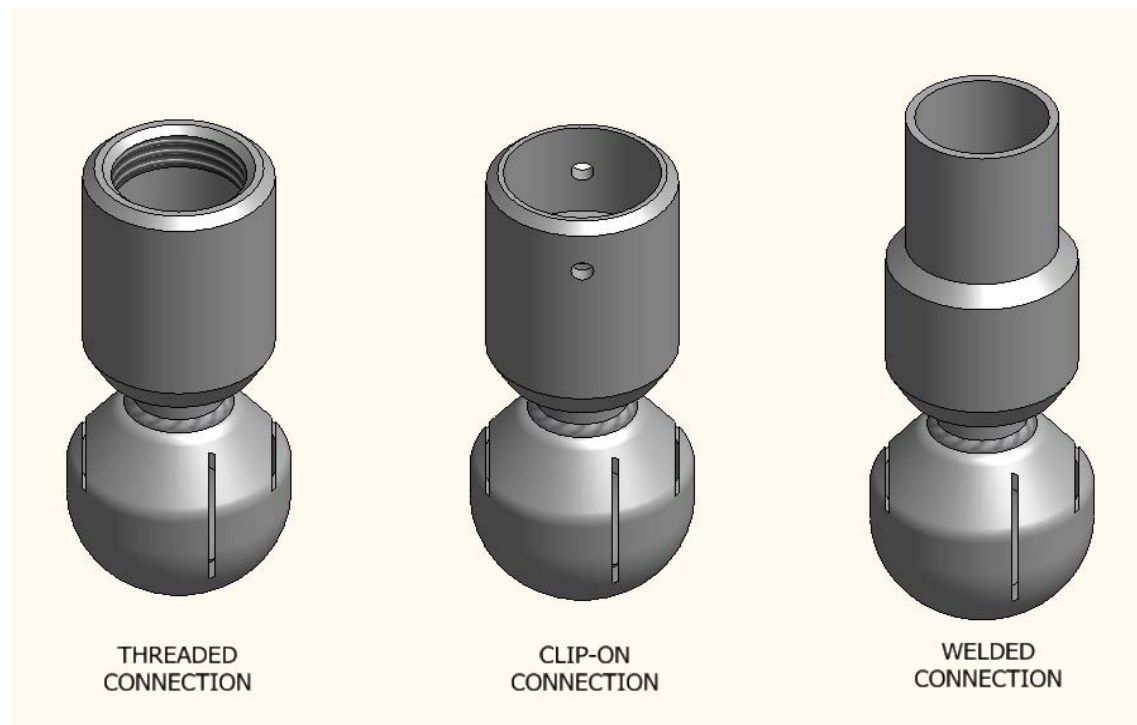


Figure 1 – Types of HydroWhirl S Connections

3.2. Identifying Pipe or Tube Size

To identify the connection size required, simply measure the Outside Diameter (OD) of the connector pipe in your application and refer to tables 1 & 2 below.

Connection Type	Nozzle Number														
	HWS 20-3 HWS 20-4 HWS 20			HWS 30-5 HWS 30-6 HWS 30			HWS 40-7.5 HWS 40-8 HWS 40-9 HWS 40			HWS 40HF-11 HWS 40HF			HWS 50-16 HWS 50		
FNPT/G	-	-	1/4"	-	-	1/2"	-	-	1/2"	-	-	1"	-	-	1"
Pipe Clip On	1/8"	-	-	3/8"	-	-	3/4"	-	-	3/4"	-	-	1 1/4"	1-1/2"	-
Pipe Weld	1/4"	1/4"	-	1/2"	1/2"	-	1"	1/2"	-	1"	1/2"	-	1"	1"	2"
Tube Clip On	-	-	-	1/2"	3/4"	-	1"	-	-	1"	-	-	1 1/4"	1 1/2"	2"
Tube Weld	3/8"	1/2"	3/8"	-	3/4"	-	-	3/4"	-	-	3/4"	-	1"	-	-
DIN Clip On	DN8	-	-	DN15	-	-	DN20	DN25	-	DN15	DN20	DN25	DN40	DN50	-
DIN Weld	-	DN10	DN10	-	-	DN15	-	-	DN20	-	-	DN15	-	-	-

Table 1 – HydroWhirl S Available Connections

	Size	Outside Diameter (OD)	
		In	mm
Pipe	1/8"	0.405	10.3
	1/4"	0.540	13.7
	3/8"	0.675	17.1
	1/2"	0.840	21.3
	3/4"	1.050	26.7
	1"	1.315	33.4
	1 1/4"	1.660	42.2
	1 1/2"	1.900	48.3
Tube	2"	2.375	60.3
	3/8"	0.375	9.5
	1/2"	0.500	12.7
	3/4"	0.750	19.1
	1"	1.000	25.4
	1 1/4"	1.250	31.8
DIN 11866 Part A Pipe	1 1/2"	1.500	38.1
	2"	2.000	50.8
	DN8	0.394	10.0
	DN10	0.512	13.0
	DN15	0.748	19.0
	DN20	0.906	23.0
	DN25	1.142	29.0
DN40	1.614	41.0	
DN50	2.087	53.0	

Table 2 – Connector Pipe Size vs OD

3.3. Preparing Pipe for Nozzle Installation

3.3.1. Welded Connection Pipe Preparation

Welding procedures vary greatly by industry and company. The appropriate size pipe should be prepared in accordance with the weld procedure of the end user.

3.3.2. Clip-On Connection Pipe Preparation

A hole of diameter E, located at a maximum distance D from the end of the pipe will need to be drilled completely through the pipe as shown in Figure 2. Values for diameter E and distance D are listed in Table 3 below.

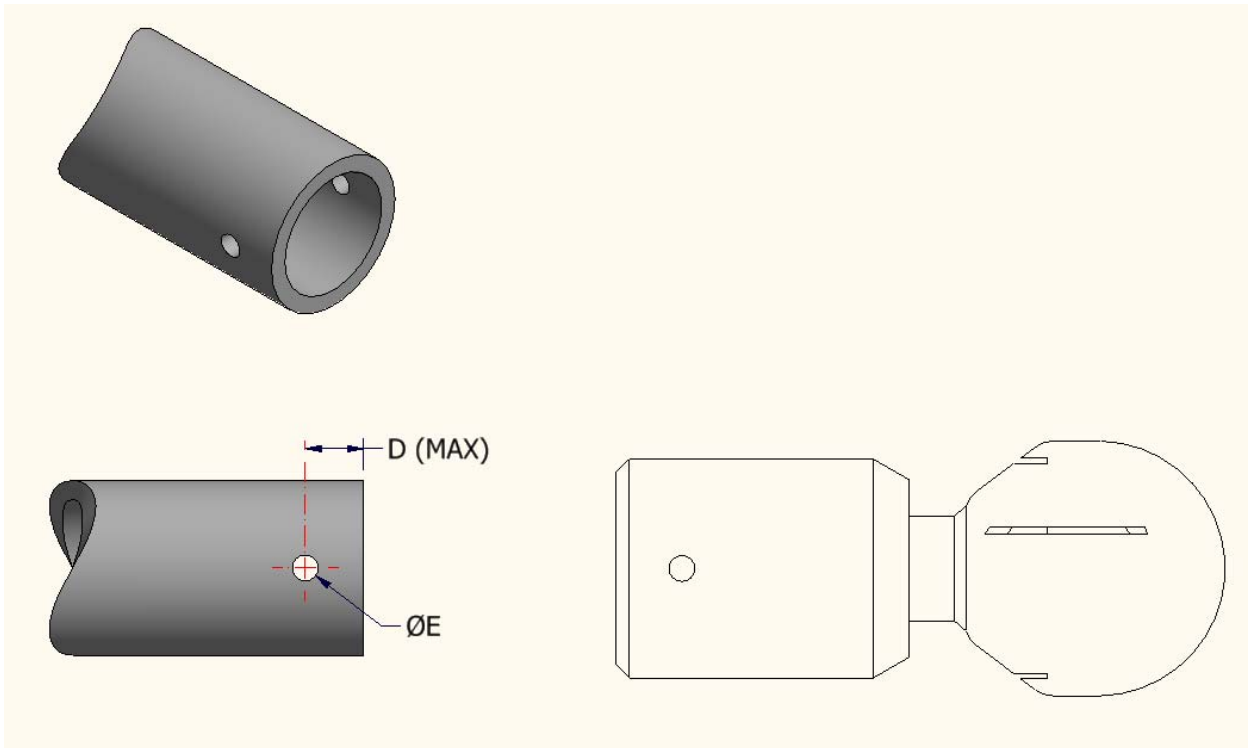


Figure 2 - Illustration of Hole Location for Clip-On Connections

Pipe and Tube Clip - Connector Hole Dimensions				
Nozzle Number	ØE		Dim D	
	In	mm	In	mm
HWS-20...	0.086	2.1844	0.15	3.81
HWS-30...	0.086	2.1844	0.21	5.334
HWS-40/40HF...	0.156	3.9624	0.35	8.89
HWS-50...	0.219	5.5626	0.35	8.89

Table 3 - Values of E and D for Clip-On Connections

3.3.3. Female Threaded Connection Pipe Preparation

The end of the pipe should be prepared with a male NPT or G pipe thread in accordance with ASME B1.20.1 for NPT threads or ISO 228 for G threads. Use of thread sealant is not necessary. Use of an anti-galling compound is suggested.

3.4. Piping System Grounding

The piping system feeding the HydroWhirl S nozzle **MUST** be grounded in accordance with all applicable local, state, and government codes if used in any kind of explosive environment.

3.5. Piping System Filtration

A system capable of filtering out particles 70 microns (200 mesh) and larger should be installed upstream of the nozzle to help prevent clogging and reduce bearing wear.

3.6. Piping System Purge

To avoid clogging or damaging the nozzle, prior to installing the nozzle, the piping system should be purged to ensure all burrs, weld spatter, dirt, and any other debris is removed.

3.7. Installing the Nozzle

3.7.1. Welded Connection Installation

The temperature in the area of the bearing balls (see Figure 3) must not exceed 194°F (91°C) when welding the nozzle, otherwise damage might be caused to the housing and a faulty rotary motion may result. Appropriate cooling measures must be taken to ensure this. The distance *W* from the end of the weld connector to the bearing balls can be found in Table 4. The nozzle should be welded in accordance with the welding procedures of the end user. Welding should only be performed by qualified personnel. For further information, contact a local mechanical contractor.

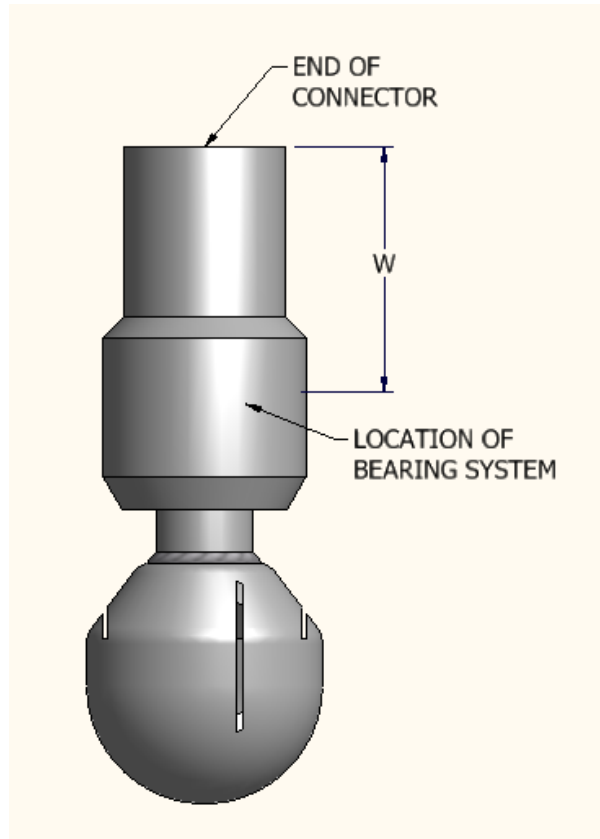


Figure 3 - Distance W from end of Weld Connector to Bearing Balls

Distance From End of Weld Connector to Bearing System for Pipe, Tube and DIN Connectors		
Rating	Dim W	
	In	mm
HWS-20...	1.5	38.1
HWS-30...		
HWS-40/40HF...		
HWS-50...	2	50.8

Table 4 - Values of Dim W for Welded Connectors

3.7.2. Clip-On Connection Installation

1. Align pin holes in connector pipe with pin holes on nozzle (Figure 4).
2. With the curved section of the connector pin up and to the right of the straight section (Figure 5), slide the straight section of the connector pin through the nozzle and the connector pipe
3. Rotate the connector pin until it snaps into place around the nozzle
4. If the connector pin needs to be replaced, it must be replaced with the specified BETE stock number listed in Table 5 or the nozzle may become detached from the pipe and cause damage to the vessel or components in the vessel.

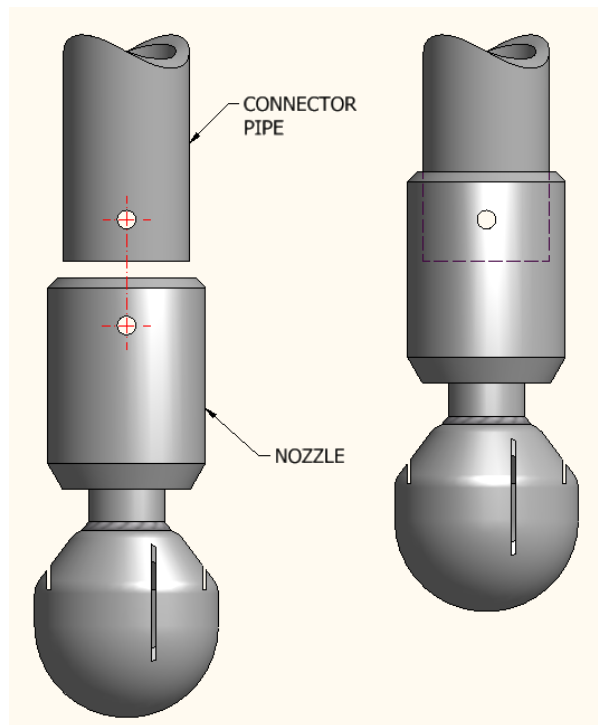


Figure 4 - Preparation for Installation

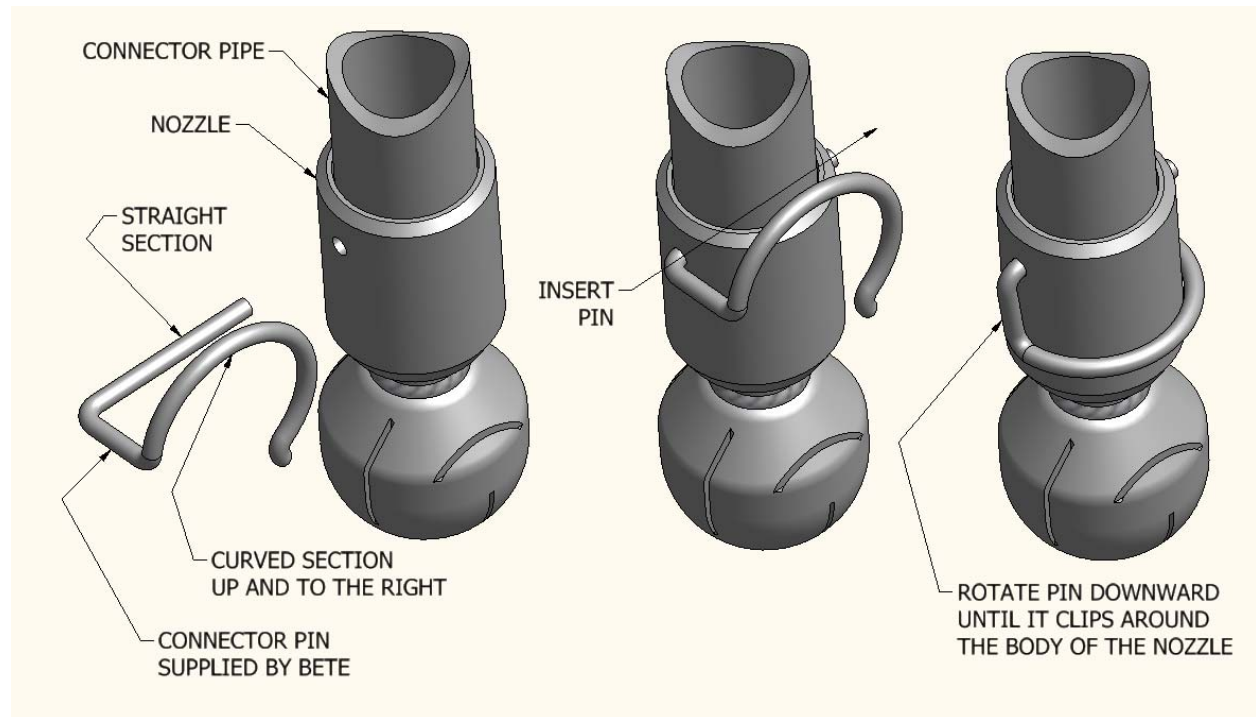


Figure 5 – Final Installation

Nozzle	Connector Pin Stock Number
HWS-20...	167234
HWS-30...	167233
HWS-40	167232
HWS-40HF...	
HWS-50...	167228

Table 5 - BETE Connector Pin Stock Numbers

3.7.3. Female Pipe Thread Installation

1. In order to properly install the HydroWhirl S nozzle with a female pipe thread connection, the use of a strap wrench with a non-metallic strap or soft-jaw pliers is required in order to make sure the surface of the nozzle is not damaged.
2. Hand tighten the nozzle on to the pipe until it stops.
3. Using the strap wrench or soft jaw pliers directly over the threaded section (see Figure 6), tighten the nozzle 1 to 2 turns. If possible try to avoid applying torque directly over the bearing system.

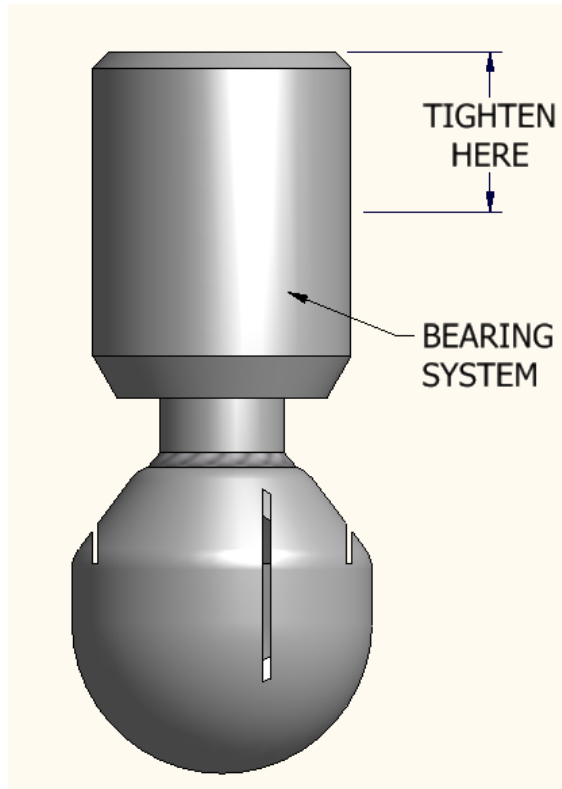


Figure 6 - Illustration of where to Tighten Threads

4. Operation

4.1. Startup

In order for the nozzle to operate, liquid pressure drop greater than 10 PSI (0.7 bar) must be present across the nozzle. Typically pressure is generated by use of a pump or by supplying municipal water pressure and the nozzle is started by opening a valve upstream of the nozzle.

4.2. Nozzle Performance

Nozzle performance is measured by the flow rate of the nozzle. As the pressure drop across the nozzle increases so does the flow rate. The flow rates at various pressures are listed in Table 6. Flow rates for HydroWhirl S nozzles with a clip-on connector generally flow 10-15% higher than the values in Tables 6 and 7.

Female Pipe Size	Nozzle Number	GALLONS PER MINUTE @PSI					
		10 psi	20 psi	30 psi	40 psi	50 psi	60 psi
1/8"	HWS-20-3	1.26	1.63	1.89	2.10	2.28	2.44
	HWS-20-4	2.14	2.79	3.26	3.64	3.97	4.26
	HWS-20	3.16	4.31	5.45	6.41	7.16	7.83
3/8"	HWS-30-5	2.31	3.29	4.12	4.80	5.37	5.88
	HWS-30-6	5.54	6.97	7.98	8.78	9.46	10.1
1/4"	HWS-30	5.70	8.10	9.96	11.5	12.9	14.3
3/4"	HWS-40-7.5	5.60	7.87	9.60	11.1	12.4	13.6
	HWS-40-8	6.39	8.96	10.9	12.6	14.1	15.4
	HWS-40-9	7.94	11.3	13.9	16.0	17.8	19.6
	HWS-40	9.08	13.1	16.1	18.3	20.3	22.2
	HWS-40HF-11	12.2	17.1	20.8	24.1	26.9	29.4
	HWS-40HF	15.0	21.3	26.0	29.7	32.6	35.4
1 1/2"	HWS-50-16	24.2	33.8	41.4	47.8	53.4	58.5
	HWS-50	37.2	52.4	64.1	74.2	82.9	90.9

Table 6 - Flow Rates at Different Pressures - English Units

Female Pipe Size	Nozzle Number	LITERS PER MINUTE @BAR					
		0.5 bar	0.7 bar	1 bar	2 bar	3 bar	4 bar
1/8"	HWS-20-3	4.39	4.79	5.40	7.05	8.19	9.11
	HWS-20-4	7.41	8.10	9.20	12.2	14.2	15.9
	HWS-20	10.8	12.0	13.9	20.2	25.3	29.1
3/8"	HWS-30-5	7.71	8.80	10.4	15.3	18.9	21.9
	HWS-30-6	19.5	21.0	23.4	29.8	34.2	37.6
1/4"	HWS-30	19.1	21.7	25.7	37.0	45.4	53.1
3/4"	HWS-40-7.5	18.8	21.3	25.1	35.7	43.8	50.7
	HWS-40-8	21.5	24.3	28.6	40.6	49.6	57.2
	HWS-40-9	26.6	30.2	35.7	51.5	63.0	72.7
	HWS-40	30.2	34.6	41.2	59.9	71.8	82.5
	HWS-40HF-11	40.9	46.4	54.5	77.3	95.0	109
	HWS-40HF	50.4	57.3	67.5	97.0	116	132
1 1/2"	HWS-50-16	81.6	92.0	108	154	188	218
	HWS-50	125	142	167	238	293	338

Table 7 - Flow Rates at Different Pressures - Metric Units

4.3. Operating Pressure Range

The HydroWhirl S nozzle operates best in a pressure range of 10-60 PSI (0.7-4.1 bar). Pressures below 10 PSI (0.7 bar) reduce the reach of the nozzle resulting in less effective cleaning. Pressures above 60 PSI (4.1 bar) will atomize the spray more quickly also resulting in less effective cleaning, and in addition, cause the nozzle to rotate faster, which may shorten bearing life. The recommended pressure for the best performance and maximum service life is between 30 and 50 PSI (2.1 and 3.4 bar).

4.4. Maximum Operating Pressure

The maximum operating pressure for the HydroWhirl S is 150 PSI (10 bar).

4.5. Maximum Operating Temperature

- a. The operating temperature is determined by the temperature of the spray media
- b. Refer to section 2.5 for additional precautions
- c. For ATEX applications the maximum operating temperature is 175°F/80°C
- d. For Non-ATEX applications the maximum operating temperature is 200°F/95°C
- e. The maximum Non-Operating (when the nozzle is stationary) temperature is 800°F/426°C. For ATEX applications, the nozzle must be cooled to the appropriate temperature prior to operation.

5. Maintenance

5.1. Preventative Maintenance

The most important preventative maintenance that will ensure a long, trouble free lifetime for the HydroWhirl S nozzle is to have a 70 micron or finer filtration system upstream of the nozzle that is cleaned on a regular basis. The frequency of cleaning depends on the quality of the liquid flowing through the filter and must be determined by facility maintenance personnel.

5.2. Cleaning

The HydroWhirl S is designed to be self-cleaning. If recommended filtration is provided and maintained, the nozzle should not clog. In the event that the nozzle does become clogged, remove it from service and soak it in an appropriate solvent. The nozzle should then be rinsed with clean water. If this does not remove the clog, try cleaning in an ultrasonic bath for 30-60 minutes. If the clog persists the nozzle must be replaced.

5.3. Replacement Parts

With the exception of connector pins for clip-on connectors (see section 2.5.2, Table 4), there are no replacement parts for the HydroWhirl S nozzle. These pins should be periodically inspected for wear and replaced if worn. Once the HydroWhirl S nozzle has reached the end of its service life it should be replaced.

6. Support

6.1. Nearest Distributor or Representative

The most up-to-date list of BETE representatives and distributors can be found at <http://www.bete.com/contact/index.html>.

6.2. BETE Corporate

6.2.1. BETE Corporate Contact for Europe

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7.1 EC Type Examination Certificate

Available from the BETE website's Approvals and Certifications page at

www.bete.com/products/spraynozzleapprovals.html

listed under the ATEX heading.