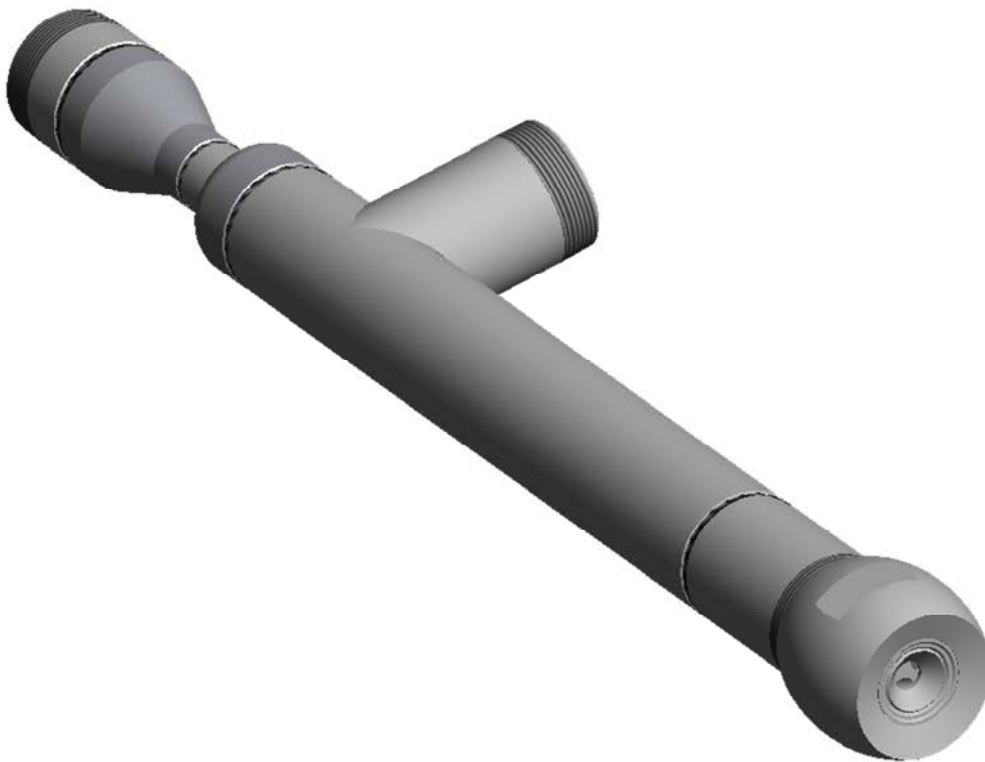




Spillback Lance Manual



BETE Fog Nozzle Inc.
www.BETE.com

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Safety

The following symbols are used to call the reader's particular attention to areas of concern:

General Warning:

This symbol alerts you to a situation or condition that could cause damage to the lance or personal injury.



Danger of Injury:

This symbol warns you of potential for serious injury.



Danger of Exposure to Gases:

This symbol warns you of potential for exposure to noxious gases and other substances.



- Read, understand, and adhere to all of your company's safety policies and local codes and regulations.
- Spillback lances are designed to have a high pressure inlet line and high pressure return line to a reservoir. All connections should be inspected before operating the lance.
- There is no standard internal device to prevent process fluids in the vessel from travelling upstream through the nozzle and out the connections. The user must provide a valve at the lance inlet and outlet to prevent escape of process fluids if the lance will be removed while the process vessel is in operation.
- The piping for the spillback lance has a max recommended operating pressure of 750 psi (50 bar). The connections used may limit the max operating pressure. Verify the allowable operating pressure of the connections. Exceeding these conditions may result in damage to the lance or system. Contact BETE directly if operating outside these conditions.
- High pressure tubes, pipes, fittings, couplings, quick connects, unions, flanges, hoses, or other pressure retaining elements that are damaged should be replaced immediately with new or refurbished parts to avoid any risk of injury or damage. Only use components rated for operating conditions.
- High pressure hoses are commonly used with spillback lances for ease of use during inspections and repair. Hoses should be inspected during maintenance and installation to ensure they are free of damage or defects.
- Avoid exposing the lances to temperatures above 220°F (100°C) when not in operation. This could happen during startup, decommissioning, or system failure. Use good practice to avoid thermal shock.
- Never disassemble or loosen anything under pressure.



Scope

This manual covers installation, operation, and maintenance of BETE Spillback lances and nozzles. This documentation supplements drawings, performance charts, and inspection reports that accompany the assembly.

Introduction

BETE Spillback lances (See Figure 1) are intended to facilitate installation of spillback nozzles inside a process vessel, piping, or ducting. A spillback nozzle allows an operator to adjust flow into the system without changing the supply pressure to the lance. See Appendix A for theory of operation.

Lance Nomenclature

Standard Features:

- **Liquid Inlet:** The connection receives fluid from a pump at a desired constant operating pressure. (See Figure 1)
- **Spillback Outlet:** The connection is for the diverted flow that is not sprayed into the process system. (See Figure 1)
- **Fluid Cap:** The fluid cap provides the injection spray into the system. (See Figure 2 & 3)
- **Swirl:** The swirl imparts a tangential velocity on the full flow from the pump into the fluid cap. (See Figure 2)
- **Insert:** The insert is an adapter with a fixed orifice to connect the inner pipe to the swirl. (See Figure 2)
- **Swirl Insert:** For 2" assemblies the swirl and insert are made as one piece. (See Figure 3)
- **Gasket:** The gasket creates a seal between the outer lance pipe and swirl. (See Figure 2 & 3)
- **Mounting Flange:** The mounting flange holds the lance in position in the system and seals the system, preventing contamination of the process and outside environment. (See Figure 1 & 5)

Optional Features:

- **Protective Shroud:** The protective shroud is a pipe that covers the lance. (See Figure 4 & 5)
- **Air Purge Shroud:** The air purge shroud is the same as the protective shroud with the addition of an inlet to provide a constant flow of purge air to cool the lance and reduce buildup. (See Figure 4 & 5)
- **Shroud Adapter:** The shroud adapter is for removing the lance from the system without removing the shroud, mounting flange, or changing the inserted length of the lance. (See Figure 5)
- **Adjustment Collar:** The adjustable collar allows the user to vary the insertion length. The collar is non-sealing and meant for systems at atmospheric pressure or under vacuum. (See Figure 5)
- **Handle:** The handle is to assist in moving the lance. (See Figure 1 and 5)

- Spillback Control Valve: The valve is installed in the spillback line. When opened, the pressure in the spillback line decreases allowing for flow to be diverted from the fluid cap, decreasing injection flow into the system. (See Figure 7)

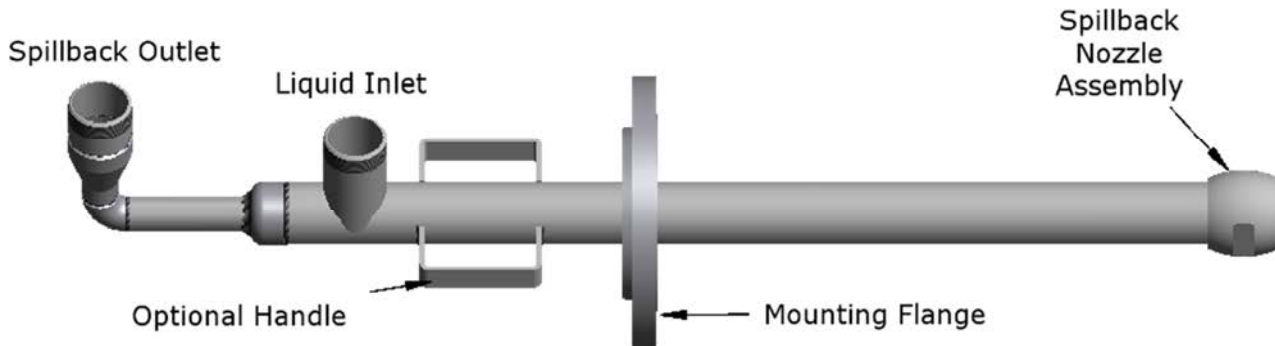


Figure 1: Basic Lance Configuration

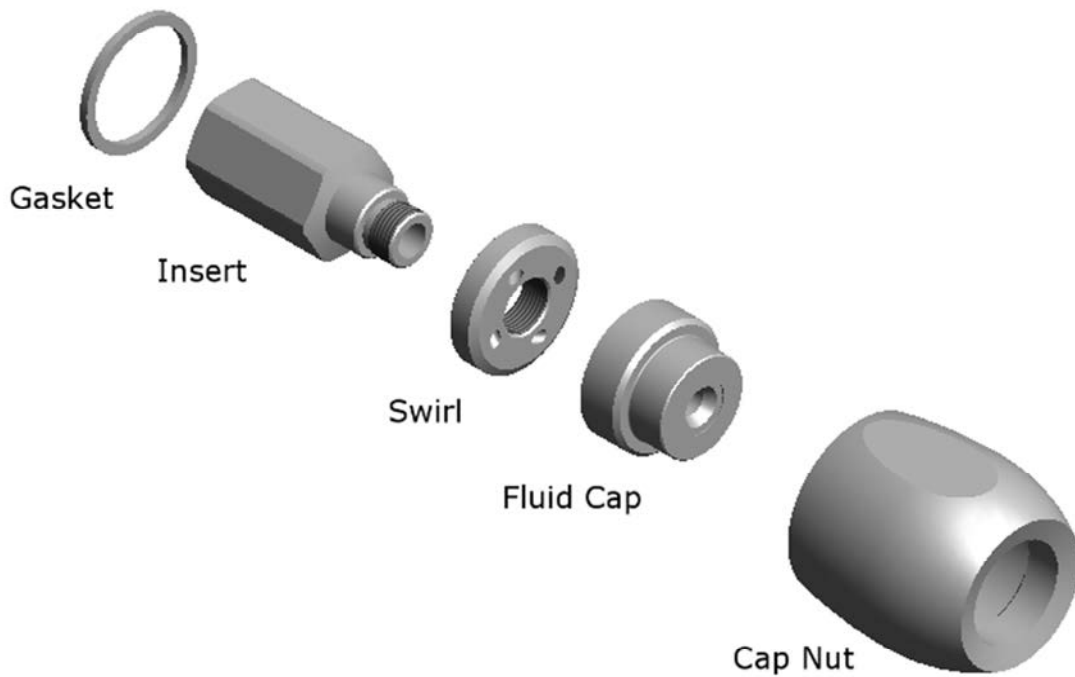


Figure 2: Exploded View $\frac{3}{4}$ " and 1" Nozzle Assembly

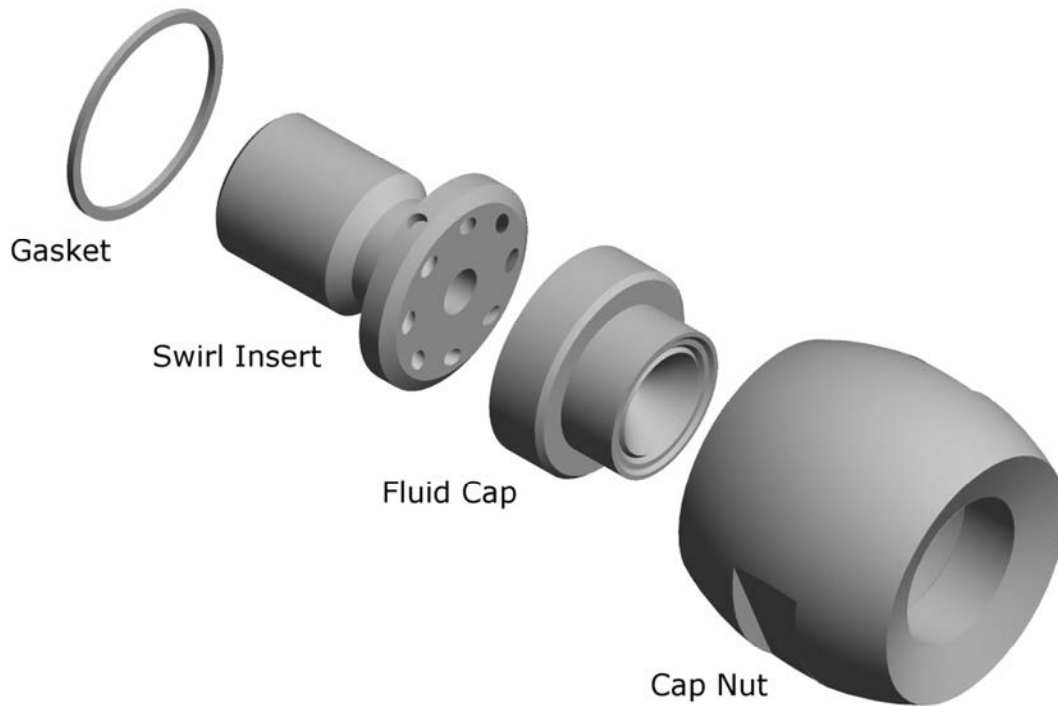


Figure 3: Exploded View 2" Nozzle Assembly

Examples of Available Options

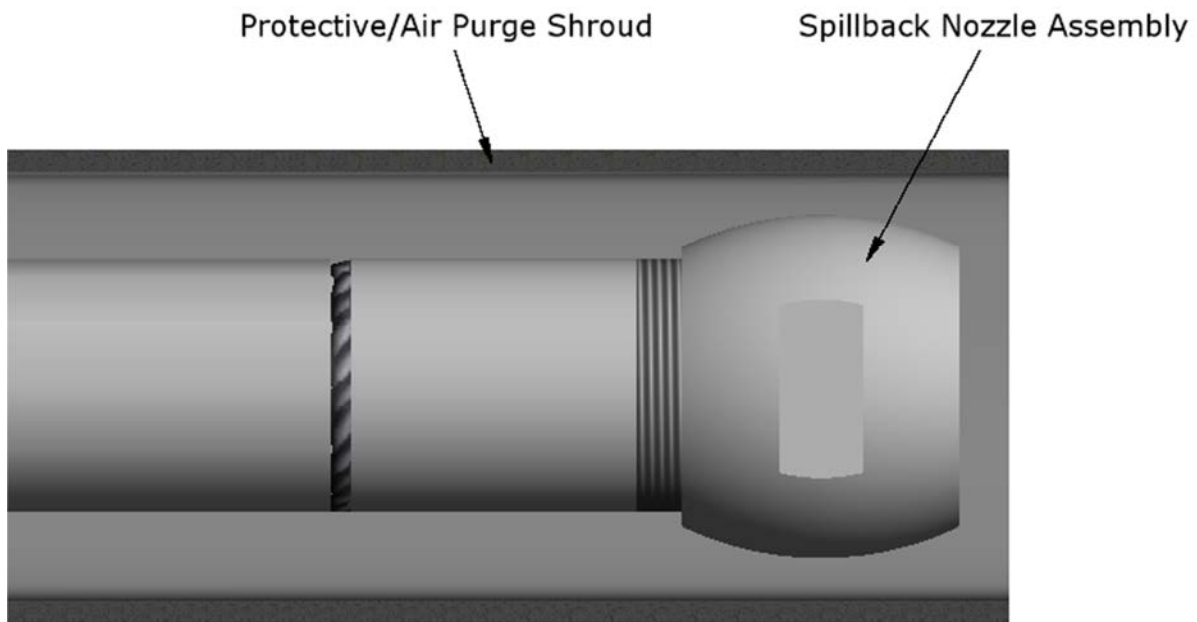


Figure 4: Nozzle Tip and Protective Shroud

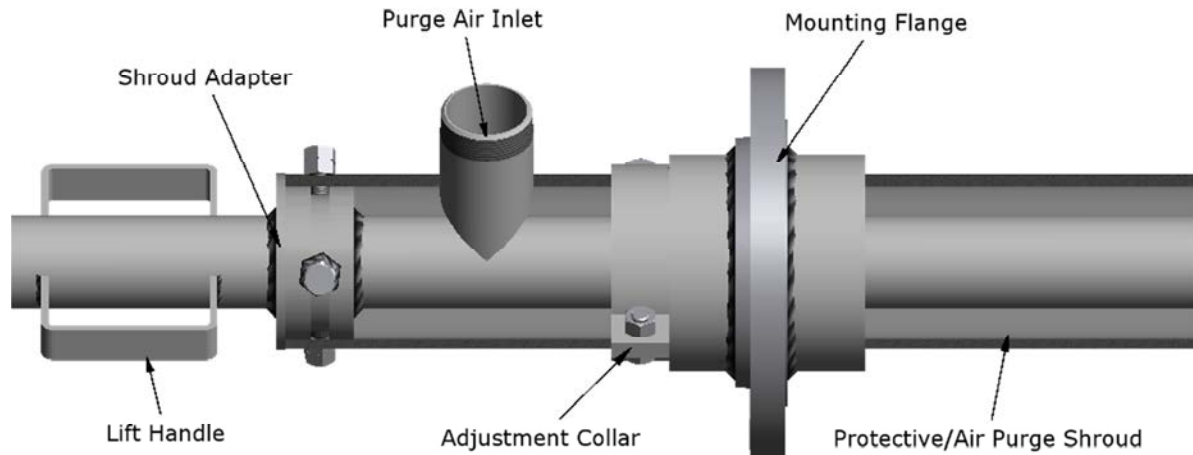


Figure 5: Optional Mounting Components

Lance Installation

1. Unpacking:
 - Remove the lance from the packing crate, inspect for damage, and confirm that the lance is suitable for installation by reviewing documentation.
 - Check to make sure that foreign matter is not inside the lance piping or nozzle.
 - Retain any documentation in the shipping crate.
2. Cleaning:
 - Ensure mounting surface on the vessel port and lance are clean and undamaged.
 - Make sure the sealing surface of the mating flanges, threads, and any other connections are cleaned of old sealant or gasket material.
3. Positioning:
 - Using good piping practice, insert the lance through the vessel port.
 - Avoid impacting the gasket with the lance.
 - Be sure to check the orientation of the connections on the lance. Orientation may be critical for the process connections.
 - Align the bolt holes, install bolting hardware, and tighten to the gasket manufacturer's recommended torque using a staggered tightening pattern.
4. Connect the inlet hose/piping and spillback hose/piping.
 - The lance will not function properly if the connections are reversed and may cause damage to the system.
 - Check that all nozzle and piping connections are adequately tightened.
 - The lance can come with a variety of connections, such as threaded fittings, quick connects (with and without check valves), and flanged connections. Reference manufacturer's documentation and plant procedures for proper use and installation.



- The spillback lance may be connected to supply and return piping with flexible high pressure hoses.
 - It is recommended to install manual valves in the hard piping before the hoses to isolate the lance from the liquid supply and bleed valves to drain the line. (See Figure 7)
5. Review and follow plant startup procedure for the system.
 6. Check for leaks on the initial startup.
 - If the fluid is toxic or noxious be sure to take appropriate safety precautions when checking for leaks.



Lance Removal

Lances can become extremely hot during operation. Suitable protective clothing should be used during removal.



1. Ensure the process, vessel, or piping is depressurized or under vacuum.
2. Close any valves for the liquid inlet and spillback outlet to isolate lance.
3. Drain liquid in the lances to relieve excess liquid if bleed valves are installed.
4. Disconnect supply line and spillback line.
5. Remove the lance according to one of the following steps depending on mounting arrangement.
 - Unbolt the mounting flange to remove the entire lance assembly.
 - Mark the insertion length and loosen the adjustment collar to remove the lance with the shroud.
 - Unbolt the shroud adapter to remove the lance only.
6. Install port cover on vessel flange.
7. Inspect the nozzle and perform maintenance as needed.
 - Reference Troubleshooting section and Nozzle Assembly section in this manual.



Troubleshooting

If the desired quality of spray and target temperature in a cooling process has not been achieved review the following.

Symptoms in System: Possible Causes

- Poor Cooling: See Items 1, 2, and 3
- Excessive Buildup: See Items 2 and 4
- Incomplete Evaporation: See Items 1, 2, and 4

Action/Possible Solutions:

- 1. The lance is spraying a straight jet of liquid.**
 - a. Connections may be reversed.
 - b. Make sure nozzle was assembled correctly.
- 2. The pattern is streaky or uneven.**
 - a. Remove nozzle and inspect components for wear.
 - b. Remove nozzle and inspect for plugging.
- 3. Not enough flow into the system.**
 - a. Remove nozzle and inspect for plugging.
 - b. Verify inlet line and spillback line pressure.
 - c. Verify spillback valve is functioning.
- 4. Too much flow into the system.**
 - a. Remove nozzle and inspect for plugging in the insert.
 - b. Inspect the spillback line for obstructions.
 - c. Verify spillback valve is functioning.
 - d. Verify inlet line and spillback line pressure.
 - e. Remove nozzle and inspect components for wear.

Contact BETE for further troubleshooting if spray performance issues persist.

Maintenance

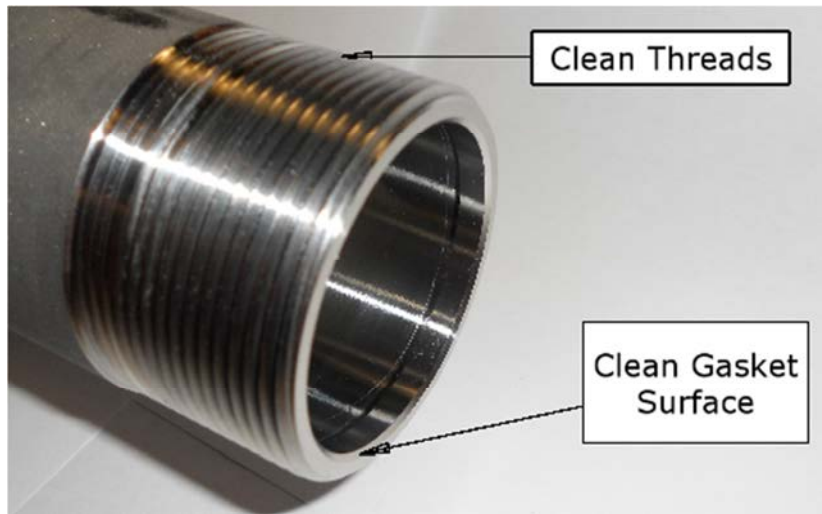
Function and spray checks should be performed as needed.

1. Remove the lance for spray testing. (See Lance Removal section.)
2. Position the lance in a secure holding device.
3. Attach the lance to an appropriate inlet line and spillback line.
4. Spray test the lance.
5. Visually observe spray pattern and record flow rate if possible.
6. The lance or nozzle may need to be replaced or cleaned if there are jets of liquid in the spray cone, heavy streaking, or large droplets.

Replacement and maintenance work should be carried out as needed.

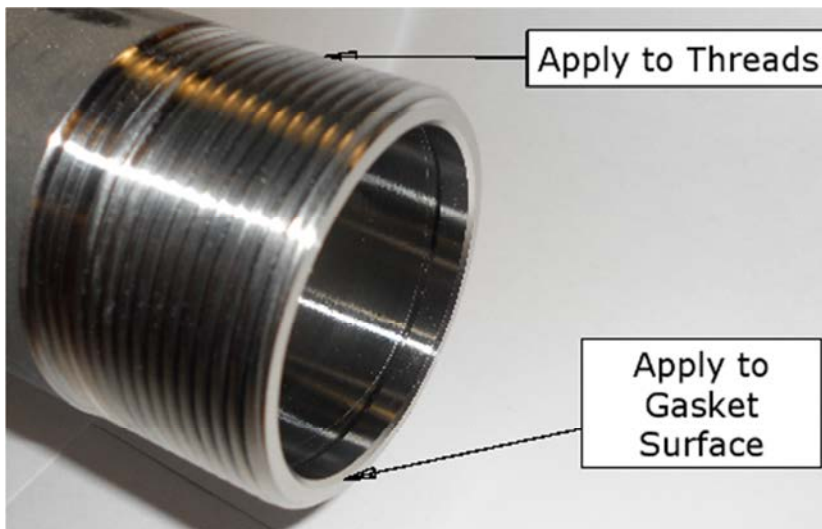
Nozzle Assembly

1. Clean and dry threads.
2. Polish gasket surface with honing stone.
3. Wipe gasket surface clean. (See Assembly 1)

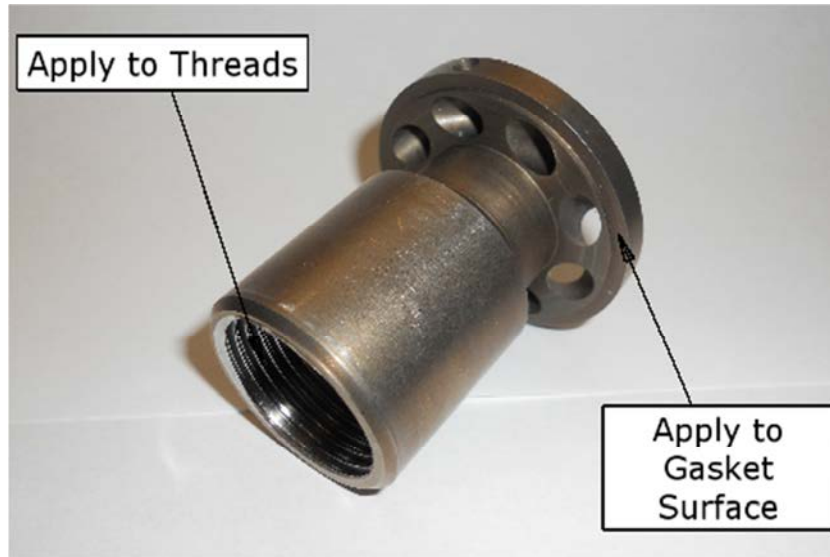


Assembly 1: Clean Surfaces

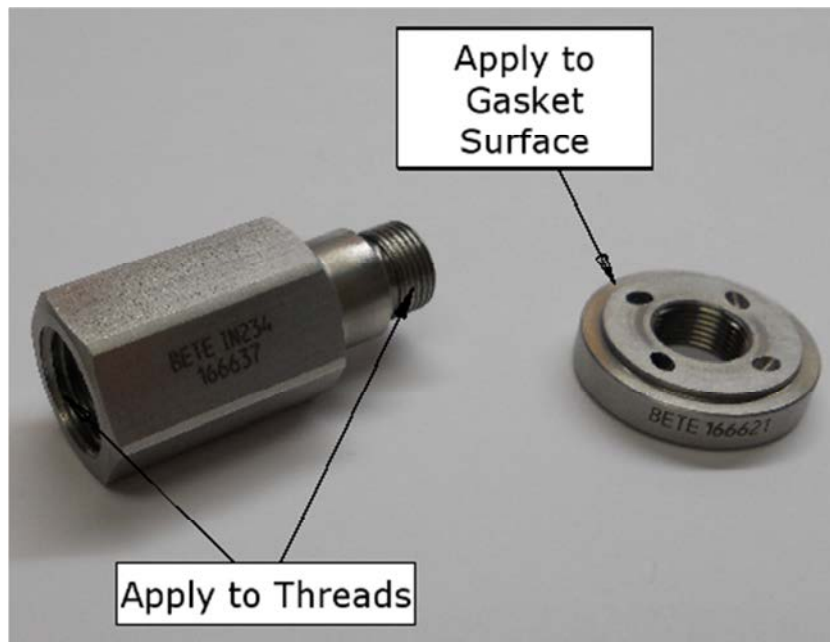
4. Apply anti-seize compound to the threads and gasket surface. (See Assembly 2 & 3a/3b)



Assembly 2: Apply Anti-Seize Compound to the Threads and Gasket Surface



Assembly 3a: Apply Anti-Seize Compound to 2" Swirl Insert Threads and Gasket Surface



Assembly 3b: Apply Anti-Seize Compound to ¾" and 1" Insert Threads and Swirl Gasket Surface

5. For $\frac{3}{4}$ " and 1" nozzles only, thread the insert into swirl until firmly snug. (See Assembly 4)



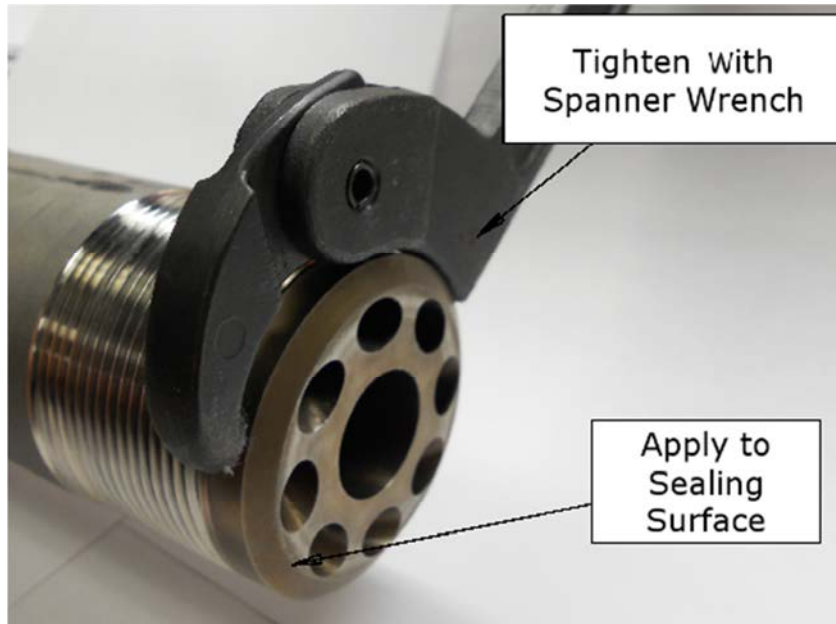
Assembly 4: Install Insert into Swirl

6. Install spillback gasket onto swirl. (See Assembly 5)



Assembly 5: Install Spillback Gasket

7. Tighten swirl insert with a spanner wrench until firmly snug and apply anti-seize compound to sealing surface. (See Assembly 6)



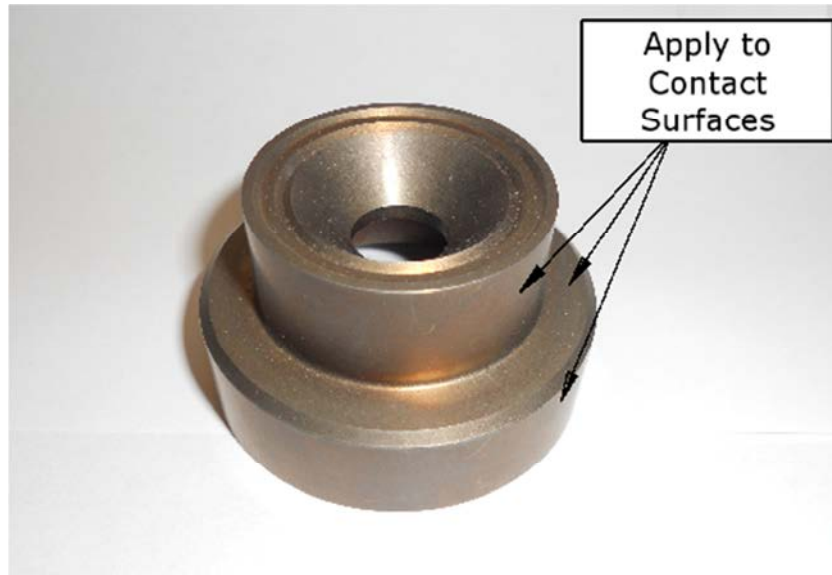
Assembly 6: Tighten the Swirl and Apply Anti-Seize Compound to the Surface.

8. Apply anti-seize compound to the sealing surface between the swirl and fluid cap. (See Assembly 7)



Assembly 7: Fluid Cap Sealing Surface

9. Apply anti-seize compound to the contact surface between the fluid cap and cap nut. (See Assembly 8)



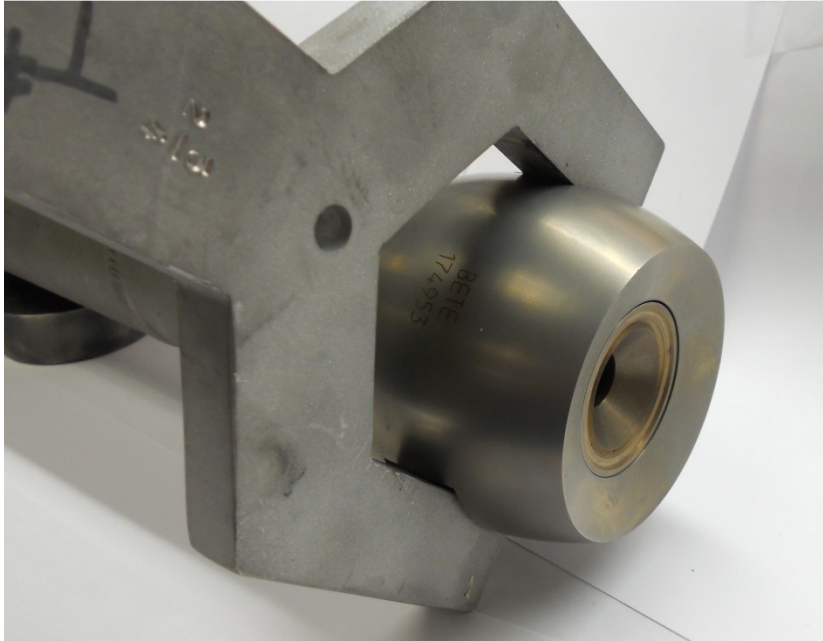
Assembly 8: Fluid Cap Contact Surfaces

10. Insert fluid cap into cap nut. (See Assembly 9)



Assembly 9: Install Fluid Cap into Cap Nut

11. Install cap nut onto lance and tighten to 75 ft*lbs (100 N*m). (See Assembly 10)



Assembly 10: Tighten Cap Nut

12. Clean excess anti-seize compound from threads and mating surfaces.



Assembly 10: Complete Nozzle Assembly

13. For disassembly, reverse order of assembly procedure.

Appendix A

General Theory of Spillback Nozzle Operation:

A spillback nozzle is a type of whirl nozzle that is equipped with two connections instead of the single inlet on most traditional whirl nozzles. Fluid enters the swirl chamber in the fluid cap through angled holes in the swirl component that impart a tangential velocity to the fluid. As the fluid exits the fluid cap orifice, the tangential velocity creates a cone pattern and atomization of the fluid. Spillback nozzles achieve a 10:1 turndown ratio of the injection flow rate by diverting a portion of the flow rate through an internal return line, using a spillback valve in the return line to adjust the return flow rate. An increase in flow rate through the return line results in a decrease in injection flow rate through the orifice. A constant supply pressure maintains liquid velocity through the internal swirl disk component, providing relatively constant atomization throughout the flow range.

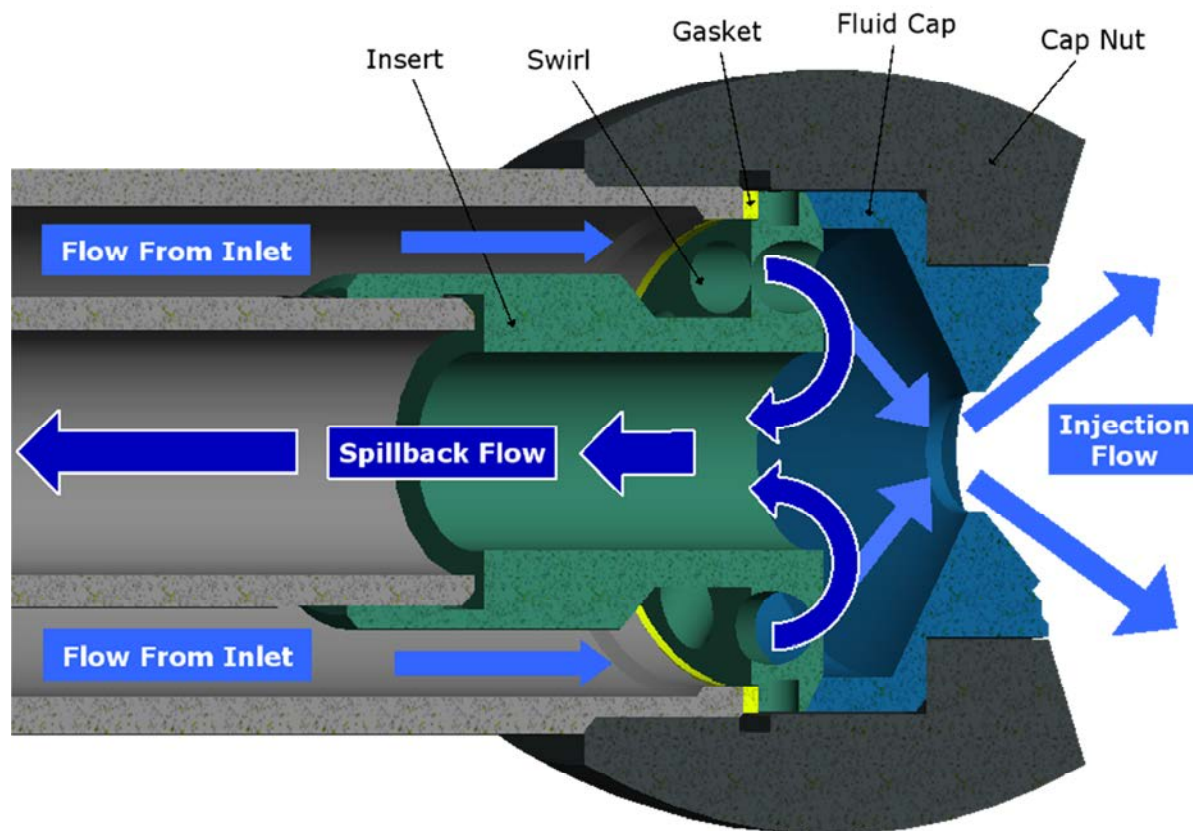


Figure 6: Flow Direction in Nozzle Head

General Spillback System Operation:

Additional components are required to operate the spillback nozzle and lance to provide nearly consistent atomization into the process vessel. A reservoir tank (1) holds the supply liquid to be pumped to the nozzle and receives the spillback liquid that has been not been injected to the process. The pump (2) and motor (3) are selected to provide adequate operating pressure and flow rate for the supply liquid. The spillback valve (4) controls the amount of liquid flow through the spillback return line to the reservoir and the amount of injection flow through the nozzle. The spillback valve is commonly connected to a control system (5) for remote or automatic feedback control of injection fluid. The manual shutoff valves (6) are used to isolate the final length of pipe or hose that connects the spillback lance to the supply and spillback pipes. The bleed valves (7) are used after closing the manual shutoff valves to release pressure in the supply (8) and spillback (9) pipe or hose and isolate the spillback nozzle and lance (10) prior to removal or installation.

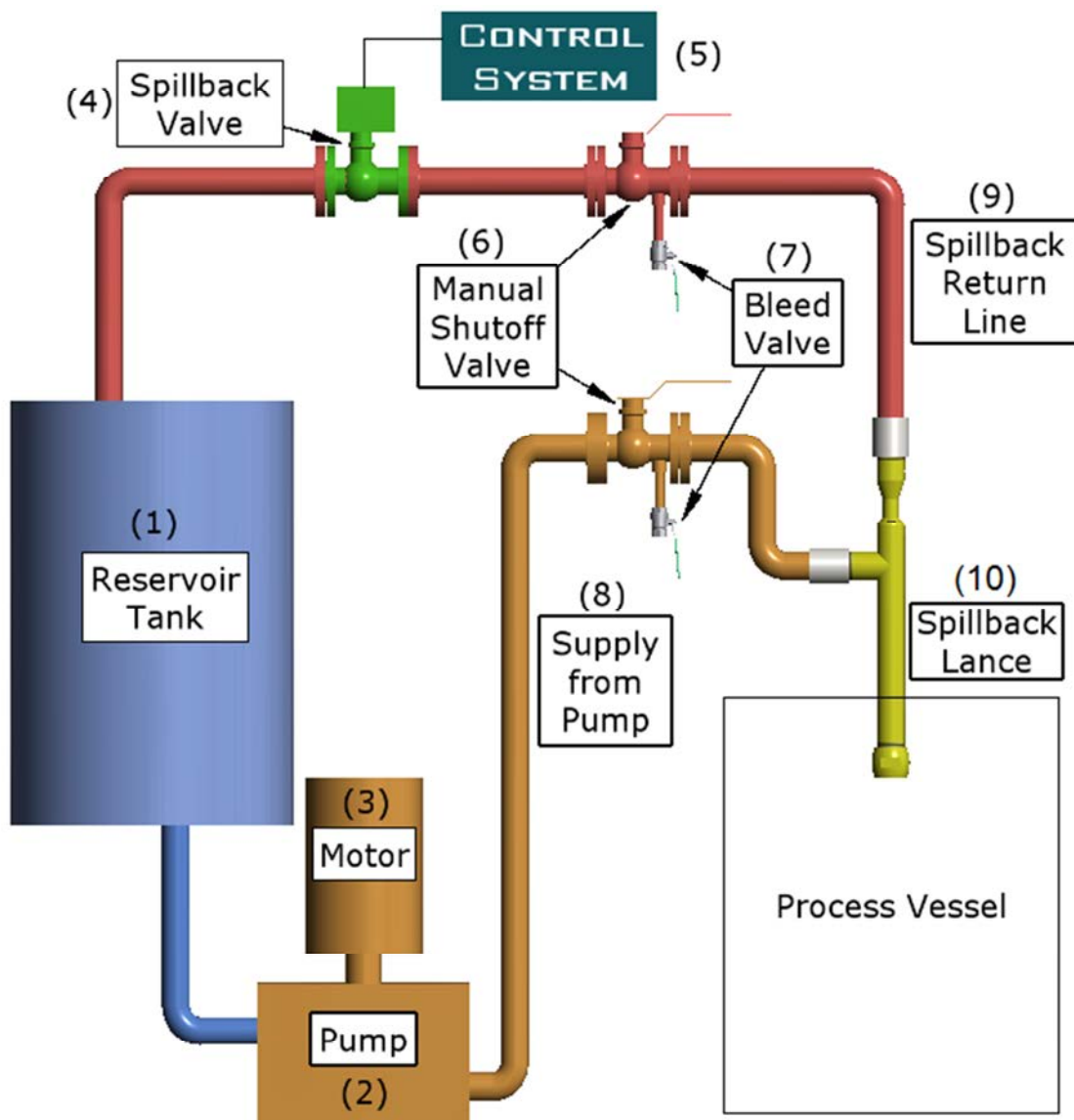


Figure 7: Spillback System Diagram