SAFETY INDUSTRIES
Pty Limited

# HORIZONTAL BLADDER TANK

# PROPORTIONING SYSTEMS

# INSTALLATION,

# OPERATION & MAINTENANCE MANUAL

**CONTENTS**




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## A. WARNING

# WARNING

**This manual must be read carefully before installing or operating the bladder tank proportioning system. Failure to follow the procedures contained in this manual may result in damage to the equipment and/or personal injury.**

**The bladder tank is a pressure vessel designed to contain only liquid, it is essential that all air be eliminated from the tank before operation. The presence of compressed air in the tank greatly increases the risk of personal injury when maintenance is performed on the tank or in the event of failure of the pressure vessel.**

**All Warnings and Cautions highlighted in this manual must be observed for the system to be operated safety.**

| ISSUE | | D |
|---|---|---|
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# B. GENERAL

The Bladder Tank Proportioning system is one form of balanced pressure proportioning. In balanced pressure proportioning systems, the foam concentrate is injected into the proportioner at the same pressure as the water enters. Such a proportioning system maintains a fairly constant mixing rate (proportioning rate) over a wide range of flows and pressures.

In the Bladder Tank Proportioning system, the foam concentrate is stored in a rubber bladder inside a pressure tank. Water from the foam system is applied to the outside of the rubber bladder, pressurising the bladder to the same pressure and displacing the foam concentrate in the tank as the supply is used. This arrangement produces automatic pressure balancing.

Once the foam concentrate supply is exhausted the system must be shut down, the water drained from the tank and then refilled with foam concentrate. It is not practical to refill the tank with foam concentrate while the system is in operation in most instances.

# C. INSTALLATION

The selection of materials of construction for piping, valves and fittings must be made with reference to the type of foam concentrate. The following general rules are offered as a guide. The foam concentrate manufacturer should be consulted before final selection is made.

| Item | Synthetic Foam Concentrates | Protein Based Foam Conc |
|---|---|---|
| Piping | 316 or 304 S/Steel | Black Steel *** |
| | Glassed Reinforced | |
| Valves | Cast Brass | Cast Brass |
| | Stainless Steel | Cast Iron/Bronze |
| Valve Seats & Seals - Preferred | Teflon, EPDM | Teflon, EPDM |
| Valve Seats & Seals -Acceptable | Buna N, Viton & Neoprene | Buna N, Viton & Neoprene |
| | | |

*** NOT Galvanised or coated pipe.

The proper selection of foam concentrate for an application is important. Check your application with the manufacturer. Also, note that foam is a conductor and should not be used on energised electrical equipment.

**CAUTION**: THE BLADDER TANK IS SUPPLIED WITH THE RUBBER BLADDER FITTED INSIDE THE TANK. **DO NOT WELD ON THE PRESSURE VESSEL**.

The most common bladder tank arrangement is shown in Fig 1 below.

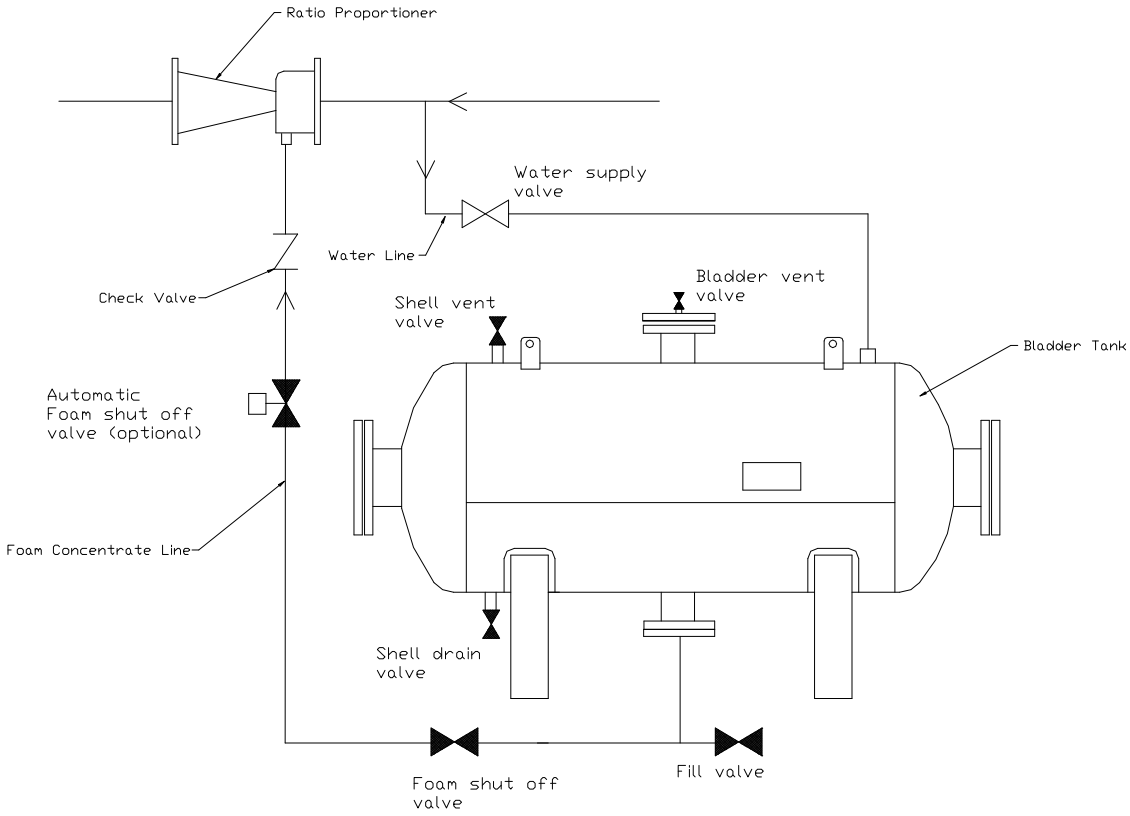



**Fig. 1. Typical Bladder Tank System**

When installing the tank:

1. Care should be taken when offloading and moving the tank to avoid damage to the tank and fittings.
2. Mount the tank on a concrete slab and secure the tank to the slab using the bolt holes provided. In high wind areas (cyclone affected areas) or areas subject to earthquakes additional securement may be required.
3. Adequate clearance for removal of the sparge pipe and bladder should be allowed where the tank is to be installed (full height & length of tank).
4. **The Ratio Proportioner must be mounted above the top of the tank shell.** Loss of foam concentrate into the system pipe work may occur if this is not done.
5. All interconnecting pipe work must be self supporting or adequately brackets so as to avoid strain on the tank.
6. **Always flush water and foam solution lines before making connections to the bladder tank, foreign objects entering the tank may damage the bladder.**
7. Always flush water and foam solution lines before installing foam proportioners and foam makers. Clean all strainers after flushing.

# D. FILLING PROCEDURE

When filling the bladder it is essential that the bladder is fully supported in the tank during filling and that large pressure differentials across the bladder are avoided. If this procedure is not followed carefully the bladder may be damaged and the foam concentrate may then become contaminated by water.

To fill the tank you will require a foam concentrate pump (hand pump for small tanks or positive displacement type for larger tanks (about 80 lpm at 200 kPa), an air supply, pressure gauges (0-200 kPa), two lengths of hose and fittings needed to connect from the tank to the water supply and the drain, and a 44 gallon drum (empty).

### D.1 Prepare for the work.

- Notify all relevant parties.
- Plan the work.
- Do safety checks and HAZOP.
- Get appropriate work permits.
- Organise the necessary tools and equipment.

### D.2 Equipment required.

1. Foam Concentrate (the same foam as used in the tank if refilling).
2. Foam fill pump, suction hose and fill hose.
3. Appropriate couplings to connect to the tank & tools for fitting and tightening couplings.
4. An industrial vacuum cleaner.

CAUTION: Opening vent and drain valves on the bladder tank when the tank is pressurised will damage the bladder if this procedure is not followed

### D.3 Tank Filling Steps

1. Isolate the tank from the water supply and the proportioner.
2. Depressurise the tank.
3. Drain water from the tank.
4. Attach industrial vacuum cleaner to the shell vent valve & inflate the bladder by removing all air from the tank shell using the vacuum cleaner.
5. Pump in foam concentrate until the tank is filled to the required level.
6. Re-instate tank to normal operating conditions (refill with water and bleed air from the tank and reset valves).

## D.4 Step 1 - Isolate the tank and depressurise the tank

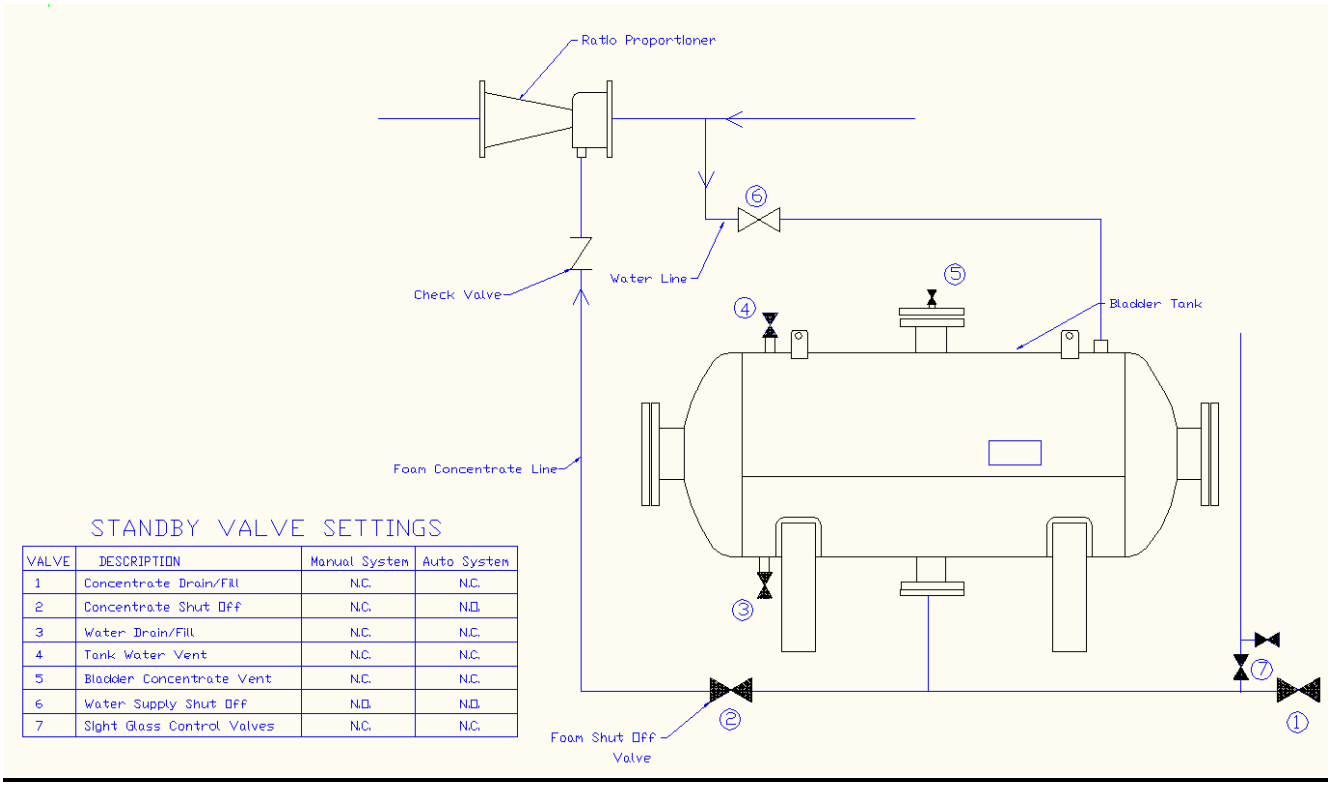
1. Isolate the Bladder from main water supply by closing - Valve 6.
2. Isolate the Proportioner from bladder foam by closing - Valve 2

## D.5 Step 2 – Depressurise the tank

1. Very slowly open valve #5 and vent any air. Close #5 then open Valve #4 to relieve any additional pressure.

## D.6 Step 3 – Drain all water from the tank

1. Fully open – valves 4 & 5.
2. Then SLOWLY open - valve 3
3. Water should drain from valve 3.
4. If the liquid draining from the tank is foaming it may (but not always) be an indicator that the bladder is damaged.
5. It could also mean that foam solution has flowed back through the proportioner.




| VALVE | DESCRIPTION | Manual System | Auto System |
|---|---|---|---|
| 1 | Concentrate Drain/Fill | N.C. | N.C. |
| 2 | Concentrate Shut Off | N.C. | N.O. |
| 3 | Water Drain/Fill | N.C. | N.C. |
| 4 | Tank Water Vent | N.C. | N.C. |
| 5 | Bladder Concentrate Vent | N.C. | N.C. |
| 6 | Water Supply Shut Off | N.O. | N.O. |
| 7 | Sight Glass Control Valves | N.C. | N.C. |

## D.7 Step 4 – Inflate the bladder

1. Valves 4 & 5 are open
2. Connect a suction hose to Valve 4 and the vacuum cleaner.
3. Run the vacuum cleaner until no more air enters Valve 5.
4. Close Valve 4 and remove vacuum cleaner.

5. The bladder is fully inflated.

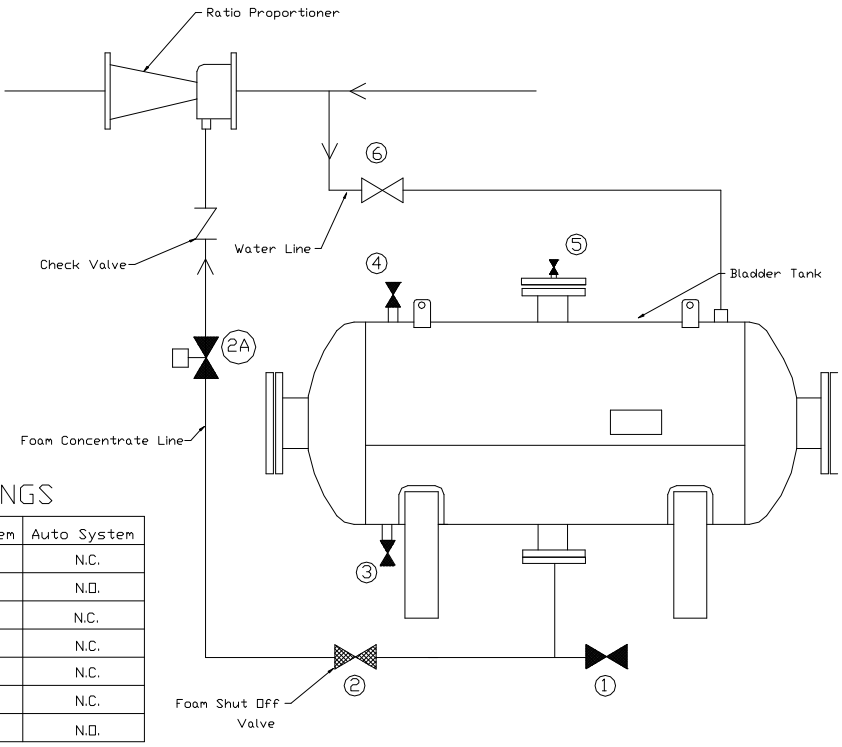
### D.8 Step 5 – pump in the foam concentrate

- Connect the foam pump to Valve 1.
- Open Valve 1
- Valve 5 MUST BE OPEN
- Pump in foam until the tank is full or all foam concentrate is used.

### D.9 Step 6 – re-instate the system

1. Valves 7 & 8 Closed.
2. Valves 4 & 5 Closed
3. Valves 1, 2 & 3 Closed
4. PARTIALLY open valve 6 to re-pressurise the tank slowly. Open SLOWLY.
5. Once pressurised fully open valve 6.
6. Very slightly open Valves 5 then Valve 4 to bleed out any air. Close valves when all air is released.

# E. OPERATION & MAINTENANCE




STANDBY VALVE SETTINGS

| VALVE | DESCRIPTION | Manual System | Auto System |
|---|---|---|---|
| 1 | Concentrate Drain/Fill | N.C. | N.C. |
| 2 | Concentrate Isolation | N.C. | N.O. |
| 2A | Concentrate Shut Off - Auto | ---- | N.C. |
| 3 | Water Drain/Fill | N.C. | N.C. |
| 4 | Tank Water Vent | N.C. | N.C. |
| 5 | Bladder Concentrate Vent | N.C. | N.C. |
| 6 | Water Pressure Shut Off | N.O. | N.O. |

**Fig 5. Standby Valve Settings**

## E.1 OPERATION (MANUAL)

1. Open the foam solution discharge valve(s) for the required foam system(s).
2. Check that all proportioning system valves are in the correct standby positions.
3. Open the foam concentrate discharge valve(s) for the required foam system(s).

## E.2 SHUTDOWN

1. Close the foam concentrate discharge valve(s) for the foam system(s).
2. Allow water to run until clear water is discharged from the foam makers.
3. Close foam solution discharge valves.
4. Return all valves to their standby positions.
5. Recharge the foam tank with foam concentrate as per the filling procedure.
6. Replace all breakable components such as glass diaphragms, rupture disks etc. in foam makes or foam lines.

## E.3 INSPECTION & MAINTENANCE

Monthly.

1. Check the operation of any automated valves (the main water and foam concentrate valves should be closed for this).
2. Inspect the tank for surface damage, missing paint or corrosion. Repair any problems.
3. Check system piping for leaks.
4. Check flange bolts for tightness.
5. Check that all valves are in their standby positions.

Annually or after system operation.

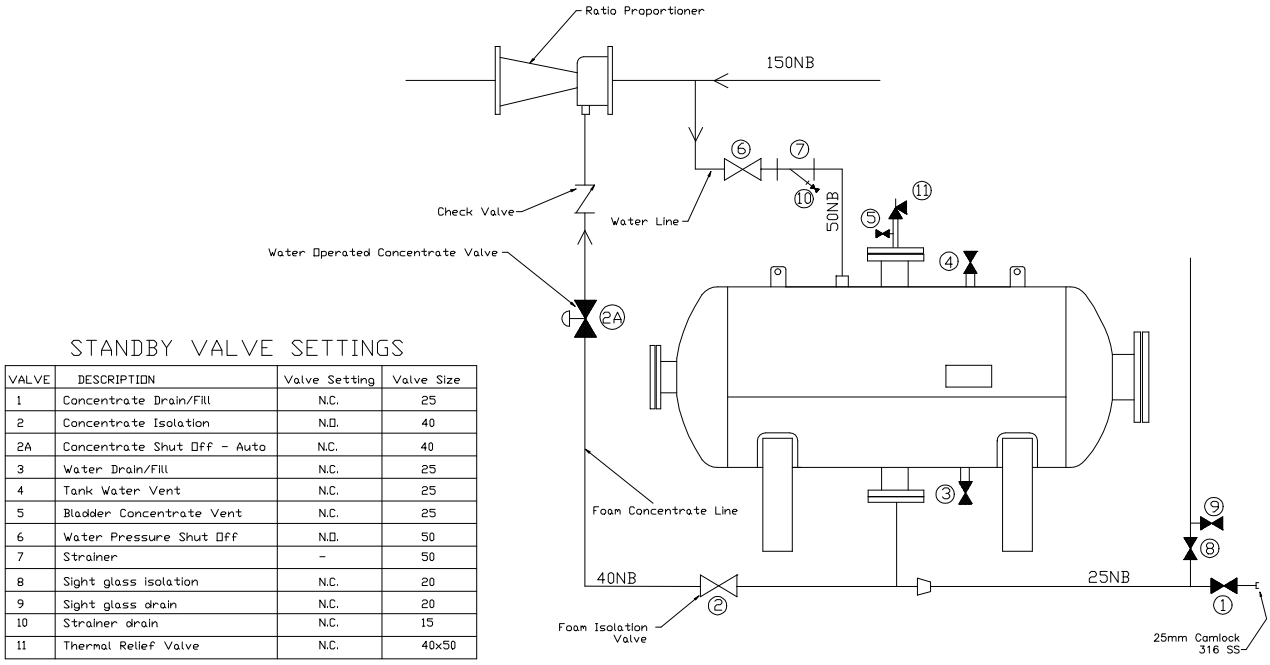
1. Check the operation of any automated valves (the main water and foam concentrate valves should be closed for this).
2. Inspect the tank for surface damage, missing paint or corrosion. Repair any problems.
3. Check system piping for leaks.
4. Check flange bolts for tightness.
5. Check that all valves are in their standby positions.
6. Check all strainers and clean as needed.
7. Drain some water from the shell drain valve and inspect for traces of foam concentrate. If traces of foam concentrate are found inform the person responsible.
8. A full discharge test should be conducted for the foam system annually as per the operating procedure.
9. Flush the system after the test.
10. Check that all valves are in their standby positions.
11. Take a foam sample for testing to NFPA 11.

If the tank is fitted with a level gauge, check the level in the tank. (See Fig 6)

**NOTE**: The level cannot be measured while the tank is pressurised.

**To check the foam concentrate level:-**

Close the water supply valve (Valve # 6).
Slowly open the following valves (Caution: the tank will be pressurised). In this order.
Bladder Vent Valve # 5 (Open slightly to vent any air, then fully after valve 4 is opened)
Tank Vent Valve # 4. (Open this valve to relieve any additional pressure)
Water Drain Valve # 3 (**Caution**: if this valve is opened while the tank is pressurized the bladder will be damaged)
Level Gauge Control Valve # 8.




STANDBY VALVE SETTINGS

| VALVE | DESCRIPTION | Valve Setting | Valve Size |
|---|---|---|---|
| 1 | Concentrate Drain/Fill | N.C. | 25 |
| 2 | Concentrate Isolation | N.O. | 40 |
| 2A | Concentrate Shut Off - Auto | N.C. | 40 |
| 3 | Water Drain/Fill | N.C. | 25 |
| 4 | Tank Water Vent | N.C. | 25 |
| 5 | Bladder Concentrate Vent | N.C. | 25 |
| 6 | Water Pressure Shut Off | N.O. | 50 |
| 7 | Strainer | - | 50 |
| 8 | Sight glass isolation | N.C. | 20 |
| 9 | Sight glass drain | N.C. | 20 |
| 10 | Strainer drain | N.C. | 15 |
| 11 | Thermal Relief Valve | N.C. | 40x50 |

**Fig 6. Bladder Tank With Sight Glass**

The main water supply valve (6) and foam concentrate valves (2) must be closed.

When water stops flowing from Valve #3 observe the concentrate level.

Return all valves to their normal standby positions. Drain the sight glass (Valve #9).

Open Valve #4. and very slightly crack valve #6. This will slowly refill the tank with water. CAUTION: Rapidly opening valve #6 may damage the bladder.

Once water begins flowing from valve #4 close it and allow the tank to fully pressurise. When flow has stopped fully open Valve #6.

Open valve #5 slightly and release any air in the bladder (slowly). Close it.

Open Valve #2. The system is ready for operation.

# F. TROUBLE SHOOTING

There are three possible problems, which may occur with Bladder Tank Proportioning systems.

## 1. NO PROPORTIONING

a) Check the position of valves 2 and 6, they should be **fully** open. If the system is automatic, check the operation of the automatic valve. Check positions of all other valves.

b) When testing the system, you must allow enough time for the foam solution to reach the foam makers.

c) Make sure that there is foam concentrate in the tank.

d) Check for pipeline blockages (blocked strainers etc).

e) Check that the system is running at the correct flow and pressure. The proportioner has minimum flow and pressure limits.

f) Blockage in foam inlet to proportioner.

## 2. LOW PERCENTAGE OF PROPORTIONING

a) Check the position of valves 2 and 6, they should be **fully** open. If the system is automatic, check the operation of the automatic valve. Check positions of all other valves.

b) When testing the system, you must allow enough time for the foam solution to reach the foam makers.

c) Check for pipeline blockages (blocked strainers etc).

d) Check that the system is running at the correct flow and pressure. The proportioner has minimum flow and pressure limits.

e) Foam concentrate piping is undersized or too long.

f) Reduced flow valves are used instead of full flow valves.

g) Proportioner metering orifice is incorrect (too small).

h) Blockage in foam inlet to proportioner.

i) Ratio Proportioner elevated too far above tank.

j) Drain Valves partly open.

## 3. HIGH PERCENTAGE OF PROPORTIONING

a) Ratio Proportioner mounted too far below tank.

b) Proportioner metering orifice is incorrect (too large).

c) The tank is pressurised by a different water source than the main supplying the ratio proportioner.

# G. ALTERNATIVE FILLING PROCEDURE

When no power or air is available for use during filling the following procedure may be used.

CAUTION: There is more risk of damage to the bladder using this technique. Take care not to over pressurize the bladder.

**Step 1 (See Fig 7).**

Close all valves. Open the bladder vent valve, fill valve, and the shell drain and vent valves.
Connect the water supply with the pressure gauge to the shell drain valve

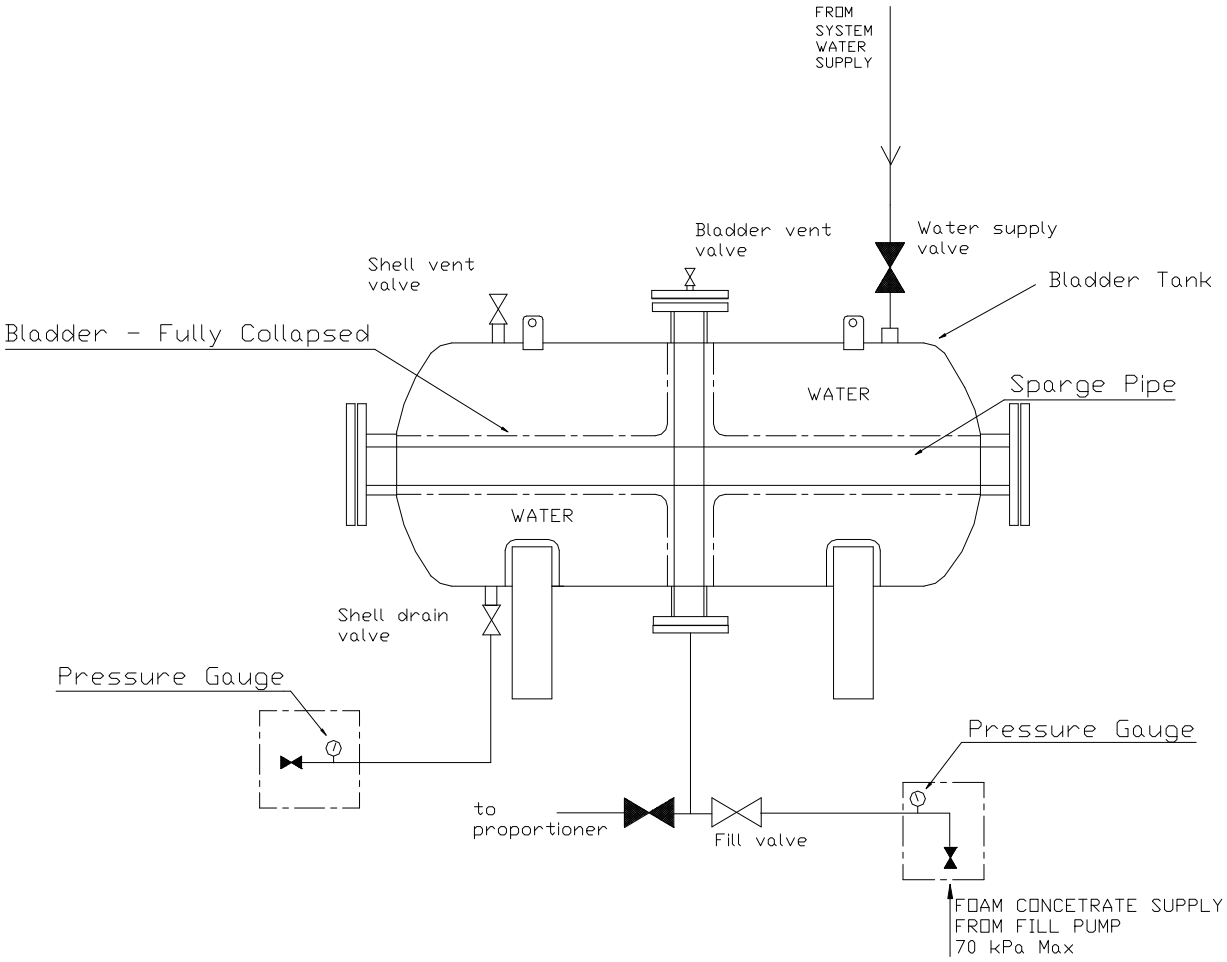



*Fig 7. Collapsing the bladder*

**Step 2.**

Open the water supply valve slowly (Be Very Careful). Constantly monitor the water inlet pressure to ensure that the pressure NEVER exceeds 70 kPa. If the pressure exceeds 70 kPa the bladder may rupture. Close the water supply valve when no more air is venting from the bladder vent valve.

Close all valves. Open the fill valve and slowly open the water supply valve until the pressure reaches 70 kPa, then shut off. Ensure that no water discharges from the fill valve (there may be some foam concentrate or condensation initially), this would indicate a leak or ruptured bladder. The tank should retain the 70 kPa pressure. In the event of leakage contact the person responsible for the system.

If there is no leakage open the shell vent valve to depressurise the tank.

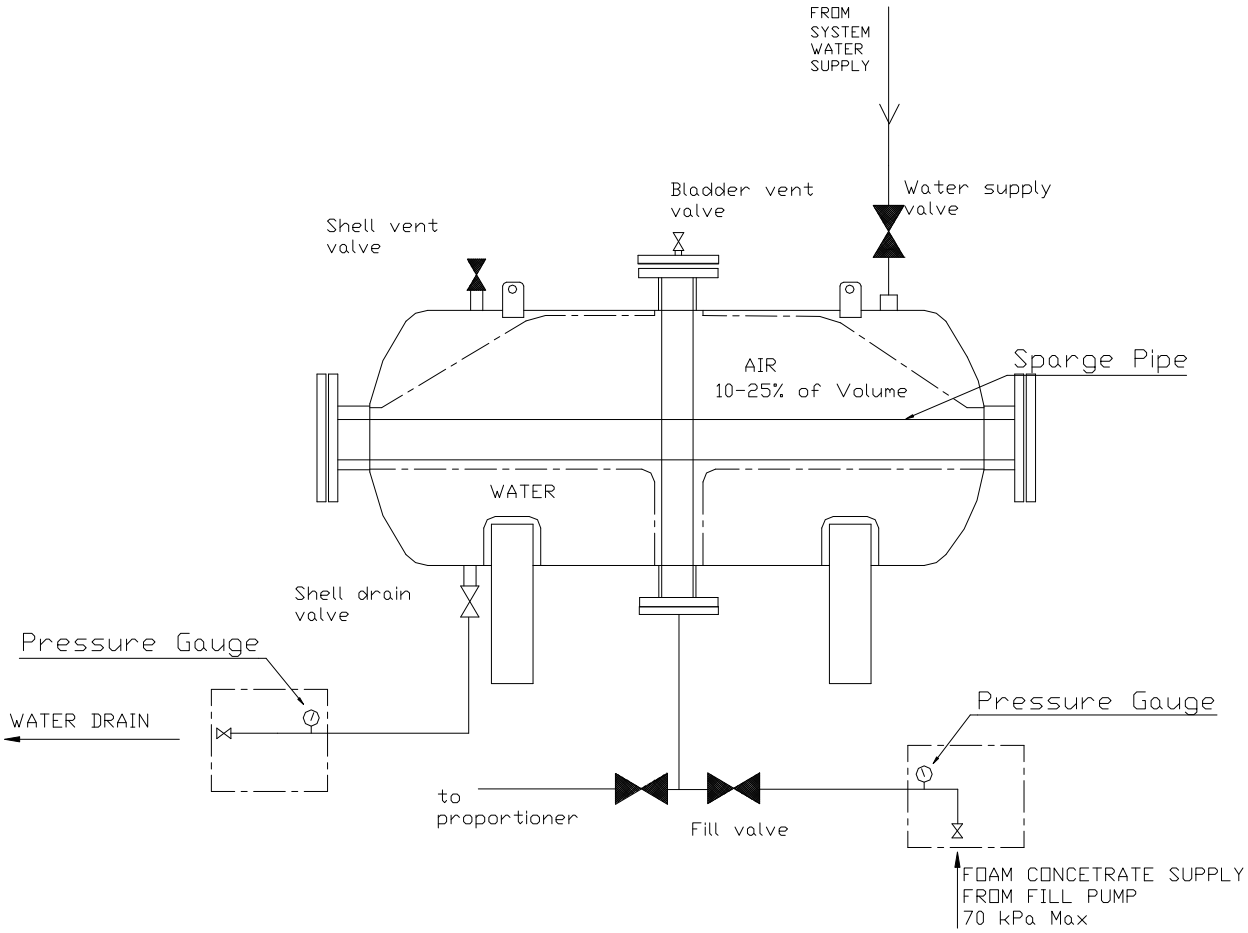



*Fig 8. Adding air*

**Step 3 (Fig 8).**

Open the shell drain valve and the bladder vent valve. All other valves should be closed.

Drain out about 10% of the tank volume. Air will enter the bladder as the water drains out.

Close all valves.

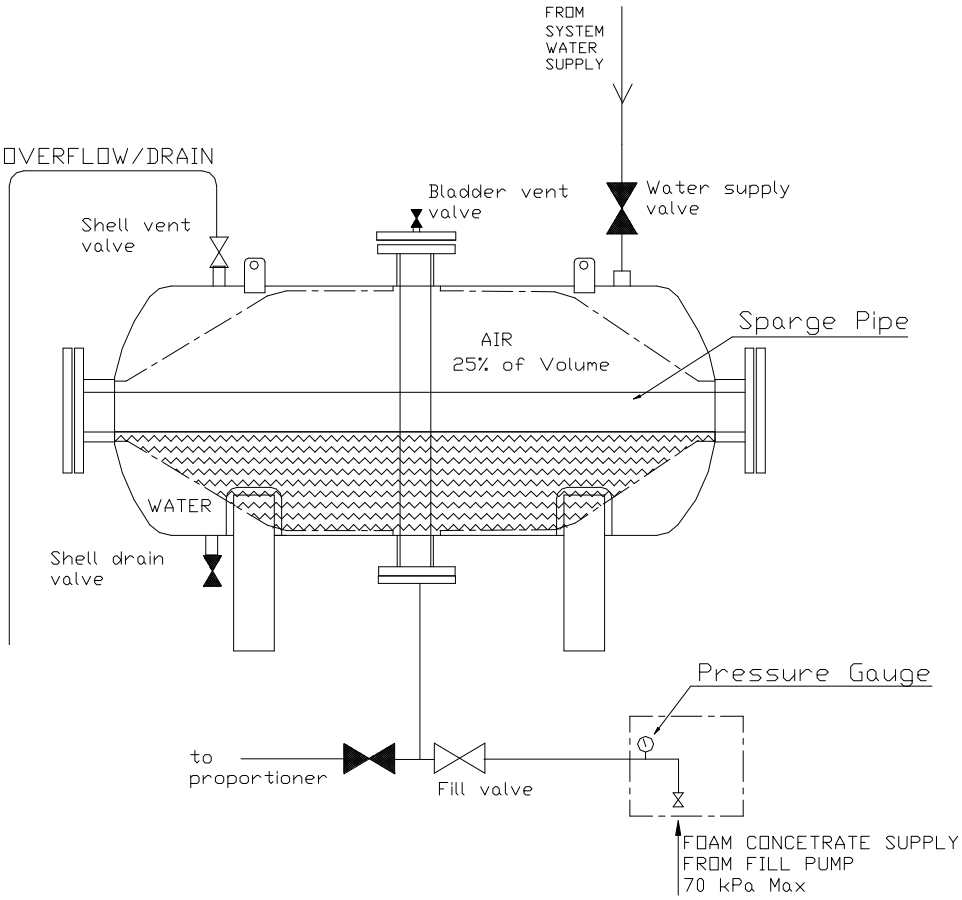



*Fig 9. Filling*

**Step 4 (Fig 9).**

Open the Shell vent valve.

Connect the foam concentrate pump to the fill valve and start pumping foam concentrate, ensuring that the pressure never exceeds 70 kPa. Water will be forced out the shell vent valve, if this is too slow, shell drain valve may be opened slightly (not fully as too much water will drain from the bottom and the bladder will no longer be properly supported). The bladder vent valve may be fully open only after the tank is more than half full.

When the tank is about three quarters filled open the bladder vent valve. Stop pumping when the nominal tank fill has been pumped in or when concentrate starts to flow from bladder vent valve.

Close all valves and then set them to their standby positions.

Pressurise the tank to system pressure. Open the bladder vent valve slightly to vent any air. Close when all air is released.