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FACT SHEET

ANHYDROUS AMMONIA

Storage Facility Transfer System Guidelines and Requirements

Minnesota Rules, Part 1513.0200 corresponds with current anhydrous ammonia liquid transfer system requirements. Guidelines and requirements outlined have been developed, in part, utilizing manufacturer recommendations. A pumping system can be defined as the riser excess flow valves, pressure-actuated bypass, pump, and piping involved with transferring anhydrous ammonia (NH3) into nurse tanks or back into the storage tank. Figure 1 illustrates a "typical" NH3 pumping system.

RISER EXCESS FLOW VALVE

Riser excess flow valves, in conjunction with pull-away protection, provide flow control protection in the event of a hose rupture or pull away incident. Two such riser valves, Fisher F190 and Squibb-Taylor AL477, have an excess flow valve rated for closure at approximately 70 gallons per minute. Both the F190 and AL477 will complement the maximum flow rating of most pumping systems. If a riser pull away occurs where the hose substantially ruptures, NH3 will seek the path of LEAST resistance, allowing the greatest possible opportunity for either the F190 or AL477 to close off in a minimal period of time. The intake section of both the F190 and AL477 must be installed in the 2-inch section of liquid riser piping to afford full flow capacity. If installed in liquid piping smaller than 2 inches, the excess flow will close prematurely.

GAUGES AND PUMPS

A 0-400 psi/NH3 rated pressure gauge is required in the discharge side of the pump to aid in **setting the pressure-actuated bypass**. It is recommended that a LIQUID FILLED pressure gauge be used because vibration from the pump may quickly deteriorate a non-liquid filled gauge. The following are pumps commonly used for transferring NH3 in a typical storage facility:

1. **3-inch Blackmer:**
   Operating speed of 650 RPM's, using a 7-1/2 to 10 HP motor, generates a flow of approximately 120 to 130 GPM. The 0-400 psi pressure gauge must be installed in the 1/4-inch hole on the top of the pump closest to the pump discharge.

2. **3-inch Corken:**
   Operating speed of 700 RPM's, using a 7-1/2 to 10 HP motor, generates a flow of approximately 100 to 110 GPM. The 0-400 psi pressure gauge must be installed in the 1/4-inch hole at the back of the pump closest to the pump discharge.

   A 3-inch pumping system should be equipped with a 225+ GPM-rated excess flow valve, positioned in the main liquid port of the storage tank to prevent premature closure.

3. **2-inch Blackmer or Corken:**
   Operating speed of 800 RPM's, using a 5 HP motor, generates a flow of about 60 to 80 GPM. The 0-400 psi pressure gauge must be installed as indicated for the 3-inch Blackmer and Corken pumps, respectively.

4. **Blackmer or Corken Vapor Pumps (Compressors):**
   Operating speed of 750 RPM, using a 5 to 7-1/2 HP motor, generates a flow of approximately 40 to 60 GMP. The 0-400 psi pressure gauges must be installed on both sides of the compressor. Compressors do not require a pressure-actuated bypass to aid in flow regulation.

Due to the restrictions of motor HP (7-1/2 to 10 HP) and sizing of nurse tank valves, the maximum flow rating that can be achieved to a nurse tank is approximately 80 GPM. This is a key reason why the F190 and AL477 riser excess flow valves, in conjunction with a properly sized/adjusted pressure-actuated bypass valve, are well adapted to most NH3 pumping systems.

anhydrous amm liq pump.indd
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PRESSURE-ACTUATED (PA) BYPASS VALVE

A PA bypass valve (PA bypass) functions as an AUTOMATIC FLOW REGULATOR for a pumping system protecting the pumping system from excessive liquid/back pressure. Excess liquid from the pumping system is routed through the PA bypass back into the storage tank. This helps to:

1. Minimize excessive pressrue (psid) and wear on the pumping system; and
2. Maximize the flow of NH3 to the risers without premature closure of the riser excess flow valves.

The PA bypass and piping must be adequately sized and adjusted to accommodate the FULL flow of the pump. Factors such as pump size, operating speed of the pump, and size/length/ configuration of discharge piping for both the pumping system and the PA bypass must be considered when determining the size/adjustment of a PA bypass valve, spring and piping. Generally, a 1.25- to 1.5-inch PA bypass valve and piping for a 2-inch pumping system is adequate. Typically, a 3-inch pumping system will require a 1.5- to 2-inch PA bypass valve and piping. The PA bypass piping must be routed back into the storage tank as illustrated in Figure 1. NEVER route PA bypass piping back into the pump intake piping.

A key PA-bypass component is the spring. The PA bypass spring must have a psid rating range that allows the PA bypass to be adjusted for protecting the pump from excessive psid while maximizing the flow of NH3 to the risers. If the spring has too high of a psid rating, the PA bypass will be unable to open sufficiently to relieve the pumping system of excessive psid. Generally, a spring that allows for a PA bypass setting of approximately 30 to 50 psid will be adequate for most pumping systems. Figures 2 through 4 illustrate four different PA bypass valves and springs that should meet the requirements of a typical NH3 pumping system.

HOW TO SET/TEST A PRESSURE-ACTUATED (PA) BYPASS

The following is a procedure to determine if the PA bypass is properly sized and adjusted for the respective pumping system:

1. Attach and open all liquid and vapor riser and nurse tank valves OR manual bypass valve if there is a manual bypass in the pumping system. Let pressure to equalize in connected tanks and piping.
2. Once tanks and piping are equalized, record the pressure on the 0-400 psi pressure gauge located at the discharge side of the pump before starting the pump. This is the **STATIC PRESSURE**.
3. Start pump and route NH3 into a nurse tank OR through the manual bypass valve back into the storage tank.
4. Slowly close off liquid riser valve OR manual bypass valve. If pump pulls down and/or an excessive pressure differential (psid) is created as indicated on by the 0-400 psi pressure gauge, the PA bypass spring is either out of adjustment or is too big large (too high a psid rating to allow the PA bypass to open as it should).

   If the PA bypass spring is too big, a correctly rated spring will need to be installed. The PA bypass may also need to be thoroughly cleaned/ lubricated and new gaskets and O-rings installed. Refer to Figures 2 through 4 to determine proper spring and other components needed.

   Using the 0-400 psi pressure gauge at the discharge side of the pump, adjust the PA bypass to a psid (generally 30 to 50 psid) that will allow the PA bypass to take the FULL flow of the pump without pulling down the pump. Once adjustments are completed and the liquid riser value or manual bypass value is closed, the full flow of pump is now bypassing back into the storage tank.

6. Record the pressure on the 0-400 psi pressure gauge at the discharge side of the pump. This is the **BYPASS PRESSURE** reading. Subtract the difference between the **STATIC PRESSURE** from the **BYPASS PRESSURE** to obtain the PSID.

   Bypass pressure – Static pressure = PSID

7. Time the transfer on one nurse tank. If not already done, connect and open riser liquid/vapor and nurse tank valves. For an empty 1,000-gallon nurse tank use 850 gallons (85% on the float gauge) as the total amount transferred for determining the GPM flow of the pumping system.

   Adjust the PA bypass so that a flow of 60 to 70 GPM is achieved. If the liquid riser excess flow valve snaps shut, back off the PA bypass setting until snapping stops.

   It should take 12 to 14 minutes to transfer 850 gallons into a 1,000- gallon nurse tank.

   Document and maintain the **BYPASS** and **STATIC PRESSURE** and resulting PSID for MDA review or future reference.

   Now the PA bypass is set where the pumping system operates **AUTOMATICALLY**.

Note: the manual bypass must remain closed during normal operations to allow the PA bypass to perform its intended function.

Figure 1. **Typical NH_3 Pump Transfer System**

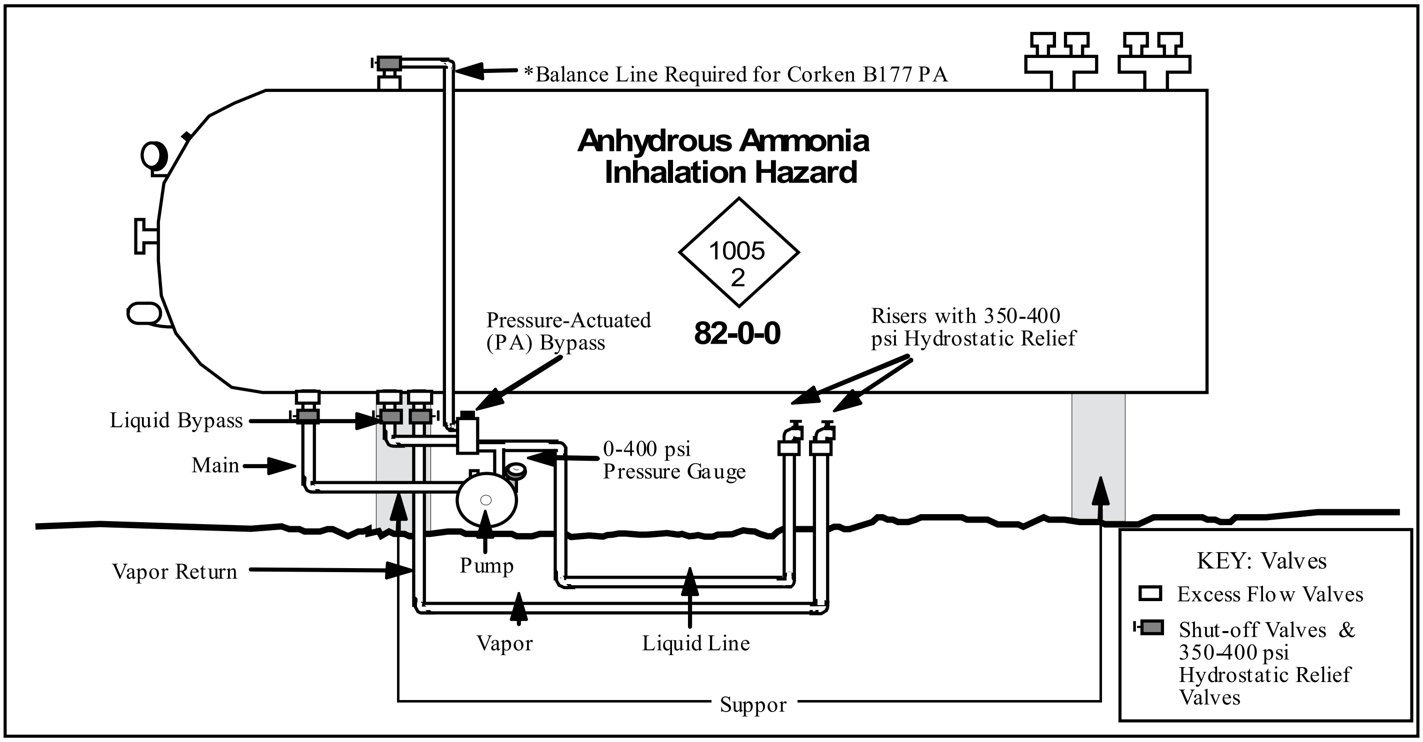
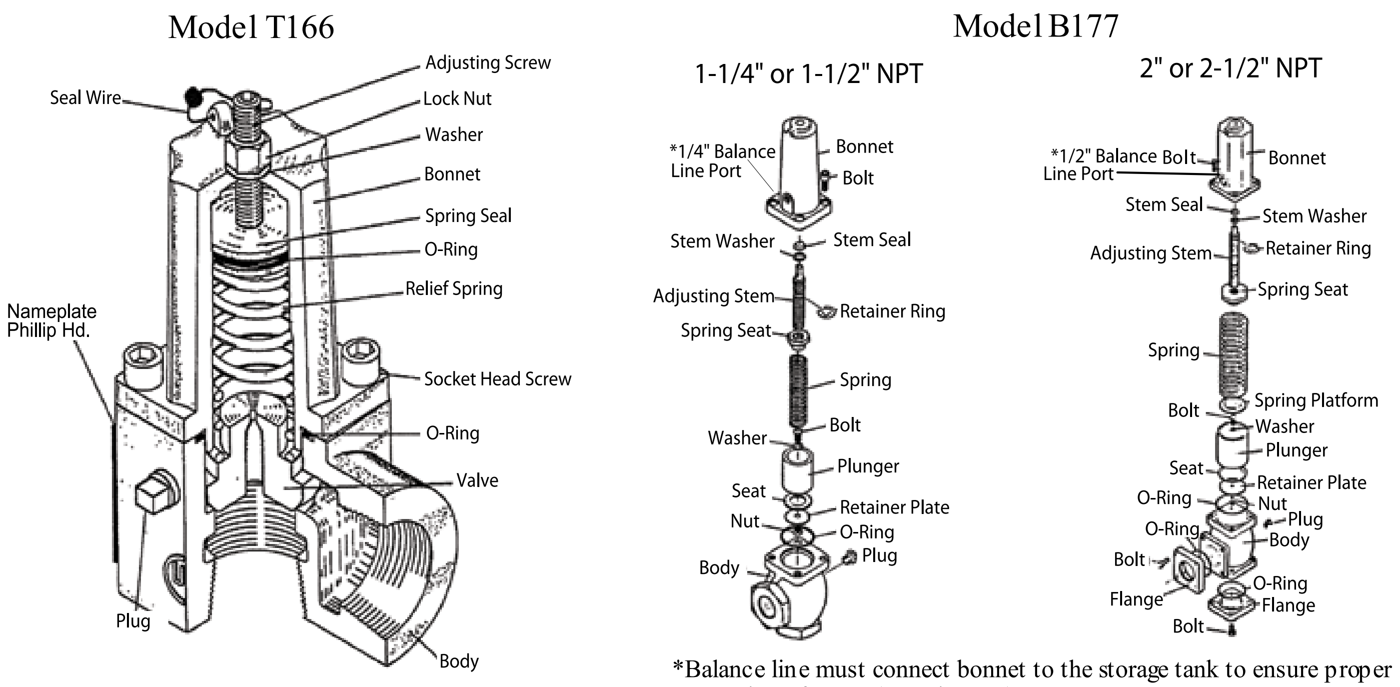


Figure 2. **Corken PA Bypass Valves**

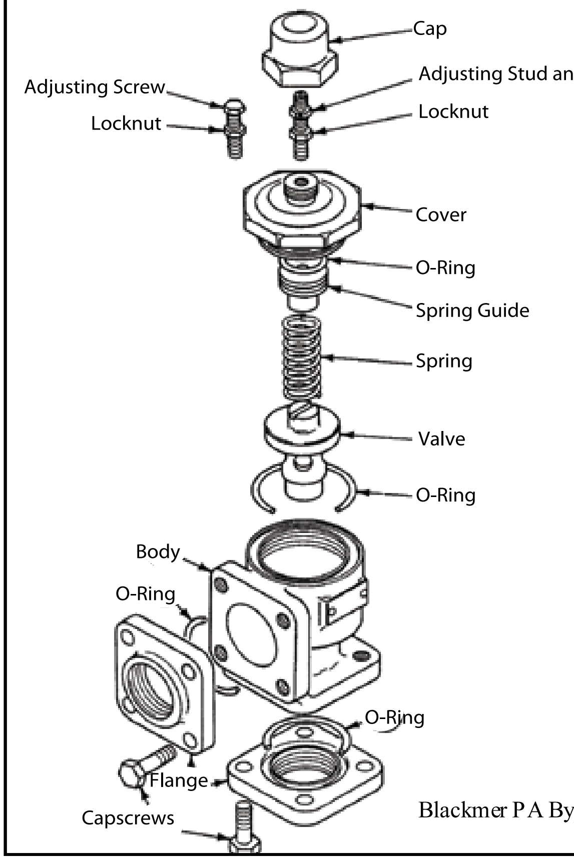


*Balance line must connect bonnet to the storage tank to ensure proper operation of B177 (See Figure 5).

Spring Selection Table for Corken Bypass Valves					
Models B166 and T166		Model B177 (1-1/4”- 1-1/2”)		Model B177 (2” - 2-1/2”)	
Spring No.	Differential Range PSID (Bars)	Spring No.	Differential Range PSID (Bars)	Spring No.	Differential Range PSID (Bars)
1138	25-60 (1.7-4.1)	1817	20-70 (1.3-4.8)	1783	10-40 (.69-2.8)
				1785	30-80 (2.1-5.5)

Corken PA Bypass Valve illustrations reproduced with consent of Corken, Inc.

Figure 3. **Blackmer Differential PA Bypass Valve**



Model BV2

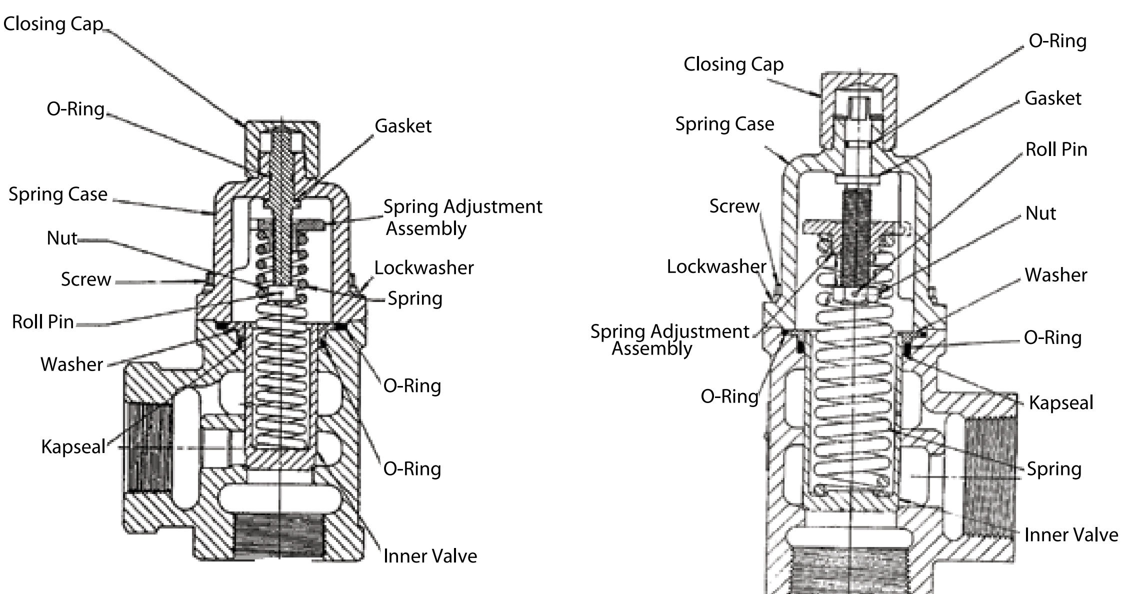
Spring and Adjusting Screw Selection Table for Blackmer Differential Bypass			
Adjusting Screw No.	Differential Range	Spring No.	Differential Range
437803	20-40 psi	471803	20-40 psig
437803	41-70 psi	471805	41-70 psig

Blackmer PA Bypass Valve illustration reproduced with consent of Blackmer/A Dover Resources

Figure 4. **Fisher PA Bypass Valves**

Model N100 Series

1" - 1-1/2" 2" - 2-1/2"



Spring Selection Table for Fisher Bypass			
Model N100A (1"- 1-1/2")		Model N100 (2"- 2-1/2")	
Spring No.	Differential Range	Spring No.	Differential Range
1P3841 38992	25-75 psi	1R1955 37022	25-75 psi

Fisher PA Bypass Valve illustrations reproduced with consent of Fisher Controls International, Inc.