MIDLAND™

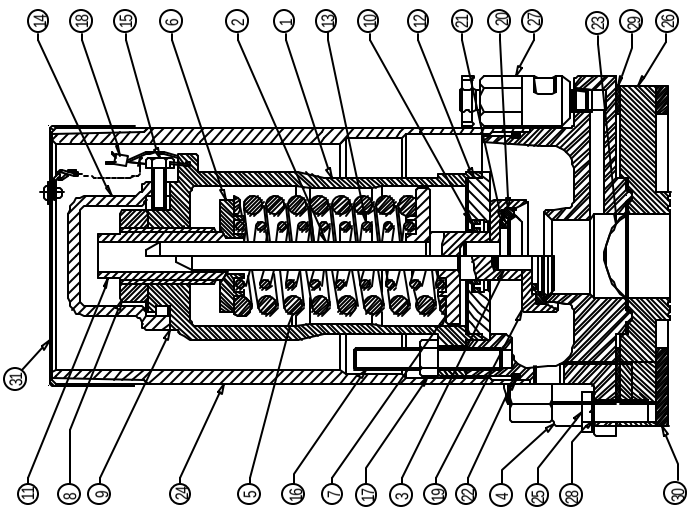
Pressure Relief Valves

Instructions for Series A-1000 through A-37000

Installation
Operation
Inspection
Maintenance

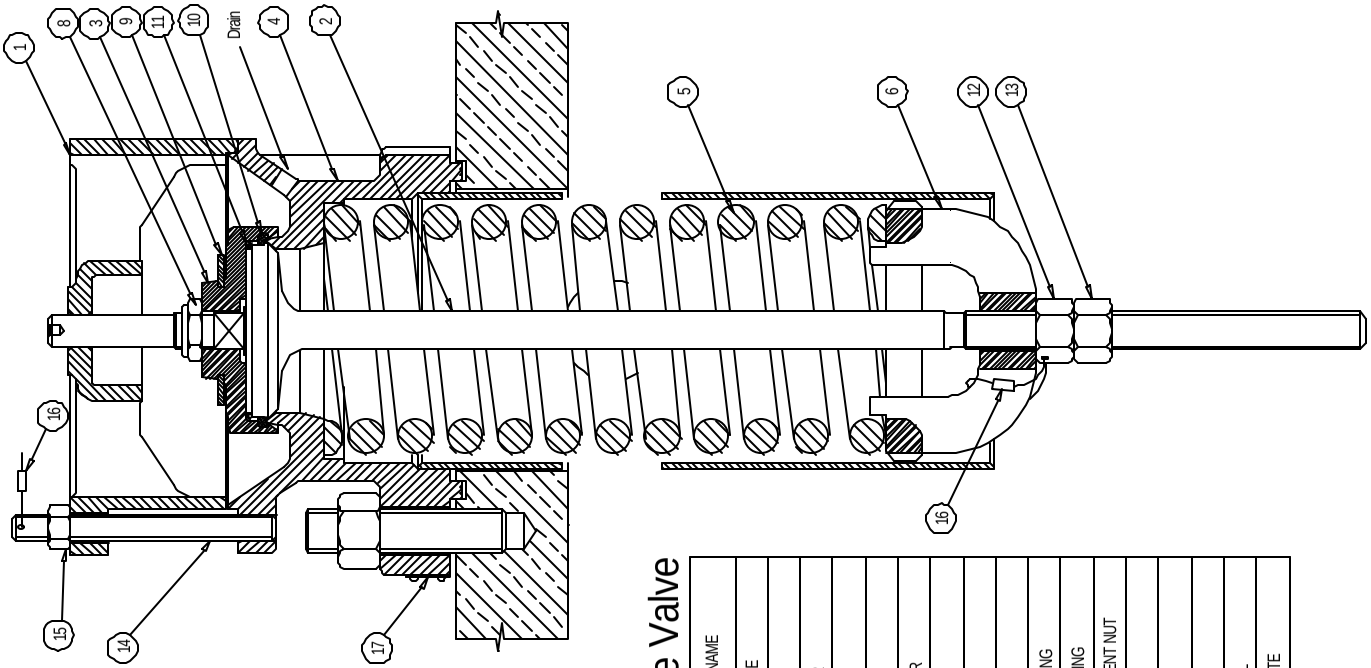
Doc. No. INST A1000/A37000 Rev. 1.2 1/03

Top-style Valve



ITEM	QTY	PART NAME
1	1	TOP GUIDE
2	1	STEM
3	1	PLUG
4	1	BODY
5	1	OUTER SPRING
6	1	FOLLOWER
7	1	GUIDE
8	1	TOP NUT
9	1	TOP GASKET
10	1	SHAFT SEAL
11	1	ADJUSTING SCREW
12	1	SEAL RETAINER
13	1	INNER SPRING
14	1	CAP
15	1	SET SCREW
16	4	STUD
17	4	NUT
18	1	WIRE SEAL
19	1	RETAINER
20	1	SEAT "O" RING
21	1	PLUG "O" RING
22	1	FLUE "O" RING
23	1	RUPTURE DISC
24	1	FLUE
25	4	RUP. DISC FLG BOLTS
26	1	RUP. DISC FLANGE
27	1	1/8" VALVE
28	1	NAMEPLATE
29	1	UPPER FILLER
30	1	LOWER FILLER
31	1	PROTECTIVE CAP

Internal-style Valve



ITEM	QTY	PART NAME
1	1	TOP GUIDE
2	1	STEM
3	1	RETAINER
4	1	BODY
5	1	SPRING
6	1	FOLLOWER
7		
8	1	LOCK NUT
9	1	WASHER
10	1	SEAT O-RING
11	1	STEM O-RING
12	1	ADJUSTMENT NUT
13	1	LOCK NUT
14	4	STUD
15	4	HEX NUT
16	2	WIRE SEAL
17	1	NAMEPLATE

Valve Installation

CAUTION: Toxic Hazard
To avoid exposure to toxic or hazardous materials, make sure the tank car is empty and clean, and that the work area is free of hazardous chemicals before removing a valve or installing a new one.

Preliminary Considerations

New valves are tested, adjusted and sealed at Midland. If a new valve has been left in its original shipping container, is undamaged, and is not more than six months old, it may be installed on a tank car without retesting or recalibration.

Keep the new valve in its original shipping container. This will ensure it remains clean and will protect the tongue (flat sealing-flange face, see Fig. 1) from nicks.

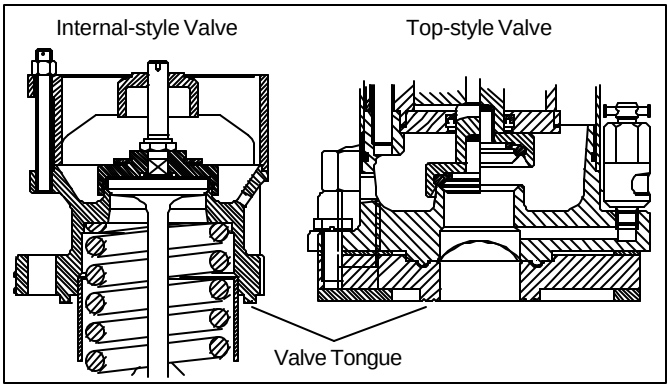


Figure 1 - Valve Tongue

Procedure

1) Remove the old valve and then insert a soft rubber plug into the tank opening to block debris during cleaning of the valve mounting groove and studs (Fig. 2) of the tank car flange.

2) Thoroughly wire brush the threads of the mounting studs to remove rust or scale. Nuts should run freely on clean studs. Studs should not exhibit corrosion.

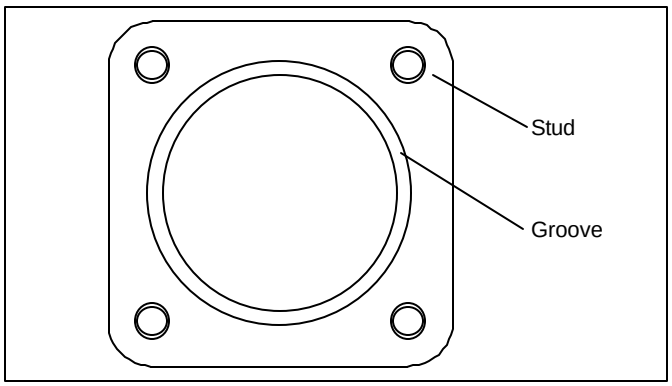


Figure 2 - Valve Mounting Cover Plate Groove

3) Pry out the old gasket with a nonmetallic tool and discard the gasket. Be careful not to scratch the metal in the bottom of the groove when removing the old gasket.

4) Using a lint-free cloth and appropriate cleaning solvent, wipe clean the valve mounting flange, cover-plate groove and the threads of the mounting studs.

5) Examine the sides of the groove. Because the valve fits tightly into the groove, any peening-over of the edges of the groove may make it difficult to properly seat the valve tongue on the gasket in the groove. If any irregularities are found, correct them according to approved repair practices.

6) Install the new gasket in the cover-plate groove. Ensure it is fully seated. When the gasket is fully seated, 1/16” of free space should remain above the gasket to permit locating and entry of the valve tongue.

CAUTION: Gasket Damage
Do not use a sharp instrument to press the new gasket into place or gasket damage may result.

7) Inspect the sealing tongue of a reconditioned or retested valve by running your fingernail around its inner and outer edges to check for nicks and burrs. The tongue dimensions have diameter tolerances of ±0.003", thus any excess material

Valve Installation

on these diameters will make it difficult to locate the tongue in the cover plate groove. If minor irregularities are found, correct them according to approved repair practices. Report any significant valve tongue damage to your supervisor before continuing.

8) Remove the rubber plug from the cover plate.

9) Hold the valve by the cross bars (if applicable, Fig. 4) of the top guide and lower it gently into the mounting. If the valve is a top-style design (spring and other parts are above the valve's orifice), grip the top guide above the valve body to position the valve tongue into the mounting groove..

10) Install the nuts and tighten them evenly in a sequence alternating diagonally from 1 to 2, and then 3 to 4 as shown in Figure 3. Do not over tighten one side as it may tilt the valve and prevent a good seal.

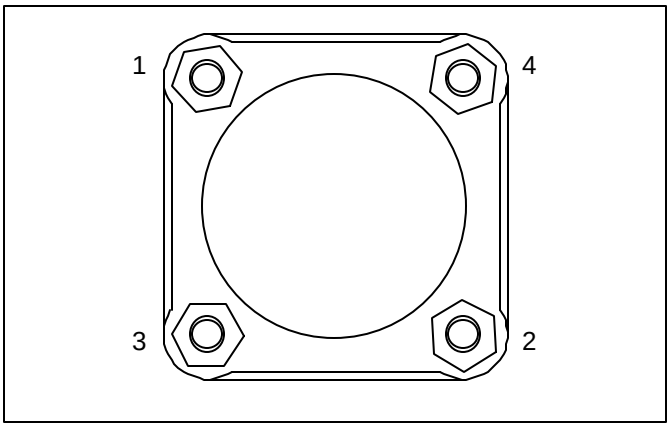


Figure 3 - Mounting Nut Tightening Sequence

11) Tighten the nuts in 1/3 torque increments to a torque setting prescribed by your engineering department.

WARNING: Valve Leakage
Improper valve tongue seating in the flange groove, loose nuts and damaged gaskets may result in leaks at the valve mounting joint.

12) **Inspect for leaks.** Follow your company leak testing procedure. The primary area to check is the flange tongue and groove connection between the relief valve and the cover plate, or mounting nozzle.

Valve Operation

NOTE: Operation of the valve must conform with all applicable TC, AAR, DOT specifications (Parts 173.31, 174.67, etc.), other governmental bodies, and the operating instructions of your company.

1) The pressure relief valves are spring loaded and are actuated by overpressure in the railcar tank. There are no provisions for manual activation of the valve.

CAUTION: Product Damage
Never attempt to manually actuate (open) the valve by pressing the threaded stem (Fig. 5) against a hard surface or with prying tools as this may damage the valve and result in valve opening/ closing in service.

2) On the top-style design only, there is a nut under the weather cover that allows adjustment of the spring compression. Adjust this nut only when the valve is on a test stand for recalibration. The valve should not be adjusted when it is mounted on the pressure vessel. If the valve leaks, advise your supervisor so corrective measures may be implemented.

CAUTION: Incorrect Setting
Never attempt to adjust the spring compression of a valve while it is mounted on the vessel cover plate or incorrect settings may result.

Valve Inspection

When performing maintenance, follow the guidelines below for inspecting the condition of the various valve components after disassembly. In some instances a component can be properly evaluated for damage or cracks only with the use of specialized techniques, such as dye penetration or magnetic particle testing according to a qualified procedure by certified trained personnel. Testing requirements are indicated where mandatory below.

Additionally, specific inspections must be performed during and after reassembly of the valve to ensure proper and reliable operation.

1) **Top Guide (internal-style valves)**
The top guide (Fig. 4) is principally a structural part. There should be **no paint** on the guide bushing of this part where the valve stem enters it, or between the adjacent surfaces of the top guide and valve body.

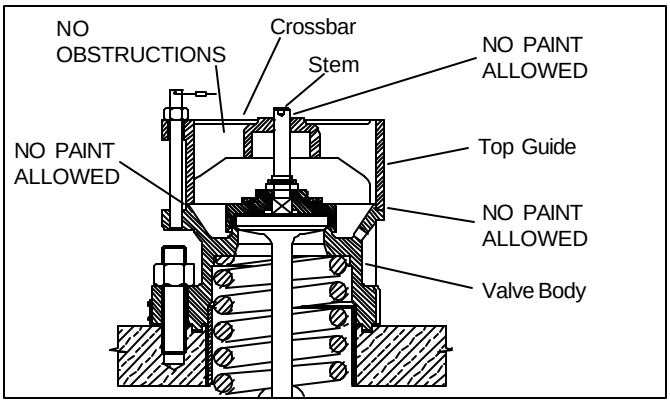


Figure 4 - Top Guide Unpainted Areas

The area of discharge through the top guide must be unobstructed by foreign matter that would hinder free flow of discharging fluid.

2) **Valve Stem Threads**
The threads should be clean and lightly lubricated. If the threads are slightly galled, run a thread die over the affected area. Wire brush the entire length of the stem to remove scale, solidified product, and other foreign material. Look for any cracks in the stem. Use magnetic particle or dye penetration inspection to detect any cracks. Cracks are stress concentrators and can cause catastrophic failure of the stem and uncontrolled venting.

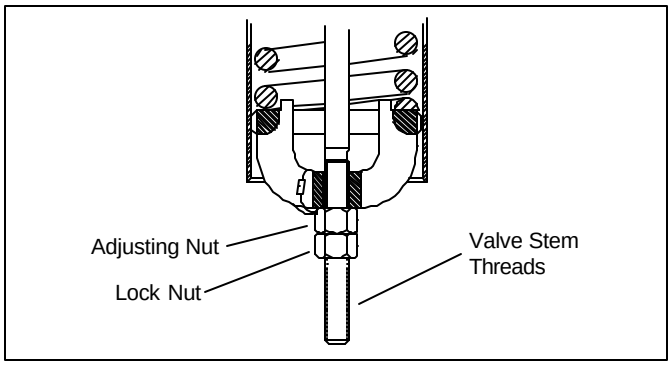


Figure 5 - Valve Stem Threads

Also inspect for corrosion pitting. Any corrosion pitting is reason for rejection since it may indicate more severe corrosion at the threads and the starting point for difficult-to-detect cracking.

All nickel bearing stainless steels have a likelihood of galling. Wrenching the adjusting nut without relieving the spring's load will frequently result in galled stem threads. Always check for galled threads and chase the threads with a thread die or replace stems with significant thread damage.

3) **Valve Stem Concentricity**
The valve stem should must be straight within the tolerances specified in the applicable stem inspection drawing. Rotate the stem on V-blocks set up with a dial indicator (Fig. 6). If the dial indicator readings are not within the allowable tolerance, replace the stem or contact Midland for recommendations on repair techniques.

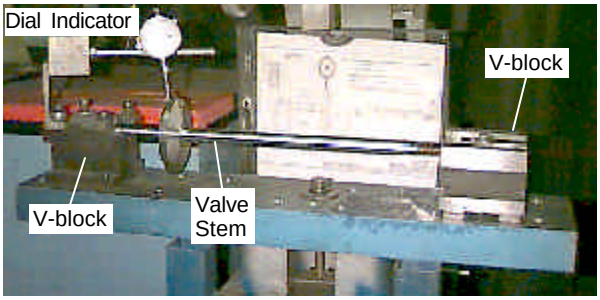


Figure 6 - Valve Stem Concentricity Check

Valve Inspection

WARNING: Stem Eccentricity
Excessive valve stem eccentricity will cause binding that can result in high start-to-discharge pressure settings, reduced valve capacity and/or low vapor-tight pressures.

WARNING: Valve Stem Failure
Cracks and corrosion of pressure relief valve stems can result in stem failure and uncontrolled venting.

WARNING: Valve Stem Straightening
Straightening of s stem by bending it in a press may result in the buildup of uneven stresses in the stem which may result in valve malfunction.

4) **O-ring Retainer Grooves**
The grooves (Fig. 7) must be free of gouge marks, corrosion, pits and rust. Since the O-rings must seal against these surfaces, any irregularities can cause the valve to leak. Clean the groove by sanding it lightly with emery paper (400 grit). If this does not effectively clean it, replace this part.

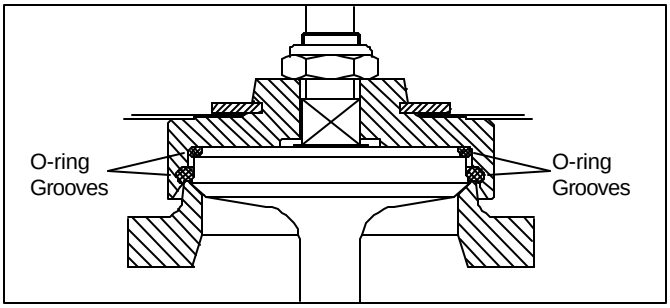


Figure 7 - Retainer O-ring Grooves

5) **Valve Body**
Examine this component as described below.

Valve Seat: The sealing surface is the crown of the seat (Fig. 8). It must be free from imperfections. Clean it with emery paper (400 grit) then wipe it clean with a lint-free cloth and a suitable solvent. Run your fingernail over the surface to detect any flaws. **Repair work is limited to cleaning and polishing.** (See Paragraph A4.11.1 of the Tank Car Specifications.)

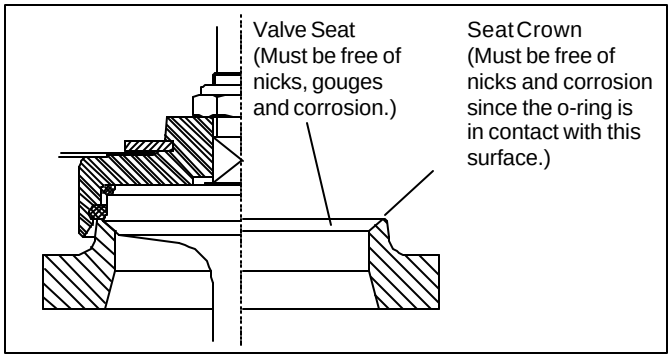


Figure 8 - Valve Seat Details

WARNING: Avoid Machining
Machining, grinding, welding or other alterations to the valve seat can cause the valve to malfunction.

Sealing Surface: On the underside of the valve body is the surface that seals the valve to the mounting plate on the railcar (Fig.9). Redressing of this surface is permitted. (Refer to paragraph

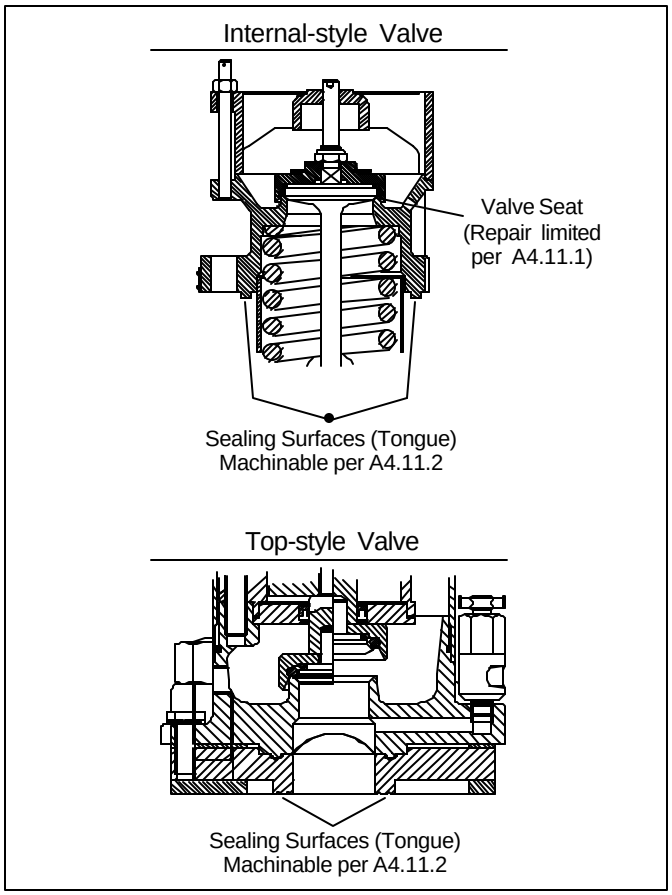


Figure 9 - Machinable Sealing Surfaces

Valve Inspection

A4.11.2 of the Tank Car Specifications.) Also consult Appendix E for the dimensions and applicable tolerances. A good seating surface is necessary to insure there are no leaks in this area.

NOTE: Some valves do not include a tongue and groove. On valves with a flat mounting flange, refer to A4.11.2 of the Tank Car Specification for machining specifications.

6) **Valve Spring**
This part is highly stressed. The exterior surface must be free of pitting, cracks, and corrosion. Use **magnetic particle or dye penetration inspection** (performed by certified trained personnel) to evaluate exterior surfaces and ensure that they are free of cracks and corrosion pits.

WARNING: Possible Valve Failure
Defects, such as cracks and corrosion pits, in coil springs can act as stress concentrators. Failure to detect these defects can result in coil spring breakage and uncontrolled valve venting.

Verify that the free height of the coil spring is within the applicable specified tolerance. If it is not, replace the coil spring.

Also observe the spacing between the spring coils when the valve spring is in the set position. There must be enough deflection left to permit the valve stem to fully lift. A minimum of 30% of the deflection (total spacing between spring coils in the free position) should remain after the valve is at the set or STD position.

WARNING: Deficient Valve Travel
Coil springs of internal-style valves that have taken a "set," resulting in an undersize free height, will not allow the valve to open fully.

Also, the spring should not be bowed more than 1/4" when in the assembled position. More than 1/4" of bowing can cause the spring to bear on the inside wall of the spring guide tube and adversely affect the pressure settings. If any of the defects mentioned above are observed, the spring cannot be repaired and must be replaced.

Aluminum Clad Springs
Aluminum clad springs cannot be inspected by magnetic particle or dye penetration methods. Confirm that the aluminum cladding is not cracked or flaking off. Load test the springs as follows:

A) Measure spring free-height and record.
B) Compress spring to solid height and hold for 30 seconds.
C) Measure new free-height of spring and record.

If the spring height declines more than 1%, or to a height below the low limit, replace the spring.

7) **Spring Follower or Guide**
This structural part has guides on its outer edges (Fig. 10). Move it up and down the length of the guiding bore, twisting it as you move it, to confirm that it doesn't bind. If it binds in an area, look for dents or bent surfaces in the tube. Repair the dents or damage to allow free movement of the guide.

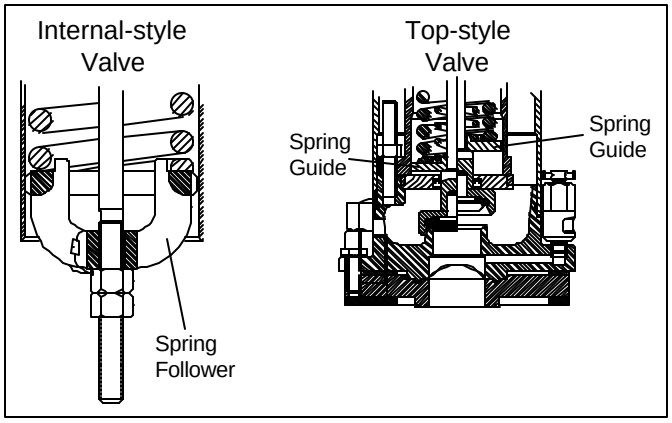


Figure 10 - Spring Follower or Spring Guide

WARNING: Valve Sticking
If the spring follower or guide binds in the guiding bore, the valve may stick in the open position or be prevented from opening. Always ensure free travel of the guide before reassembling the valve.

Valve Inspection

Valves with Rupture Discs

8) **Rupture Disc**
Some top-style valves include a rupture disc (Fig. 11) beneath the valve assembly. Examine the disc for nicks, damage or any signs of stretching. Replace the disc if any defects are observed.

9) **Rupture Disc Flange**
Look very carefully at the section of the disc flange (Fig. 11) that is contoured to hold the disc. No scratches, radial tool marks, nicks, burrs, or corrosion can be present in the groove or the disc will fail to maintain a pressure-tight seal. If dents, pits or gouges are observed, **do not** attempt to remove them by machining. Discard the flange and obtain a new one.

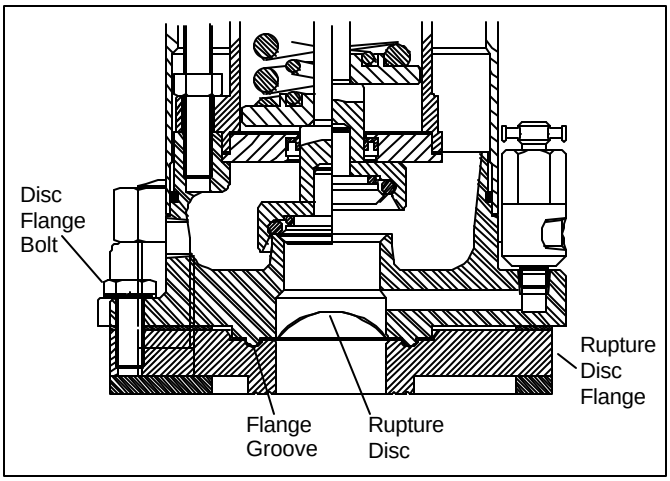


Figure 11 - Rupture Disc and Rupture Disc Flange

Similarly the tongue on the underside of the valve body flange (also in contact with the rupture disc) must be completely free of imperfections. Examine it carefully. No remachining is permissible. Replace the valve body if defects are observed.

Perishable Parts

10) **O-rings**
These must be replaced at the time of the periodic valve restest and when the valve is disassembled. O-rings develop micro cracks, can swell or shrink, and become harder or softer with age and chemical exposure. An O-ring that fits loosely in the cap, or can only be pushed into the O-ring retainer with difficulty, is quite likely not the correct size. Many of Midland's O-rings are made on special molds to nonstandard sizes and are obtainable only from Midland.

If any parts appear defective, it is recommend they be replaced, or consult with Midland for recommended repair techniques when applicable.

Special Inspection Considerations

1) Previous procedures may not cover all conditions encountered in the field. Therefore, it is the responsibility of the repair agency to obtain approval from Midland for inspection, evaluation, repair and maintenance procedures not covered herein.

2) Facilities performing recommended dye penetration and magnetic particle testing must carry out such testing according to a qualified procedure conducted by certified trained personnel.

3) Evaluation of critical component metal surfaces of the valves after cleaning, inspection and specialized testing performed by agencies other than the repair facility are the responsibility of the repair facility.

4) Where numerical tolerances cannot be provided, the disposition of the internal integrity and surface quality of parts is under the jurisdiction of the repair facility and dependent on its experience and judgement.

Maintenance

NOTE: It is essential to establish a periodic retesting and preventive maintenance program for pressure relief valves. The DOT and AAR have set forth a retesting interval that should be considered the maximum length of time between tests. However, if your company's experience indicates that a shorter interval is advisable, a program with more frequent retesting should be implemented.

NOTE: It is an AAR requirement (See D4.04) that new O-rings be installed when a valve is retested.

Retesting of Valves in Storage
Midland valves are factory set and sealed. If they have been left in their original shipping containers, are undamaged, and are not more than six months old, they may be installed without being retested.

Precautions for Mounted-Valve Repair
When performing maintenance on a pressure relief valve that is mounted on a railcar, observe the following precautions.

- Wear protective clothing and equipment suitable for withstanding the materials to which you may be exposed.
- Position yourself on the upwind side of the valve when possible.
- Work with a partner who can help you in the event of an emergency.
- Follow approved safety precautions for hazardous or toxic materials.

Required Tools

Obtain the required tools and supplies before attempting maintenance procedures.

Recommended Wrenches

SAE	METRIC	Component
3/4"	19 mm	1/2" top guide nut
7/8"	23 mm	5/8" top lock nut
15/16"	24 mm	3/4" top lock nut
1-1/16"	27 mm	Flats on small valve O-ring retainer, 5/8" mounting stud nuts
1-1/4"	32 mm	Flats on large valve O-ring retainer, 3/4" mounting stud nuts
1-7/16"	37 mm	7/8" mounting stud nuts

Other Tools and Supplies

Screwdrivers	Vise Grips
Wheel puller	Lint-free cloth
Silicone grease (or eqiv. lube.)	Emery paper (400 grit, cut in 1" strips)
O-ring retainer cap with O-rings epoxied in place.	

1) Leak Repair on a Mounted Valve

Top-style Valves
If a valve of top-style design (spring and other parts are above the valve orifice), the seals of the valve cannot be changed unless the tank car is depressurized and the valve is disassembled.

Internal-style Valves
If a valve of internal-style design (spring is below the valve mounting flange and inside tank), it is possible to replace the retainer cap O-rings while the valve is in place and the tank car pressurized.

NOTE: Conducting this procedure may be hazardous (depending on the material in the tank car). Maintenance personnel should be

Maintenance

1) Leak Repair on a Mounted Valve (cont.)

carefully trained before being permitted to perform the procedure below on a pressure relief valve mounted on a pressurized tank.

1) Remove the top seal wire (Fig. 12).

2) Remove the four top guide nuts and situate them so they won't be dropped or lost.

3) Mark the top guide and body with a vertical line to allow the top guide to be reinstalled in the same orientation.

4) Pry up and remove the top guide.

5) Put a wrench on the flats of the O-ring retainer and another wrench on the top locknut (Fig. 13). Hold the retainer in place to prevent it from rotating while backing off and removing the top locknut.

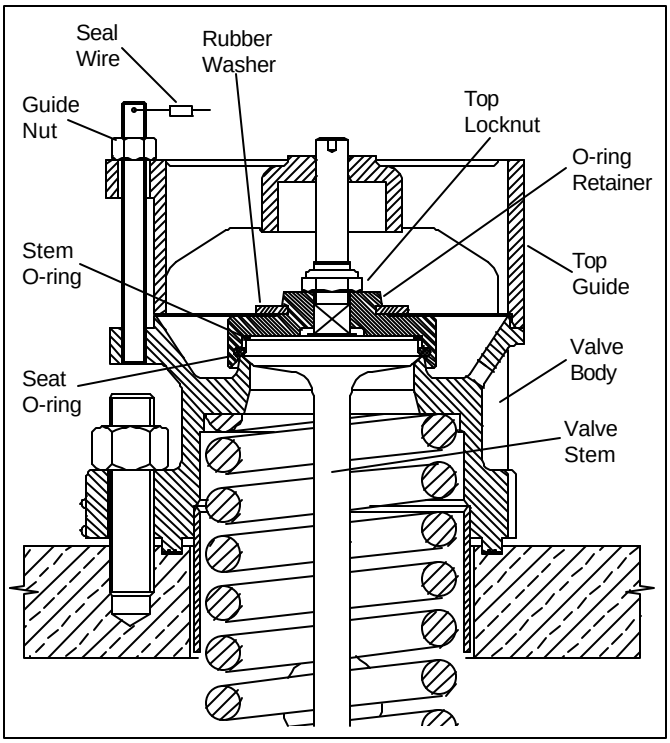


Figure 12 - Internal-style Valve Components

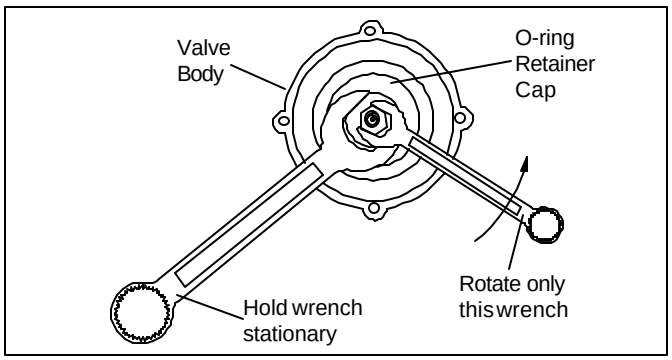


Figure 13 - Top Locknut Removal Method

CAUTION: Valve Discharge
When the O-ring retainer cap is raised up, there will be a significant amount of product discharging. Have the emery paper, cleaning cloth, replacement O-ring retainer cap (with epoxied O-rings) and silicone grease close at hand. Use a wheel puller, or two screwdrivers 180° apart, to quickly dislodge the O-ring retainer (Fig. 14).

6) Remove the o-ring retainer. Remove the two o-rings from the retainer and inspect the o-ring grooves (see step 4 in Valve Inspection and Fig. 15 below).

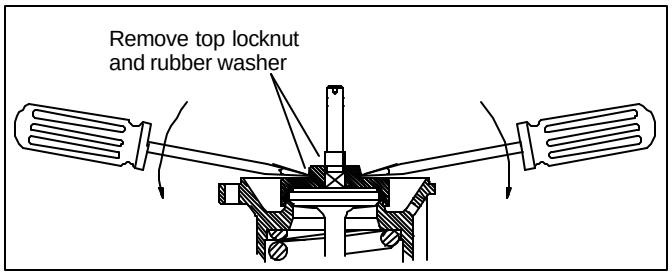


Figure 14 - Prying Up O-ring Retainer Cap

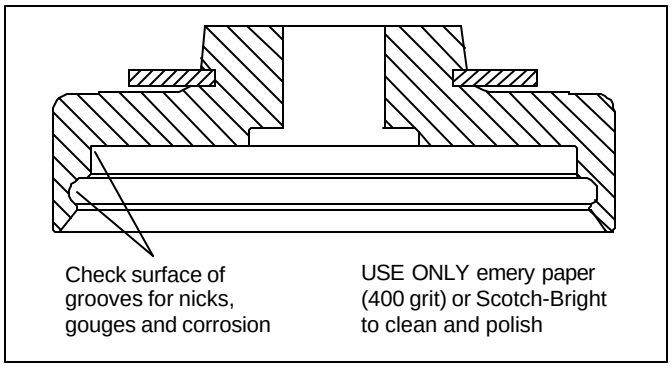


Figure 15 - Retainer O-ring Grooves

Maintenance

1) Leak Repair on a Mounted Valve (cont.)

7) Look carefully for nicks, rust, scale, solidified product, and other foreign material on the valve seat (Refer to Fig. 8 in Valve Inspection, and Fig 16 below). The O-ring

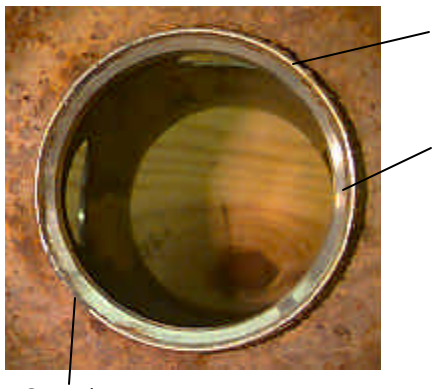


Figure 16 - Valve Seat Inspection

makes its seal on the top of the crown of the valve seat and on a small area (on the outboard side) past the top of the seat. Use emery paper (400 grit) to clean this surface, then wipe away any loose residue. Run your fingernail over this surface to detect any irregularities that may still be there. **(A fingernail can detect flaws that are not apparent in a visual examination.)**

8) After cleaning and confirming that the valve seat area is clean and free of defects, apply a small amount of lubricant to the crown of the valve seat, and also on the exposed thread of the valve stem (Fig. 17).

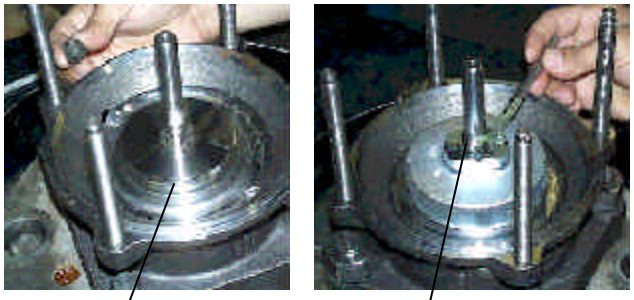


Figure 17 - Lubricate Seat Crown & Stem Threads

9) Install the new O-ring retainer and secure it with the top locknut. Take care to prevent rotation of the retainer using two wrenches as shown in Figure 13.

10) Install the top guide and secure it with the four guide nuts.

CAUTION: Replace Retainer
After the tank car is emptied, replace the epoxied O-ring retainer just installed with another one containing lightly lubricated, freely moving O-rings. **If valve leakage exceeds the sealing capability of the O-ring, replace or rebuild the valve.**

2) Pressure Testing and Valve Adjustment

Determining Applicable Pressure Values
Refer to AAR publication “Regulations for Tank Cars.” Appendix A applies specifically to valves. This section prescribes the start-to-discharge pressure (STD), the vapor tight pressure (VTP) and their tolerances.

NOTE: A “popping pressure” is not specified. It is only necessary to ascertain the STD pressure as pressure is increased, and to establish the vapor-tight pressure as pressure is being reduced. (STD is defined as a continuous discharge in contrast to the start-to-leak pressure, which is defined as the first bubble leak. Vapor-tight is defined as being bubble-tight.)

Test Stand and Gauge Requirements
The test stand must have a mounting equivalent to the AAR M1002 figures E19.14 through E19.23 for the valve being tested. The pressure gauge must meet the requirements of D4.5 Test Gauge Standards and date tagged.

Maintenance

2) Pressure Testing and Valve Adjustment (cont.)

Specialized Mounting Nozzles

Valves of the A-2035 through A-2169 type require a mounting nozzle duplicating the dimensions of figure E21A of AAR M1002.

WARNING: Use Proper Guide Tube
Testing and setting valves without the proper guide tube will result in incorrect high-pressure settings.

Valve Testing Procedure

If your company has an approved test procedure, follow it. If it does not, this procedure provides essential guidelines.

NOTE: When testing a valve of the combination-type (a top-style valve mounted above a rupture disc - Fig. 11), remove the rupture disk prior to testing.

1) Install the valve on the test fixture and tighten down all the nuts alternately.

2) Seal the drain holes of the bowl or top guide with putty (Fig. 18), or a similar material.

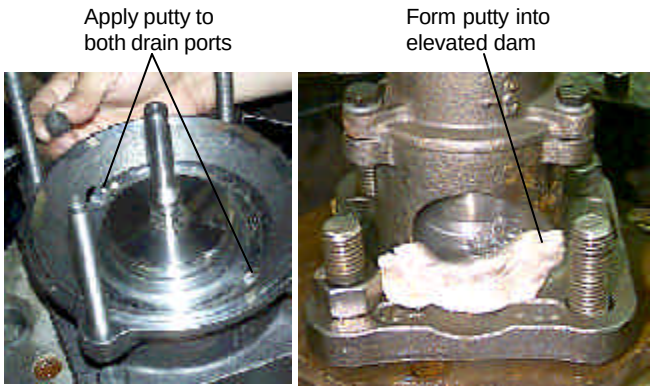


Figure 18 - Blocking Water Drainage with Putty

3) Pour water into the bowl or top guide of the valve body.

4) Take a position allowing you to observe the pressure gauge while also watching for the bubbling of air in the bowl or top guide of the valve body.

5) Increase the test air pressure slowly.

6) Increase the air pressure until the valve STD is reached. The initial opening of the valve may be slightly high and not indicative of the actual STD because the O-ring may have been partially stuck to the valve seat.

7) Reduce the air pressure until leakage stops and then reduce pressure to less than one half of the STD pressure. Then slowly increase the pressure.

8) Observe the STD pressure and then bleed off the pressure slowly to observe the VTP.

9) Repeat this procedure at least two more times. The STD and VTP should be consistent in all three occurrences.

10) AAR Specifications state that the VTP is 80% of the STD. Valves with good seats and O-rings should exhibit a VTP above 80% of the STD (usually up to 95% of the STD).

11) For internal-style valves only: if the STD or VTP is not satisfactory, take the O-ring retainer cap off the valve and follow the previous Maintenance instructions in **1) Leak Repair on a Mounted Valve** to replace the retainer cap O-rings. Exception: when performing that procedure, there should be no pressure in the test chamber, and the retainer-cap O-rings should be loose (and lightly lubricated), not epoxied into the O-ring retainer as specified in that procedure.

Maintenance

2) Pressure Testing and Valve Adjustment (cont.)

12) If the valve is an internal-style type, remove it from the test fixture and follow steps 13 through 24. If the valve is a top-style type, go to step 25.

Internal-style Valve – Adjustment

13) Remove the wire seal from the spring adjustment nut.

14) Lubricate the valve stem threads.

15) Loosen the locknut nearest the free end of the threaded valve stem a few turns to separate it from the adjusting nut.

16) Using a manual or air operated press, invert the valve to compress the spring and relieve pressure from the adjusting nut. Use a tubular fixture (Fig. 19) that is partially cut away to press down on the spring follower, further compressing the spring.

Note: Since all nickel bearing stainless steels have a likelihood of galling, wrenching the adjusting nut without relieving the spring's load will frequently result in damaged stem threads.

17) Apply indicator (reference) marks to the bottom adjusting nut and the spring follower, and then loosen or tighten the adjusting nut two turns.

18) Release the spring compressor.

19) Tighten the lock nut against the adjusting nut to lock the setting.

Figure 19 - Yoke for Spring Compressing

20) Retest the valve STD and determine how much pressure change occurred when the adjusting nut was rotated two turns. Based upon this calculation, re-compress the valve spring and alter the valve adjustment for the midpoint in the STD tolerance range.

21) Retest the valve.

22) If the test results are erratic, trouble-shooting is more complex. Consult with your supervising engineer or a Midland representative.

23) When the test results are acceptable, tighten the valve adjusting nuts together with the applicable torque value shown below. Then install a new wire seal.

A-1000 series valves: 45 ±3 ft-lbs.
Large valves with
3/4" stem thread: 150 ±10 ft-lbs.

24) Go to Post-test Procedures and perform them.

Maintenance

2) Pressure Testing and Valve Adjustment (cont.)

Top-style Valve – Adjustment

25) Remove the protective cap and discharge flue from the valve body (Fig. 20).

26) Remove the wire seal from the valve cap set screw. Loosen the set screw and remove the valve cap to expose the top nut (spring adjustment screw nut).

27) Loosen the top nut to allow rotation of the spring adjustment screw.

28) Loosen the spring adjustment screw two turns (counterclockwise).

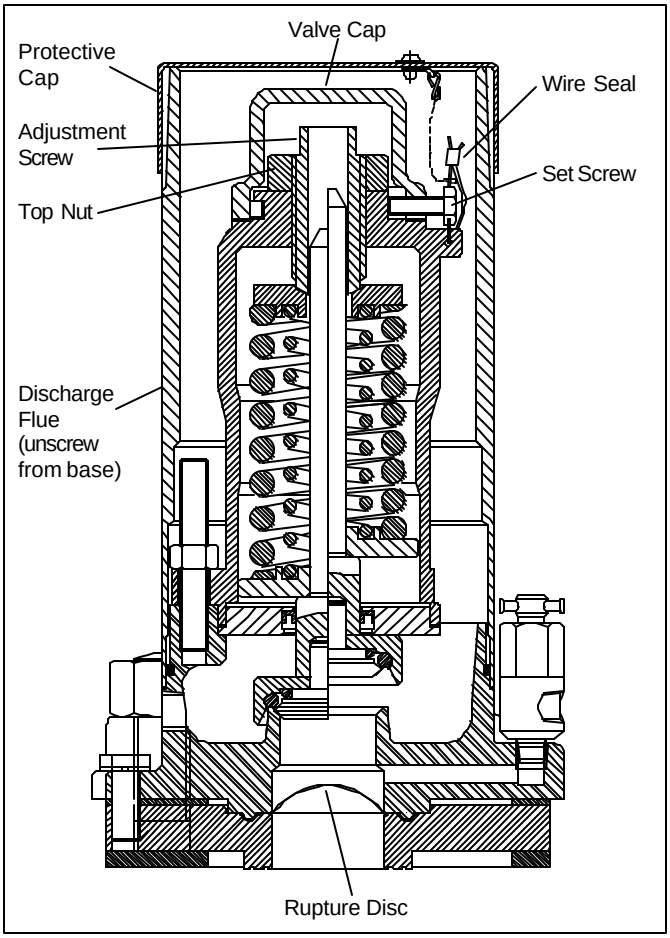


Figure 20 - Top Style Flue and Cap

29) Tighten the top nut to lock the setting. Make sure that the spring adjustment screw does not rotate.

30) Retest the valve STD and determine how much pressure change occurred when the adjusting screw was loosened two turns. Based upon this calculation, re-compress the valve spring and alter the valve adjustment for the midpoint in the STD tolerance range.

31) Retest the valve.

32) If the test results are erratic, trouble-shooting is more complex. Consult with your supervising engineer or a Midland repre-sentative.

33) When the test results are acceptable, tighten the top nut to a torque of 45 ±3 ft-lbs.

34) Reinstall the valve cap, tighten the set screw and install a new wire seal through the cap setscrew hole. Reinstall the discharge flue and the protective cap.

35) If the valve does not include a rupture disc, go to Post-test Procedures and perform them.

Combination Valve w/Rupture Disc Only

36) If the valve is a combination device (a top-style valve that includes a rupture disc - Fig. 20), reinstall the rupture disc making sure that the disc and mounting flange are in the serviceable condition specified under **Inspection**, sections 8) Valve Disc and 9) Rupture Disc Flange. Install the rupture disc flange bolts.

NOTE: Rupture discs are made of very thin metallic films (only .001 or .002 thick). Do not expose them to rough handling or abrasion or they will be damaged.

Maintenance

2) Pressure Testing and Valve Adjustment (cont.)

Combination Valve w/Rupture Disc Only (cont.)

37) Install the assembled combination valve on the test stand and bolt it in place. Screw the stud nuts down evenly to avoid cocking the flanges or distorting the disc.

38) If there is a needle valve, pipe plug, or other type of indicator on the side of the valve, open it or remove the plug. This equalizes pressure in the chamber above the disc.

39) Slowly increase pressure in the test chamber. **Do not** permit the pressure to exceed 60% of the disc's rating **(or the disc may be damage or distorted).** For example, if the disc is rated at 100 psi, **do not** allow the pressure to exceed 60 psi.

40) Put soap suds over the bleed hole opening or needle valve outlet and around the circumference of the flange joint. A bubble may form initially that is only the result of the disc slightly deforming upward and displacing air in the chamber above it. After a minute, if there is no change in the size of the soap bubble, slowly vent the pressure from the test stand and unmount the valve.

41) If the soap bubble on the bleed hole or needle valve continues to grow in size, a pressure leak into the chamber above the disc is indicated. Vent the pressure from the test stand, unmount the valve and unscrew the bolts securing the rupture disc flange.

42) Inspect the disc crown for a crack or pin hole leak or where the crown meets the flat part of the disc. If the disc does not include a vacuum support and Teflon liner, hold it up to a light to detect defects. Also look at the radial seating surface of the disc for creases, or small bumps that could be leak paths. Since the disc is the most fragile part of the assembly, imperfections in any of the parts may be most easily seen in the disc. Also inspect the disc flange and mating surface on the underside of the valve body for any imperfection.

43) If there is any imperfection in the disc, it cannot be used. Replace it. If there is no visible cause for the leak, consult with your supervising engineer or with a Midland representative to determine other causes.

Post-test Procedures

1) After testing the valve, close the test stand pressure inlet valve to the test chamber, relieve the pressure in the test chamber and remove the valve from the test fixture.

2) Drain off any water that may have accumulated and wipe or blow away any soap suds and water used in the testing.

3) Particularly for top-style valves, install a plastic protector over the valve body tongue to prevent damage to it.

4) Apply an appropriate preservative or paint to the exterior of the valve. Be sure to mask the nameplate so that it will be readable afterward. **DO NOT** paint the sealing surfaces of the valve that will contact the mounting cover plate surfaces.

5) Permanently attach a metal tag to the valve body with date of repair and repair facility identification.

6) Fill in the test date information on the tag on the valve and store the valve in a dry place until ready to use.

REGULATIONS

The Midland valves are used in contact with a variety of products, most of which are hazardous materials. The acceptance and transportation of products are regulated by the DOT and AAR in the U.S.A., and in Canada by CTC and Transport Canada. Regulations of other governmental bodies must be complied with for stationary and mobile applications. All personnel should be familiar with and follow these regulations. Nothing in these instructions is intended to conflict with or supersede these regulations.

The information in this document was gathered from knowledgeable sources, but Midland Manufacturing Corporation makes no representations or guarantees about its accuracy or completeness and assumes no liability for this information. Specifications are subject to change without notice.

Obtaining Product Drawings

Assembly drawings of Midland pressure relief valves are available at no charge, and will be mailed upon request. Address any questions concerning valve maintenance or usage to the Engineering Dept., Midland Manufacturing Corp.

Warranty

Midland warrants the products of its own manufacture to be free of defects in material and workmanship, under normal use and proper operation, for a period of thirty (30) days from date of shipment from Midland's plant. Furnished materials and accessories purchased from other manufacturers are warranted only by and to the extent of those manufacturers' warranties, if any.

MIDLAND MAKES NO WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, OTHER THAN AS SPECIFIC-ALLY STATED HERE MIDLAND MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE. Midland's obligation under this warranty is strictly limited, at its option, to 1) repair or replacement at its factory of a like quantity of product: 2) refunding to purchaser money paid to Midland for its product: or 3) issuance of written authorization for the Purchaser to repair or replace, at costs comparable to Midland's normal manufacturing costs those parts proven defective, provided that Purchaser has given to Midland immediate notice upon discovery of such defect Merchandise claimed to be defective shall not be returned without first obtaining Midland's written consent. The undertaking of repair or replacement by the Purchaser, or its agents, without Midland's written consent, shall void Midland's warranty and relieve Midland of all responsibility. Under no circumstances shall Midland be liable for any direct, incidental, consequential or other damages of any kind in connection with the installation, operation, maintenance, repair, inspection or other use of any product purchased from it.

MIDLAND

A DOVER RESOURCES COMPANY

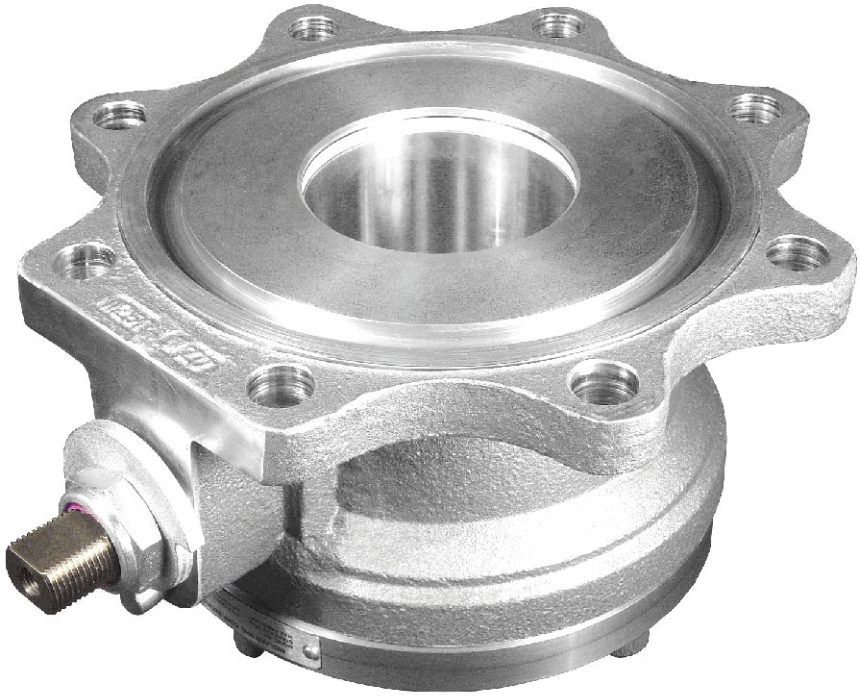
Mail to: P.O. Box 226, Skokie, IL 60076-0226
7733 Gross Point Road, Skokie, IL 60076-0226
Phone: (847)677-0333, Fax: (847)677-0138

MIDLAND™

4” Ball Valve - Bottom Outlet

Instructions for Series A-520 and A-522

Installation
Operation
Inspection
Maintenance



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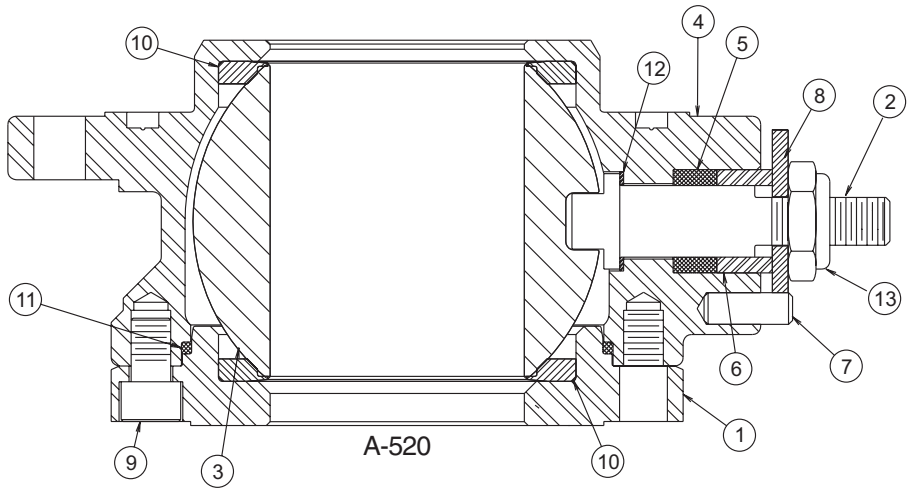
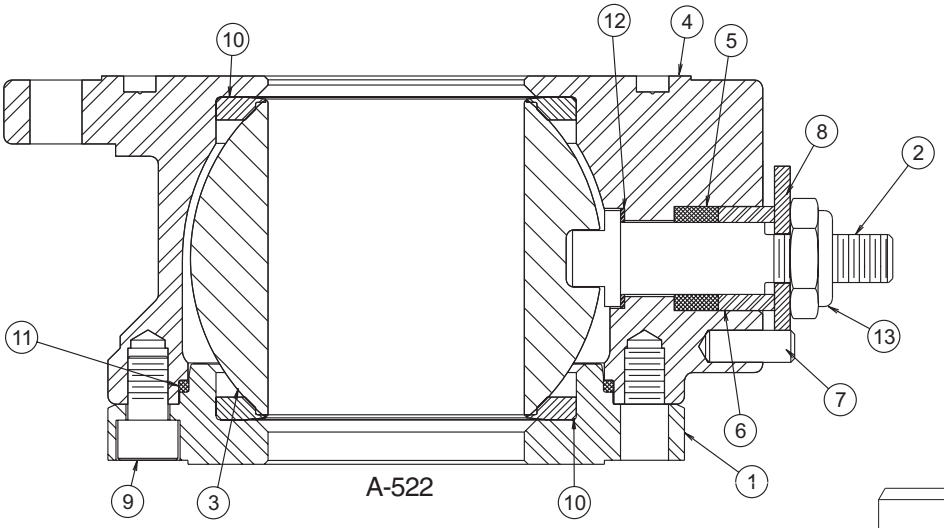
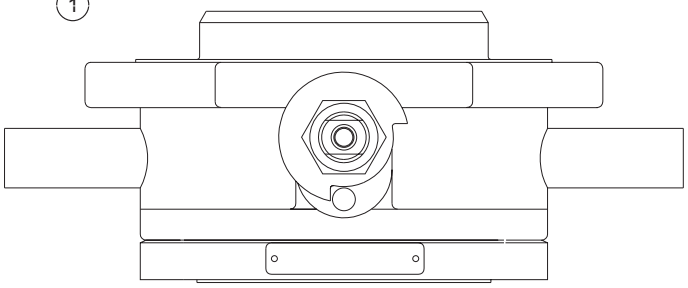


A-520

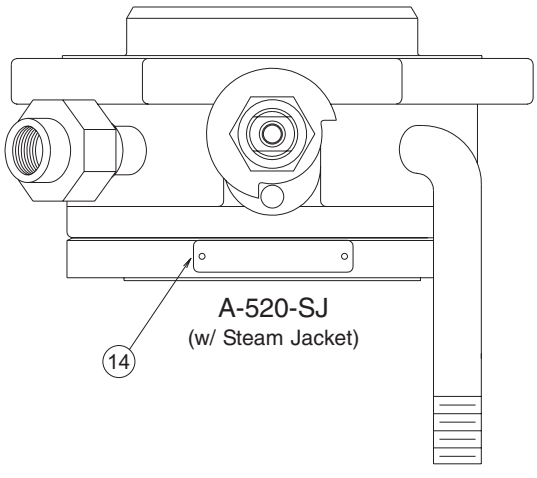
ITEM	QTY	PART NAME
1	1	CAP
2	1	STEM
3	1	BALL
4	1	BODY
5	1	PACKING
6	1	SPACER
7	1	PIN
8	1	STOP PLATE
9	4	CAPSCREW, HEX-SOC, 5/8"-11UNC-2A X 1" LG
10	2	SEAL, BALL
11	1	SEAL, VALVE BODY
12	1	WASHER, THRUST
13	1	LOCKNUT, HEX, THIN, 1 1/8"-12UNF, NY. INSERT
14	1	NAMEPLATE
15	1	HANDLE (Optional)
16	1	WASHER, HANDLE (Optional)
17	1	BOLT, HANDLE (Optional)



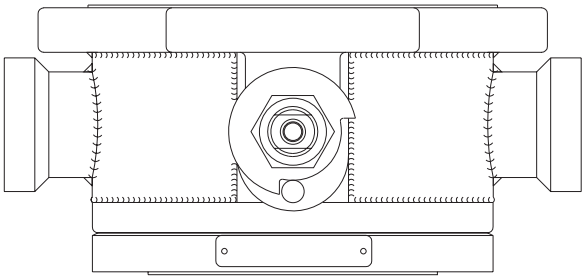
A-522



A-520-SJ3
(w/ Steam Jacket)



A-520-SJ
(w/ Steam Jacket)



A-522-SJ
(w/ Steam Jacket)

Figure 1 - Ball Valve Components and Steam Jacket Configurations

1.0 VALVE INSTALLATION

CAUTION: Toxic Hazard
To avoid exposure to toxic or hazardous materials, make sure the tank car is empty and clean, and that the work area is free of hazardous chemicals before removing a valve or installing a new one.

1.1 Preliminary Considerations

New valves have passed final inspection at Midland. If a new valve has been left in its original shipping container, is undamaged, and is not more than six months old, it may be installed on a tank car without retesting.

Keep the new valve in its original shipping container. This will ensure it remains clean and will protect the gasket groove and ball (Fig. 2) from nicks and damage.

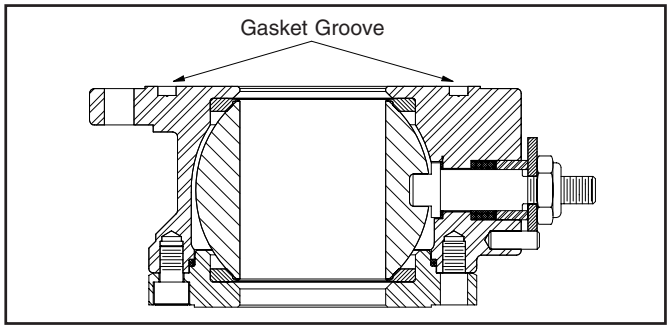


Figure 2 - Valve Gasket Groove

1.2 Installation Procedure

1.2.1 Remove the old valve from the tank car. If the valve includes a steam jacket, cut or disconnect the steam lines from the valve taking care to preserve the integrity of the valve’s original steam inlet and outlet piping.

1.2.2 Clean the tank car mounting flange and saddle plate (if present) of all product, debris and corrosion. Wipe the inside-bottom of the tank near the outlet opening to remove loose debris. Clean out the threaded holes in the mounting flange to ensure easy installation of the new mounting hardware.

1.2.3 Using a lint-free cloth and appropriate cleaning solvent, wipe clean the mounting flange and tongue.

1.2.4 Inspect the sides and edges of the tank car mounting-flange tongue. Because the valve fits tightly over the tongue, any peening-over of its edges may make it difficult to properly seat the new valve. Mounting-flange surfaces should be flat within 0.015 inches TIR. If any irregularities are found, correct them according to approved repair practices.

1.2.5 Inspect the gasket groove of the reconditioned or retested valve for nicks and burrs. The mounting-flange tongue and gasket groove dimensions have diameter tolerances of ±0.003", thus any excess material on these diameters will make it difficult to locate the valve groove onto the tongue. If minor irregularities are found, correct them according to approved repair practices. Report any significant damage to your supervisor before continuing.

CAUTION: Gasket Damage
Do not use a sharp instrument to press the new gasket into place or gasket damage may result.

1.2.6 Install the new gasket in the gasket groove of the valve. Ensure it is fully seated. When the gasket is fully seated, 3/16” of free space should remain above the gasket to permit locating and entry of the mounting-flange tongue.

1.2.7 Install the ball valve in the open position (Fig. 3) so the ball surfaces are protected during the following steps. Do not install the valve handle at this time.

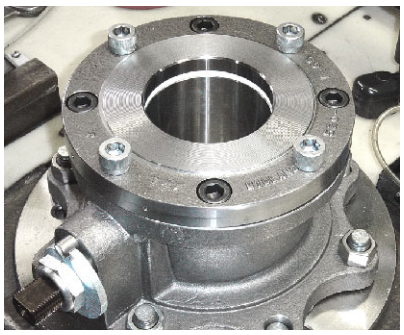


Figure 3 - Ball Valve in Open Position

1.0 VALVE INSTALLATION

1.2 Installation Procedure (cont.)

CAUTION: Potential Lifting Injury
The ball valve, with the outlet cap in place, weighs in excess of 95 pounds (depending on model). Use mechanical assistance or additional manpower when lifting and locating the valve during installation.

1.2.8 Raise the valve up to the tank car mounting-flange surface with the valve-handle shaft oriented so that it is pointing away from the tank car. Carefully align the mounting-flange tongue with the gasket groove in the valve, while also taking care to align the mounting holes in the valve flange with those in the mounting flange.

1.2.9 Raise the valve only until its gasket groove engages with the mounting-flange tongue.

1.2.10 Install four (4) mounting bolts 90° apart and tighten them gradually in an even sequence only enough to retain engagement of the valve with the mounting-flange tongue.

1.2.11 Remove the mechanical lifting device.

1.2.12 Install the remaining four (4) mounting bolts.

1.2.13 Tighten all eight (8) mounting bolts alternating diagonally as shown in Figure 4. Do not over tighten one side as it may tilt the valve and prevent a proper seal.

1.2.14 Tighten the mounting bolts in 1/3 torque increments to a final torque setting prescribed by your engineering department.

1.2.15 Ensure that an even gap exists all around between the valve flange and the mounting flange. The gap should be 1/8” to 3/16”, depending on the mounting-flange tongue height (which may vary between 5/16” and 3/8”).

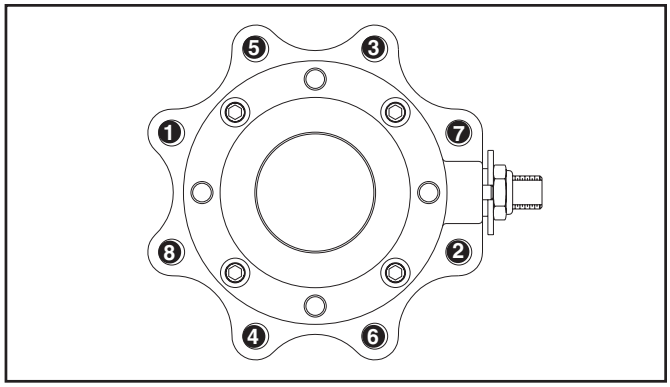


Figure 4 - Mounting Bolt Tightening Sequence

1.2.16 If the valve includes a steam jacket, connect the steam supply and return lines to the valve ports according to the prescribed practices of your company.

1.2.17 Install the valve handle onto the valve shaft with the Nord-lock washer and cap screw provided.

1.2.18 Fully close and open the valve a few times to confirm free operation. Check that the valve handle fits into both the “Open” and “Closed” brackets that secure its position.

WARNING: Valve Leakage
Improper flange-tongue seating in the valve groove, loose bolts and damaged gaskets may result in leaks at the valve mounting joint.

1.2.19) **Inspect for leaks.** Follow your company leak testing procedure.

NOTE: Valve Operation
Operation and use of the valve must conform with all applicable TC, AAR, DOT specifications (Parts 173.31, 174.67, etc.), other governmental bodies, and the operating instructions of your company.

2.0 VALVE INSPECTION

Follow these instructions and guidelines for assessing the condition of a leaking ball valve prior to rebuilding it.

2.1 Disassembly for Inspection

Follow the steps below to disassemble the valve.

2.1.1 Locate the valve on a bench and preferably on a pressure test fixture to which it may be bolted for safety and rigidity during hardware removal. Secure it with the 8-bolt flange downward (Fig. 5).

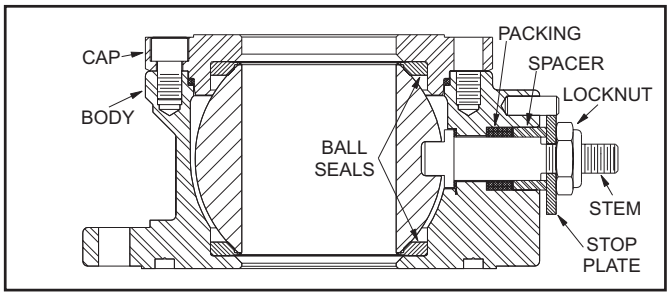


Figure 5 - Valve Inverted

2.1.2 Set the valve to the closed position. This must be done to allow removal of the valve ball. Then remove the valve handle by removing the cap screw and lock washer from the valve stem.

2.1.3 Remove the outlet cap assembly (if present).

4) Remove the four socket hex head capscrews from the valve cap.

WARNING: Valve Damage
Avoid forceful tool contact with seal-support surfaces when removing ball seals and stem packing, or damage may result.

2.1.5 Carefully lift off the valve cap taking care to avoid its contacting the valve ball. Remove the ball seal from the cap plate.

2.1.6 Reach both hands into the valve body on either side of the valve ball. Lift the ball out of the body and set it on a padded surface (Fig. 6).

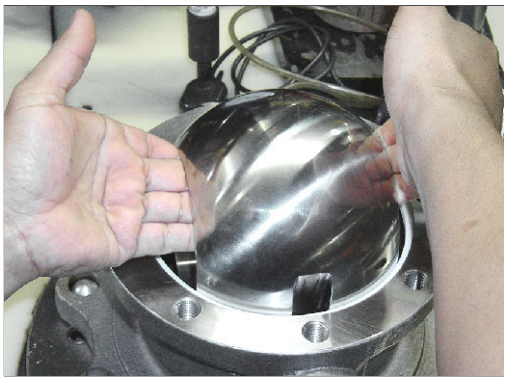


Figure 6 - Valve Ball Removal

2.1.7 Remove the locknut from the valve stem by turning it counterclockwise (Fig. 5).

2.1.8 Remove the stop plate and then carefully press the valve stem into the body cavity and remove it. The use of a brass or plastic hammer may be required to overcome the resistance of the compressed stem packing.

2.1.9 Remove the stainless steel spacer collar from the valve stem bore.

2.1.10 Remove the Teflon packing from the valve stem bore. Avoid scratching or gouging the interior surfaces of the valve stem bore.

2.1.11 Carefully remove the ball seal from the inside-bottom of the valve body.

2.1.12 Clean all the disassembled components to facilitate inspection.

2.2 Inspection of Components

Inspect the valve body, ball and stem components as described below.

2.2.1 Valve Body Inspection

2.2.1.1 Check the valve body and the cap ball-seal surfaces for signs of corrosion, cracks and scratches. No defects are allowed.

2.0 VALVE INSPECTION

2.2.1 Valve Body Inspection (cont.)

2.2.1.2 Use a light to inspect the valve stem bore for gouges or corrosion. It must be free of defects.

2.2.2 Valve Ball Inspection

2.2.2.1 Clean the valve ball with solvent (to remove any adhering product), or in an ultrasonic bath.

2.2.2.2 Slide your fingernail over scratches to determine severity (Fig. 7). If your fingernail is unable to "catch" in an abrasion, it is not of a depth that would allow leakage or affect the ball seals.

Figure 7 - Checking Scratch Severity

WARNING: Do not repair valve ball! Attempts to repair scratches or gouges will result in a change of the ball diameter. This will cause deficient sealing and result in valve leakage. Replace a ball having scratches that fail the fingernail severity test.

2.2.2.3 If any scratches fail the fingernail test, replace the ball. It cannot be repaired

2.2.3 Valve Stem Components Inspection

2.2.3.1 The 1-1/8"-12 UNF threads should pass a thread ring Go gauge test. If the threads exhibit stripping or unrepairable damage, replace the valve stem.

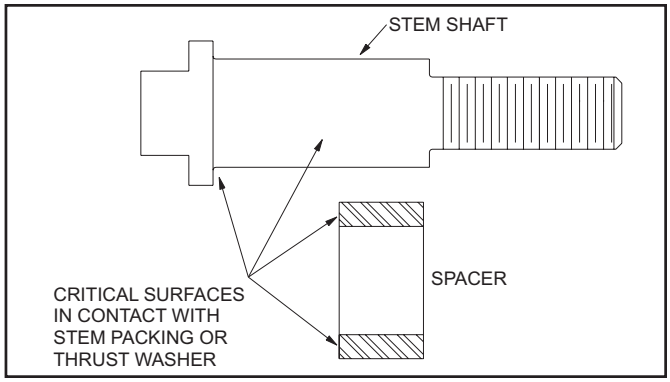


Figure 8 - Valve Stem and Spacer Surfaces

2.2.3.2 Inspect the surfaces of the spacer bushing that contact the stem packing and thrust washer (Fig. 8). Also, inspect the surface of the stem shaft. These surfaces should be smooth and clean.

2.2.3.3 Inspect the valve stem locknut for damage to the threads and the nylon locking insert. Replace the locknut if damage is observed and if the nylon insert is cracked, embrittled or frayed.

2.3 Special Inspection Considerations

2.3.1 Previous procedures may not cover all conditions encountered in the field. Therefore, it is the responsibility of the repair facility to contact an authorized Midland technical representative for recommendations regarding unusual valve conditions or repair circumstances that may be encountered.

2.3.2 Evaluation of critical component metal surfaces of the valves after cleaning and inspection by the repair facility are the responsibility of the repair facility.

2.3.3 Where numerical tolerances cannot be provided, the disposition of the part or parts is under the jurisdiction of the repair facility and dependent on its experience and judgement.

3.0 MAINTENANCE

3.1 Leak Checking in the Field

Because of the ball valve's simplicity, the only maintenance procedure consists of checking the valve for leaks. If the valve is leaking from its outlet port, rebuild or replace it. If minor leakage is detected only at the valve-stem packing, remove the handle and increase the tightening torque on the locknut, but do not exceed 150 Ft.-Lbs. If this fails to stop the leak, rebuild or replace the ball valve.

3.2 Valve Assembly and Testing (at 70°F)

3.2.1 Test Equipment Requirements

Test Stand and Gauge Requirements

The test stand must have an appropriate mounting for the valve being tested. The pressure gauge must meet the requirements of D4.5 Test Gauge Standards and be date tagged.

Valve Testing Procedure

If your company has an approved reassembly/test procedure, follow it. If it does not, this procedure provides essential guidelines.

3.2 Valve Assembly and Testing Procedure

Perform this procedure only after you have conducted the procedures in **2.0 Valve Inspection** for determining the condition of the valve components, repairing or replacing them.

3.2.1 Ensure that you have all the valve components at hand, including the new seal kit that contains the valve-body seal, the valve-stem thrust washer, the valve-stem packing (5 pcs.) and the two ball seals. Figure 9 shows all the valve components.

3.2.2 Thoroughly clean the valve components to remove paint, dirt, oils and tank car product from all surfaces. Clean the valve ball with an appropriate solvent or immerse it in a heated, ultrasonic bath to ensure removal of all particulates. Dry and wipe down the valve ball and all valve interior surfaces with a lint-free cloth. Secondary cleaning is recommended during assembly procedure handling of components.

Figure 9 - Valve Components (A-522)

3.2.3 Mount the valve body onto the assembly fixture and secure it in place.

3.2.4 Install the thrust washer onto the valve stem as shown in Figure 10.

Figure 10 - Installing Thrust Washer

3.2.5 Insert the valve stem through the shaft bore from inside the valve body. Ensure that it seats properly.

3.0 MAINTENANCE

3.2 Valve Assembly & Testing Procedure (cont.)

CAUTION: Packing Ring Order
There are three types of Teflon rings that comprise the valve-stem packing (5 rings total). Do not alter their arrangement or improper sealing will result. Their correct stack-up is shown below (Fig. 11).

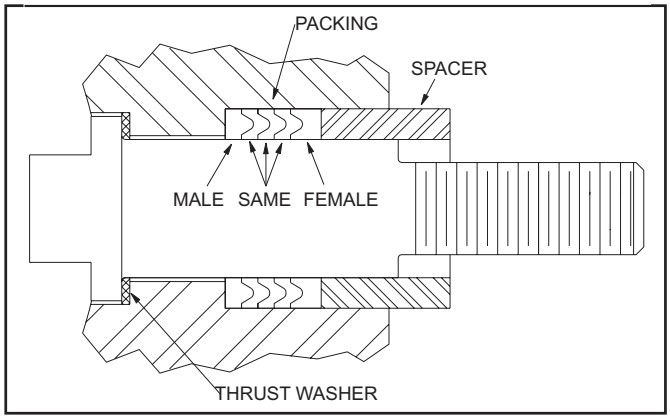


Figure 11 - Packing Rings Orientation

3.2.6) Install the packing (5 rings) onto the valve stem, pushing them into the shaft bore (Fig. 12).

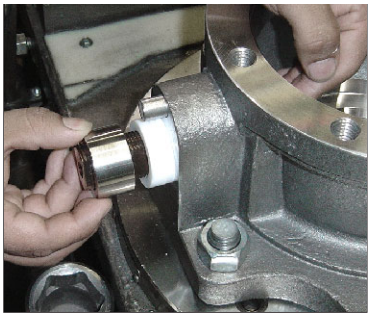


Figure 12 - Installing Packing and Spacer

3.2.7 Insert the spacer collar into the shaft bore (Fig. 12). It will protrude about 1/4” when seated. This is normal.

3.2.8 Install the stop plate as shown in Figure 13 so that the valve will be closed in the full-clockwise position (unless specific applications requrie full CCW position).

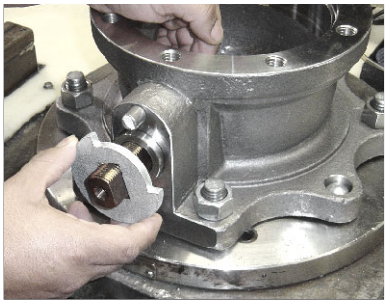


Figure 13 - Installing Stop Plate

3.2.9 Install the locknut and torque it to 150 Ft.-Lbs.

3.2.10 The gap between the stop plate and the valve body must be 1/8” minimum, 1/4” maximum.

3.2.11 Secure the test sealing cap onto the valve body (Fig. 14). Torque the cap bolts to 50 Ft.-Lbs.

Figure 14 - Valve Stem Leak Test

3.2.12 Pressurize the assembly to 160 PSI for 2 minutes. During this period, apply leak detecting fluid (snoop) to the exterior of the spacer protruding from the shaft bore while watching for any bubbles and foaming. NO LEAKS ARE ALLOWED.

3.2.13 Depressurize the valve body and remove the sealing cap. Wipe off any remaining water.

3.0 MAINTENANCE

3.2 Valve Assembly & Testing Procedure (cont.)

3.2.14 Wipe down one of the ball seals and then place it into the bottom seat of the valve body, flat side downward (Fig. 15). Be very careful to avoid damaging the seal during installation.

Figure 15 - Installing First Ball Seal

3.2.15 Wipe down the large, Teflon, valve body seal and then place it into the top of the valve body (Fig. 16). This will prevent the valve ball from touching the body during ball placement.

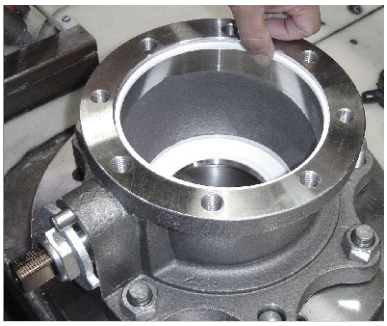


Figure 16 - Body Seal Installation

3.2.16 Clean the valve ball with warm water and soap, or immerse it in a heated ultrasonic bath (125-150°F) for 5 minutes. Then rinse the ball with clean, cold water. Dry it with a lint-free cloth. Allow it to return to room temperature before continuing.

3.2.17 Perform a final check of the ball for scratches or nicks. Run your fingernail around both rims of the ball (Fig. 17). Any damage is cause for rejection.

Figure 17 - Checking for Nicks

3.2.18 Rotate the valve stem so that its end that engages the ball slot is oriented vertically.

3.2.19 Carefully place the valve ball into the valve body aligning the ball slot with the stem end as shown in Figure 18.

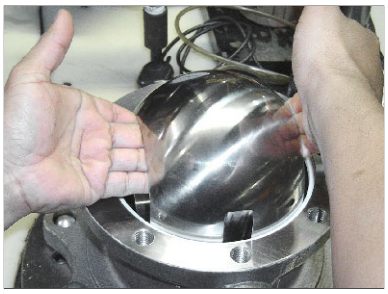


Figure 18 - Placing the Valve Ball

3.2.20 Check the inside surfaces of the cap plate for nicks and debris.

3.2.21 Wipe down the second ball seal and then place it into the seat of the cap plate, flat side downward (Fig. 19). Be very careful to avoid damaging the seal during installation.

Figure 19 - Installing Ball Seal in Cap Plate

3.0 MAINTENANCE

3.2 Valve Assembly & Testing Procedure (cont.)

3.2.22 Place the cap plate onto the body (Fig. 20).

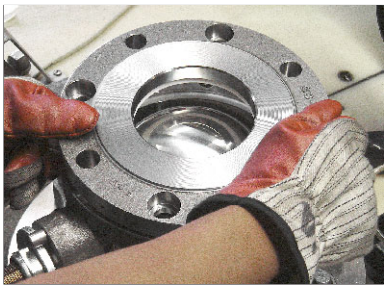


Figure 20 - Placing Cap Plate on Body

3.2.23 Orient the cap so that the nameplate (or its holes) straddle the valve stem (Fig. 21).

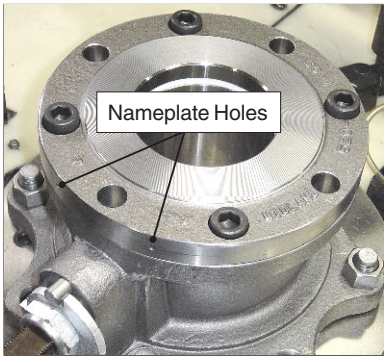


Figure 21 - Name Plate Holes Orientation

3.2.24 Fully open the valve with a wrench.

3.2.25 Apply two drops of Loctite 242 (Medium - or equiv.) to the threads of four (4) hex socket head cap screws and then screw them into the four counterbore holes as shown in Figure 22.

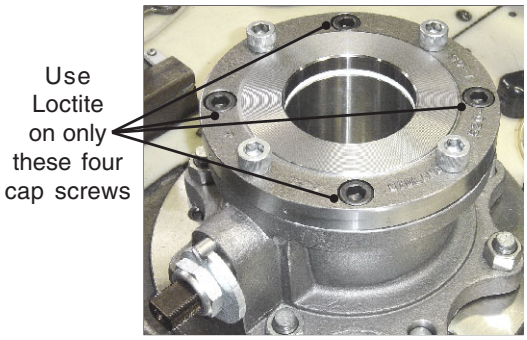


Figure 22 - Valve Cap Screws Installation

3.2.26 Install the four (4) extra 5/8"-11 UNC 2A 1-3/4" long cap screws, without Loctite (Figure 22).

3.2.27 Tighten the eight cap bolts in a crisscross sequence until the cap plate contacts the body. Then tighten them to 130 Ft.-Lbs.

3.2.28 Use a .002 inch feeler gauge to confirm that the cap is in contact with the valve body all around, with no gaps allowed (Fig. 23).

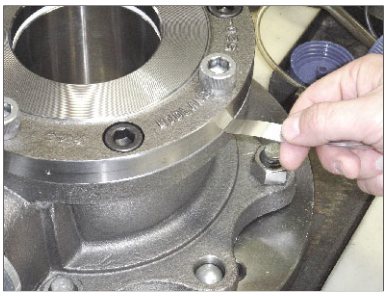


Figure 23 - Checking Cap-to-Body Contact

NOTE: Cap Bolt Torque
If uniform cap-to-body contact is not achieved, increase the torque on the cap bolts in 40 Ft.-Lbs. increments until it is, but do not exceed a maximum of 250 Ft.-Lbs.

3.2.29 Attach the updated valve nameplate to the cap. It must be oriented upside down (with respect to the valve position in these photos) so that it will read properly when the valve is inverted and mounted on the tank car.

3.2.30 Remove the valve from the assembly fixture and install protective caps in both ports.

3.2.31 Store the valve for at least 12 hours at room temperature to allow compression setting of the ball seals.

3.2.32 Remove the protective caps from the valve ports. Install the valve on the assembly/test fixture.

3.2.33 Use an applicable valve handle (two feet long) to fully close the ball valve (with the stem stop plate contacting the stop pin).

3.0 MAINTENANCE

3.2 Valve Assembly & Testing Procedure (cont.)

3.2.34 Pour water into the valve outlet port so that it covers the sealing area (Fig. 25).

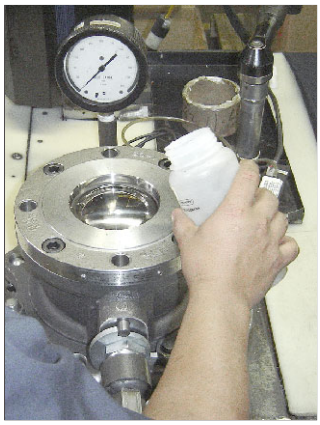


Figure 25 - Immersing Seal for Leak Test

3.2.35 Apply air pressure to the valve at 300 PSI.

3.2.36 Brush away initial bubbles and look for any new ones during a 2-minute dwell period. NO NEW BUBBLES ARE ALLOWED. If any new bubbles appear during this period, the valve must be rejected.

3.2.37 Siphon or wipe the water from the valve port. Blow it dry with an air gun.

3.2.38 Depressurize the valve body.

3.2.39 Fully open the valve and install a protective cap in the outlet port.

3.2.40 Remove the four (4) 5/8"-11 UNC 2A 1-3/4" long cap screws from the valve cap.

3.2.41 Remove the valve from the assembly/test fixture.

3.2.42 Clean the mounting flange and gasket groove. Install a protective cap in the inlet port.

3.2.43 If applicable, install thread protectors on the steam jacket inlet and outlet nipples.

3.2.44 Spray the valve's exterior surfaces with WD-40 or equivalent dry lubricant.

3.2.45 Store the valve in a cardboard box or in a protective enclosure.

4.0 NOTICES AND WARRANTY

4.1 Regulations

Midland valves are used in contact with a variety of commodities, many of which are hazardous materials. The acceptance and transportation of products are regulated by the DOT and AAR in the U.S.A., and in Canada by CTC and Transport Canada. Regulations of other governmental bodies must be complied with for stationary and mobile applications. All personnel should be familiar with and follow these regulations. Nothing in these instructions is intended to conflict with or supersede these regulations.

The information in this document was gathered from knowledgeable sources, but Midland Manufacturing Corporation makes no representations or guarantees about its accuracy or completeness and assumes no liability for this information. Specifications are subject to change without notice.

4.2 Obtaining Product Drawings

Assembly drawings of Midland bottom outlet ball valves are available at no charge, and will be mailed upon request. Address any questions concerning valve maintenance or usage to the Engineering Dept., Midland Manufacturing Corp.

4.3 Warranty

Midland warrants the products of its own manufacture to be free of defects in material and workmanship for a period of one (1) year from the date of invoice. Furnished materials and accessories purchased from other manufacturers are warranted only by and to the extent of those manufacturers' warranties, if any.

MIDLAND MAKES NO WARRANTY OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, OTHER THAN AS SPECIFICALLY STATED HERE. MIDLAND MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE. Midland's obligation under this warranty is strictly limited, at its option, to: 1) repair or replacement at its factory of a like quantity of product; 2) refunding to purchaser money paid to Midland for its product; or 3) issuance of written authorization for the Purchaser to repair or replace, at costs comparable to Midland's normal manufacturing costs, those parts proven defective; provided that Purchaser has given to Midland immediate notice upon discovery of such defect. Merchandise claimed to be defective shall not be returned without first obtaining Midland's written consent. The undertaking of repair or replacement by the Purchaser, or its agents, without Midland's written consent, shall void Midland's warranty and relieve Midland of all responsibility. Under no circumstances shall Midland be liable for any direct, incidental, consequential or other damages of any kind in connection with the installation, operation, maintenance, repair, inspection or other use of any product purchased from it.

MIDLAND™
A DOVER RESOURCES COMPANY
Mail to: P.O. Box 226, Skokie, IL 60076-0226
7733 Gross Point Road, Skokie, IL 60076-0226
Phone: (847)677-0333, Fax: (847)677-0138