USER INSTRUCTIONS

Nordstrom

Figure 50165 and 50169
Dynamic Balance® Iron Plug Valve

FCD NVENIM2006-00 09/05 (Replaces IOM-50169)

Installation
Operation
Maintenance

Experience In Motion

Contents

1 Valve Selection

Introduction

It is beyond the scope of this manual to make recommendations for specific applications because misapplication of a valve type could result in operating problems that adversely affect system safety and efficiency. This manual is intended to call attention to important considerations in the selection of valves. The manual addresses the important subjects of Shipping and Storage, Installation, and Operation and Maintenance. Observance of the recommendations and cautions offered herein will provide increased assurance of satisfactory valve performance.

The valve industry offers a wide variety of valve types and materials for use in industrial piping applications. There are usually several possible choices for a given requirement; any one valve may offer significant advantages and/or limitations compared to another valve. It is good practice to consult the manufacturer regarding specific requirements. The purchasing function includes the responsibility for securing the required valves at the lowest cost, but must also ensure that the valves purchased are in fact satisfactory for the intended service. The lowest total user (life cycle) cost criteria should be used only in choosing between alternatives that are known to satisfy the service requirement.

Pressure/Temperature Rating

The pressure/temperature rating of the valve must be properly selected for the service requirement. If the service involves a temperature above 100ºF (38ºC), the valve pressure rating at the service temperature must be verified as meeting the requirements of the application.

If system testing will subject the valve to a pressure in excess of its working pressure rating, then the intended testing pressure and a statement explaining whether the test pressure is through the opened valve or a differential across the closed valve, should be included in the purchase specification.

Some Source References for Pressure-Temperature Ratings: MSS SP-78; Cast Iron Plug Valves, Flanged and Threaded Ends

Bending Strength

Piping systems are subject to mechanical constraints at fixed support points such as rigid nozzles, anchors, etc. Cold springing at assembly and system temperature changes, together with gravity, possible inertia loads, landslides, non-uniform subsidence in buried lines, etc. all potentially affect the bending moment at various points in the piping.

Valves are also subjected to the bending moment occurring in the adjacent pipe that is in addition to the normal pressure loading. Bending loads can cause deformation in valve bodies that can be detrimental to valve functional performance. It is therefore a recommended design practice to avoid locating valves at points of large bending loads.

In many cases, normal valve design practice results in a body strength greater than the strength of the adjoining pipe thereby providing inherent protection against valve damage. In other cases, piping conditions or systems designs may actually increase the possibility of harmful valve body deformation.

The following are examples of possible problems.

a) Basic “standard” valves that are made into “venturi” type valves by providing enlarged end connections on the smaller standard basic valves.

b) Any “standard” valve installed in heavy-wall “overweight” piping where the extra thickness may e the pipe to be stiffer and stronger than the valve.

Valve designs having a high body bending strength should be used if there is reason for concern regarding possible high bending loads.

Pressure Surge

Closure of a valve in a flowing fluid line causes the velocity of the fluid to be reduced to zero. If the fluid is a relatively incompressible liquid, the inertia of an upstream column produces a pressure surge at the valve whose mag nitude is inversely proportional to the time required for closure. The surge pressure is also proportional to the length of the upstream fluid column and the fluid velocity prior to closure initiation. If the application involves a long upstream line, a long downstream line, high velocity, and/or rapid closure, singly or in any combination, the possibility of an unacceptable pressure surge should be investigated.

Also to be considered are condensation-induced pressure surges which occur when a fluid velocity change is caused by rapid condensation or when a slug of water is accelerated by contact with steam. An example would be when condensate collects on one side of a closed valve that has steam on the other side. Opening the valve causes collapsing steam voids, sharp pressure surges and acceleration of condensate slugs. Condensation-induced pressure waves can result in pressure pulses that are significantly higher than those produced by a sudden valve closure. In such events, non-shock rated gray iron valves installed in steel piping systems are particularly vulnerable to catastrophic failure. Traps are required to prevent condensate accumulation and “blow off’ valves, located at the low point in the system, are needed to ensure condensate drainage. Operation and maintenance personnel must be aware of the function of these devices in relationship to the “shutoff’ valve operation and the necessity for them to function properly.

Throttling Service

Valves used to control the rate of fluid flow may be subject to severe fluid turbulence that can have the effect of creating a high-energy conversion within the valve and piping system. This energy conversion is usually indicated by high noise levels, either from cavitation of liquids or shock waves from gases. (The noise in a water faucet is an example of a low-level cavitation noise.)

The possibility exists for mechanical damage to the valve and piping system when throttling of liquid flow results in severe and continuous cavitation conditions. Likewise, with gas flow under severe throttling conditions, shock waves can possibly result in damage to the system.

Flowserve Nordstrom Valves should be consulted on proper valve selection for throttling applications.

Temperature Changes

Valve structural materials expand with rising temperatures and contract with falling temperatures. Generally, increasing temperature causes a decrease of mechanical strength that is regained on return to a lower temperature. A condition of non-uniform temperature in a structure may impose significant thermal stresses or distortion with possible adverse effect on valve performance.

The possibility of thermal stress fatigue should be considered in applications involving frequent temperature cycling. This possibility is increased by any one or a combination of the following: increasing temperature range, increasing temperature level, increasing rate of temperature change, increasing thermal conductivity of the fluid, increasing thickness of metal sections or increasing the number of cycles. In some cases, thermal cycling may also increase the tendency for stem seal leakage.

Over-pressurization

Dynamic Balanced iron plug valves are not provided with a pressure relief device. It is the user's responsibility to provide a relief device as part of the system in which the valve will be used.

Trapped Pressure

When a closed valve containing liquid is heated (e.g., from process condition, radiation or solar heating) the cavity pressure will increase due to volumetric expansion or vaporization of the liquid. Conversely, cooling an undrained cavity below the freezing point may also result in volumetric expansion of the media. These expansions can result in extremely high pressures occurring in the valve.

The purchaser should consider the necessity of providing positive means for prevention of such over-pressurization where these conditions can be anticipated.

Material Compatibility

It is important that valve structural materials and lubricants be chemically compatible with the other piping system components, line fluids and the environment. Guidance should be obtained from informed sources such as NAI or the system engineers whenever there appears to be reason for such concern.

Operating Effort

Manually operated valves are usually designed to require a reasonable amount of physical effort applied to a handwheels or handle to open or close at rated working pressure. However, typical use of a valve may involve a lower working pressure thereby substantially reducing the differential pressure across a valve closure element and a resulting reduced operating effort. Lower operating effort can also be achieved by opening a bypass valve in some cases.

In all cases, the purchaser should determine that the manually operated valves selected will be capable of being operated under the anticipated operating conditions by the personnel required to perform such operation. Oversize handwheels and gear operators will require specific operator training to prevent applying damaging overloads. NAI should be consulted for specific instruction on operating torques.

2 Shipping and Storage

Introduction

Flowserve recognizes the importance of maintaining the as-built condition of valves, and has prepared this section to call attention to important considerations in the handling of valves prior to installation.

Industrial valves as manufactured, tested, and ready for delivery to users, are typically well-designed products that are property fabricated and inspected and capable of giving satisfactory service. Valves enjoy a degree of inherent protection against degradation by impact, impingement or invasion of harmful materials after installation. However, the intervening period between the production test and the installation in line may involve substantial exposure to such degradation that can adversely affect the subsequent service performance of the valves.

Observance of the recommendations and cautions offered herein should provide increased assurance of satisfactory valve performance.

Handling

Appropriate care in handling valves should be complementary to the degree of protection provided in preparation for transport. A basic consideration in handling valves should be to avoid damaging the protection provided for shipment. An obvious general rule is that valves should never to thrown or dropped. Valves whose size requires handling by crane or lift truck should be “slung” or “rigged” carefully to avoid damage to exposed valve parts. Handwheels and stems, in particular, should not be used as lifting or rigging points for large valves.

Storage

The problems to be considered in regard to storage are generally the same as those previously discussed relative to preparation for transport. The time element is important as conditions that would not be seriously harmful for a period of a few days could result in need for costly reconditioning if extended over weeks or months.

Valve end protectors should not be removed unless necessary for inspection and installation.

Protection against weather should be provided. Ideally, valves should be kept indoors with actual valve temperatures always higher than the dew point.

Valves should be supported off the ground and/or pavement and protected by a watertight cover if outdoor storage is unavoidable.

3 Installation

Introduction

A most critical point in time in the life of an industrial valve is the moment of installation. The possibilities for degradation of the valve are numerous. Conversely, the exercise of proper care in this process will assure increased probability of trouble-free valve service.

The valve industry has prepared this Section in order to provide useful information, warnings and reminders, in a format that will be helpful to all concerned. A judicious selection of these pages, delivered to the installation site with the valve itself, will provide the opportunity for the person having the greatest need to know to be informed or reminded of what is most important at the time such information can be the most useful.

Inspection

The testing and inspection required by applicable standards and specifications make it generally reasonable to assume that a new valve, about to be installed in a piping system, has been properly designed and manufactured. Nevertheless, it is important to recognize that in the transport, handling and storage of a valve between the time of manufacture and the time of installation, there are numerous possibilities for accident or error that could adversely affect valve performance.

It is therefore important to determine that the valve is in satisfactory condition before installation. The following points are generally applicable and may be helpful in avoiding subsequent valve problems.

a) Carefully unpack the valve.

b) Make a point of noting any special warning tags or plates attached to or accompanying the valve and take any appropriate action.

c) Check the valve for any marking indicating flow direction. Make sure that the valve is installed in the proper flow orientation when a flow direction is indicated on the valve.

d) Inspect the valve interior to the extent practical through the end ports. Make sure it is reasonably clean, free from foreign matter and harmful corrosion. Remove any special packing materials.

e) If practical, actuate the valve through an open-close-open or close-open-close cycle. Inspect any significant functional features such as guides or seat faces that are made accessible by such actuation.

⚠ **CAUTION:** Avoid contact with the valve closure element during cycling. It is usually desirable to leave the valve closure member in the position in which it was shipped following such inspection.

f) Check the piping to which the valve is to be fastened for proper alignment, cleanliness and freedom from foreign materials immediately prior to valve installation.

Flanged Joint Assembly

Flanged joints depend on compressive deformation of the gasket material between the facing flange surfaces for tight sealing. The bolting must provide the mechanical force necessary to maintain the compressive stresses on the gasket, as well as resist the normal pressure forces tending to separate the joint. It should be recognized that with "brute force" alignment of misaligned flanges, sufficient bolting force may not be available to sustain the required gasket loading and to resist the load caused by the pressure separating force, resulting in a joint leakage problem. The following practices should be observed for satisfactory flange joint make-up.

a) Check the mating flange facings. Do not attempt to assemble the flanges if a condition is found which might cause leakage (e.g., a deep radial groove cut by a retracting cutting tool or a dent across the face caused by mishandling), until the condition is corrected

b) Check the gasket materials. See ASME B16.5 for additional requirements for flange joints using low strength bolting, (e.g., gray iron flanges or Class 150 steel flanges). Metal gaskets (flat, grooved, jacketed, corrugated, or spiral wound), should not be used with these flanges.

Types of Gaskets

There are two basic styles of gaskets used: full-face gaskets and flat ring gaskets. Full-face gaskets cover the face of the flange and the bolting goes through them. Flat ring gaskets extend only to the bolting.

What the Codes and Standards say about flanges and gaskets

ASME B16.1 covers Class 125, 250, and 800 Cast Iron Flanges and Flanged Fittings. Information about these flanges is shown in the Flowserve Nordstrom Iron Plug Valves brochure under Drilling Templates, Flange Dimensions, and Bolting Data.

ASME B16.1, Section 5.2 recommends the use of bolting conforming to ASTM A307 Grade B for installing items that have cast iron flanges. A footnote to this section reads as follows:

For Class 25 and Class 125 flanges note: The carbon steel bolts prescribed for the flanges in this standard are based upon using a flat "ring" gasket that extends to the bolts.

Where cast iron-to-cast iron flanges or cast iron to steel flanges are used with full-face gaskets, higher strength bolts may properly be used.

Where cast iron flanges are bolted to steel flanges and flat ring gaskets are used, carbon steel bolts prescribed in this standard shall be employed.

MSS SP-92 in part, reads as follows:

Section 3.4c Cast iron flanges are less “forgiving” of improper installation than flanges of ductile materials. The use of lower strength bolting is recommended to reduce the possibility of overstressing the flanges by excessive flange bolt preload. Full-face gaskets on flat flanges provide desirable protection against flange breakage by over-torquing of flange bolts. A flat-face flange should not be installed against a raised face flange.

Good preassembly alignment is especially important in cast iron flange joints in order to assure that adequate gasket compression can be achieved without excessive bolting loads.

Section 3.4d Check gasket material. For flange joints using low-strength bolting, such as may be provided for iron flanges (see Section 3.4c above) or Class 150 steel, metal gaskets (flat, grooved, jacketed, corrugated, or spiral wound), should not be used. See ASME B16.5 for additional requirements.

In summary, all of this means that the following is to be considered:

1. Either full-face or flat ring gaskets may be used in conformance with recognized standards.
2. The use of flat ring gaskets requires the use of low-strength ASTM A307 Grade B bolting.
3. The use of full-face gaskets should minimize flange breakage.
4. Cast iron flange breakage is always a possibility if the mating flanges are not properly aligned.

c) Check the gaskets for freedom from injurious defects or damage.

d) Use care to provide good alignment of the flanges being assembled. Use suitable lubricants on the bolt threads. Sequence the bolt tightening to make the initial contact of the flanges and gaskets as flat and parallel as possible. Tighten the bolts gradually and uniformly to avoid the tendency to twist one flange relative to the other. Use of a torque wrench is helpful to ensure correct and uniform final tightening of the flange bolting. Parallel alignment of flanges is especially important when assembling a valve into an existing system. It should be recognized that if the flanges are not parallel, then it would be necessary to bend something to make the flange joint tight. Simply forcing the flanges together with the bolting may bend the pipe or it may bend the valve. This is particularly true in large diameter piping. Such conditions should always be brought to the attention of someone capable of evaluating the bending condition and the corrective measures that need to be taken. The assembly of certain “short pattern” valves between mating flanges requires that the installation be checked for any possibility of interference between the moving parts of the valve and the adjacent pipe, fitting, or valve.

⚠ **CAUTION:** Torque wrenches should always be used to assure proper tightening of the flange bolting. If, in the tightening process, the torque on a given bolt has been increasing with each part turn and then is observed to remain unchanged or increase a much lesser amount with an additional part turn, that bolt is yielding. That bolt should be replaced and discarded since it is no longer capable of maintaining the proper preload.

Testing and Adjustment

It is reasonable to assume that a valve that has been properly inspected and installed will be in good condition and ready to operate. However, the actual operability of a valve can only be proved by test.

A first observation can be made by actuating the valve through an open-close-open or close-open-close cycle. If no obvious problems are observed, an actual test at pressure may then be applied while tightness and operability are checked.

It is common practice after the installation of a piping system to clean the system by blowing through the system with a gas or steam or flushing with a liquid to remove debris and/or internal protective films and coatings. It should be recognized that valve cavities may form a natural trap in a piping system and material not dissolved or carried out by the flushing fluid may settle in such cavities and adversely affect valve operation.

⚠ **CAUTION:** If the system is being cleaned with a cleaning material (gas or liquid) different from the line media, the effect of the cleaning material upon the valve sealant must be evaluated prior to use.

4 Operation and Maintenance

Introduction

An industrial valve, reasonably matched to a particular service application and properly installed in a piping system, can be expected to have a long service life with a minimum of attention. Unlike totally passive components such as pipe fittings, vessels, etc., valves are a special kind of "machinery" having moving and wearing parts. The satisfactory performance of these working parts depends on the long-term preservation of various highly finished surfaces. Therefore, it is important to give adequate attention to the specific requirements for proper operation and reasonable maintenance of all valves throughout their service life.

Operation, Manual Valves

Most valves are actuated manually with rotational movement of a handwheel, wrench, handle, etc. Care is required to assure that such movement is in the correct direction, is not too fast or too slow and is applied through the proper distance. The terminal positions, open and/or closed, have important functional significance.

Plug valves do not rely on stem actuating force to provide tight shutoff. However, the correct position of the closure element in these types of valves is very important. In some cases the effort required to move the closure element might increase substantially during final approach to the closed position, giving a false impression of having reached the required position. Failure to get to and stop at the full closed position can result in leakage and consequent damage to the sealing elements.

Plug valves require correct positioning of the closure element to seal properly. Closing travel should not stop until a positive stop is reached or a position indicator reaches the "closed" position.

Purchase specifications requiring restrictive maximum forces to be applied on levers or handwheel rims may also lead to damaging forces being applied to valves or actuators in actual practice as larger forces are some-times applied in the field. Users should consider this fact in training of operating personnel. Be sure to consult the gearing manufacturers maintenance manual for more detailed information.

Operation, Power Actuated Valves

Functionally, closure performance characteristics and backseating considerations are associated with all valve types regardless of the means of operation. Satisfactory valve performance with power actuation requires appropriate programming of the various requirements and constraints into the actuator controls. Therefore, the actuator should be adjusted to deliver an adequate opening, running and closing force to suit the anticipated service conditions. For position-sensitive valve types, the closing operation should be position controlled by external stops or limit switches. Be sure to consult the actuator manufacturer's operation manual for more detailed information.

Data required for selection and adjustment of power actuators should be delineated clearly in purchase specifications for actuated valves. This data shall include but not necessarily be limited to:

a) Upstream pressure and differential pressure conditions at which both opening and closing shall be required. Specify direction if applicable. Additionally, specify if valve operation is required under high-flow "blow down" conditions.

b) Speed of operation required or the maximum time for opening and/or closing. Also, specify a minimum time if required due to fluid dynamics.

c) Electrical power supply available (AC or DC voltage, phase, frequency) for electrical power actuators or controls. Operating conditions for reduced voltages should also be considered.

d) Pneumatic pressure available for pneumatic actuators (cylinders or diaphragms). Also, specify fail-open, fail-closed, fail-as-is, or any special requirements.

e) Requirements for position indication signals.

Actuator selection and adjustments should normally be made by NAI based on published literature and/or technical advice of actuator manufacturer. NAI should be consulted when a manually operated valve must be retrofitted with a power actuator.

⚠ **CAUTION:** Some valve actuators, when sized to provide specified loading, may have much higher output at maximum switch or control settings and therefore be capable of damaging valves if misadjusted. Valve and actuator manufacturer instructions should be followed closely to prevent overloading valve stems, backseats and other structural parts. Successful operation of power operated valves requires a diligent coordination of the skills and efforts of the valve specifier, NAI and the actuator manufacturer. Most applications are problem-free, but miscommunication can lead to unreliable operation at one extreme and possible valve or actuator damage at the other extreme.

Fluid Dynamics of Shutoff Valve Operation

A flowing fluid in a piping system has mass and velocity. Anything that causes a moving mass to change its velocity will experience a reacting inertia force in proportion to the magnitude of the mass and the rate of the imposed velocity change.

However, in the flow of gases the reacting inertia forces are inherently moderated by the compressibility of the fluid that permits the instantaneous velocity change to be effectively limited to the mass of fluid in the immediate vicinity. This, in addition to the self-cushioning capacity of the fluid column in the upstream pipe, effectively precludes any significant problem of pressure surge in rapidly closed valves in gaseous fluid piping.

In contrast, the inertia of the fluid column in a liquid pipeline is not so easily overcome. Its relative incompressibility provides no such cushion or proximity-limiting mechanism. The entire upstream fluid mass is required to be decelerated at once by the closing valve and the resulting pressure surge may be of sufficient magnitude to cause structural damage.

An additional potential problem can occur downstream from the closing valve. This may be described as fluid column rupture and involves the inertia of the fluid column carrying it away from the closed valve with the proximate space being occupied by a bubble of the fluid vapor or, simply, a substantial vacuum. If there is sufficient backpressure in the line, the fluid column will reverse its velocity and close the void created by the fluid column rupture and causes another pressure surge when it reaches the valve.

It should be recognized that pressure surge intensity is roughly proportional to the length and velocity of the fluid column upstream of the closing valve and inversely proportional to the time taken to close the valve. Fluid column rupture and return surge intensity is proportional to the same condition on the other side of the valve in addition to the back pressure in that section of piping. Therefore, a slow closing is helpful in limiting the magnitude of the pressure surge phenomena.

In large long distance liquid pipelines it is critically important to evaluate pressure surge possibilities and to establish limits on the speed of closure of the flow shutoff valves. In operating such valves or setting the speed of operation of power actuated valves, design limits on speed of closure should be conscientiously observed.

Rapid closure of a valve in any flowing liquid pipeline can cause a substantial pressure surge that may manifest itself in a sharp “bang” or possibly a series of “bangs”. This is frequently referred to as water hammer. This phenomenon can occur in any flowing liquid line and is not limited to waterlines. Rapid closing of a shutoff valve in a flowing liquid line should be avoided especially during the last part of the stem travel.

Noise

There are many different valve-operating conditions that can result in noise. Such noise may be “normal” considering the nature of the fluid and the pressure, temperature and velocity of flow. There may be a “wind” noise in a flowing gas line. There may be clear or hoarse whistling sounds resulting from the shape of the flow passage, including the flow path through a valve. Cavitating conditions in a liquid line can cause a “white noise” that ranges from a whisper to a sound like rocks and gravel to a deafening roar. There may also be mechanical noises as a result of movement of internal parts acted on by the flowing fluid. Some of these noises may be relatively harmless insofar as system integrity and performance are concerned. Mechanical damage in lines with compressible fluid is generally limited to points of sonic or supersonic velocity, or where a vortex resonance with an internal component causes movement and wear or breakage.

Vortex resonance with an internal component may also cause problems in liquid service. In addition, noise may be evidence of cavitation which has the potential for causing mechanical, damage, including massive erosion of the metal walls of a valve or pipe walls and/or other internal components.

A full technical discussion of all of the sound-generating mechanisms is beyond the scope of this document. Nevertheless, it is recommended that an evaluation be made of any condition of remarkable noise in a piping system at least to the point of understanding its cause. If a valve is involved, a determination should be made as to whether the valve is the source or just happens to be the location of the noise. Usually, if the valve is the source, the noise can be “tuned” by slightly “throttling” the valve.

Mechanical or high intensity fluid noise in the vicinity of a valve may be a warning of potentially serious trouble. Expert assistance should be obtained from system engineers or the valve manufacturer to determine the cause and evaluate possible need for action.

Noise emitted from a closed valve is a special case that may indicate seat leakage requiring repair. A whistling sound may indicate sever erosion of seating surfaces while “gurgling” or “popping” sounds may signify less severe leakage.

Maintenance

Valves are properly considered to be a hybrid structure, a combination of a pressure vessel and operating machinery. Maintenance procedures therefore, must reflect the requirements of the occasional opening or closing of the “machinery” and the predominant operating condition of the valve where pressure is continuously applied and nothing is moving. The important performance parameters are pressure boundary integrity, actuating effort required and internal leak tightness. Maintenance should logically address the importance of preserving these performance parameters.

Valves that remain in one position for long periods of time may be hard to operate and/or not function as well as when originally installed. This reduction of operability can result from either a loss of effective lubricants, aging of packing, surface corrosion of moving parts, or an accumulation of deleterious solids. In some applications it may be desirable to schedule periodic partial or full cycle exercising of such valves.

Pressure boundary integrity requires basically sound pressure-containing parts, a pressure-tight static seal at assembly joints and in most cases, an effective working seal between a moving stem and the valve body. Maintenance of pressure boundary parts and the static seal of assembly joints are not usually considered to be a problem. However, continuous monitoring is recommended to confirm that problems do not occur. The need for paint protection against corrosion of exposed piping should be obvious from normal observations of the system.

5 Dynamic Balance Iron Plug Valve Maintenance

Notice

This manual is intended as a maintenance guide for Flowserve Nordstrom Dynamic Balance Iron Valves. Before working on any Nordstrom valve or related product, the reader should review and fully comply with this manual and its warnings as well as the reader's company safety procedures.

If anything in this manual is unclear, contact the Flowserve Nordstrom Valves Customer Service Department for assistance.

Flowserve and its employees are in no way responsible for damage to property or for personal injury or death that may result through the use or misuse of any Flowserve Nordstrom Valves product, publication, audio or visual aid.

Economics of Valve Repair

The instructions listed in this maintenance manual are intended to serve as a basic guide for reconditioning or repairing all Dynamic Balance Plug Iron Valves.

Whether a used valve justifies repair is an individual matter and should be decided by comparing the probable cost of repair with the cost of purchasing a new valve for replacement. Naturally, the cost of repair will depend upon the amount of work involved and the cost of parts, if any are required.

The reclamation of Dynamic Balance iron valves of all sizes and figure numbers is usually worthwhile when the condition of the valve is such as to require only cleaning, inspection, and reassembly with new packing, diaphragms, and gaskets.

In severe cases, the valve body may require boring and fitting an oversize plug. Repairs of this extent are economically justified for a great many sizes and figure numbers of Dynamic Balance valves. Only general indications can be given since repair costs will vary due to differences in labor and overhead rates in various shops.

Before any repair is started, it is suggested that the cost of non-guaranteed repair valve performance be considered. Many times valves repaired by other than the original equipment manufacturer can cost more in faulty performance and short life than is necessary. In order to maintain the high standards of performance expected of Flowserve Nordstrom Valves, we offer the service of valve remanufacturing that provides a three-year warranty at a percentage of new valve cost!

Many Nordstrom valve users find it more economical to have Nordstrom remanufacture their valves than to repair them themselves because of the following features and benefits:

1. Repair work guaranteed under a three-year warranty.
2. Valve is tested to new valve standards.
3. A like-new valve at a percentage of a new valve cost.

Customer Service

If at any time you require assistance from Nordstrom in the maintaining of your Dynamic Balance valve, feel free to call your Customer Service Representative, at the appropriate number listed on the back cover of this manual.

Or write us at:

Flowserve Sulphur Springs Operations
1511 Jefferson Street
Sulphur Springs, Texas 75482
USA

Or FAX us at: (903) 439-3411

Field Service

Our Sales Representatives are the best in the business. They can provide you with technical information about your Dynamic Balance Plug Valve, and are available to visit your facility to conduct general maintenance seminars.

In addition, Nordstrom maintains a highly skilled staff of Service Representatives who provide maintenance assistance over the telephone, or visit your facility to conduct maintenance seminars or to assist you in the maintenance and repair of your Dynamic Balance iron valve.

DVDs

It is often difficult to assemble the appropriate people for training. Nordstrom has produced a series of DVDs that allow training at your convenience. For your Dynamic Balance iron plug valves, we suggest:

- Operation and Maintenance of Nordstrom 400-D Handgun and Hypregun-Plus

To obtain copies of this training video, contact your Flowserve Sales Representative or Customer Service Representative.

When You Call or Write...

Be sure you provide the correct information and/or part numbers for your Dynamic Balance plug valve. Over the years there have been design changes due to our continuing effort make a great valve even better. It is very important that we are provided the information necessary to correctly identify your valve.

The following information, located on the valve Nameplate, is required to ensure the correct information and/or parts are provided for your valve:

1. The valve Size and Figure Number (including any prefixes or suffixes).
2. The Bill of Material Number.

Introduction

The maintenance procedures outlined in this manual are designed to help you reestablish quick and easy operation, drop-tight shutoff, and a long service life of your Dynamic Balance plug valves.

Some procedures listed in this manual can be performed with the valve in-line and under pressure while others require that the valve be removed from line pressure. Those procedures that require the valve to be removed from line pressure will be so noted.

Pressure can become trapped in the valve body cavity even after line pressure has been removed.

Before removing pressure-retaining parts, be sure to:

- Cycle the valve once line pressure has been removed, and
- Stand away from the valve when removing the Gland and Cover.

A number of procedures in this manual may cause flying debris that may cause eye injuries. Safety glasses should be worn at all times while repairing and maintaining Dynamic Balance valves.

The procedures described in this manual are intended only for Dynamic Balance Plug Valves. Do not follow these procedures for any other brand or type of valve.

Basic Construction Principles

So that you may develop a plan of proper maintenance, it is best to understand the basic principles involved in Dynamic Balance iron plug valves.

The lubricated plug valve was invented by Sven Nordstrom in 1914, and basically represented an application of *Pascal's Law of Hydraulics* to the dry plug cock. Mr. Nordstrom created a valve sealant system to prevent taper lock in plug valves and enable the valve closure member to be operated easily. Over the years, as valve services became more severe and as technology improved, several design improvements were made. However, the basic principle of the use of Pascal's Law has not changed and continues to be used in the sealant systems of lubricated plug valves today.

All Nordstrom Lubricated Plug Valves use the same basic principles of design. In the Dynamic Balance Plug Valve, these principles consist of a *body, plug and stem, cover, adjustment member, and sealant*. The function of each of these items is as follows:

1. The **Body** connects the valve to the pipeline. The body also mates with the **Plug** to form a pressure vessel, capable of operation under various pressures and temperatures.
2. The **Plug**, rotated by operation of the **Stem**, has a tapered surface designed to mate with the body taper bore to provide tight shutoff.
3. The **Cover** prevents external leakage and is designed to allow a finite floating of the plug.
4. The **Adjustment Member** is provided so the position of the Plug can be set in the proper relation to the Body.
5. **Sealant** is an integral part of all lubricated plug valves and has three functions:
    - To ensure bubble-tight shutoff on hard-to-hold line media by acting as a secondary seal against seat leakage.
    - Provides a flexible and renewable seat, eliminating the need to force fit or replace sealing parts to obtain a seal.
    - Applies Pascal's Law by providing the hydraulic means necessary to push the plug from its tapered seat in the body.

Sealant System

Flowserve Nordstrom Valve Sealant functions as an integral part of the lubricated plug valve. Sealant is the basic improvement over the dry plug cock. In order for sealant to be effective, the valve requires a system of internal channels - the Nordstrom Sealdport Grooving System.

The Nordstrom Sealdport Grooving System provides complete shutoff of line media regardless of the flow direction of material through the valve. Nordstrom valves can be lubricated with the plug in any position while the valve is subjected to line pressure. With the plug in the closed position, the downstream port is completely surrounded by a film of Sealant between the body and plug seating surfaces. When rotating the plug between the open and closed positions, the grooves exposed to the valve flow passages are disconnected from the sealant system.

By maintaining a periodic sealant injection schedule, the Sealdport grooving system will sustain a pressurized sealant system regardless of whether the valve is in the open, closed or throttled position.

Design Features

To better understand the Dynamic Balance plug valve, listed are the principal design features. Refer to pages 34–37 for illustrations.

1. **Stem** Wrench operated stems have wrench flats which align the wrench handle with the flow passage of the Plug, thus becoming an easily visible position indicator.
2. **Stem Seals** O-rings are used for stem sealing.
3. **Plug Balancing Spring** Designed to preload the plug to prevent vibration and thermal cycling from wedging the plug into the body taper even when the valve is installed upside down.
4. **Bottom Balancing Hole** An integral part of the Dynamic Balance System. The balancing hole maintains pressure equalization between the plug port and the bottom of the plug.
5. **BalanceHole with Ball Check (not shown)** Ensures that pressure above the plug is the same as or greater than in the plug port.
6. **Sealant Injection Fitting** Permits restoration of damaged seats for drop-tight shutoff.
7. **Stem Weather Seal** (Wrench operated only) Specially shaped and constructed to protect the stem-to-body joint from hostile environments that can lead to corrosion.
8. **Tapered Plug** individually matched to each body and lapped to achieve the best possible fit. The sealant grooves in the plug match the sealant grooves in the body to form the Sealdport groove system.
9. **Plug Adjustment Screw** provides a means of properly positioning the plug into the body after valve assembly. A hex-head bolt (or three-bolt cover plate) is provided to reduce the chance of accidental turning of the Plug Adjustment Screw.

Valve Front Identification

This manual will periodically refer to the valve front. For clarification, the front of the valve will have these things in common:

- Sealant Injection Fitting
- Handwheel (gear operated only)

Note: Refer to the Technical Data section for a parts list and exploded view of a "typical" wrench operated Dynamic Balance Plug Valve.

Gearing

Simple or single reduction worm gearing is used on Dynamic Balance iron plug valves.

All gear mechanisms are enclosed in weatherproof housings and packed with gear grease.

A Position Indicator, mounted on the upper end of the gear segment, aligns with the plug port to provide a visible means of plug port positioning in relation to the flow line of the valve.

During operation, all parts of the gearing have free movement.

Sealants

Valve sealant is a viscous material that resists chemical attack and the dissolving characteristics of line media. Sealant performs four specific functions in a lubricated plug valve.

1. **Drop-Tight Seal** To secure an absolutely tight seal, the film of sealant works to form a seal between the body and plug. This seal is formed by sealant transmitted in a system of grooves around each port. With proper selection of sealant for your particular service, this tight seal can be retained over a wide range of temperatures and pressures.
2. **Lubrication** A protective film of sealant prevents metal-to-metal contact of the bearing surfaces of the valve by filming over bearing surface irregularities. The film of sealant permits the plug and body of a plug valve to glide smoothly over each other allowing the valve to operate easily.
3. **Renewable Seat** Sealant is a structural part of the valve that provides a flexible and renewable seat. There is no need to disassemble the valve or remove it from the line to repair the seats. Injection of sealant is all that is required.
4. **Plug-Jacking** The fundamental operating principal of the traditional plug valve design lies in the application of Pascal's Law. Sealant, under pressure developed by the injection of sealant, supplies the hydraulic means for lifting the plug from its tapered seat in the valve body thus allowing the plug to float freely in the body and allow easy operation.

A regularly scheduled sealant injection program will allow your Dynamic Balance plug valves to operate more easily and will extend the service life of your valves. For more information on sealant injection, refer to *Installation, Operation, and General Maintenance Manual for Nordstrom and Dynamic Balance Plug Valves*.

Flowserve Nordstrom Valves supplies many different types of sealant for use in plug valves. When selecting Sealant for your specific services, please refer to the Nordstrom Valve Sealants brochure, or consult your Flowserve Nordstrom Customer Service Representative

VXX Valve Purge

VXX Valve Purge, a non-hazardous formulation, was developed for cleaning valves in-line, returning them to service without disassembly, and eliminating down time. Periodic injection of sealant into a valve flushes debris from the sealant system and allows sealant to flow more freely. See procedures in the Troubleshooting section.

Sealant Injection Equipment

So that Sealant injection can be performed easily, Nordstrom offers five designs of heavy-duty valve sealant injection equipment.

1. 400-D Hydraulic Hand Gun – uses "J" stick sealant and Gun Pak sealant
2. Hypregun-Plus 5Q – uses a five-quart can of sealant
3. Hypregun-Plus 5G – uses a five-gallon pail of sealant
4. 400-A Screw Prime Hand Gun – uses "K" stick sealant and cartridge sealant
5. 400-B five-Gallon Bucket Pump – uses the contents of a five-gallon pail of sealant

For additional information about Nordstrom Sealant Injection Equipment, refer to the appropriate Nordstrom Sealant Injection Equipment brochure.

Valve Maintenance

NOTE: The procedures described in this manual are intended for use on valves that are in-line.

Proper valve performance depends on:

- A periodic program of Sealant injection to maintain adequate sealant pressure in the valve to ensure positive shutoff and smooth operation.
- Selecting the correct Nordstrom Valve Sealant for the valve service conditions. Because of variations in the product temperature, line pressure, and frequency of valve operation, proper sealant selection is essential. An "all purpose" valve sealant or lubricant does not exist. Only the correct Nordstrom Valve Sealant can assure proper valve performance.
- The proper application of the correct sealant. Knowing how to correctly inject sealant will keep your Dynamic Balance plug valve in proper working order without removing it from the line.

Be sure to remember:

1. Sealant injection may be performed with the valve in-line and under pressure.
2. Never attempt to attach or detach the 400-D Hand Gun or Hypregun-Plus while the gun hose is pressurized.

Basic Sealant Injection

NOTE: High pressures are generated during sealant injection. It is recommended that safety glasses and thick leather gloves be worn during sealant injection.

1. Before injecting sealant into the valve, determine if the valve is fully open or closed. While the Dynamic Balance plug valve can be lubricated with the plug in any position, either the full open or full close position allows the Sealdport groove system to completely distribute the pressurized sealant to the valve seating surfaces.
2. Locate the Sealant Injection Fitting on the side of the valve. Remove any debris from the face of the sealant fitting and attach your sealant injection device to the fitting. Be careful not to damage the fitting in any way. A smooth contact surface is necessary to ensure an adequate seal is formed between the button head coupler and the Sealant Fitting.
3. Inject sealant following the operating instructions for the injection equipment that you are using.

4. There are four gauge scenarios that will help you determine valve seat leakage problems. Once you have identified the applicable gauge scenario, you can apply the appropriate maintenance procedures, found in the specific valve maintenance manual, to ensure your valves are operating at their peak.

   - **Gauge Scenario One:** The gauge does not indicate a pressure increase above the initial pressure required to inject sealant into the valve. Assuming your injection equipment is operating correctly, there are two possible problems: a) the sealant system is not full, or b) the seat is leaking. Leakage may be caused by too loose an adjustment or damage to the valve's seating areas.

   - **Gauge Scenario Two:** As sealant is injected, the gauge indicates a gradual increase in pressure until an initial plateau is reached, then at some point the pressure increases to a higher plateau and abruptly falls back to a lower level. This scenario indicates that the valve is receiving sealant properly, the valve sealant system has filled, and the plug has moved off the seat. Even though this scenario shows the plug has moved off the seat, it is still possible that the valve may be difficult to operate. Operation difficulties may be caused by a) too tight an adjustment, b) stem corrosion, or c) gearing problems on gear operated valves.

   - **Gauge Scenario Three:** This scenario is much like Scenario Two except the sealant pressure gauge reaches a plateau and remains at that point as the injection equipment is operated, even after you have injected more than enough sealant to fill the valve. This scenario signals one of two quite different conditions. If the plug is not locked in the body taper, then the plug may be unseated and additional sealant is simply bypassing the plug. This is normal and indicative of a properly maintained and well pressurized valve. However, if the plug is locked in the taper and cannot be operated, this indicates that the plug or valve body may be damaged and sealant is bypassing the sealing surfaces. In Scenario Three it is also possible for the valve to be difficult to operate. The likely causes are the same as with Scenario Two: a) too tight an adjustment, b) stem corrosion, or 3) gearing problems on gear operated valves.

   - **Gauge Scenario Four:** The gauge indicates a continual rise in pressure as sealant is injected, but never indicates a pressure decrease. This scenario indicates three possible problems: a) the valve sealant fitting is faulty, b) the sealant system is blocked, or c) the plug has seized in the body taper.

5. Open and close the valve several times while continuing to inject sealant. If conditions do not allow you to fully open or close the valve, rotate the plug back and forth (approximately 20 degrees) several times.

6. After you have completed the injection of sealant, relieve the pressure within the injection equipment and remove it from the Sealant Fitting.

Valve Maintenance: Troubleshooting

This section lists common problems you may encounter with the Dynamic Balance plug valve, the probable causes, and solutions that should remedy the situations. The listed procedures are intended to serve as guides to remedy conditions you may encounter when performing maintenance on your valve. The procedures, as well as information shown in the Tables of this manual are based on factory valve assembly procedures. Precise estimates of field conditions are not feasible. Judgement and experience must be applied when working on valves in actual field site conditions.

It is highly recommended that sealant be injected into the valve prior to proceeding with valve adjustment or repair. Gauge scenarios, as detailed earlier, will help you focus on specific solutions to remedy your valve problem. Your sealant injection equipment should be operating properly prior to diagnosing valve problems.

⚠ **CAUTION:** If a non-compressible fluid is trapped in the center cavity of the plug, when the valve is in the closed position, injecting sealant at high pressures or high volumes can cause the plug to lock in place. This can also cause the Cover Bolts to yield, thus producing Cover leakage.

Problem: Valve seat leakage

Cause 1: Insufficient sealant in the valve
Solution: The lack of sufficient sealant to adequately fill and pressurize the sealant system is the most common problem associated with seat leakage. Inject the correct amount of sealant into the valve and again check for seat leakage.

Cause 2: Plug adjustment is too loose
Solution: Loose plug adjustment may also be recognized by the valve operating torque being lower than normal. If possible, operate the valve a number of times prior to adjusting the Plug Adjustment Screw and make adjustments using the following procedures:

1. Remove the hex head cap screw or thin metal plate located on the Bottom Cover of the valve to expose the Plug Adjustment Screw. After the valve is assembled at the factory, the Plug Adjusting Screw and valve cover is marked by chisel point to locate the position of factory adjustment. Check the Plug Adjustment Screw for tampering. If the Adjusting Screw has been moved in counter-clockwise direction, you should retighten to the factory adjustment mark.

2. Insert the proper size hex head wrench into the hexagonal shaped hole in the Plug Adjustment Screw.

   Note: During factory assembly, thread-locking compound is applied to the Plug Adjustment Screw. The screw may be initially difficult to turn.

3. Operate the valve back and forth through its 90° operating range, and simultaneously tighten the Plug Adjusting Screw. This action will help disperse previously injected valve sealant. If operating conditions prevent rotating the plug completely through its 90° operating range, you can rotate the plug through a 20° arc to disperse the sealant. Continue to tighten the Adjusting Screw until a noticeable torque increase makes the plug harder to turn. This will indicate you have metal-to-metal contact between the body and plug.

   ⚠ **CAUTION:** Over-adjustment of the Plug Adjusting Screw will lock the plug into the body taper.

4. Loosen the adjustment screw ⅛ turn. If possible, the valve should be in the full open position for final plug adjustment.

5. Inject sealant (see pages 24 & 25.) You should receive a higher pressure reading on the gauge. If you still do not get a pressure increase on the gauge, repeat Steps 3 and 4. If a second attempt at plug adjustment is unsuccessful, it is likely there is a damaged area on the plug or body-seating surface. Refer to Cause 3.

6. Replace the Plug Adjusting Screw cover.

Cause 3: Damaged plug
Solution: A simple way to determine if the plug is damaged is to rotate the plug 180 degrees to place the upstream seat into the downstream position. The following procedure is a temporary solution to the seat leakage problem and the valve should be identified for remanufacture or replacement.

For a Wrench Operated Valve:

a) Loosen the Plug Adjusting Screw ½ turn.

b) With the valve in the full open or full closed position, remove the Retaining Ring and the Stop Collar.

c) Rotate the valve Stem 180 degrees.

d) Replace the Stop Collar and the Retaining Ring.

e) Adjust the Plug as described in Valve Sealant Leakage, Cause 2, Steps 3 through 6.

f) Inject sealant – see pages 24 and 25.

For a Gear Operated Valve:

a) Loosen the Plug Adjusting Screw ½ turn.

b) With the valve in the full open position, remove the Gear Housing Bolting.

c) Turn the Gearing Handwheel clockwise. The Gear Housing will move counterclockwise (be careful not to damage the Gear Housing Gasket while rotating the gearing). Turn the Handwheel until the Gear Housing bolt holes align with the next hole in the Gear Flange.

d) Replace two of the housing bolts to hold the Gearing firm.

e) Turn the Handwheel counterclockwise until the Gear Segment contacts the valve stop.

f) Repeat steps c) and d) until the Gear Housing has been rotated 180 degrees.

g) Replace the Gear Housing bolting.

h) Inject sealant – see pages 24 and 25.

i) Adjust the Plug as described in Valve Seat Leakage; Cause 2 Steps 3 through 6.

Problem: Operation difficulties

Cause 1: Insufficient sealant in the valve
Solution: The lack of sufficient sealant to adequately fill and pressurize the sealant system is the most common problem associated with a valve being hard to operate. Inject the correct amount of sealant into the valve and again check the operating torque of the valve.

Cause 2: Too tight of a plug adjustment
Solution: Loosen the plug adjustment.

1. Loosen the Plug Adjusting Screw ⅛ turn.
2. Inject sealant into the valve.
3. The valve should now be operable.

Cause 3: Minor Stem corrosion (wrench operated valves)
Solution: Lubricate the Stem-to-Gland joint.

1. Remove the Retaining Ring and Stop Collar.
2. Remove the Weatherseal and inspect it for signs of damage. If the Weatherseal is damaged, replace it. Check for corrosion on the stem or internal surface of the gland.
3. If corrosion exists, dam the area around the Stem-to-Gland joint with a heavy grease or Nordstrom stick grade sealant.
4. Introduce penetrating oil into the Stem-to-Gland joint. Allow the penetrating oil to saturate for a minimum of 24 hours. Periodically operate the valve.
5. If the valve becomes operable, clean the Stem-to-Gland joint of excess penetrating oil.
6. If penetrating oil does not free the valve, clean the Stem and inside surface of the Gland as described in Operation Difficulties, Cause 4.
7. Coat the area under the Weatherseal with lithium base grease.
8. Replace the Weatherseal, Stop Collar, and Retaining Ring.

Cause 4: Severe Stem corrosion (wrench operated valves)
Solution: Remove corrosion from the Stem and interior surface of the Gland or Gland Retainer (gear operated valves).

1. Remove the Retaining Ring and Stop Collar.
2. Remove the Weatherseal and inspect it for signs of damage. If the Weatherseal is damaged, replace it. Check for corrosion on the Stem or internal surface of the Gland.
3. If corrosion exists, attempt to lubricate the Stem-to-Gland joint as described in Operation Difficulties, Cause 3. If this does not work, continue with Step 4.

   Remove line pressure from the valve before performing the following procedures.

4. Remove the Gland and Gland Bolts.
5. Remove internal corrosion from the Gland by scraping and/or #120 emery cloth.
6. Remove Stem corrosion by scraping and/or #120 emery cloth.

7. Remove the liquid gasket from the Gland contact area of the Body.
8. Clean debris from the top of the Packing and from the Gland bolt holes.
9. Fill the relief area of the Gland with valve sealant.
10. Apply liquid gasket to the Gland-to-Body mating surface.
11. Replace the Gland.
12. Apply an anti-seize compound to the Gland Cap Screws and install. Use the bolting torque guidelines as referenced in the Technical Data: Procedure for Tightening Cap Screws.
13. Apply lithium base grease to the bottom of the Weatherseal and replace.
14. Replace the Stop Collar and Retaining Ring.

Cause 5: Gearing problems
Solution: Check to see if the valve gearing is causing operational problems.

1. Remove the Indicator.
2. Completely remove the Gearing.
3. Remove the Gear Segment Key.
4. Replace the Gearing less the Segment Key.
5. Rotate the Handwheel to operate the Gearing. If the Gearing is difficult to operate, the problem is in the Gearing. If the gearing is easy to operate, the problem is within the valve.
6. Inspect the Gear Segment and the Worm Gear for excessive wear or damage or lack of lubrication.
7. Rotate the Worm Shaft to determine if the Bearings are binding.
8. Replace any parts as necessary and ensure the Gearing operates properly before reassembling to the valve.

Problem: Blockage of sealant system

Cause 1: Sealant groove blockage
Solution: Some sealant can harden in the valve sealant system if not properly maintained. Hardened sealant can prevent or reduce the flow of sealant injected into a valve. To clear the valve sealant system of hardened sealant, inject VXX Valve Purge.

1. Inject VXX Valve Purge liberally into the valve using sealant injection equipment. If possible, the valve should be operated several times during application.
2. Allow the VXX Valve Purge to remain in the valve for an extended period of time with periodic valve operation.
3. Repeat Steps 1 and 2.
4. Inject an excess amount of the appropriate valve sealant into the valve.
5. If valve operation is improved by this procedure but the valve is still not operating properly, repetition of this procedure may be required.
6. Under conditions of severe sealant deterioration, VXX Valve Purge may not be capable of dislodging sealant residues and valve disassembly and physical cleaning may be required.

Cause 2: Sealant Fitting blockage
Solution: In the event no sealant is being injected into the valve even though the sealant equipment is pressurized, the Sealant Fitting may be blocked and should be replaced.

⚠ **CAUTION:** The following procedures should be performed with extreme caution. Make sure the sealant fitting is pointed away from your body before attempting. Heavy leather gloves should be worn during these procedures.

1. Check for sealant pressure behind the Sealant Fitting by pressing the center button of the fitting with a small punch or screwdriver. If a small amount of fresh sealant is released through the Sealant Fitting center button, the fitting is accepting sealant and operating properly.

   If the center button of the Sealant Fitting cannot be depressed the Sealant Fitting is faulty or clogged with debris and/or hardened sealant and should be cleaned or replaced. Proceed to Step 2.

   If a steady stream of sealant or line fluid is ejected from the Sealant Fitting, the Check Valve is not operating properly and should be flushed or replaced. See Blockage of Sealant System, Cause 3.

   Before replacing a faulty Sealant Fitting, remove the valve from line pressure.

2. First, test for trapped pressure below the Sealant Fitting by carefully unscrewing it while attempting to move the fitting back and forth. If pressure is present, continue to move the fitting back and forth until the pressure is relieved. Do not remove the fitting until all pressure is relieved.
3. Once the fitting is removed, attach the sealant injection equipment to the fitting and inject sealant. If sealant does not flow from the fitting, the fitting is faulty and must be replaced. If sealant can be pumped through the fitting, the problem may be with the Check Valve or valve sealant-grooving system.
4. Replace the Sealant Fitting, if necessary.

Cause 3: Check Valve blockage
Solution: Check Valve blockage may be the result of debris or hardened sealant not allowing the Check Valve ball to move off of its seat. Remove the sealant fitting as described in Cause 2, Step 2. Inject sealant and/or VXX Valve Purge before continuing with this procedure. Flush or replace the Check Valve if the solution to Sealant System Blockage, Cause 1 and 2 are unsuccessful.

Before replacing a faulty Check Valve, the valve must be removed from the line.

1. Remove the Sealant Fitting as described in Cause 2.
2. Using a .188" square tool or an Allen wrench, remove the Check Valve.
3. Once the Check Valve has been removed, clean the removal area of all debris and check for thread damage. Failure to do so may allow contaminates to enter the valve sealant system and damage the sealing surface of the Plug and/or Body.
4. Lubricate the new Check Valve threads with light machine oil.
5. Install a new Check Valve.
6. Replace the Sealant Fitting.
7. Inject sealant into the valve.

Cause 4: Plug seized in the Body taper
Solution: Adjust the Plug.

1. If the plug cannot be unseated by sealant injection, remove the Plug Adjusting Screw cover.
2. Turn the Plug Adjusting Screw counterclockwise 1/8 turn.
3. Inject sealant into the valve and move the Plug Adjusting Screw back and forth, until the Plug lifts off of the Body taper.
4. Once the Plug has lifted off of the body taper, retighten the Plug Adjusting Screw until the valve becomes difficult to operate.
5. Loosen the Plug Adjusting Screw 1/8 turn.
6. Inject sealant into the valve.

Problem: Cover leakage

Cause 1: Damaged Gasket
Solution: Replace the Gasket. It is recommended that the old Gasket be replaced with new parts whenever the Cover is removed from the valve.

The valve must be removed from line pressure before removing the Cover.

1. Be sure there is no pressure trapped in internal cavities of the valve (refer to the Introduction). Operate the valve one complete quarter-turn cycle, and then put the valve in the full open position. If your valve is equipped with a Relief Fitting, loosen the fitting as a final release for pressure, and then tighten it.
2. Remove the hex head cap screw, or thin, bolted plate, located on the bottom Cover of the valve. This exposes the Plug Adjustment Screw, the threads of which have been treated with a thread-locking compound at the Nordstrom factory.
3. Loosen the Plug Adjustment Screw until there is no mechanical load on it.
4. If the valve is installed vertically, support may be required for the Cover so that the internal parts, which are secured by the Cover, will not fall out when the Cover Bolts are removed.
5. Loosen and remove the Cover Bolts. Remove the support piece and carefully remove the Cover, Ball, and Ball Seat.
6. Carefully remove the Gasket and all traces of it from the valve Body.
7. Apply a film of sealant on the entire surface of the large end of the plug.
8. Place the new Gasket onto the Body.
9. Place the Ball on the Plug.
10. Place the Ball Seat and O-rings into the Cover.
11. Place the Cover on the valve.
12. Lubricate the Cover Bolts with a quality thread lubricant.

13. Insert the Cover Bolts, but do not screw the bolts all the way down.
14. Tighten the Cover Bolts, using the appropriate torque values from Table 1 and the procedure for Tightening Cap Screws and Nuts.
15. Remove the Plug Adjusting Screw and apply a thread-locking compound.
16. Insert the Plug Adjustment Screw into the Cover until the screw is “even” with the inside of the Cover.
17. Adjust the Plug as follows:
    - Tighten the Plug Adjustment Screw to a “snug” condition.
    - Loosen the Plug Adjustment Screw 1/16" to 1/8" of radial movement.
18. Inject sealant.

Cause 2: Non-compressible fluid trapped in port of plug while in the closed position.
Solution: Allow pressure to self-relieve over a period of time. If Cover leakage continues, follow procedures as described in Cause 3.

Cause 3: Loose bolting.
Solution: Tighten the cover bolting to the torque and order as listed in the section Tightening Cap Screws and Nuts.

1. Loosen the Plug Adjustment Screw approximately ½ turn.
2. Tighten the Cover cap screws to the torque shown in Table I, Torque Values for Pressure Retaining Bolting.
3. Tighten the Plug Adjustment Screw until the Plug is tight in the Body, and then loosen the Adjustment Screw approximately ¼ turn. The valve should be in the full open position if possible.
4. Inject Sealant.
5. If leakage continues, then it is probable that the Cover Gasket or O-rings on the Ball Seat have been damaged. These can be replaced only when the valve is out of service. Procedures for replacing the Gasket and O-rings are described in Cover Leakage Cause 1.

Problem: Leakage at the Stem

Cause 1: Line pressure is bypassing Stem O-rings.
Solution: Replace Stem O-rings.

Line pressure must be removed from valve before changing Stem O-rings.

1. Make sure there is no internal pressure trapped inside the valve. Operate the valve one complete quarter-turn cycle, and then place the valve in the full open position.
2. For wrench operated valves – Remove the Retaining Ring and Stop Collar.
3. For gear operated valves – Remove the Position Indicator and Gearing. Remove the Gear Segment and Segment Key from the Stem.
4. For wrench operated valves – Remove the Gland Bolts and the Gland with Weatherseal.
5. For gear operated valves – Remove the Gland Bolts and the Gland.
6. Remove the existing O-rings and thoroughly clean the Gland.
7. Install the new Stem O-rings.
8. Prepare the Gland for installation.
    a) For wrench operated valves – Examine the Stem Weatherseal and replace it if necessary.
    b) For wrench and gear operated valves – Apply sealant to the inside diameter of the Gland.
9. Install the Gland.

    Apply a thin film of good quality gasket compound to the mating surface of the Body or Gland and install the Gland. On wrench operated valves the stop lug is to the left when facing the front of the valve.
10. Lubricate the Gland Bolts with a good quality thread lubricant and install.
11. Tighten the Gland Bolts as described in the section Tightening Cap Screws and Nuts.
12. Install the Stop Collar (remember to position it so the valve will turn clockwise to close and counterclockwise to open) and the Retaining Ring.
13. Inject sealant.

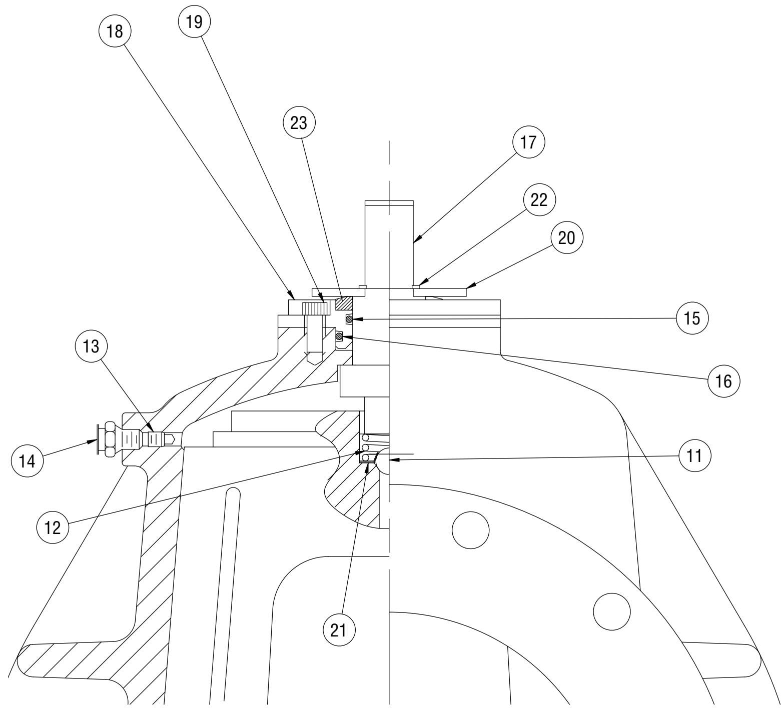
Problem: Sealant Fitting leakage

Cause: Line pressure bypassing Check Valve.
Solution: Leakage at the Sealant Fitting indicates there is leakage around or through the Check Valve (located behind the Sealant Fitting). Follow the Steps as listed in Cause 3 of Sealant System Blockage.

Problem: Check Valve leakage

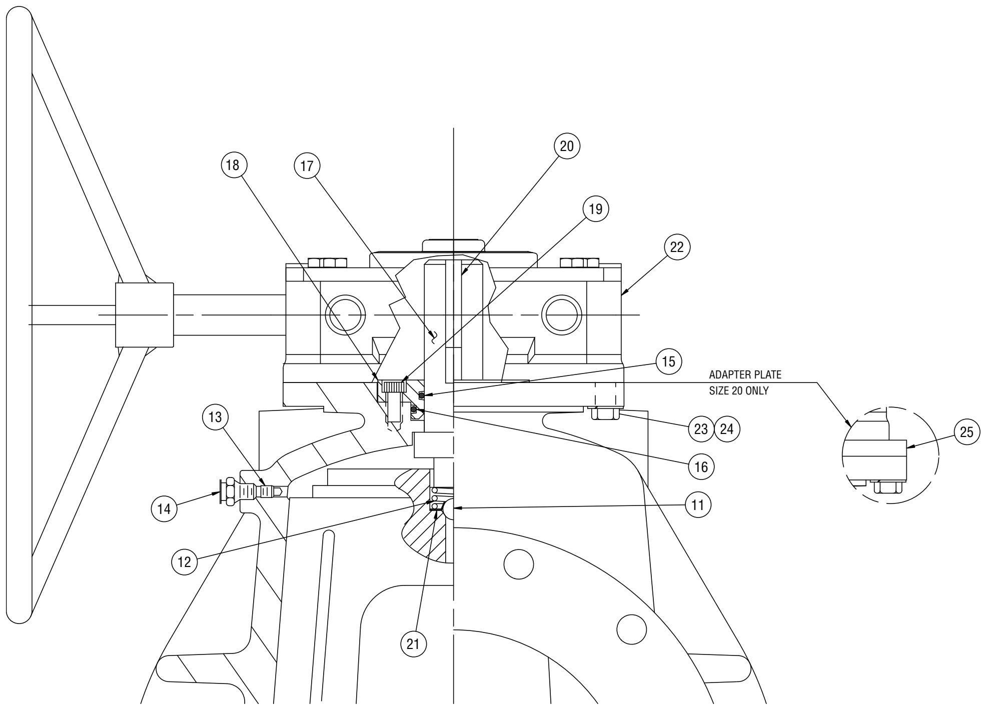
Cause 1: The Check Valve ball is not seating properly.
Solution: Clean or replace the Check Valve. Follow the Steps as listed in Cause 3 of Sealant System Blockage.

Detail Sketch: Stem End Detail – Wrench Operated Valve



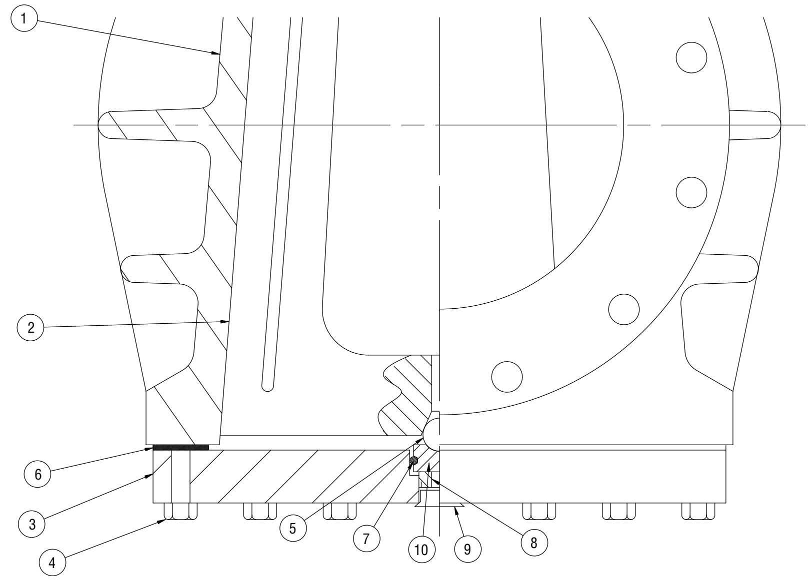
No.	Item Description
11	Balance Ball
12	Spring
13	Check Valve
14	Sealant Fitting
15	O-Ring
16	O-Ring
17	Plug Stem
18	Gland
19	Cap Screw
20	Stop Collar
21	Ball Retaining Washer
22	Retainer
23	Weather Seal

Detail Sketch: Stem End Detail – Gear Operated Valve



No.	Item Description
11	Balance Ball
12	Spring
13	Check Valve
14	Sealant Fitting
15	O-Ring
16	O-Ring
17	Plug Stem
18	O-Ring Gland
19	Cap Screw
20	Key
21	Ball Retaining Washer
22	Gearing
23	Lock Washer
24	Cap Screw
25	Adapter Plate (size 20 only)

Detail Sketch: Cover End Detail – Ball Seat Arrangement



No.	Item Description
1	Body
2	Plug
3	Cover
4	Cover Cap Screw
5	Thrust Ball
6	Ring Gasket
7	O-Ring
8	Adjusting Screw
9	Adjusting Screw Cap
10	Ball Seat

Technical Data: Procedure for Tightening Cap Screws

Note: This procedure is intended only as a guide. It is impossible for Flowserve Sulphur Springs Operations to know actual field-site conditions, so your judgement and experience must be exercised.

1. Inspect applicable parts to be sure that:
   a) Tapped holes are clean, dry, and free of foreign matter.
   b) Threads are free of nicks, grit, and burrs.
2. Apply a quality thread lubricant on the threads of the Cap Screws/Nuts, or the tapped holes, and the contact face of the Cap Screws/Nuts.
3. Install all Cap Screws/Nuts by hand. Engage the threads at least ½ of the diameter before using a wrench.
4. Hand-tighten the first four Cap Screws/Nuts in the sequence shown in Diagram 1. This is to avoid cocking the parts.
5. Tighten the Cap Screws in a crisscross pattern. Tighten them first to the 10% torque value, then in a crisscross pattern to the 75% torque value.
6. Repeat Step 5, tightening the Cap Screws to the full torque value as shown in the table below.
7. Recheck the torque on all Cap Screws. If the torque is less than the minimum shown, tighten them to the full torque.

Valve Size	Intermediate		Final	
	10%	75%	Min.	Max.
4	14	104	127	150
6	22	167	205	240
8	34	257	315	370
10	22	167	205	340
12	34	257	315	370
14	34	257	315	370
16	54	407	500	585
18	70	521	640	750
20	70	521	640	750

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