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MSS Valve User Guide

Standard Practice
Developed and Approved by the
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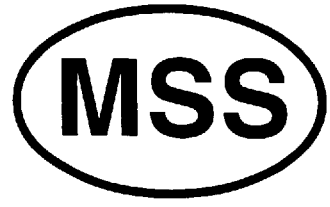

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FOREWORD

When a complex product is used for a variety of applications and in various operating environments, it is reasonable to expect that the performance of such a product will reflect upon it suitability for the specific service as well as its proper installation and maintenance. Recognizing that operating problems involving industrial valves frequently involve the use of valves not properly selected for the intended service, or adversely affected by improper handling, installation, operation, or maintenance, the manufacturers Standardization Society has prepared this Valve User Guide.

The Society or its members, jointly or severally, make no guarantee and assume no liability or responsibility regarding the contents of this document. It has not been possible to include every consideration related to the satisfactory use of valves, and, especially in abnormal or unusual circumstances, the possible need for other considerations and precautions should be recognized.

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VALVE USER GUIDE

1. SCOPE

This Guide presents information which should be helpful to users desiring to avoid the most obvious causes of problems with valves. The material is divided into four sections, "Selection", "Shipping and Storage", "Installation", and "Operation and Maintenance"

2. REFERENCES

The standards and specifications listed in Annex A of this MSS SP are included as useful source documents to help the user understand the various valve types and their operational limitations. This is particularly important when selecting equipment for a specific pressure/temperature/fluid application.

3. SELECTION

3.1 General

3.1.1 It is beyond the scope of this standard practice to make recommendations for specific applications because misapplication of a valve type could result in operating problems which adversely affect system safety and efficiency. However, observance of the considerations, recommendations and cautions offered herein will provide increased assurance of satisfactory valve performance.

3.1.2 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.

3.2 Pressure-Temperature Rating

3.2.1 The pressure-temperature rating of the valve must be properly selected for the service requirement. If the service involves a temperature above 100 °F (38°C), the valve pressure rating at the service temperature must be verified as meeting the requirements of the application.

3.2.2 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.

3.3 Bending Strength

3.3.1 Piping systems are subject to mechanical constraints at fixed support points such as rigid nozzles, anchors, etc. Cold springing at assembly, 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.

3.3.2 Valves are also subjected to the bending moment occurring in the adjacent pipe which is in addition to the normal pressure loadings. 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.

3.3.3 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

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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) Cast iron valves installed in steel piping.

c) Any "standard" valve installed in heavy wall "overweight" piping where the extra thickness may cause the pipe to be stiffer and stronger than the valve.

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

3.4 Fire Safety

3.4.1 The terms "Fire Safe" or "Fire Tested" are not definitive and should not be used without an accompanying specification of what is required. Such a specification may be provided in the form of a requirement for a defined test or for limitations on the valve failure mode. Examples of such limitations are:

a) Destruction of elastomeric or polymeric materials in the valve shall not result in gross valve pressure boundary leakage.

b) Destruction of elastomeric or polymeric materials in the valve shall not result in leakage greater than a specified rate when the valve is closed.

c) External heating of the valve shall not cause uncontrolled buildup of pressure in the body cavity of a double seated valve.

3.4.2 Requirements related to after-fire operability and seat tightness are difficult to define other than by actual testing using standardized procedures. Valve post-fire operability simulation "Fire Testing" is covered by such standards as API 589, "Fire Test for Evaluation o. Valve Stem Packing" and API 607, "Fire Test for Soft-Seated Quarter-Turn Valves".

3.5 Pressure Surge

3.5.1 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 a upstream column produces a pressure surge at the valve whose magnitude 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.

3.5.2 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, then opening the valve will cause 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 "shut-off" valve operation and the necessity for their being in proper working order.

3.5.3 The flowing media should be considered as being "stopped" instantaneously in the

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case of a check valve closure on a flow reversal. Consequently, the pressure surge may be very high depending on the velocity of the reverse flow at the instant of closure and the length of the fluid column. Applications of check valves in liquid lines should always be evaluated for possible pressure surge (water hammer) problems.

3.6 Check Valve Application

3.6.1 Check valves are actuated by the flow or pressure of the line fluid. Problems involving excessive wear of internal parts or noisy operation can result from the use of check valves which are not fully opened by the normally sustained flow.

3.6.2 A check valve should not be used as a primary "shut-off" valve for any application, including energy source isolation. Check valves should be applied as containment devices to prevent gross backflow. For example, to restrict backflow into equipment such as boilers and pumps operating off a common header.

3.6.3 Piston and ball check valves that are designed with close diametrical clearances between the moving parts are sensitive to a "sticking operation" when used in a service where internal rust or other solids may develop. It is recommended that check valves selected for use in this type service be tolerant of a rust buildup in the valve.

3.6.4 Applications involving gas or steam flow may be complicated by an energy transfer phenomenon which can cause valve cycling even under steady flow conditions. Such cycling may cause rapid wear and premature valve failure or malfunction. Valve closure element cycling may also be a problem when the flow is cycling as it would be at the discharge of a reciprocating pump.

3.6.5 The preferred sizing of a check valve is such that at normal sustained flow, the valve closure element will be held against its stop in the full open position. Applications in gas or steam lines, or in liquid lines with low or unsteady flow, should be described fully in the purchase specification so that the manufacturer can evaluate the suitability of the valve design as some check valves require a minimum flow rate for stable operation.

3.6.6 Check valves should not be located close to upstream flow disturbances such as control valves, elbows and tees. Turbulence in the flowing fluid entering the valve may cause disc motion and excessive wear. It is recommended that check valves be located at least five pipe diameters downstream from elbows and ten diameters downstream from tees and control valves; even greater distance is recommended in the case of control valves that operate with high pressure drop or severe cavitation.

3.6.7 Check valves are normally seated by forces due to reversed pressure and may not seal "through leakage" as tightly as some other valve types. Also, some check valves may not seat and seal tightly with very low reversed pressures. Use of a stop check valve instead of a simple check valve should be considered if sealing tightness is essential. The use of another type of valve (shut-off valve) in series with the check valve may be considered.

3.7 Throttling Service

3.7.1 Valves used to control the rate of fluid flow may be subject to severe fluid turbulence which 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 by cavitation of liquids or by shock waves from gases. (The noise in a water faucet is an example of a low level cavitation noise.)

3.7.2 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.

3.7.3 The valve manufacturer should be

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consulted on proper valve selection for throttling applications.

3.8 Temperature Changes

3.8.1 Valve structural materials expand with rising temperatures and contract with falling temperatures. Generally, increasing temperature causes a decrease of mechanical strength which 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.

3.8.2 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.

3.8.3 Practical problems can result from failure to anticipate temperature effects. An important example is a solid wedge gate valve in steam service that is normally open to flowing steam and then closed in the hot condition. The body-bonnet will contract more in cooling down from the initial hot condition than the stem from its initial "partly cool" condition. The result is a relative shortening of the body-bonnet height and/or the relative lengthening of the stem-wedge height with a resulting "jamming" of the wedge into the seats. The valve may then be found to be "stuck" in the closed position when an attempt is made to open the valve.

3.9 Trapped Pressure

3.9.1 When a closed double seated 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.

3.9.2 In addition to the risk of pressure boundary leakage or failure, high center cavity pressure in some double seated valves may cause very high opening force requirements (pressure locking). This should be considered if reliability of valve opening is essential.

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

3.10 Material Compatibility

3.10.1 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 the valve manufacturers or the system engineers whenever there appears to be reason for such concern.

3.11 Operating Effort

3.11.1 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.

3.11.2 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 damag-

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ing overloads. Refer to paragraph 6.11. The valve manufacturer should be consulted for specific instruction on operating torques.

4. SHIPPING AND STORAGE

4.1 Introduction

4.1.1 Industrial valves; as manufactured, tested, and ready for delivery to users, are typically well designed products that are properly fabricated and inspected and capable of giving satisfactory service. Valves enjoy a degree of inherent protection against degradation by either impact, impigement 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 degration which can adversely affect the subsequent service performance of the valves.

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

4.2 Preparation for Transport

4.2.1 Consideration should be given to the need for protection against mechanical damage and harmful exposure to dirt or other deleterious material. In most cases, the critical points of exposure are the valve end ports and exposed surfaces of the stem. The following checklist may be helpful in avoiding or minimizing problems:

a) Is the valve dry or internally protected against rusting or galvanic corrosion?

b) Are the valve ends protected against mechanical damage to either the threads, flange faces, weld end preps, etc.?

c) Is the valve in the best set position for handling? Globe, diaphragm, and gate type valves are usually shipped closed to prevent rattling. Ball, plug and through conduit type valves are usually open to minimize exposure of the functional surfaces. Butterfly valves are usually shipped closed or in a slightly open position. Check valves can be shipped in either the "blocked open" or the "blocked closed" position.

4.3 Handling

4.3.1 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.

4.4 Storage

4.4.1 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 re-conditioning if extended over weeks or months.

4.4.2 Certain valve components may have a recommended shelf life which should be stated by the manufacturer and the purchaser should take appropriate action.

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

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

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

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5. INSTALLATION

5.1 Introduction

5.1.1 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.

5.1.2 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.

5.2 Inspection

5.2.1 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 which could adversely affect valve performance.

5.2.2 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 and check tags or identification plates, etc. against the bill of material, specifications, schematics, etc.

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 indicatin flow direction. Make sure that the valve is in stalled 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 such as blocks used to prevent disc movement during shipping and handling.

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 an freedom from foreign materials immediatel prior to valve installation.

5.3 Threaded Valve – Pipe Assembly

5.3.1 Threaded pipe joints depend on a good fit between the external and internal pipe threads for tight sealing. Usually, a compatible soft or viscous material is used between the assembled threads to assist in ensuring a leak-free seal. The following installation practices are recommended:

a) Check the threads on both the valve and the mating pipe for correct thread form and cleanliness. Be alert for any indication of an impact that might have deformed the thread either out-of-round or by a local indentation. Be sure no chips or grit are present.

b) Note the internal length of the threads in the valve ends and the proximity of the valve internal seat to make sure the pipe end will not hi the seat when assembled. If there appears to b a possibility of a problem, carefully check the pipe end thread to make sure there is no extended straight portion beyond the standard tapered section.

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c) Apply an appropriate thread tape or thread compound to the external pipe threads except when dry seal threading is specified. Avoid getting the thread tape or thread compound into the internal flow area.

d) Use care to align the threads at the point of assembly. Tapered pipe threads are inherently a loose fit at entry. Substantial wrenching force should not be applied until it is apparent that the threads are properly engaged.

e) Assemble the joint wrench-tight. The wrench on the valve should be on the valve end into which the pipe is being threaded. *Caution:* Because there is no clear limit on the torque that may be developed in a tapered thread joint, it is possible to damage the valves or piping by applying excessive twisting forces through the body of the valve.

f) Repeat the process at the second valve end. Again, apply the wrench at end of the valve to which the pipe is being assembled.

5.4 Flanged Joint Assembly

5.4.1 Flanged joints depend on compressive deformation of the gasket material between the facing flange surfaces for tight sealing. 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, must be provided by the bolting. 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 bolting for proper size, length, and material. A carbon steel bolt on a high temperature flange joint can result in early joint failure.

High strength material is always required for flange bolting on steel flanges Class 400 or higher. Such bolting is usually stamped "B-7" on the end but other grades may be used in some cases. The proper matching of flanges, bolting and gaskets is important. Specific requirements of ASME B16.5 should be satisfied.

Low strength bolting may be used for lower pressure flanges, Classes 150 and 300 for operating temperatures not exceeding 400 °F (204 °C), when using approved gaset materials. See ASME B16.5 for gasket specification.

c) Gray iron flanges are less "forgiving" of improper installation than flanges of ductile materials. The use of lower strength steel bolting is recommended for gray iron flanges to reduce the possibility of overstressing the flanges by excessive bolt preload. Full face gaskets on flat flanges provide desirable protection against flange breakage by overtorquing of the flange bolts. A flat face flange should not be installed against a raised face flange.

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

d) 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.

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

f) Use care to provide good alignment of the flanges being assembled. Use suitable lubri-

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cants 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 will 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 "wafer type" or "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.

g) *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 scrapped since it is no longer capable of maintaining the proper preload.

5.5 Weld Joint Assembly

5.5.1 Welded joints that are properly made provide a structural and metallurgical continuity between the pipe and the valve body. It is important that the joint should not constitute a "notch" or "weak link" in the pipe-valve-pipe assembly. Therefore, the weld fillet for socket weld joints must always have more cross sectional area than the pipe.

5.5.2 Butt welds joints require full penetration welds and a weld thickness at least equal to that of the pipe. Welding a pipe of a high strength alloy to a valve with body material of lower mechanical strength requires that the weld taper to a compensating greater thickness at the valve end. An alternative would be to have a matching high strength "weld-on extension" or "pup" welded to the valve prior to welding in the line.

5.5.3 Sound welds are obviously important. *Caution:* this guide is *not* a complete welding instruction. All welding should be in accordance with any Code or jurisdictional regulations applicable to the construction of the piping system. The welds must be made following approved welding procedures and be inspected as required by all applicable specifications. The following points are intended to be helpful as point-of-use reminders of important requirements of good welding practice:

a) Consult the manufacturer for the correct installation procedure of a metal seated valve prior to preheating, welding and post weld heat treatment of a butt weld or socket weld valve. To avoid the possibility of arcing between the yoke bushing, stem, disc and/or seats, always attach the ground directly to the body.

b) Consult the manufacturer for the correct installation procedure before welding a soft seated valve into a line. As a minimum, a soft seated ball or plug valve should be in the full open position prior to welding to prevent seat damage and/or weld splatter from adhering to the ball or plug. A means for venting the ball cavity is recommended to relieve any fluid pressure that might develope due to thermal effects.

c) Check materials marking on the pipe and valve to confirm that they are as specified.

d) Inspect the welding end surfaces for dimensions and cleanliness. Correct any condition that might interfere with assembly and satisfactory welding.

e) Check all backing rings that may be used to confirm that the ring material is compatible with the pipe and valve materials and that the individual rings fit and are clean.

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f) Determine that all required welding parameters, including preheating and post weld heat treating, are in accordance with the approved welding procedure.

g) Inspect the "valve to pipe end" alignment and adjust as required.

h) Securely tack weld the mating parts when required if part of the approved procedure.

i) Complete the weld using the approved welding procedure.

j) Clean and inspect the finished weld.

k) Repair any defects using an approved weld repair procedure when necessary.

5.6 Testing and Adjustment

5.6.1 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.

5.6.2 A valve having adjustable stem packing should be checked to determine that the packing has been properly installed and the gland bolting has the correct initial adjustment before testing the system. A first observation can be made by actuating the valve through an open-close-open or close-open-close cycle. Packing gland bolt tightness should be checked and bolts should be retightened if necessary. If no obvious problems are observed, an actual test at pressure may then be made while the stem packing tightness and operability of the valve is checked. Gland bolts should be retightened if packing leakage is observed.

5.6.3 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. Also, abrasive material carried by a high velocity fluid stream may cause serious damage to seating surfaces.

6. OPERATION AND MAINTENANCE

6.1 Introduction

6.1.1 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.

6.2 Operation, Manual Valves

6.2.1 Most valves are actuated manually by causing some linear or 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. This is particulatly true in the closed position where the internal closure element (disc, plug, sphere, etc.) must be correctly positioned in relation to the seat to assure a positive seal.

6.2.2 Valves in which the closure element moves to and from the seat, such as in globe, angle, diaphragm and wedge gate valves, depend to some degree on the mechanical force of the stem holding the closure element against the seat to make and maintain a tight shut-off. This is most important if the line pressure to be shut off acts on the closure element in a direction so as to push it off the seat. When

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globe type valves are installed so that the line pressure then acts in the *same* direction as the stem force and also in wedge gate type valves, the line pressure then acts to increase the seating load making valve stem loading less critical. However, substantial stem force will still be required at low line pressures. The stem force may even be more important at low line pressures than at high line pressures.

6.2.3 Globe type valves (straight, angle or Y-pattern) and stop check valves with pressure under the disc, require sufficient stem loading to balance the line pressure and provide adequate net seat load. The higher the line pressure, the higher the required stem loading to achieve a leak tight seal. Follow the manufacturer's recommendations on torque or handwheel rim force for seating of manually operated valves as well as impacting of impactor-type handles or handwheels. *Caution:* The use of valve wrenches on handwheels may lead to valve damage or injury to operators. See Section 6.3 for information relative to valves with power actuators.

6.2.4 Most valves in which the internal closure element slides across the seat as in ball, plug, non-wedging gates, butterfly etc., do not rely on stem actuating force to provide tight shut-off. 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 may 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.

6.2.5 Ball, plug, butterfly, and non-wedging gate 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 mark. Caution: Some non-wedging gate valves require the closure element to be backed off slightly from the positive stop position to allow the closure element freedom to move.

6.2.6 Thermal expansion and contraction can cause solid wedge gate valves to "lock up" if closed while hot. As the relative cooler stem heats up to body temperature, and/or the body cools down toward the stem temperature, the stem expansion and/or body contraction will cause stem thrust to increase. If the thrust increases sufficiently, the wedge may be "locked" between the tapered seats.

6.2.7 Certain valve stems are provided with a backseat arrangement, that is a shoulder on the stem or on another part of the stem-disc assembly, that engages a corresponding seat shoulder on the inner side of the bonnet.

6.2.8 It has become generally recognized that the use of the stem backseat for stem sealing may mask an unsatisfactory condition of the stem packing. For this reason, the use of the backseat for normal operational stem sealing is not recommended. It is recommended that the valve be opened against the backseat as a means of determining that the full open position has been reached and the stem should then be backed off slightly from the backseat.

6.2.9 If circumstances necessitate use of the backseat for stem sealing to permit system operation until a shutdown will allow replacement of the stem packing, it should be recognized that backseats are usually much smaller than "mainseats" and care should be exercised to avoid applying excessive stem force in backseating. Impactors, gears, or similar features provided to assist in mainseating valves should not be used for backseating.

6.2.10 *Caution:* Some users consider that backseats are provided for the purpose of repacking valves which are under pressure. When the packing is removed in this situation, any leakage past the backseat escapes directly to the atmosphere and constitutes a potential safety hazard to personnel. The practice of repacking under pressure is not recommended. Further, if a valve is operated in the backseated position for any reason, exercise caution when moving the stem away from the backseat as the packing may have deteriorated while iso-

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lated from the line fluid and then leak when exposed to pressure.

6.2.11 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 sometimes applied in the field. Users should consider this fact in training of operating personnel.

6.3 Operation, Power Actuated Valves

6.3.1 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 and the valve type. For the position-sensitive valve types, the close control should be position controlled by external stops or limit switches.

6.3.2 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 "blowdown" 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 (see Section 6.4).

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.

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

6.3.4 Backseating valves should be adjusted to stop slightly below the backseated position.

6.3.5 *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 manufacturers 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, the valve manufacturer 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.

6.4 Fluid Dynamics of Shut-off Valve Operation

6.4.1 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.

6.4.2 However, in the flow of gases the reacting inertia forces are inherently moderated by

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the compressibility of the fluid which 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.

6.4.3 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.

6.4.4 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 back pressure in the line, the fluid column will reverse its velocity and close the void created by the fluid column rupture and cause another pressure surge when it reaches the valve.

6.4.5 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.

6.4.6 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 shut-off 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.

6.4.7 Rapid closure of a valve in any flowing liquid pipeline can cause a substantial pressure surge which 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 water lines. Rapid closing of a shut-off valve in a flowing liquid line should be avoided especially during the last part of the stem travel.

6.5 Check Valves

6.5.1 Check valves are one-way valves that function to automatically stop a flow reversal in a flowing line. Therefore, in most applications, the fastest possible closure is desirable. The speed of closure is understood in terms of the shortest possible time to achieve closure following the instant of flow reversal. It follows then, that the shorter that time interval can be made, the lower the velocity of the reverse flowing liquid will be.

6.5.2 The pressure surge resulting from a check valve closure is likely to be *more* severe than that in the case of the shut-off valve as the shut-off valve will usually provide a throttling action, while the check valve closure may be virtually instantaneous with little preliminary throttling.

6.5.3 A check valve closure can also cause downstream fluid column rupture just as in the case of shut-off valves. Furthermore, on fluid column reassembly, the pressure surge may be of sufficient magnitude to reopen the check valve, starting another sequence of closure, surge, etc. Under certain conditions a protracted succession of closure "hammers" may result.

6.5.4 The kinetic energy in flowing fluids presents special problems regarding check valve performance. Quick closing is normally desirable, but special features may be required for certain situations. Careful systems analysis may be required in complex applications.

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6.5.5 While a rapid closure of a check valve is normally the best method of minimizing pressure surges due to flow reversal, some applications produce flow reversals that are too rapid to prevent excessive reverse velocity before the closure of a standard check valve could occur. Such applications may require consideration of special valve features such as:

a) A spring or method of other loading to provide more rapid closing,

b) A dashpot or snubber to provide a slower more controlled closure to reduce reverse flow velocity by a throttling action as in a shut-off valve.

6.6 Quarter Turn Valves

6.6.1 A strong opening or closing torque may be produced in some valves actuated by rotation of a stem through a fraction of a turn due to the distribution of fluid pressure on the closure element. Such a valve may suddenly *open* or *close* itself if not forcefully restrained. As previously noted, a rapid closure action can produce a high pressure surge or "hammer" that is potentially capable of causing structural damage.

6.6.2 An additional point of concern is the possible injury to personnel operating the valve. The person may grasp an operating handle and start to move it only to have it suddenly slam to the open or closed position. This can result in a personal injury depending on how the person is positioned and how the handle is grasped. Care should always be exercised in operating a quarter turn valve that is not equipped with self-locking gearing or other substantial stem restraints. Serious consideration should be given to the possibility that the operating handle may suddenly slam to the open or closed position.

6.7 Noise

6.7.1 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 "things" 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.

6.7.2 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.

6.7.3 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.

6.7.4 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.

6.7.5 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

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"gurgling" or "popping" sounds may signify less severe leakage.

6.8 Maintenance

6.8.1 Valves are properly considered to be a hybrid structure, a combination of a pressure vessel and operating mechinery. 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.

6.8.2 Valves which 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 in the stem threads, 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.

6.8.3 Check valves require special consideration because they normally have no external stems, actuators, or packings that might indicate a pending operational problem. Complete internal failure may occur due to wear with no obvious advance warning. Preventive maintenance is recommended particularly where sudden check valve failure may require expensive plant or system shutdown.

6.8.4 Noise or vibration emitted at or near a closed check valve may be an indicator of leakage (see Section 6.7). Distinctive noises may also be produced from internal motion of the parts of check valves that are not fully open during forward flowing conditions. "Thumping" or "tapping" may indicate that the disc is impacting either on the seat or the full-open stop, or simply "rattling" in its guides. These types of conditions can lead to rapid wear and failure of the valve. Special non-intrusive diagnostics systems can be used to augment the evaluation of the noise. Periodic disassembly and internal inspection of selected valves may be advisable, particularly where they are located close to upstream flow disturbances (see Section 3.6).

6.8.5 Stem seals may be a source of problems, particularly in valves that are frequently cycled or must operate at high pressures or temperatures. The stem seal must prevent or minimize leakage of line fluid between a movable stem and a stationary bonnet. While special mechanical arrangements, elastomers, or proprietary seals are used in some cases, the normal arrangement includes a cylindrical chamber in the bonnet surrounding the stem, with compression packing material retained in the chamber by a gland and associated bolting.

6.8.6 Conventional compression packing requires that the gland bolting provide sufficient load to eliminate any communicating porosity in the packing material and to compress it into intimate contact with the stem and bonnet. Clearances between the associated parts must be close enough to contain the packing material and minimize extrusion. Maintenance practices that increase clearances (e.g. machining of glands and/or bonnets to remove corrosion) may result in packing extrusion and leakage or "blowout".

6.8.7 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 bonnet. Maintenance of pressure boundary parts and the static seal of assembly joints is 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.

6.8.8 Wear and loss of packing material are normal expectations in frequently cycled valves. However, current packing materials

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and systems will minimize this deterioration, particularly in new and well-maintained valves. Packing gland adjustment may be necessary from time to time but routine "repacking" should not be required in most valves that are otherwise well maintained. Packing replacement can usually be deferred until a time when other valve maintenance is required as long as the packing gland shows adequate room for further adjustment. See Section 6, Paragraph 6.2.10 regarding the hazards to personnel involved in repacking a backseated valve under pressure. This practice is not recommended.

6.8.9 Valve manufacturers and packing manufacturers should be consulted regarding the best design features and compression packing materials available to solve chronic packing problems. Ongoing developments in valve design and packing technology may offer improvements that can be implemented by retrofitting a valve with improved designs, materials and installation procedures. For example, spacers may be used in deep packing chambers common in old valves that were designed for use with old style asbestos packings so that new packings/materials may be effectively installed.

6.8.10 Severe throttling service may cause the valve to be subjected to damage of the seating surfaces and other parts. Severe cavitation can cause gross damage of the internal parts, including the valve body and downstream piping. Good preventive maintenance procedures including periodic inspections, may prevent serious failures which require expensive shutdowns. Methods of evaluation and solutions for maintenance problems are beyond the scope of this Guide. Valve manufacturers should be consulted concerning design features and operating procedures for valves.

6.8.11 External valve mechanisms, actuators and accessories are generally readily accessible for inspection and maintenance. Reasonable protection should be provided to prevent mechanical damage and potentially degrading environmental exposure to such things as airborne grit, chemicals or moisture. Working surfaces such as stem threads, bearings, and gears should be lubricated on a reasonable schedule using the lubricants recommended or approved by the valve or actuator manufacturers.

6.8.12 Maintenance of valves must involve a good preventive maintenance program, particularly for check valves and valves in severe throttling service. Stem sealing problems may be alleviated by use of the newest technology in valve design, packing materials and installation procedures.

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ANNEX A
REFERENCED STANDARDS AND APPLICABLE DATES

This Annex is an integral part of this Standard Practice which is placed after the main text for convenience.

Standard Name and Designation

ASME, ANSI/ASME, ANSI, ASME/ANSI	
B16.33-1990	Manually Operated Metallic Gas Valves for Use in Gas Piping Systmes
B16.34-1996	Valves – Flanged, Threaded and Welding End
B16.5-1996	Pipe Flanges and Flanged Fittings
API	
API 6D -1994	Specification for Pipeline Valves, End Closures, Connectors and Swivels
API 589-1993	Fire Test for Evaluation of Valve Stem Packing
API 594-1991	Wafer Check Valves
API 599-1994	Steel Plug Valves, Flanged or Buttwelding Ends
API 600-1996	Steel Gate Valves, Flanged and Buttwelding Ends
API 602-1993	Compact Steel Gate Valves
API 603-1991	Class 150, Cast, Corrosion-Resistant, Flanged-End Gate Valves
API 607-1993	Fire Test for Soft Seated Quarter Turn Valves
API 609-1991	Butterfly Valves, Lug Type and Wafer Type
MSS	
MSS SP-42-1990	(R95) class 150 Corrosion Resistant Gate, globe, Angle and Check Valves with Flanged and butt Weld Ends
MSS SP-45-1992	Bypass and Drain Connections
MSS SP-67-1995	Butterfly Valves
MSS SP-68-1997	High Pressure – Offset Seat Butterfly Valves
MSS SP-70-1990	Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71-1990	Cat Iron Swing check Valves, Flanged and Threaded Ends
MSS SP-72-1992	Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78-1987	(R92) Cast Iron Plug Valves, Flanged and threaded Ends
MSS SP-80-1997	Bronze Gate, Globe, Angle and Check Valve
MSS SP-81-1995	Stainless Steel, Bonnetless, Flanged Knife Gate Valves
MSS SP-85-1994	Cast Iron Globe & angle Valves, Flanged and Threaded Ends
MSS SP-88-1993	Diaphragm Type Valves
MSS SP-91-1992	(R96) Guidelines for Manual Operation of Valves
NACE	
MR0 175-97-1997	Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment

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Publications of the following organizations appear in the above list:

API	American Petroleum Institute 1220 L. Street, N.W., Washington, D.C. 20005
ASME	American Society of Mechanical Engineers 3 Park Avenue, New York, NY 10016-5990
MSS	Manufacturers Standardization Society of the Valve and Fitting Industry, Inc. 127 park Street, N.E., Vienna, VA 22180
NACE	NACE International P.O. Box 218340, Houston, TX 77218-8340

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List of MSS Standard Practices
(Price List Available Upon Request)

Number	
SP-6-1996	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
SP-9-1997	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-1998	Standard Marking System For Valves, Fittings, Flanges and Unions
SP-42-1999	(R 95) Class 150 Corrosion Resistant Gate, Glove, Angle and Check Valves with Flanged and Butt Weld Ends
SP-43-1991	(R 96) Wrought Stainless Steel Butt-Welding Fittings
SP-44-1996	Steel Pipeline Flanges
SP-45-1998	Bypass and Drain Connections
SP-51-1991	(R 95) Class 150LW Corrosion Resistant Cast Flanges and Flanged Fittings
SP-53-1999	Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method
SP-54-1999	Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Radiographic Examination Method
SP-55-1996	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method for Eval. of Surface Irregularities
SP-58-1993	Pipe Hangers and Supports - Materials, Design and Manufacture
SP-60-1999	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
SP-61-1999	Pressure Testing of Steel Valves
SP-65-1999	High Pressure Chemical Industry Flanges and Threaded Stubs for Use with Lens Gaskets
SP-67-1995	Butterfly Valves
SP-68-1997	High Pressure Butterfly Valves with Offset Design
SP-69-1996	Pipe Hangers and Supports - Selection and Application
SP-70-1998	Cast Iron Gate Valves, Flanged and Threaded Ends
SP-71-1997	Gray Iron Swing Check Valves, Flanged and Threaded Ends
SP-72-1999	Ball Valves with Flanged or Butt-Welding Ends for General Service
SP-73-1991	(R 96) Brazing Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings
SP-75-1998	Specification for High Test Wrought Butt Welding Fittings
SP-77-1995	Guidelines for Pipe Support Contractual Relationships
SP-78-1998	(R 92) Cast Iron Plug Valves, Flanged and Threaded Ends
SP-79-1999a	Socket-Welding Reducer Inserts
SP-80-1997	Bronze Gate, Globe, Angle and Check Valves
SP-81-1995	Stainless Steel, Bonnetless, Flanged, Knife Gate Valves
SP-82-1992	Valve Pressure Testing Methods
SP-83-1995	Class 3000 Steel Pipe Unions, Socket-Welding and Threaded
SP-85-1994	Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
SP-86-1997	Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators
SP-87-1991	(R 96) Factory-Made Butt-Welding Fittings for Class 1 Nuclear Piping Applications
SP-88-1993	Diaphragm Type Valves
SP-89-1998	Pipe Hangers and Supports - Fabrication and Installation Practices
SP-90-1986	(R 91) Guidelines on Terminology for Pipe Hangers and Supports
SP-91-1992	(R 96) Guidelines for Manual Operation of Valves
SP-92-1999	(R 92) MSS Valve User Guide
SP-93-1999	(R 92) Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components - Liquid Penetrant Examination Method
SP-94-1999	Quality Std for Ferritic and Martensitic Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Ultrasonic Examination Method
SP-95-1999	(R 91) Swage (d) Nipples and Bull Plugs
SP-96-1996	Guidelines on Terminology for Valves and Fittings
SP-97-1995	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Buttwelding Ends
SP-98-1996	Protective Coatings for the Interior of Valves, Hydrants, and Fittings
SP-99-1994	Instrument Valves
SP-100-1997	Qualification Requirements for Elastomer Diaphragms for Nuclear Service Diaphragm Type Valves
SP-101-1989	Part-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-102-1989	Multi-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-103-1995	Wrought Copper and Copper Alloy Insert Fittings for Polybutylene Systems
SP-104-1995	Wrought Copper Solder Joint Pressure Fittings
SP-105-1996	Instrument Valves for Code Applications
SP-106-1990	(R 96) Cast Copper Alloy Flanges and Flanged Fittings, Class 125, 150 and 300
SP-107-1991	Transition Union Fittings for Joining Metal and Plastic Products
SP-108-1996	Resilient-Seated Cast Iron-Eccentric Plug Valves
SP-109-1996	Welded Fabricated Copper Solder Joint Pressure Fittings
SP-110-1996	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-111-1996	Gray-Iron and Ductile-Iron Tapping Sleeves
SP-112-1999	Quality Standard for Evaluation of Cast Surface Finishes - Visual and Tactile Method. This SP must be sold with a 10-surface, three-dimensional Cast Surface Comparator, which is a necessary part of the Standard. Additional Comparators may be sold separately at $19.00 each. Same quantity discounts apply on total order.
SP-113-1999	Connecting Joint between Tapping Machines and Tapping Valves
SP-114-1995	Corrosion Resistant Pipe Fittings Threaded and Socket Welding, Class 150 and 1000
SP-115-1999	Excess Flow Valves for Natural Gas Service
SP-116-1996	Service Line Valves and Fittings for Drinking Water Systems
SP-117-1996	Bellows Seals for Globe and Gate Valves
SP-118-1996	Compact Steel Globe & Check Valves - Flanged, Flangeless, Threaded & Welding Ends (Chemical & Petroleum Refinery Service)
SP-119-1996	Belled End Socket Welding Fittings, Stainless Steel and Copper Nickel
SP-120-1997	Flexible Graphite Packing System for Rising Stem Steel Valves (Design Requirements)
SP-121-1997	Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves
SP-122-1997	Plastic Industrial Ball Valves
SP-123-1998	Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube

(R-YEAR) Indicates year standard reaffirmed without substantive changes

A large number of former MSS Practices have been approved by the ANSI or ANSI Standards, published by others. In order to maintain a single source of authoritative information, the MSS withdraws its Standard Practices in such cases.

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