British Standard

BS 6683:1985

Incorporating Amendment No. 1

Guide to

Installation and use of valves

UDC 621.646.005

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Piping Systems Components Standards Committee (PSE/-) to Technical Committee PSE/7, upon which the following bodies were represented:

Amalgamated Union of Engineering Workers
Associated Offices Technical Committee
Association of Bronze and Brass Founders
Association of Hydraulic Equipment Manufacturers
British Chemical Engineering Contractors Association
British Compressed Gases Association
British Foundry Association
British Gas Corporation
British Maritime Technology
British Shipbuilders
British Valve Manufacturers' Association Ltd.
Copper Development Association
Copper Tube Fittings Manufacturers' Association
Electricity Supply Industry in England and Wales
Energy Industries Council
Engineering Equipment and Materials Users' Association
GAMBICA (BEAMA Ltd.)
General Council of British Shipping
Greater London Council
Health and Safety Executive
Institute of British Foundrymen
Institution of Chemical Engineers
Institution of Gas Engineers
Institution of Mechanical Engineers
Institution of Water Engineers and Scientists
Society of British Gas Industries
Steel Casting Research and Trade Association
Water Authorities' Association
Water Companies' Association

This British Standard, having been prepared under the direction of the Piping Systems Components Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 October 1985

The following BSI references relate to the work on this standard:
Committee reference PSE/7
Draft for comment 84/72775 DC

ISBN 0 580 14746 0

Amendments issued since publication

Amd. No.	Date of issue	Comments
6604	April 1991	Indicated by a sideline in the margin

Contents

Foreword

This British Standard has been prepared under the direction of the Piping Systems Components Standards Committee.

Since the incorrect use of valve types may result in operating problems which adversely affect system safety and efficiency, the valve industry recognizes that it will benefit all concerned if information can be made conveniently available to those responsible for installing and using valves to help them avoid such problems.

Valves are of many types and are used in a wide variety of service conditions. Having correctly selected a valve, its satisfactory performance depends on proper packing and protection during handling and storage, installation and operation, and adequate maintenance.

This standard presents information which should help users to avoid the most obvious causes of trouble. The standard does not include requirements but is intended to make the user more aware of the problems that can arise. Advice regarding a particular application should be obtained from the manufacturer of the valve. 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.

Observance of the recommendations and precautions given in this standard will provide increased assurance of satisfactory valve performance.

It is intended that this standard should be used in conjunction with the appropriate valve product standards (see **1.1**). In addition, this standard may be used to provide guidance for the installation and use of valves not covered by product standards.

Sections of this standard have been based on MSS SP92 "Valve user guide" by kind permission of the Manufacturer's Standardization Society of the Valves and Fittings Industry Incorporated.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1.1 Scope

This British Standard provides important guidance on the handling, storage, installation, and operation and maintenance of valves.

This standard applies to the installation and use of valves complying with the following valve product standards:

BS 1414	BS 5152	BS 5157	BS 5351
BS 1868	BS 5153	BS 5158	BS 5352
BS 1873	BS 5154	BS 5159	BS 5353
BS 5150	BS 5155	BS 5160	BS 6364
BS 5151	BS 5156	BS 5163	

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

Section 2. Service and environmental considerations

2.1 Fluid

Since a fluid can take many forms, careful consideration should be given to the properties of the fluid to be handled in order that the valves and materials chosen will adequately withstand the corrosive, erosive or other nature of the fluid. Attention is also drawn to the effect of materials on the fluid(s) to be conveyed.

Fluids may be classed as gases, vapours, liquids, fluidized solids or solids in suspension and each class presents its own handling problem. The problems are determined by the fluidity, particle size, viscosity, velocity, pressure, temperature, etc. of the fluid and whether the state remains constant throughout the system. A liquid, for example, may flash into a gas due to the pressure drop across a valve and mixtures of fairly innocuous liquids may cause severe corrosion problems when combined and heated. Other problems which have to be considered are the osmotic or penetrating properties of the fluid. Erosion is mainly dependent upon the velocity and particle size and hardness, and small changes in these can materially affect the choice of a suitable material.

2.2 Pressure-temperature rating

The pressure-temperature rating of the valve should be consistent with the service conditions and in accordance with the appropriate valve product standard.

If system testing will subject the valve to pressure in excess of its working pressure rating, the intended testing pressure and a statement explaining whether the test pressure is through the open valve or is a differential pressure across the closed valve should be included in the enquiry and/or order for a valve.

2.3 Layout and siting

It is necessary at the design stage to consider where and how the valve will be located. Valves should be provided with adequate supports, where necessary; this is especially important if the pipework is constructed from plastics materials. Valves should be accessible for operation, adjustment, maintenance and repair.

Generally, it is preferable for valves to be mounted with the stem in the vertical position. In a branch system, consideration should be given to the possibility of removing single valves for overhaul without having to shut down the whole system. Easy removal and replacement of important valves should be ensured and isolating valves fitted at appropriate locations.

Check valves should be carefully installed; some are only suitable for horizontal pipe systems, others only for vertical pipe systems whilst some are suitable for both horizontal and vertical pipe systems. In addition, check valves should not be located immediately downstream from pipe elbows, because turbulence in the flowing fluid may cause disk motion and excessive wear.

2.4 Bending strength

Pipe systems are subject to mechanical constraints at support points, 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., may all potentially affect the bending moment at various points in the system.

Valves are subjected to the bending moments in the adjacent pipe in addition to normal pressure loadings. It is therefore recommended design practice to avoid locating valves at points of large bending moments.

In many cases, normal valve design practice results in a body strength greater than the strength of the adjoining pipe, providing inherent protection against valve damage. In other cases, conditions may increase the possibility of harmful valve body deformation. The following are examples of possible problems:

a) reduced-bore type valves, made by providing enlarged ends on smaller basic valves;

b) cast iron valves installed in steel piping;

c) where the pipe may be stiffer and stronger than the valves;

d) rigidly bonded linings, e.g. glass lining.

If there is reason for concern regarding possible high bending moments, valve designs having inherent body bending strength weakness should be carefully evaluated.

2.5 Fire-tested

The term fire-tested is intended to replace the previous misleading term of fire-safe. A fire-tested valve indicates that prototype valves of a certain design, materials and manufacturer have been tested in accordance with a specified test, such as given in Appendix A of BS 6755-2:1987. Such a test demonstrates that during the fire test the leakage from the stem, body joint and cover was not in excess of that specified and that after fire testing, with the valve closed, the seat leakage was not in excess of that specified.

2.6 Pressure surge and cycling

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 the upstream column produces at the valve a pressure surge 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, a high fluid velocity and/or rapid closure, singly or in any combination, the possibility of unacceptable pressure surge should be investigated. This is particularly applicable where power operation is required as this usually enables faster operation to be achieved than is normal with manual operation, and this could increase the pressure surge, resulting in the actuator being unable to operate the valve.

In the case of check valve closure on flow reversal, it can be considered that velocity cut-off is instantaneous. Pressure surge may consequently be very high, depending on the velocity of the reverse flow at the instant of closure and, again, the length of the fluid column. Applications of check valves in liquid lines should always be evaluated for possible surge (water hammer) problems.

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 or from the pulsing or instability of such flow.

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.

In liquid lines, valve cycling is not normally a problem unless the flow itself is cycling, as at the discharge of a reciprocating pump.

In all cases, the preferred sizing of check valves is such that at normal sustained flow, the valve closure element will be held against its stop in the fully open position.

2.7 Throttling

Control of flow or pressure may involve very severe fluid turbulence and to get the best performance from a valve used for control it is important that it is correctly sized, having regard to the conditions of the flowing media. Reference should therefore be made to the manufacturer for confirmation of the methods of calculation used.

If, for example, the control valve chosen is too large, it will be only open by a small amount which will result in poor flow control, blockage, dewatering effects or vibration causing damage.

Depending upon the type of fluid, whether liquid or gas, and the pressure drop across the valve, fluid energy conversion equivalent to the output of a large pump or boiler may be required in the valve. Such energy conversion may be the source of high intensity noise. In throttling of a gas, e.g. steam or air, the noise may be produced principally by shock waves as the flow breaks the sound barrier. In liquids, a major source of noise is cavitation, or more specifically the collapse of cavitation vapour bubbles as the fluid static pressure recovers downstream. The noise in an ordinary water tap is an example of low level cavitation noise. If examination of the flow data suggests the probability of a noise problem, then advice should be sought from the manufacturer.

In cases where cavitation is especially heavy and/or continuous for extended periods, the possibility of mechanical damage should be evaluated.

2.8 Flow coefficients

It is often convenient, particularly with control valves, to be able to express the relationship between pressure drop and flow rate through a valve by a coefficient. In many parts of the world, including the UK and the USA, the flow coefficient in most general use is *Cv*. However, testing methods can vary and this should be borne in mind when comparing the performance of valves on the basis of *Cv* values.

2.9 Effects of temperature

A condition of non-uniform temperature in pipework may impose significant thermal stresses or distortion, with possible adverse effects on valve performance.

In applications involving frequent temperature cycling, the possibility of thermal stress fatigue should be considered.

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

2.10 Trapped pressure

Certain codes and standards warn against a particularly serious danger associated with temperature changes. If a double-seated valve contains liquid and if it is in the closed position, the liquid in the body cavity between the two seats is effectively trapped. If, as a result of start up or another change in the mode of, operation, or exposure to solar heating, the temperature of the closed valve is then caused to increase, the vapour pressure of the trapped liquid will increase, causing an increase in the cavity pressure. In a case where liquid completely fills the cavity, the thermal expansion of the liquid can cause a rapid increase in the hydrostatic pressure. Similar effects can be caused when subzero conditions freeze water in these cavities.

In all cases for which such a possibility can be anticipated, the necessity of providing positive means for prevention of such overpressurization should be considered.

2.11 Corrosion

The need for valve structural materials to be chemically compatible with line fluids and/or the environment is obvious. It should be noted, however, that the performance of a material in an actual plant service situation can be influenced, sometimes quite significantly, by many factors such as the design and operating conditions of the valve itself, the type of process involved, fluctuations in the concentration and temperature of the line fluid, and the presence of other chemicals.

Detailed information or service conditions should be given to the valve manufacturer whenever possible.

2.12 Stem sealing

The valve stem may have a turning or sliding movement or a combination of both and the sealing should be capable of contending with the movement of the stem while ensuring tightness against the pressure of the fluid inside the valve. The temperature of the fluid may also be a factor influencing the type of stem seal used, and toxic and dangerous fluids require special consideration. There are many types of stem seals for use with dangerous fluids, including "O" rings, bellows and proprietary seal designs.

2.13 Cryogenic services

For cryogenic services, reference should be made to BS 6364.

2.14 Operating effort

2.14.1 Manual operation

Manually operated valves are designed so as to require reasonable physical effort applied to a handwheel, handle or removable key. Attention should be given to the location, environment and personnel required to operate the valves.

2.14.2 Actuator operation

The operation of a valve by means of some form of power device may be required for several reasons, including the following.

a) The force required to operate the valve is too great for convenient manual operation.

b) A faster operation is desired than can be achieved by manual means.

c) It is required to operate the valve remotely.

d) Operation of the valve is to be in a controlled sequence related to other equipment functions.

Many types of actuator are available to power valves. Pneumatic, hydraulic and electric types, or combinations of any two of these, form the majority of those in service. Fail-safe action is desirable in many situations and in the case of pneumatic operation three modes are possible, i.e. on failure of the operating air supply the actuator stem can be made to extend, retract or lock. In terms of a valve action, this means air-fail-close, air-fail-open or air-fail-lock. Which mode is chosen depends on the process or operational requirements; the user should decide which is best suited to his system as a whole. Hand operated override mechanisms can be furnished with most actuators irrespective of the power media. These provide an additional feature for plant personnel enabling flows to be maintained while difficulties are overcome.

One particularly important point that should be emphasized with regard to power operation is that, with most types of actuators, the same force is available for operating the valve whether the valve is actually on full differential pressure or on zero differential pressure and excessive seat wear or even valve damage can occur if actuator sizing is based on unrealistically high line working pressures or low actuator air pressure or voltage.

2.15 Vibration

In the majority of cases, vibration in a pipework system is designed to be kept to a minimum, but in instances where vibration cannot be avoided, the user should be aware of the damage that can arise, suitable precautions should be taken and valves should not be left in the partially-opened position where vibration can result in rapid wear, fatigue or self-operation.

Section 3. Storage and handling

3.1 General

The intervening period between the production test and the installation in line may involve substantial exposure to degradation by impact, impingement or invasion of harmful materials, which can adversely affect the subsequent service performance of the valves.

3.2 Handling

A basic consideration in handling protected valves should be to avoid damaging the protection and valves should never be 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 valves.

3.3 Storage

Valves should be stored in accordance with manufacturers' recommendations with the obturator in the position specified in the valve product standard, if appropriate. If lengthy storage is required, special precautions may be necessary to prevent deterioration.

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 the actual valve temperature always higher than the dew-point, particularly for valves fitted with actuators.

If outdoor storage is unavoidable, valves should be supported off the ground and protected by a weatherproof cover.

Rubber components in valves, or provided as spares, should not be exposed to heat or direct sunlight where this can be avoided, as this accelerates the ageing of the rubber. Ozone in the air around electrical appliances also accelerates the ageing of certain materials.

Section 4. Installation

4.1 General

The installation procedure is a critical stage in the life of a valve and care should be taken to avoid damaging the valve.

4.2 Inspection

Before carrying out a valve installation, it is important to determine whether the valve is in a satisfactory condition. The following generally applicable procedure may be helpful in avoiding subsequent valve problems and should be observed.

a) Carefully unpack the valve and check tags, identification plates, direction of rotation of hand-wheels, etc. against bills 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 indicating flow direction. If the flow direction is indicated, appropriate care should be exercised to install the valve for proper flow orientation.

d) As far as is practicable, inspect the valve interior through the end ports to determine whether it is reasonably clean, free from foreign matter and harmful corrosion. Remove any special packing materials, such as blocks used to prevent disk movement during transport and handling.

e) If practicable, actuate the valve through an open-close or close-open cycle. Inspect any functionally significant features, such as guides or seat faces, made accessible by such actuation. Following such inspection, it is usually desirable to leave the valve closure member in the position in which it was transported.

f) Immediately prior to valve installation, check the pipework to which the valve is to be fastened for cleanliness and freedom from foreign materials.

g) With power actuator operated valves, the following additional checks should be made, as appropriate.

1) Check that the data given on the actuator name-plates regarding electric, pneumatic or hydraulic supply requirements match the site supply.

2) Note whether any mounting orientation restrictions are indicated on the actuator or its accessories.

3) Check that the actuator enclosure is suitable for the intended valve location, i.e. that actuators having electrical components are suitable for indoor, outdoor or flammable vapour hazardous environments, or locations where flooding may occur.

4) Check that the proposed mounting location/orientation will permit satisfactory routing of cabling or pipework, i.e. that cable entries or pneumatic supply ports are not obstructed by adjacent pipework or handrails, etc.

4.3 Threaded valve/pipe assembly

For tight sealing, threaded pipe joints depend on the fit between the male and female threads and, usually, the presence of a special soft or viscous material between the assembled threads. Where parallel threaded fittings are used in parallel threaded valve ports, then some form of seal on the end face of the valve should be used. To ensure a leak-free system, the following points should be observed.

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

b) Note the internal length of threads in valve ends, and the proximity of the valve internal seat or wall. Observe any need for care regarding how far the pipe is threaded into the valve. If there appears to be a possibility of a problem, carefully check the pipe and thread to make sure there is no extended straight portion beyond the normal tapered sections.

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

d) Apply an appropriate tape or thread compound to the external pipe threads, except when dry seal threading is specified.

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 valves by applying excessive twisting forces through the body.

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

4.4 Flanged joint assembly

Pipe flanged joints depend on compressive deformation of gasket material between the facing flange surfaces for tight sealing. The mechanical force required to maintain the compressive stresses on the gasket, as well as to resist the normal pressure forces tending to separate the joint, should be provided by the bolting. It should be recognized that the bolting force used for brute force alignment of misaligned flanges will not be available to sustain gasket loading and pressure force loading, and the result may be a joint leakage problem.

In order to obtain satisfactory flange joints, the following points should be observed.

a) Check the mating flange facings (both valve and pipework flanges) for correct gasket contact face, surface finish and condition. If a condition is found which might cause leakage, e.g. a deep radial groove cut by a retracting cutting tool, do not attempt to assemble until the condition has been 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.

c) Cast iron flanges are less forgiving of improper installation than flanges made from ductile materials. The use of lower strength steel 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 overtightening of flange bolts. Flat face flanges are normally used but if raised face flanges are used, then extra care should be taken when tightening bolts.

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

d) Check the gasket material. For flange joints using low strength bolting, such as may be provided for iron flanges [see item c)], metal gaskets (flat, grooved, jacketed, corrugated or spiral wound) should not be used.

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

f) Take care to provide good alignment of the flanges being assembled. Use suitable lubricants on bolt threads. In assembly, sequence bolt tightening to make the initial contact of flanges and gaskets as flat and parallel as possible. Tighten gradually and uniformly to avoid the tendency to twist one flange relative to the other.

Parallel alignment of flanges is especially important in the case of the assembly of a valve into an existing system. It should be recognized in such instances that, if the flanges are not parallel, it will be necessary to introduce bending to make the flange joint tight. Simply forcing the flanges together with the bolting may bend the pipe, or it may bend the valve.

In the assembly of certain wafer type valves between flanges, the installation should be checked for any possibility of interference between moving parts of the valve and the adjacent pipe, fitting or valve.

g) Copper alloy valves with integral flanges, which are intended for use with full face gaskets, may present a hazard due to overstressing and distortion of the copper alloy flange if used with inside bolt (ring type) gaskets or if mated with a raised faced flange. Certain copper alloy flanges are only suitable for bolting to flat flanges (see BS 4504-3.3).

4.5 Weld joint assembly

All welding should comply with the appropriate pipe system or application code. Welded joints, 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. Thus for socket weld joints it is always required that the weld fillet has more cross-sectional area than the pipe.

Butt welds require full penetration and thickness at least equal to that of the pipe. If a pipe of a high strength alloy is welded to a valve with body material of lower mechanical strength, the weld should taper to a compensating greater thickness at the valve end, or the valve should have a matching high strength welded-on extension.

Particular care is necessary when welding valves into the line. Considerable distortion, resulting in line strains, may occur if valves are not welded into the line with care and, where required, the weld properly stress relieved, but it is necessary to ensure that such stress relieving does not result in valve internal components, e.g. in soft seated valves, being subjected to unacceptable temperatures. Slag spatter should be avoided as its presence can be detrimental to the performance of the valve.

4.6 Testing and adjustment

Following installation, all valves should be operated to check that they still function.

On new pipework systems, system pressure testing and commissioning follow after installation when various checks are made (see also **2.2**, **2.3**, **2.12**, **2.14** and **2.15**).

A first observation can be made by actuating the valve through an open-close, or close-open cycle. Electrically actuated valves should not be operated over their full stroke under any circumstances without first checking that motor rotation is correct and the actuator end of travel limit and/or torque switches have been correctly set according to the manufacturer's instructions. If no obvious problems are observed, an actual test at pressure may be applied while tightness and operability are checked.

It is common practice, after the installation of pipework systems, to clean the systems by blowing 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 pipework system and material not dissolved in 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.

Section 5. Operation and maintenance

5.1 General

Valves are a special kind of machinery having moving and wearing parts, and depend on long-term preservation of highly finished surfaces on certain of those working parts for satisfactory performance. It is therefore useful to give attention to proper operation and reasonable maintenance of valves throughout their service life.

5.2 Operation of manual valves

Most valves are operated manually be means of a hand-wheel, wrench, handle, removable key, etc. and care is required to ensure that such movement is in the correct direction.

In the closed position, the internal closure element (disk, plug, sphere, etc.) should be correctly positioned in relation to the seat, according to the valve type, as follows.

a) Valves in which the closure element moves to and from the seat, such as globe, angle, diaphragm and wedge gate valves, depend to some degree on the mechanical force of the stem holding the closure against the seat to make and maintain tight shut-off. This is most important if the fluid pressure to be shut off acts on the closure element in such a direction as to push it off the seat. In globe type valves, when pressure acts in the same direction as the stem force, and in gate type valves, pressure acts so as to increase seating load. In such valves stem loading is less critical, except that the stem force at low pressures may be more important than at high pressure.

b) Most valves in which the internal closure element slides across the seat (ball, plug, parallel slide, gate, butterfly valves, etc.) do not rely on a stem actuating force to provide tight shut-off. In such valves, however, correct position of the closure element is important. In some cases the effort required to move the 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 indicated fully closed position can result in leakage and consequent damage to the sealing elements.

c) Parallel slide valves, which are used extensively in steam and boiler feed water lines, rely upon the differential pressure across the closed downstream disk to provide tight shut-off. An effective seal is produced in either direction by means of two flat-faced disks which traverse across the flow path of the fluid, both disks being in continuous sliding contact with the parallel flat faces of the body seats. When a parallel slide valve is closed, extra effort should not be applied at the closed position as the mechanical force of the stem does not influence sealing. When manually operated slide valves are closed, it is recommended that the handwheel or stem be slightly located off the mechanical stop; this ensures the spindle or disks are free floating. The floating action of the disks reduces the effects of mechanical and thermal distortion and, together with the sliding action required to close them, prevents jamming.

d) Thermal expansion and contraction can cause solid wedge gate valves to lock up if closed while hot. As the relatively cooler stem heats up to body temperature, body contraction will cause stem thrust to increase. If the thrust increases sufficiently, the wedge will be locked between the tapered seats. Therefore, if a manually operated solid wedge gate valve is closed while hot, it is recommended that the handwheel or stem be backed off slightly to ensure that thermal expansion does not cause a lock up.

Final closure of rubber seated gate valves requires compression of the rubber seal which may create a substantial closing resistance even at low pressures. Total closure is best indicated by cessation of flow noise or of visible flow, where this is convenient. The stem should not be backed off after final closure, as the resilience of the rubber would then cause the wedge to open slightly.

e) Valves with stems that move in and out of the valve during actuation may often be provided with a backseat. This is a shoulder on the stem or other part of the stem-disk assembly which engages a corresponding seat shoulder on the inner side of the bonnet.

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. Opening to the backseat can be considered as a means for determining that the fully open position has been reached, and the stem should then be backed off the backseat to minimize the possibility of attempting to open a valve which is already fully open, which can result in broken stems.

Circumstances could necessitate use of the backseat for stem sealing, for example to permit system operation until a shut-down permits replacement of stem packing.

CAUTION. See **5.6.2** d). 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.

5.3 Operation of power actuated valves

The actuator should be adjusted to deliver adequate 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, such as by the use of extensive stops or limit switches.

There is a considerable risk of damage to the backseat of a valve with power operation and it is strongly recommended that actuator limit switches should be set so that a valve does not backseat. However, if a valve has to be backseated, then it should be adjusted to stop slightly below the back-seated position and, when required, backseating should be performed by hand operation of the actuator.

5.4 Quarter turn valves

Where valves are actuated by rotation of a stem through 90°, the distribution of static fluid pressure on the closure element as a result of highly non-uniform fluid velocity distribution around or through the element may produce a strong closing torque. If not forcefully restrained, such a valve may suddenly close itself and can produce a high pressure surge or hammer, potentially capable of causing structural damage.

The installation should allow for all dynamic loadings of the valve. If a handle is used, it should be established that the torque required by the installation can be operated safely by the handle provided.

An additional point of concern is possible injury to personnel closing the valve. If an operating handle is fitted to too large a valve, then reverse loading due to the flow down the pipe may cause the valve to slam shut or open and result in injury to the operator.

It is important that the manual operating device is sized in accordance with the manufacturer's recommendations.

5.5 Noise

There are frequently valve operating conditions that 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 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. There may be white noise ranging from a whisper, to a sound like rocks and gravel, to a deafening roar, resulting from cavitating conditions in a liquid line. Finally, there may be mechanical noises resulting from movement of internal components acted on by the flowing fluid.

Some such noises may be relatively harmless, insofar as system integrity and performance are concerned. In compressible fluid lines, mechanical damage is generally limited to points of sonic or supersonic velocity, or where a vortex resonance acting on an internal component causes movement and wear or breakage.

In liquid service, cavitation which produces noise has great potential for causing mechanical damage, including massive erosion of solid metal pipe walls and internal components.

Full technical discussion of all the sound-generating mechanisms is beyond the scope of this guide. Nevertheless, it is recommended that any condition of remarkable noise in a pipework system should be evaluated at least to the point of understanding its cause. If noise occurs in a valve, a determination should be made to find out whether the valve is the source or just the site of the noise. Occasionally, if the valve is the source, the noise can be tuned by throttling the valve.

5.6 Maintenance

5.6.1 General

Valves which remain in one position for long periods of time may be subject to some degree of reduction of operability as a result of loss of effective lubricants in threads, ageing of packing, surface corrosion of moving parts or accumulation of deleterious solids. In some applications it may be desirable to schedule periodic partial- or full-cycle exercising of such valves. Modulating valves, i.e. flow and pressure control valves, float operated valves, etc., and valves requiring frequent operation may suffer from wear and tear of the moving parts and gland seals, and such valves should be checked regularly.

Pressure boundary integrity requires basically sound pressure parts, pressure-tight static assembly joints and, in most cases, an effective working seal between a moving stem and the valve bonnet. Maintenance of pressure boundary parts and static assembly joints is not usually considered to be a problem, but rather a matter of monitoring to confirm that correct operation is maintained. The need for paint protection against corrosion of exposed pipework is likely to be obvious for reasons of appearance.

The stem seal can be a problem. It is required to prevent loss of piping fluid between a moving stem and a stationary bonnet. Stem sealing is usually accomplished by filling a cylindrical chamber in the bonnet surrounding the stem with a packing material compressed in the chamber by a gland and associated bolting, but there are many effective variations involving alternative mechanical arrangements, "O" ring bellows and proprietary seal designs [see **5.6.2** d)].

The adequacy of valve internal sealing may be adversely affected by damage or by normal wear. Use of a valve in severe throttling conditions can be harmful to sealing surfaces and materials, and in cases where the fluid is cavitating, gross damage to the valve body and/or down-stream pipework may result.

The external valve mechanism is generally readily accessible for inspection and maintenance. Reasonable protection should be provided against mechanical damage and potentially degrading atmospheric exposure, such as air-borne grit, chemicals or moisture. Working interfaces such as threads, bearings or gears should be lubricated on a reasonable schedule.

5.6.2 Safety considerations

It is essential that a safe system of work should be adopted before any maintenance work is done on a valve. The following safety considerations should be taken into account when preparing maintenance instructions.

a) Before removing valves from a pipework system to carry out maintenance on the valves, it will be necessary to open, or partially open, the valves and to flush the system to remove all traces of dangerous fluids.

b) When ball valves and other types of valves with cavities are dismantled from pipework it is necessary to isolate the valves and depressurize the valves and pipework system before any work is done on the valve.

c) For valves which have a split body design, the in-line flanges which connect the two body halves of the valves together should not be mistaken for the pipe flanges.

d) It is important to recognize the danger associated with the removal of the stem packing gland with pressure in the pipework system and the use of the backseat should not be regarded as a device permitting repacking of the stem packing gland whilst the valve is under pressure as this is recognized as a dangerous practice.

There is one special case where stem gland repacking is permitted without depressurizing the valve. This applies only to valves in the fully open position manufactured in accordance with BS 5163 for waterworks purposes.

CAUTION. On no account should stem gland repacking be attempted under pressure if the contained fluid is dangerous because of temperature, high pressure or chemical composition.

blank

Publications referred to

BS 1414, *Specification for steel wedge gate valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.*

BS 1868, *Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.*

BS 1873, *Specification for steel globe and globe stop and check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries.*

BS 4504, *Circular flanges for pipes, valves and fittings (PN designated).*

BS 4504-3, *Steel, cast iron and copper alloy flanges.*

BS 4504-3.3, *Specification for copper alloy and composite flanges.*

BS 5150, *Specification for cast iron wedge and double disk gate valves for general purposes.*

BS 5151, *Specification for cast iron gate (parallel side) valves for general purposes.*

BS 5152, *Specification for cast iron globe and globe stop and check valves for general purposes.*

BS 5153, *Specification for cast iron check valves for general purposes.*

BS 5154, *Specification for copper alloy globe, globe stop and check, check and gate valves.*

BS 5155, *Specification for butterfly valves.*

BS 5156, *Specification for diaphragm valves.*

BS 5157, *Specification for steel gate (parallel slide) valves for general purposes.*

BS 5158, *Specification for cast iron and carbon steel plug valves for general purposes.*

BS 5159, *Specification for cast iron and carbon steel ball valves for general purposes.*

BS 5160, *Specification for flanged steel globe valves, globe stop and check valves for general purposes.*

BS 5163, *Specification for predominantly key-operated cast iron gate valves for waterworks purposes.*

BS 5351, *Specification for steel ball valves for the petroleum, petrochemical and allied industries.*

BS 5352, *Specification for steel wedge gate, globe and check valves 50 mm and smaller for the petroleum, petrochemical and allied industries.*

BS 5353, *Specification for plug valves.*

BS 6364, *Specification for valves for cryogenic service.*

BS 6755, *Testing of valves.*

BS 6755-2, *Specification for fire type-testing requirements'.*

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

BSI
389 Chiswick High Road
London
W4 4AL