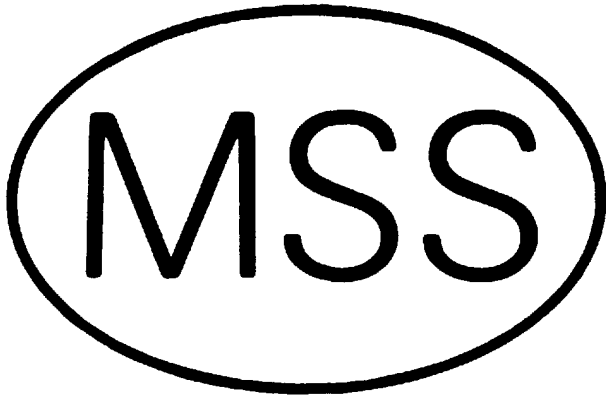


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GUIDELINES FOR MANUAL OPERATION OF VALVES

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FOREWORD

The handwheels or handles provided with manually actuated valves are designed so that reasonable effort exerted by the operator(s) is sufficient to actuate. However, operability of manually controlled valves is dependent on many factors, such as fluid pressure and temperature, location of valve in relation to operators, desired speed of operation, physical capabilities of operators, ambient conditions and frequency of operation. Suitability of valves with manual actuators should therefore be evaluated by the purchaser, based upon anticipated on-site conditions. This document was prepared to assist users in establishing actual requirements relative to valve operation. Most valves can be provided with actuators suitable for specific service conditions, regardless of severity, when conditions are defined.

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GUIDELINES FOR MANUAL OPERATION OF VALVES

0. PURPOSE

The purpose of this guide is to provide valve users with information for use in evaluating the manual operation of valves.

It must be understood that this information is general in nature and must be supplemented by specific operational data for the valve and service conditions to be experienced. The maximum and minimum torque ratings of specific valve and actuator types are not covered by this document, but must be considered when applying manual input devices to any specific valve. Data from the valve and actuator manufacturers should be consulted regarding valve and actuator types and ratings.

1. SCOPE

This document provides guidelines for the operation of manually actuated valves as affected by the valve operator's input.

2. DEFINITIONS

2.1 Manual Actuator. A device requiring manual force to provide the torque and/or thrust required to operate a valve, including levers, T-Levers, T-chain levers, handwheels, chainwheels, worm gear/spur gear/traveling nut units, and manual override units on power actuators.

2.2 Manual Impact Actuator. A hammerblow handwheel or chainwheel device which increases momentarily the breakloose torque or seating and unseating torque capability of handwheels or chainwheels by the application of impact forces.

2.3 Power Actuator. A mechanism for actuating valves using other than manual input to apply force or energy such as pneumatic, electric and hydraulic units.

2.4 Operator. Person or persons who apply manual force to an actuating device.

A Typical Operator is one who is capable of exerting approximately 150 pounds of force (670 N) on a lever with an effective length of 12 inches (300 mm) at waist level. If the intended operators or the system requirements differ, specific information should be obtained from the valve supplier.

2.5 Effective Lever or Effective T-Lever Length. The actual lever length measured from the stem center to the center of force application, 1½ inches (38 mm) from the lever end, or the total T-lever length less 3 inches (76 mm).

2.6 Effective T-Chain Lever Length. The length from stem center to the center of the chain attachment multiplied by the sine of the angle included between lever and chain in the position under consideration.

2.7 Available Lever Torque. The product of a force exerted on a lever at the effective lever length, multiplied by the effective lever length.

2.8 Handwheel Rim Force. The total rim force exerted on the rim of a handwheel or on the spokes of a capstan handwheel, which is the sum of a push and pull force.

2.9 Available Handwheel Torque. A product of the handwheel rim force multiplied by the handwheel radius (handwheel diameter divided by 2) or the product of the total capstan handwheel spoke forces multiplied by the length of one spoke, measured from center, less 1½ inches (38 mm).

2.10 Chainwheel or T-Chain Lever Torque. The product of the total pull force exerted by the operator multiplied by the chainwheel radius (effective chainwheel diameter divided by 2) or multiplied by the effective T-chain lever length.

2.11 Normal Operating Conditions. This refers to the conditions experienced by one operator when attempting to apply force to an actuating device. Normal conditions are with the manual

actuator at waist level and the plane of rotation of the lever, handwheel or chainwheel located vertical or horizontal with temperature at 70 °F (20 °C), good footing with no space restrictions.

2.12 Momentary Force. If an operator must apply a relatively high force to a manual actuator so as to cause a valve to break loose but may exert relatively lower forces to continue actuation of the valve, the initial high force is referred to as a momentary force.

2.13 Short Term Force. This is the force which an operator could be expected to exert on an actuating device for a small portion of the total valve travel such as for seating and unseating.

2.14 Uniform Force. Certain valves require that an operator exert a relatively constant force to an actuating device throughout the valve travel. The uniform force is that force which an operator could be expected to exert for a period of up to 5 minutes.

2.15 Long Term Force. This is the force which an operator could be expected to exert on an actuating device for extended periods of time.

2.16 Valve Operating Characteristics. Forces developed on the valve stem, hence the actuator, during the closed-open-closed operating cycle are indicated in terms of:

2.16.1 Torque. A turning moment developed on stems of valves such as quarter-turn ball, plug and butterfly or stem nuts of globe or gate valves.

2.16.2 Thrust. Axial force developed on valve stems such as globe or gate valves.

2.17 Net Mechanical Advantage. A multiplying factor for gearing which includes both the gear ratio and the efficiency of the device.

3. OPERATOR'S ABILITY TO APPLY FORCE

3.1 Discussion. The selection of manual actuators on valves should take into consideration

the ability of operators to apply adequate force to the device. This ability is dependent upon several factors, such as:

- a) Space available and position of device to which force is applied.
- b) Operator's physical strength, weight and height.
- c) Nature of force required such as momentary, short-term, uniform, long-term or sudden, unexpected.
- d) Environmental conditions, such as temperature, humidity, footing, bracing and protective clothing.
- e) Frequency of operation and urgency of operation.

3.2 Charts. The following charts, Figures 1, 2 and 3, represent operator capabilities as related to manual actuator dimensions, and are not intended to cover all possible valve service and differential pressure conditions. Information presented in these charts must be tempered to account for operating conditions in Paragraph 3.1.

3.3 Chainwheels. No chart is included for chainwheel size vs. force input capability as the input to a chainwheel depends upon operator weight and is not related to chainwheel size alone.

4. MULTIPLYING FACTORS

4.1 Input Factors. As indicated in Paragraph 3.1, certain factors affect the ability of an operator to apply force to an actuating device. A list of these factors is provided in Table 1 along with a multiplier which may be used in conjunction with the charts presented in Paragraph 3.2. To use, refer to the applicable chart as determined by the actuating device, locate the operator force input capability and multiply this input capability by the factor given in Table 1 for the position factor. Multiply that result by the smallest factor found for all other input considerations.

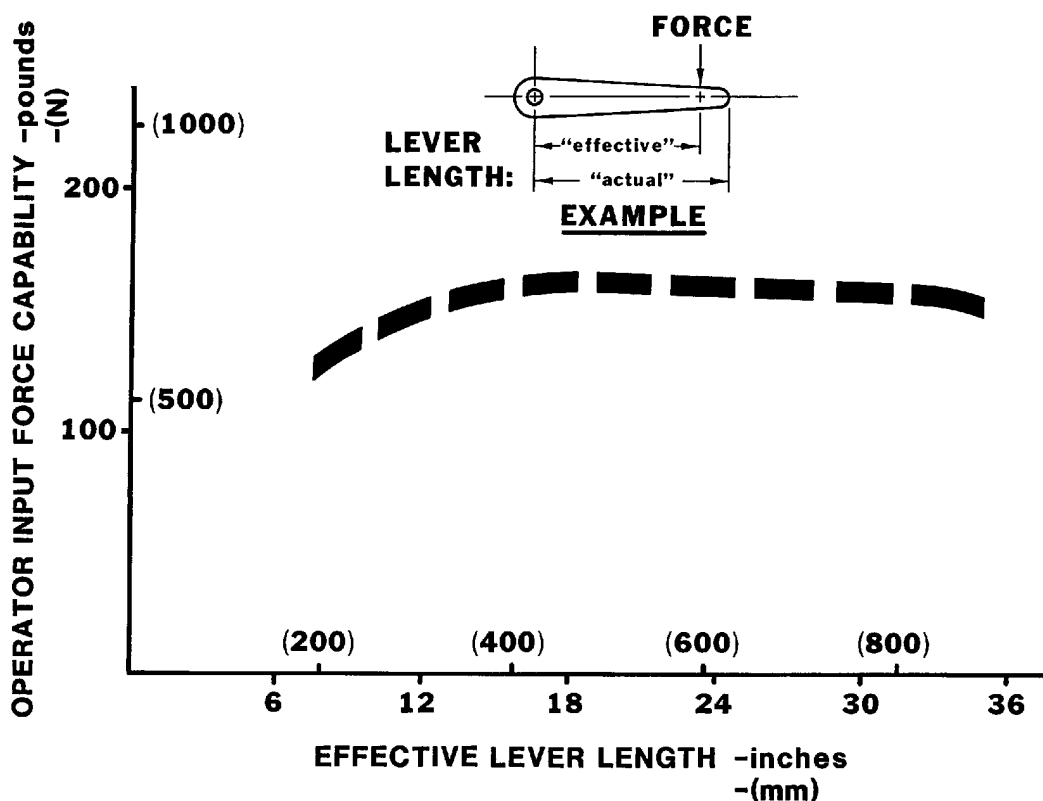


Figure 1 — LEVER TYPE MANUAL ACTUATOR (effective lever length vs force input capability with normal operating conditions)

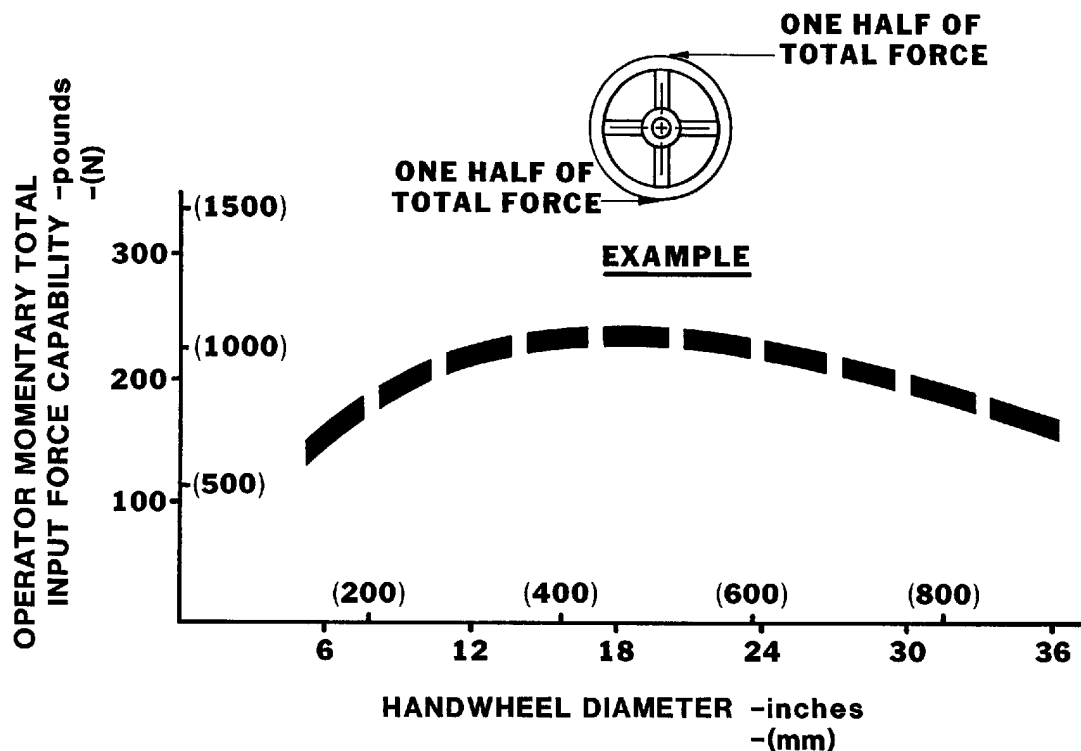


Figure 2 — HANDWHEEL TYPE MANUAL ACTUATOR (handwheel diameter vs force input capability with normal operating conditions)

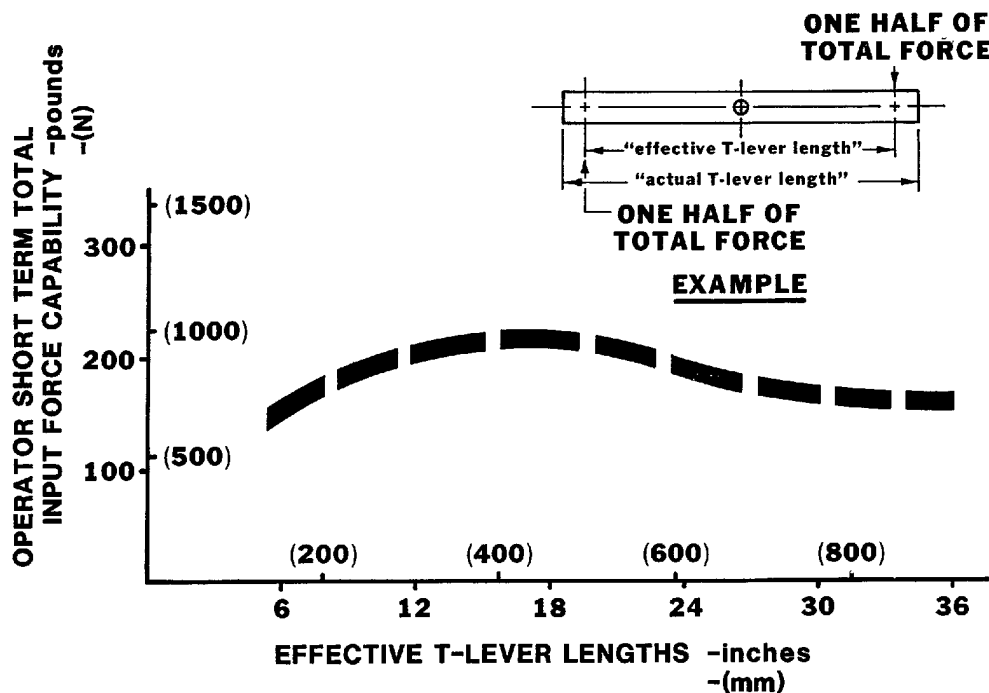


Figure 3 — T-LEVER TYPE MANUAL ACTUATOR (T-lever lengths vs force input capability with normal operating conditions)

Note: Data displayed in Figures 1-3 is based upon the combined test data furnished by several valve manufacturers for typical operating input force capabilities.

TABLE 1 — INPUT FACTOR MULTIPLIERS

Input Factor	Multiplier
Position	
Shoulder level to hip level	1
Below hip level	0.5
Above shoulder level	0.5
Manual Impact devices ^(a) —12" dia. (300 mm)	2
24" dia. (600 mm)	3
36" dia. (900 mm)	4
Space available	Must be considered on an individual basis
Momentary force	1.0
Short-term force	0.85
Uniform force	0.7
Long-term force	0.25
Environmental considerations	Must be considered on an individual basis

Note:

- (a) The effectiveness of impact devices is dependent on the diameter and length of the stem shaft and the mass of the handwheel. Consult the valve manufacturer for recommendation for using impact devices.

4.2 Mechanical Advantage. Depending on the torque or thrust necessary to operate the valve, the operator input force may be amplified, typically through the use of gearing. In these cases the operator force input capability is multiplied by the appropriate net mechanical advantage of the gearing.

5. ADDITIONAL CONSIDERATIONS

In addition to the multiplying factors provided in paragraph 5, there are other factors which must be considered as contributors to the limitations of manual valve operation. These include:

5.1 Speed of Operation Manual operation may mean that the speed with which a valve may be actuated would be too slow in an emergency situation. Rapid manual valve operation, such as is possible with a lever actuator, may cause system damage through "water hammer".

5.2 Sudden, Unexpected Forces. Sudden, unexpected forces can be encountered on quarter turn valves which may develop high dynamic forces at certain angles of opening at high flow velocity.

The ability of an operator to apply force to a manual actuating device is dependent upon the operator's ability to react to the force requirement. Given a set of operating conditions, a maximum capability to apply force exists for each operator. If, however, the force is unexpected and sudden, such as to allow little time for reaction, the operator's ability to respond is hampered.

6. VALVE OPERATING CHARACTERISTIC CURVES

Figures 4 through 11 indicate typical valve operating characteristics for commonly used styles of general purpose valves. The curves indicate generally the torque or thrust needed to move the closure member from closed-to-open-to-closed position. Positive values of torque or thrust indicate that the closure member resists the opening or closing effort. Negative values indicate that the closure member aids that effort.

The actual curve for a specific valve is dependent upon a number of factors and can vary according to valve geometry and operating conditions. Hence, only a general broad band curve is shown for each valve style.

Factors affecting specific valve characteristic curves include:

- a) Direction of flow, particularly in valve styles which may be sensitive to flow direction, such as globe or offset disc butterfly.
- b) Pressure drop, flow medium and/or flow rate, which affect the amplitude of the curves.
- c) Valve size, since curve shape and amplitude for a valve style may change as the size factors of various valve components change.
- d) Frequency of operation may affect seating and unseating forces, particularly if valves are operated infrequently.
- e) Unique design features of any particular valve style or manufacturer may change the shape and/or amplitude of the characteristic curves.

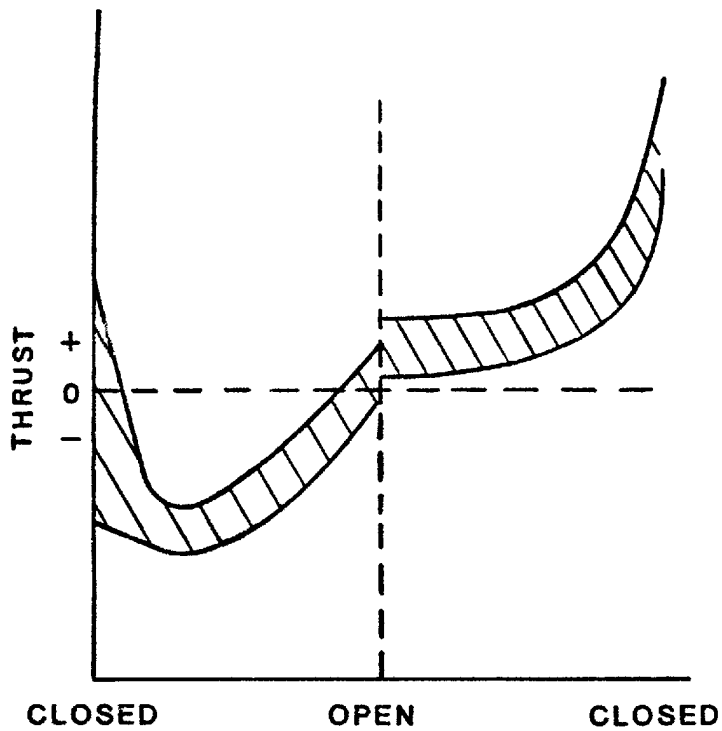


Figure 4 — GLOBE-SLIDING STEM, flow under disc (a)

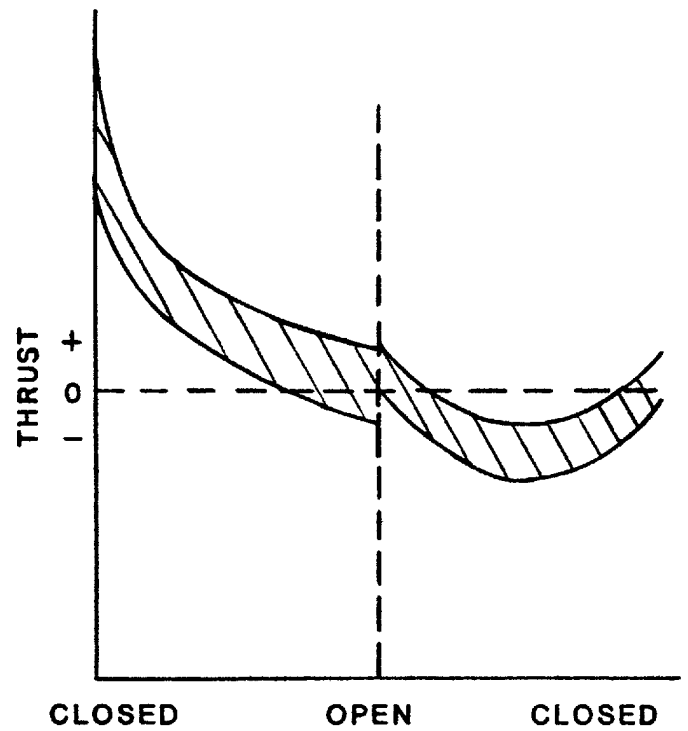


Figure 5 — GLOBE-SLIDING STEM, flow over disc (a)

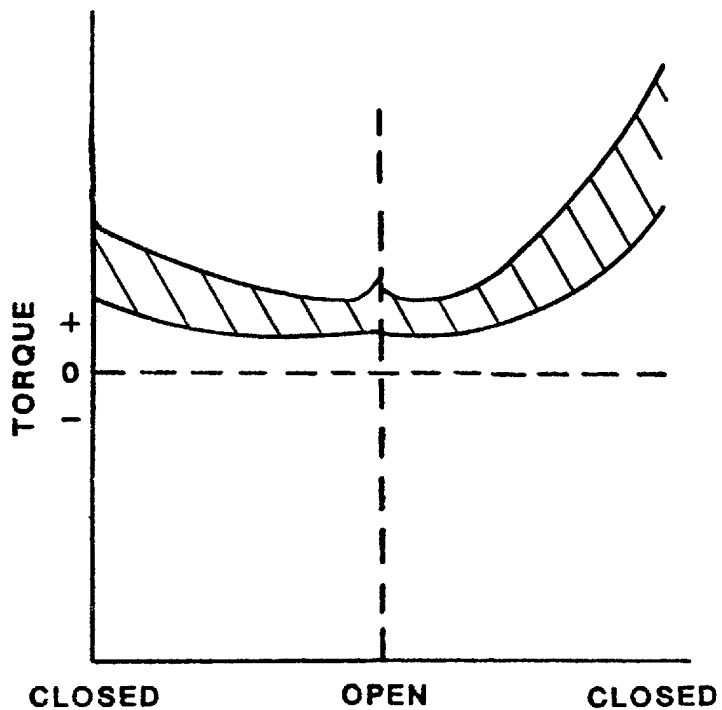


Figure 6 — GLOBE-THREADED STEM, flow under disc (a)

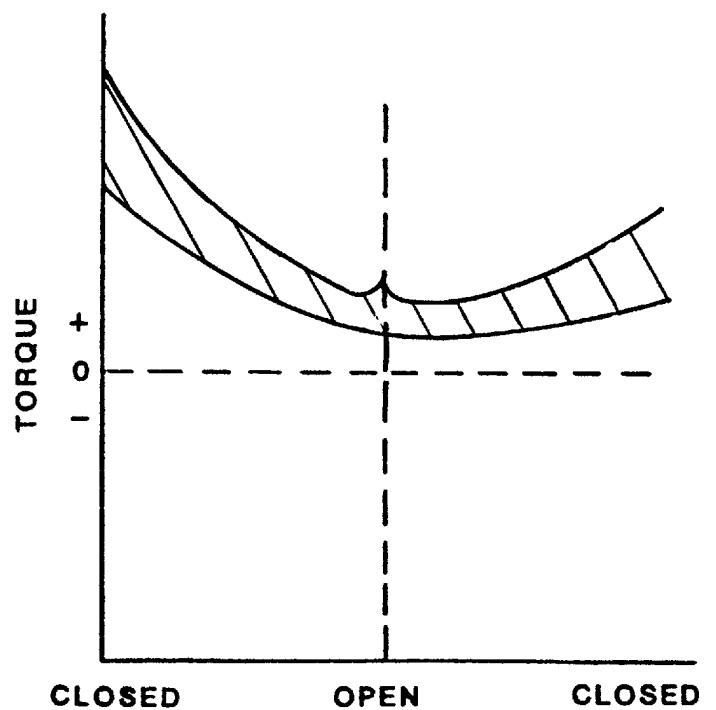


Figure 7 — GLOBE-THREADED STEM, flow over disc (a)

Note:

(a) Single seated globe valves

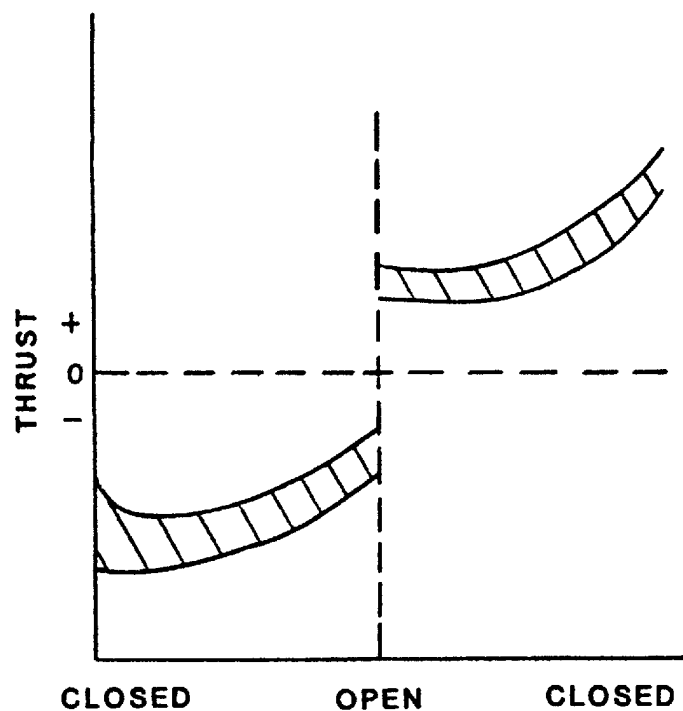


Figure 8 — DIAPHRAGM & PINCH VALVES

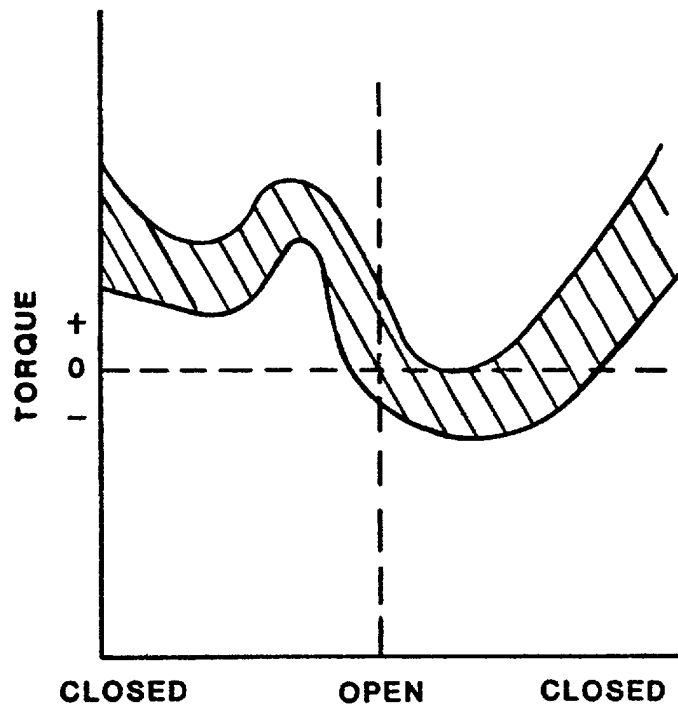


Figure 9 — BUTTERFLY VALVES

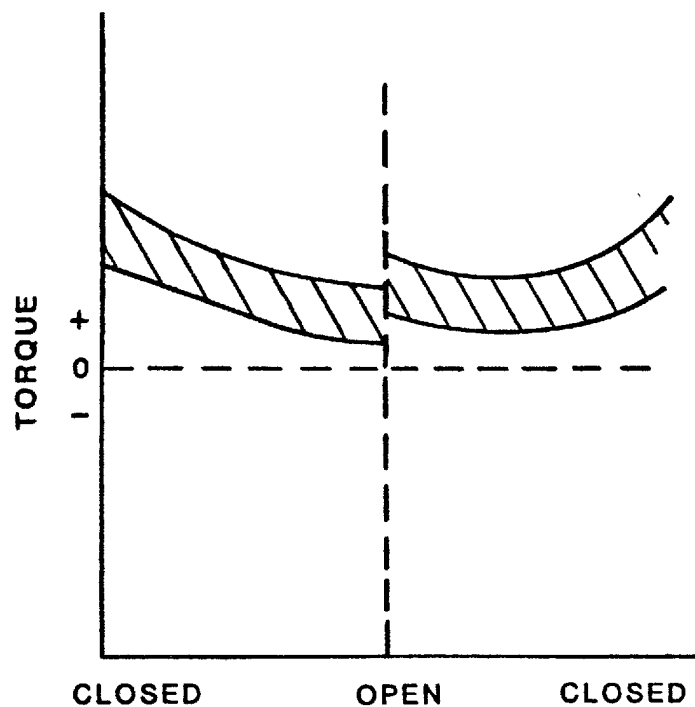


Figure 10 — BALL & PLUG VALVES

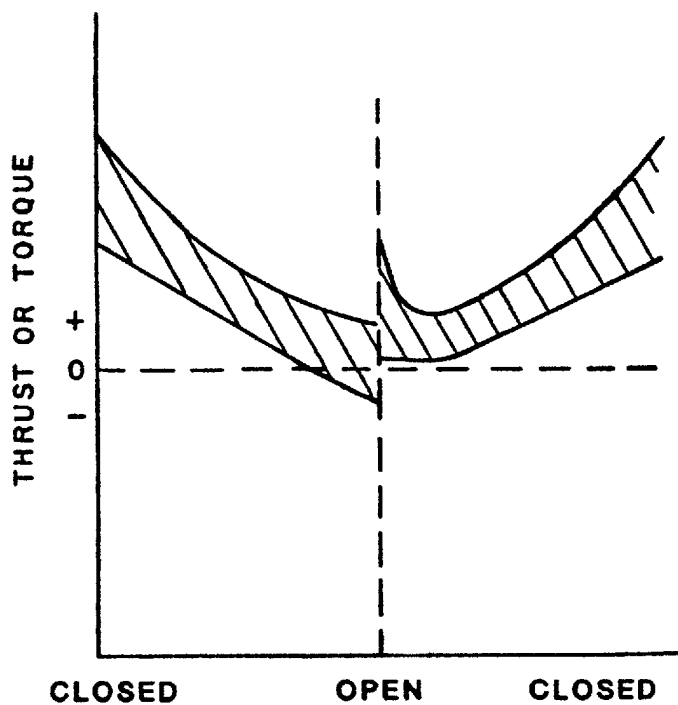


Figure 11 — GATE VALVES, rising or non-rising stem (a)

Note:

(a) Negative values are not applicable to torque characteristics for threaded stem valves.

LIST OF MSS STANDARD PRACTICES**NUMBER**

SP- 6-1990	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
SP- 9-1992	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-1993	Standard Marking System for Valves, Fittings, Flanges and Unions
SP-42-1990 (R 1995)	Class 150 Corrosion Resistant Gate, Globe, Angle and Check Valves with Flanged and Butt-Weld Ends
SP-43-1991 (R 1996)	Wrought Stainless Steel Butt-Welding Fittings
SP-44-1996	Steel Pipeline Flanges
SP-45-1992	Bypass and Drain Connections
SP-51-1991 (R 1995)	Class 150 LW Corrosion Resistant Cast Flanges and Flanged Fittings
SP-53-1995	Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components — Magnetic Particle Examination Method
SP-54-1995	Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components — Radiographic Examination Method
SP-55-1985 (R 1990)	Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components — Visual Method
SP-58-1993	Pipe Hangers and Supports — Materials, Design and Manufacture
SP-60-1991	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
SP-61-1992	Pressure Testing of Steel Valves
SP-65-1994	High Pressure Chemical Industry Flanges and Threaded Stubs for Use with Lens Gaskets
SP-67-1995	Butterfly Valves
SP-68-1988	High Pressure-Offset Seat Butterfly Valves
SP-69-1991	Pipe Hangers and Supports — Selection and Application
SP-70-1990	Cast Iron Gate Valves, Flanged and Threaded Ends
SP-71-1990	Cast Iron Swing Check Valves, Flanged and Threaded Ends
SP-72-1992	Ball Valves with Flanged or Butt-Welding Ends for General Service
SP-73-1991	Brazing Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings
SP-75-1993	Specifications for High Test Wrought Butt Welding Fittings
SP-77-1995	Guidelines for Pipe Support Contractual Relationships
SP-78-1987 (R 1992)	Cast Iron Plug Valves, Flanged and Threaded Ends
SP-79-1992	Socket-Welding Reducer Inserts
SP-80-1987	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-84-1990	Valves — Socket-Welding and Threaded Ends
SP-85-1994	Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
SP-86-1987 (R 1992)	Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators
SP-87-1991 (R 1996)	Factory-Made Butt-Welding Fittings for Class I Nuclear Piping Applications
SP-88-1993	Diaphragm Type Valves
SP-89-1991	Pipe Hangers and Supports — Fabrication and Installation Practices
SP-90-1986 (R 1991)	Guidelines on Terminology for Pipe Hangers and Supports
SP-91-1992 (R 1996)	Guidelines for Manual Operation of Valves
SP-92-1987 (R 1992)	MSS Valve User Guide
SP-93-1987 (R 1992)	Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components — Liquid Penetrant Examination Method
SP-94-1992	Quality Standard for Ferritic and Martensitic Steel Castings for Valves, Flanges, and Fittings and Other Piping Components — Ultrasonic Examination Method
SP-95-1986 (R 1991)	Swage(d) Nipples and Bull Plugs
SP-96-1991	Guidelines on Terminology for Valves and Fittings
SP-97-1995	Integrally Reinforced Forged Branch Outlet Fittings — Socket-Welding, Threaded and Buttwelding Ends
SP-98-1992	Protective Coatings for the Interior of Valves and Hydrants
SP-99-1994	Instrument Valves
SP-100-1988	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 1996)	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-Eccentric Cast Iron Plug Valves
SP-109-1991	Welded Fabricated Copper Solder Joint Pressure Fittings
SP-110-1992	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-111-1992	Gray-Iron and Ductile-Iron Tapping Sleeves
SP-112-1993	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.
SP-113-1994	Connecting Joint between Tapping Machines and Tapping Valves
SP-114-1995	Corrosion Resistant Pipe Fittings, Threaded and Socket Welding, Class 150 and 1000
SP-115-1995	Excess Flow Valves for Natural Gas Service

R-Year — Indicates year standard reaffirmed without substantive change.

Prices available upon request.

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