AMERICAN NATIONAL STANDARD

CONTROL VALVE SEAT LEAKAGE

ANSI-FCI 70-2-2006

ReTop Valve Repair Co., Ltd.

Sponsor:

Retop Valve Repair Co., Ltd.
www.valvesgrinder.com

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Retop Valve Repair Co. , Ltd.

ReTop Valve Repair Co., Ltd. was founded in 1994 and the first professional valve repair and restoration company in China, dedicated to professional solutions on valve metal sealing surface repair and valve inspection aspects.

Our technology and products have been in service for national electric, oil and gas, petrochemical, chemical, siderology, pharmacy, papermaking industries and energy sectors. With nearly two decades R&D on equipment and repairing services, now the Company had developed into a diversified company with professional industrial valve repair and restoration service, and production of valve repair equipment, valve repairing kit as well, having a group of experienced, well-trained valve inspection, repairing experts and research personnel.

The independent R&D and intellectual property multifunctional vertical valve repair and grinding machine, valve repairing kit and special grinding head, which break through the bottleneck that one kind of valve repair equipment could only repair for one single type of valve, it could repair and restore the ball valves, gate valves, stop valves, safety valves, regulating valves, power station valves, desulfuration valves etc. of various types, specifications, standards.

American National Standard

American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review and users are cautioned to obtain the latest editions.

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Suggestions for improvement of this standard will be welcome. They should be sent to the Fluid Controls Institute, Inc.
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Foreword (This foreword is included for information only and is not part of ANSI/FCI 70-2-2006, *Control Valve Seat Leakage.)*

This voluntary standard has been compiled and issued in the public interest. It is intended to eliminate present misunderstandings and to assist and guide those people involved in the specification, use or manufacture of control valves.

This standard, formerly known as ASME B16.104, was originally adopted on November 24, 1970 as FCI 70-2.

The standard has been revised several times through the years to stay current as the industry and its products have evolved and advanced. The standard was revised by the FCI Control Valve Section in 1998 in order to maintain consistency with the appropriate IEC Standards (IEC 534-4). The standard was revised in 2003 to add the option to permit low pressure gas testing to determine Class V leakage. During the canvass of the 2003 version, one respondent asked for the standard to be modified to specifically exclude on/off valves used for tight shut-off. The FCI Control Valve and Regulator Section notes that FCI 70-2 has been intended to apply to control valve seat leakage. If line isolation and/or absolute tight shut-off is a normal expectation of the valve application, the FCI Control Valve and Regulator Sections recommend specifying another standard, such as API 598, “Valve Test and Inspection.”

The existence of a Fluid Controls Institute (FCI) standard does not in any respect preclude any member or non-member from manufacturing or selling products not conforming to this standard nor is the FCI responsible for its use.

FCI recognizes the need to periodically review and update this standard. Suggestions for improvement should be forwarded to the Fluid Controls Institute, Inc., 1300 Sumner Avenue, Cleveland, Ohio, 44115-2851. All constructive suggestions for expansion and revision of this standard are welcome.

ANSI/FCI 70-2-2006
AMERICAN NATIONAL STANDARD
Control Valve Seat Leakage

1. PURPOSE

1.1 This standard establishes a series of seat leakage classes for control valves and defines the test procedures.

2. SCOPE & LIMITATIONS

2.1 Selection of a leakage class is not restricted as to valve design, but acceptable values for various commercially available designs are suggested for each class under Section 4.

2.2 The standard cannot be used as a basis for predicting leakage at conditions other than those specified.

2.3 This standard is similar to IEC 60534-4, except that no provision is made for Class IV-S1 and the standard is applicable for valves with a Cv value less than 0.1. The air leakage test and allowable leak rates for Class V are equivalent to the water test and allowable water leakage rates for a water test performed at a nominal temperature of 60ºF.

3. DEFINITIONS

3.1 Control Valve

3.1.1 A valve with a power positioning actuator for moving a closure member to any position relative to a valve seat or seats in response to and in proportion to an external signal. The energy for a control valve actuator is derived from an independent source.

3.1.2 Control valve body subassemblies on which an actuator is to be mounted at some later date are within the intent of this definition.

3.2 Cv - An experimentally determined valve sizing coefficient. (Ref. ISA S75.01, ISA S75.02 and FCI Standard 84-1).

3.3 Rated Valve Capacity. The quantity of test fluid (air or water) that would pass through the valve at rated travel under the stated pressure conditions as determined by the appropriate equations and manufacturer's ratings.

3.4 Rated Travel. The valve travel at which the manufacturer's rating is established.

3.5 Seat Leakage**.** The quantity of test fluid passing through an assembled valve in the closed position under the test conditions as defined.

4. LEAKAGE SPECIFICATIONS & CLASSES

4.1 The maximum allowable seat leakage as specified for each class shall not exceed the seat leakage in Table 1 using the test procedure as defined in Section 5. For Classes II through VI each and every valve shall be tested.

4.2 Leakage Classes

4.2.1 CLASS I. A modification of any Class II, III or IV valve where design intent is the same as the basic class, but by agreement between user and supplier, no test is required.

4.2.2 CLASS II. This class establishes the maximum permissible leakage generally associated with commercial double-seat control valves or balanced single-seat control valves with a piston ring seal and metal-to-metal seats. Use test procedure Type A.

4.2.3 CLASS III. This class establishes the maximum permissible leakage generally associated with Class II (4.2.2), but with a higher degree of seat and seal tightness. Use test procedure Type A.

4.2.4 CLASS IV. This class establishes the maximum permissible leakage generally associated with commercial unbalanced single-seat control valves and balanced single-seat control valves with extra tight piston rings or other sealing means and metal-to-metal seats. Use test procedure Type A.

4.2.5 CLASS V. This class is usually specified for critical applications where the control valve may be required to be closed, without a blocking valve, for long periods of time with high differential pressure across the seating surfaces. It requires special manufacturing, assembly and testing techniques. This class is generally associated with metal seat, unbalanced single-seat control valves or balanced single-seat designs with exceptional seat and seal tightness. Use test procedure Type B using water at the maximum operating differential pressure or Type B1 by using air at the specified conditions.

4.2.6 CLASS VI. This class establishes the maximum permissible seat leakage generally associated with

TABLE 1		
Leakage Class	**Maximum Seat Leakage**	**Test Procedure**
Class I (See 4.2.1)	See Paragraph 4.2.1	None
Class II (See 4.2.2)	0.5% of rated valve capacity	Type A (See 5.1)
Class III (See 4.2.3)	0.1% of rated valve capacity	Type A (See 5.1)
Class IV (See 4.2.4)	0.01% of rated valve capacity	Type A (See 5.1)
Class V (See 4.2.5)	5×10^{-4} ml per minute of water per inch of seat diameter per psi differential	Type B (See 5.2)
	5×10^{-12} m^3 per second of water per mm of seat diameter per bar differential	Type B (See 5.2)
	4.7 standard ml per minute of air per inch of orifice diameter	Type B1 (See 5.3)
	11.1×10^{-6} standard m^3 per hour of air per mm of orifice diameter	Type B1 (See 5.3)
Class VI (See 4.2.6)	Leakage per Paragraph 5.4.4 as expressed in ml per minute versus seat diameter	Type C (See 5.4)

resilient seating control valves either unbalanced or balanced single-seat with "O" rings or similar gapless seals. Use test procedure Type C.

5. TEST PROCEDURES

Warning: Provisions should be made to avoid overpressuring of measuring devices resulting from inadvertent opening of the valve plug.

5.1 Test Procedure Type A

5.1.1 Test medium shall be clean air or water at 10-51ºC (50-125ºF).

5.1.2 Pressure of test medium shall be 3-4 bar (45-60 psig) or within +/- 5 percent of the maximum operating differential pressure, whichever is less.

5.1.3 Leakage flow and pressure data shall be accurate to +/- 10 percent of reading.

5.1.4 The test fluid shall be applied to the normal or specified valve body inlet. The valve body outlet may be open to atmosphere or connected to a low headloss measuring device.

5.1.5 The actuator shall be adjusted to meet the operating conditions specified. The full normal closing thrust as applied by air pressure, a spring, or other means shall then be applied. No allowance or adjustment shall be made to compensate for any increase in seat load obtained when the test differential is less than the maximum valve operating differential pressure.

5.1.6 On valve body assemblies made for stock, tested without the actuator, a test fixture should be utilized which applies a net seat load not exceeding the manufacturer's normal expected load under maximum service conditions.

5.1.7 On water test, care shall be taken to eliminate air pockets in the valve body and piping.

5.1.8 The leakage rate thus obtained can then be compared to the calculated values for Classes II, III and IV. See Table 1.

5.2 Test Procedure Type B

5.2.1 Test fluid shall be clean water at 10-52ºC (50-125ºF).

5.2.2 The water test differential pressure shall be within +/- 5 percent of the maximum service pressure drop across the valve plug, not exceeding the maximum operating pressure at room temperature as determined by ANSI B16.1, B16.5, or B16.34, or some lesser pressure by individual agreement. Pressure measurement accuracy is to be in accordance with paragraph 5.1.3.

5.2.3 The fluid shall be applied to the normal specified inlet of the valve body. The valve plug shall be opened and the valve body assembly filled completely with water, including outlet portion and any downstream connecting piping, and then stroked closed.

5.2.4 The water test differential pressure as specified in 5.2.2 is then applied with the actuator adjusted to meet the operating conditions specified. The net actuator thrust shall be the specified maximum. Net actuator thrust above the specified maximum is not to be used.

5.2.5 When leakage flow is stabilized, the quantity should be observed over a period of time sufficient to obtain the accuracy under paragraph

5.2.6 The leakage rate thus obtained shall not be greater than the value calculated from the definition of maximum seat leakage for Class V as shown in Table 1. The nominal seat diameter is understood to be the diameter at the point of seating contact to the nearest 2 mm (1/16 inch).

5.3 Test Procedure Type B1

5.3.1 Test medium shall be clean air or nitrogen gas at 10-52ºC (50-125ºF).

5.3.2 Inlet pressure of test medium shall be 3.5 barg, (50 psi).

5.3.3 Leakage flow and pressure data shall be accurate to ±10 percent of reading.

5.3.4 The test fluid shall be applied to the normal or specified valve body inlet, and the outlet connected to a suitable measuring device.

5.3.5 The leakage rate thus obtained shall not be greater than the value calculated from the definition of maximum seat leakage for Class V as shown in Table 1. The orifice diameter is understood to be the diameter at the point of seating contact to the nearest 2 millimeters (1/16 inch).

TABLE 2

Nominal Seat Diameter		
Millimeters (Inches)	**ml per Minute**	**Bubbles per Minute***
< 25 (< 1)**	0.15	1**
38 (1.5)	0.30	2
51 (2)	0.45	3
64 (2.5)	0.60	4
76 (3)	0.90	6
102 (4)	1.70	11
152 (6)	4.00	27
203 (8)	6.75	45
250 (10)	11.1	
300 (12)	16.0	
350 (14)	21.6	
400 (16)	28.4	

*Bubbles per minute as tabulated are a suggested alternative based on a suitable calibrated measuring device, in this case, a 6 mm (0.25 inch) O.D. x 1 mm (0.032 inch) wall tube submerged in water to a depth of from 3 to 6 mm (0.125 to 0.25 inch). The tube end shall be cut square and smooth with no chamfers or burrs and the tube axis shall be perpendicular to the surface of the water. Other apparatus may be constructed and the number of bubbles per minute may differ from those shown as long as they correctly indicate the flow in ml per minute.

**If the valve seat diameter differs by more than 2 mm (0.08 inch) from one of the values listed, the leakage rate may be obtained by interpolation assuming that the leakage rate varies as the square of the seat diameter.

5.4 Test Procedure Type C - Class VI

5.4.1 Test medium shall be air or nitrogen gas at 10-52ºC (50-125ºF).

5.4.2 Pressure of the test medium shall be the maximum rated differential pressure across the valve plug or 3.5 bar (50 psig) whichever is the least.

5.4.3 The test fluid shall be applied to the normal or specified valve body inlet, and the outlet connected to a suitable measuring device.

5.4.4 With the control valve adjusted to meet the operating conditions specified (see paragraphs 5.1.5 and 5.1.6) and with sufficient time allowance for stabilizing flow, the leak rate shall not exceed the values in Table 2.

6. REFERENCES

6.1 “International Electrical Commission (IEC) Standard 60534-4, Industrial Process Control Valves – Inspection and Routine Testing.”

THE SERIES OF RETOP VALVE REPAIRING EQUIPMENT

ReTop Vertical Valve Repairing Grinder

ReTop valve repair grinding machine taking the professional valve repair as the design concept while the design principle is dynamic balance, by adopting variable frequency motor as the power source, to process with grid grinding and fine grinding through infinitely variable speeds, constant power, constant torque, turbine axial feeding, planet grinding head, it is the international leading professional valve repair equipment.

The remarkable characteristic of this machine tool is that it is integrated professional valve repair equipment combined with grinding and fine grinding functions.

The power source of this machine is 5KW variable frequency motor which is with strong driving power, the metal parts are with strong rigidity and stable mechanical stabilities, the grinding plate and the grinding head matching with precision, running stable, radial grinding force is strong, which allow grinding and fine grinding process after bead welding and repairing welding of valve seat, spool, wedge disc and sealing ring, connecting flanges, middle flange, ball valve seat etc. in respect to stop valve, gate valve, ball valve, power station valve, water seal valve, regulating valve, safety valve, check valve etc., hence, the sealing performance of the repaired valve is excellent and exceeding the turning effect, it could be even called as the "Good Doctor" of old and damaged valves.

Valve Repair & Restoration Process

By grasping the working condition, contact medium, bearing temperature and cause of damage etc. of the valves on the enterprise production lines, perfecting repair and restoration solutions shall be worked out with respect to the old valves, and to proceed with the perfect repair process for the valves by using of ReTop vertical valve repairing grinder.

Replaced old valves, dismantling → Cleaning → Select appropriate electrode → Bead welding of sealing surface → Grinding by valve repair and grinding machine → Fine grinding by valve grinding machine → Inspection of sealing surface → Valve assembling → Pressure rating testing with over 30% value of original valve pressure → Valve surface painting and beautification → Valve Repairing Name Plate → Valve repair and restoration completed successfully → Putting into use again

Grinding

For sealing surface after bead welding with stainless steel electrode or cemented carbide electrode, it could process with high strength grinding, and grinding roughness could reach 0.8;

Fine Grinding

On the basis of grinding function, to use the integrated design of grinding and fine grinding functions, it is no need to replace the grinding head, but only to adjust the rotary speed, it could process with fine grinding to the sealing surface, and the fitness degree could reach 100%, radial fitness 100%, surface roughness 0.4;

Chamfering

By using the special grinding head for this grinder, it could complete chamfering process for the sealing surface after grinding and fine grinding;

Taper Grinding

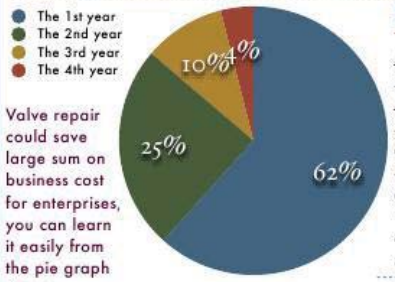
By using the special taper grinding head for this grinding machine, it could repair and restore taper sealing type valves;

Boring

Fix metacenter bushing on the operating table, it could process for Φ50-150mm (2" - 6") inner bore by using boring tools;

Milling

Fix AB carriage (latitudinal, longitudinal) and other working kit, it could process for plane and inclined plane of work piece; further fix electromagnetic plate and accessories, it could process metal sealing part and other similar parts.



Valve repair could save large sum on business cost for enterprises, you can learn it easily from the pie graph above.

Original 5 year purchasing expenditures: US$ 1,000,000

Cost on valve repairing: US$ 300,000

You having saved: US$ 700,000

Do you know: how much could valve repair save for you?

As everyone knows valves are of wearing parts, if any leakage occurs, the life of the valve shall be ended. But, is that really the case? ***Absolutely NO!***

Along with the service of the valve for a certain period, the metal stress would be eliminated, the valve body shall not be liable for further deformation, while the vast majority cases of the valve leakage are due to damage of valve body or valve spool, therefore, as long as repair scheme were scheduled to resolve the valve sealing surface leaking problems pertinent to the specific valve leaking reasons, valves that are of better quality than the new produced ones are available.

The life of metal valve body are generally designed as 5~8 years, which means it could allow one single valve to be repaired for several times, in other words, valve purchase cost shall be reduced greatly through repeated valve repairing!

Design Concept of ReTop Vertical Valve Repairing Grinder

Valve repair and grinding machine are designed as double stand column to fit the machine height requirement for valve repairing, and the working table is wide and thick; transmission device setting as variable frequency motor infinitely variable speeds, and the drive sleeve and the drive shaft are with bigger diameter, which could bearing heavy load, and with strong torque, rigidity, and good strength; feeding device is worm wheel driving the rotation axis sleeve thread, axial grinding; grinding mechanism designed with flat grinding, taper grinding and chamfer grinding, the grinding head could realize revolution and rotation planet type grid grinding, therefore, it is provided with various grinding functions needed for valve repair.

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RETOP VALVE REPAIR AND RESTORATION SYSTEM

Advantages of Setting up VRS by Enterprises

Large and medium sized chemical, electric, oil and gas, smelting, paper making, pharmacy industry enterprises will consume large quantity of industrial valves, according to statistics from Industrial Planning on Coal Industry established by National Development and Reform Commission, the valve purchase quantity for coal industry shall be 7% of the overall investment amount, while the annual replacement shall account for over 25%, therefore, as the consumable products for production, it costs very high!

ReTop Valves Repair Co., Ltd. Could customize a full and complete set of valve repair and restoration system on the basis of industrial features, production environment, service medium, operating temperature, bearing pressure etc. factors of the enterprise client, even by consideration the actual conditions of each production processes, and shall be responsible for the employee training, special device R&D etc., to service you on increasing income and decreasing expenditures and energy saving and emission reduction!

Overview of ReTop Repair and Restoration System

By use of our independent R&D vertical valve repair and grinding machine, vertical spherical grinding machine, slant rotary table, universal working knit, professional grinding head, special clamp, matching up with general machine and pressure test and inspection device, it could realize bead welding of old valve metal seal surface, fine machining of new seal surface, fitting of soft sealing surface, valve parts manufacturing, caliber and adjusting of original irregular geometric dimensions of the valves, repairing valve defects caused by various factors, and valve assembling and fitting, pressure test and inspection, painting and delivery, quality feedback, tracking service etc. as well. The combination application of the above devices and interacting technological process, and repairing procedures together constructed the valve repair and restoration system (VRS for short).

The VRS could repair GB, DIN, API, ANSI valves produced by various manufacturers. With the combination applications of the independent patented valve repair and grinding machine and universal working kit which are the key component of VRS, it could complete the repair and restoration of DN50-1000mm valves of various kinds with high quality, and even could expand to repair of DN1200mm valves by increasing the VRM machine power rate and fixing special working kit.

RETOP VERTICAL VALVE REPAIRING GRINDER

Parameters	RETOP-PM-300	RETOP-PM-500	RETOP-PM-800
Dimension (mm)	1300 × 1100 × 1300 (approx)	1300 × 1300 × 1500 (approx)	1500 × 1200 × 2300 (approx)
Weight	900 Kg (approx)	1100 Kg (approx)	1300 Kg (approx)
Operational Plate Width (mm)	1300 × 1100 (approx)	1300 × 1300 (approx)	1500 × 1200 (approx)
Operational Plate Height (mm)	800	1000	1200
Power of Variable Frequency Motor	2.2 Kw	3 Kw	4 Kw
Driving Speed	Infinitely Veritable Speed	Infinitely Veritable Speed	Infinitely Veritable Speed
Feeding Apparatus	Worm Wheel	Worm Wheel	Worm Wheel
Grinding after Bead Welding	Yes	Yes	Yes
Fine Grinding	Yes	Yes	Yes
Axial Fitness	100%	100%	100%
Grinding Roughness	0.8	0.8	0.8
Fine Grinding Roughness	0.4	0.4	0.4
Accessories	Saddle-shaped working kit, gate valve taper block, flat grinding head, taper grinding head, chamfer grinding head	Saddle-shaped working kit, gate valve taper block, flat grinding head, taper grinding head, chamfer grinding head	Saddle-shaped working kit, gate valve taper block, flat grinding head, taper grinding head, chamfer grinding head
Repair Nominal Diameter	DN50 - 300 mm 2" - 12"	DN50 - 500 mm 2" - 20"	DN50 - 800 mm 2" - 32"
Pressure Rating	0.1 - 100 MPa	0.1 - 100 MPa	0.1 - 100 MPa
Service Valve Type	The flat, angle, taper type valve sealing surface of Stop Valve, Gate Valve etc.	The flat, angle, taper type valve sealing surface of Stop Valve, Gate Valve etc.	The flat, angle, taper type valve sealing surface of Stop Valve, Gate Valve etc.

RETOP SLANT ROTARY TABLE

The independent R&D slant rotary table is the accessory equipment to match up with the vertical repair and grinding machine for the processing of slant angle seal surface of wedge gate valve, knife-type valves etc., and its design is more advanced than the slant block accessories, its model falls into SRT-DN300, SRT-DN500 and SRT-DN800, customized service also available. The body of the wedge gate valve shall be fixed on the rotary table, grinding operations for the top and bottom seal surfaces; it is no need to turn over the valve body to complete one-time repair, while the geometric accuracy of the seal surface could be guaranteed, repair efficiency improved.

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