



Clampseal® Globe Valve Servicing Instructions



CLAMPSEAL® valves have unique features which enable them to be completely serviced in line.

The following service operations are possible:

- Seat Refacing
- Disc Refacing
- Bonnet Seal Refacing
- Replacement of Bonnet Chamber Assembly
- Quick repacking by swapping bonnet chamber assemblies.
- Repack old bonnet and return to stock.

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I. INSTALLATION

METAL TO METAL SEATED VALVES

Perform installation welding in accordance with ASME Boiler and Pressure Vessel Code, Sec. I, Part PW, or ASME B31.1 Para 127.

A. **IMPORTANT**

DO NOT DISASSEMBLE VALVE. Valve must be assembled and tightly closed during welding to protect seat from heat distortion and weld splatter.

B. Allow 1/16" gap between bottom of socket and end of pipe (PW 41.5.7 or ASME B31.1 Para 127.3.(E)).

C. Preheat per Table 1.

SOFT SEATED VALVES

A. Remove stem assembly as detailed in section V. A. steps 1 - 4.

B. Reassemble valve using Metal Disc Stem Assembly as detailed in section V. G. steps 2 and 3, A. through E.

C. Follow section I., A through C.

D. Follow steps A and B to put in Soft Seated Stem Assembly.

NOTE: For Soft Seated Check valves you must remove the Disc and Spring and follow instructions for Soft Seated valves.

TABLE 1
PREHEAT AND POSTWELD HEAT TREAT REQUIREMENTS

P-1 SA-105	P-5 SA-182 GR. F22	P-8 SA-182 GR. F316	P15E SA-182-F91
PREHEAT 50° F (A100.4.1) *	PREHEAT 400° F (A100.4.4) *	PREHEAT NONE REQUIRED (A100.4.7) *	PREHEAT 400° F
POST WELD HEAT TREAT NONE REQUIRED (PW-39)	POST WELD HEAT TREAT REQUIRED WHEN NOMINAL WALL THICKNESS EXCEEDS 5/8" (PW-39) LOCALIZED ONLY PER (PW-39-4-2)	POST WELD HEAT TREAT NONE REQUIRED (PW-39)	POST WELD HEAT TREAT REQUIRED (PW-39)
* ASME BOILER AND PRESSURE VESSEL CODE, SECTION I, PART PW-38			

II. OPERATION

All CLAMPSEAL® valve stems have single pitch right hand threads with clockwise rotation of the handle to close. Valves used for “on-off” service should be fully open or fully closed.

The CLAMPSEAL® valve has a backseat feature which, in the fully open position, isolates the packing from line pressure thereby increasing packing life. This is pressure actuated and requires only a light torque to effect a seal. See Table 2 for torque values.

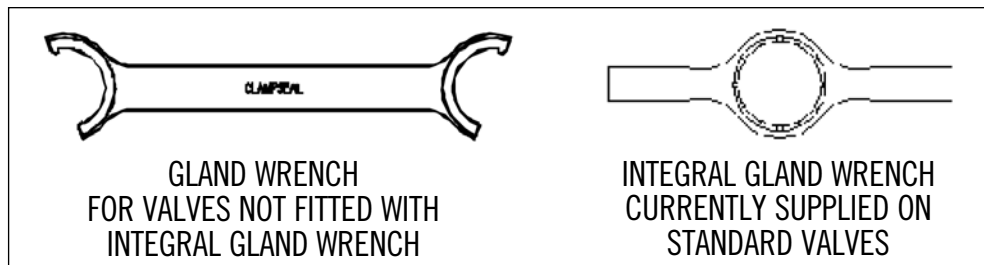
Always check packing gland tightness before taking off backseat to prevent leakage.

III. PACKING GLAND ADJUSTMENT

CLAMPSEAL® valves have a precision packing system with a single piece splined gland. Packing should be adjusted periodically to prevent leakage. Adjustment is especially important after hydro test or startup.

Most CLAMPSEAL® valves are furnished with an Integral Gland Wrench, Figure A. The I.G.W. provides for easy packing maintenance which helps extend packing life. Cycle valve several times while adjusting packing to improve packing seal.

FIGURE A



IV. MAINTENANCE

All components of the CLAMPSEAL® valve are shown in Figure B on page 7. CLAMPSEAL® valves have several distinctly different design features from other valves. These servicing instructions should be followed closely.

A. Routine Maintenance

Routine maintenance consists of a periodic tightening of the gland to prevent packing leakage. Graphite packing manufacturers recommend routine replacement of packing after 3 years of service. No other routine maintenance is required.

B. Adding a Ring of Packing Under Pressure

Packing will eventually wear to the point where tightening of the gland will not effect a seal. When this happens it is possible to add a packing ring under pressure as follows:

Note: This is only a temporary solution until the valve can be disassembled and repacked.

1. Isolate the valve and allow pressure to bleed off. Tag-out isolation valves. Follow prescribed safety procedures for your plant.

When the valve is pressurized, the valve backseat provides pressure enhanced positive sealing. This feature does not provide a two valve protection which is specified in some safety standards. **Proceed only as a last resort. Do not try to remove packing from a pressurized valve.**

2. Open the valve fully and torque onto backseat. See Table 2 for torque. Over torqueing will not enhance the seal and could cause damage.
3. Wait for leakage to stop as the fluid or gas trapped in the packing blows down.

CAUTION: IF LEAKAGE PERSISTS DO NOT PROCEED!

4. Remove handle to prevent accidental movement off of backseat.
5. Use gland wrench (Figure A.) to slowly screw the gland to full height on the yoke bushing, while checking for blow by.
6. Open new graphite filament wiper packing ring at split for insertion around the stem
7. Slide ring into bonnet chamber and compress by tightening the gland. Loosen the gland to see if another ring will fit. If so, rotate second ring split one-quarter turn from first ring.
8. Tighten gland. Do not exceed torque listed in Table 3. Rotate stem several times, in both directions, to seat packing.

TABLE 2
MAXIMUM OPERATING TORQUES (FT-LBS)

SIZE CODE	YOKE	SEATING	BACKSEAT	CLAMPBOLT
3C 3D	100	30	4	15
5C 5D	150	30	4	15
5E 5F 5G	150	60	6	15
6E 6F 6G 6H	200	60	6	15
7E	250	60	6	25
7F 7G 7H 7J	250	100	9	25
8F	350	100	9	25
8G 8H 8J 8K	350	230	12	25
9G 9H	425	230	12	60
9J 9K 9L	425	420	18	60
10H	600	230	12	105
10J	600	420	18	105
10K 10L 10M	600	500	25	105

V. REPAIR

A. DISASSEMBLY OF CLAMPSEAL STOP VALVES FOR INSPECTION AND REPAIR

CAUTION: Before any attempt is made to disassemble the valve, verify that the valve is isolated from system pressure and secured against accidental pressurization. Follow standard tag out safety procedures before proceeding.

Note: Valve with size code 8, 9, 10 are supplied with impactor handwheels.

FIGURE B

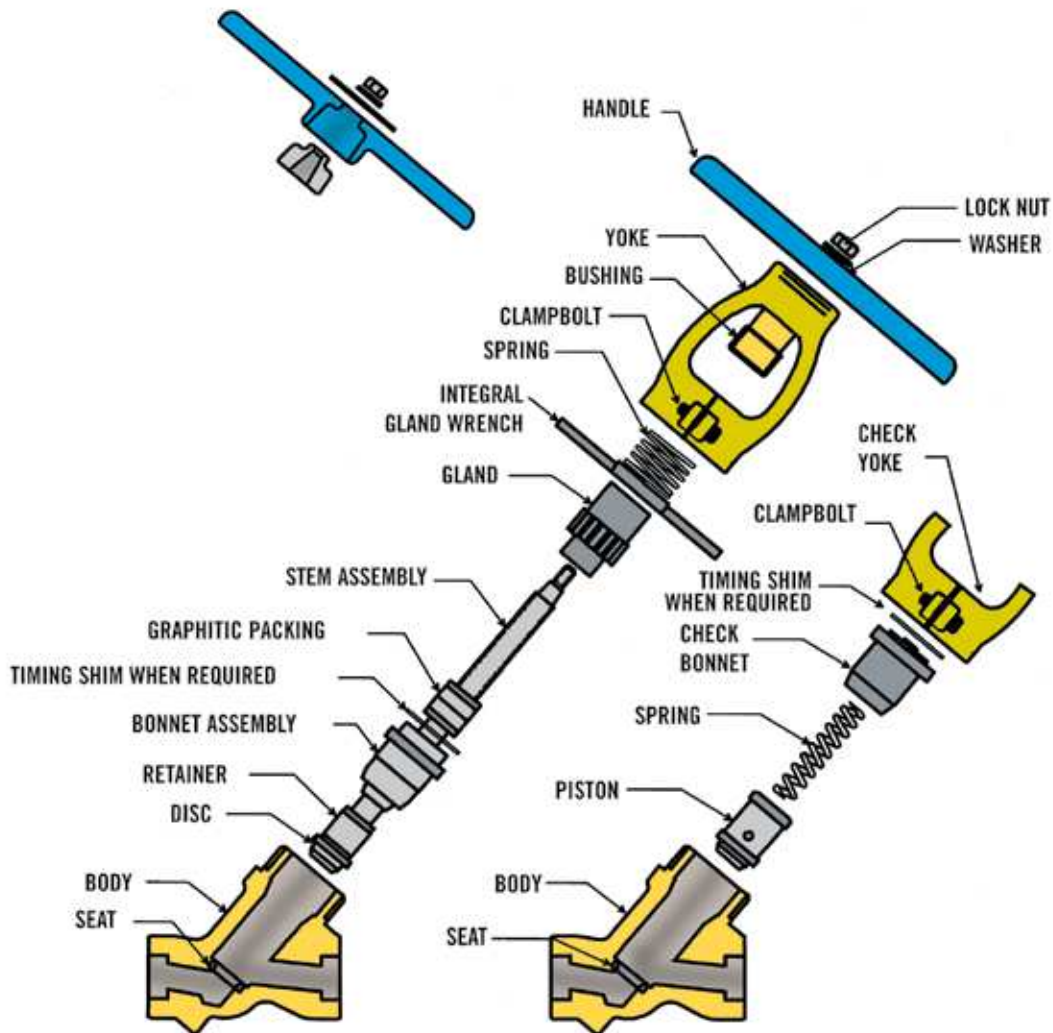


TABLE 3
OPERATING GLAND TORQUES (FT-LBS)

SIZE CODE	MINIMUM	MAXIMUM
3C, 3D	10	15
5C, 5D	10	15
5E, 5F, 5G	25	35
6E, 6G, 6H	25	35
7E	25	35
7F, 7G, 7H, 7J	45	60
8F	45	60
8G, 8H, 8J, 8K	55	75
9G, 9H	55	75
9J, 9K, 9L	115	155
10H	55	75
10J	115	155
10K, 10L, 10M	145	195

YOU MAY USE 1 OR 1A BELOW, BUT NOT BOTH.

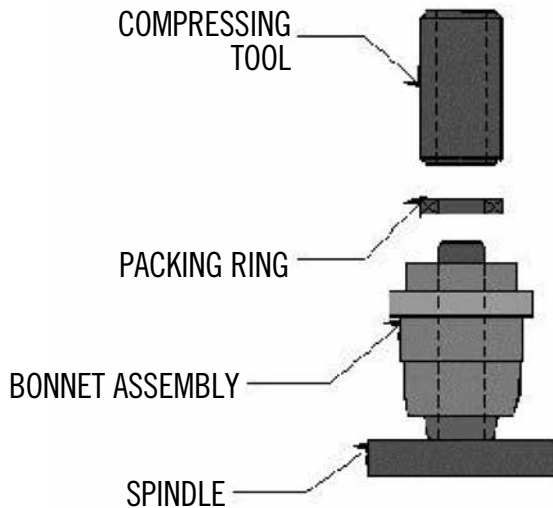
1. Completely remove the clambolt from the yoke and screw it into the opposite (threaded) side of the clambolt lug. Place a metal flat (like a fender washer) into the yoke split to stop the clambolt. Tighten clambolt, using it as a jacking screw, until the yoke split expands by 1/16" to 1/4" (this is to relieve yoke thread friction).
- 1A. Completely remove the clambolt from the yoke and keep the clambolt for reassembly. Drive a small wedge (similar to a wood chisel) straight down into the split in the clambolt lug until the yoke split expands by 1/16" to 1/4" on large valves. **CAUTION: When using method 1A, always drive the wedge straight down, never drive the wedge toward the body threads or thread damage could occur.**
2. Unscrew the yoke, using a Conval Yoke Wrench. Remove the yoke assembly carefully so that the stem and disc do not scratch the bonnet sealing surface. If the bonnet becomes stuck in the body, proceed with steps 3-5 and use a small wedge under the bonnet flange.
3. Remove lock nut, washer, and valve handle.
4. Removal of the stem from the yoke assembly requires threading the stem down through the yoke bushing. To make removal easier it is helpful to clean the stem threads thoroughly with a wire brush and solvent. Some filing may also be required to clean the threads at the handle flats.
5. Remove timing shims (if supplied) from bonnet. Shims are provided in some valves to maintain proper yoke orientation. Keep the original shim set with the valve for reassembly.
6. To remove bonnet, invert stem and press bonnet down over stem.
7. Inspection of sealing surface and valve components for damage or wear
 - Body, Seat, bonnet seal
 - Stem, disc sealing surface, packing sealing surface, backseat lip of retainer
 - Bonnet, backseat nose, body seal, packing chamber surface
 - Body threads and yoke threads. If corrosion or damage to threads is found stop the repair and replace the valve.

B. REPACKING

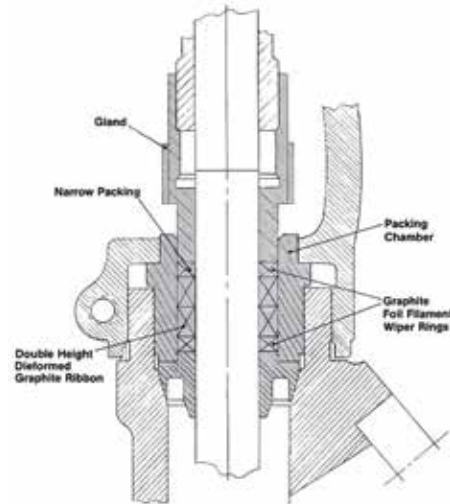
1. Remove old packing using a soft dowel (wood, plastic or brass). Put bonnet on table upside down and press rings out from the bottom. It's helpful to soak the bonnet and packing in solvent to loosen packing before removal.

WARNING: Do not use a standard packing puller. It will cause scoring of the bonnet chamber and create a leak path.

**FIGURE C
REPACKING TOOL**



PACKING GLAND SEAL



2. Clean bonnet chamber in cleaning solvent to remove contaminants which will contribute to stem pitting. Place the bonnet chamber over the spindle of the Conval repacking tool, adding rings individually and manually depress them into the chamber with the compressing sleeve. No preloading is required. The order of assembly is as shown in Figure C.

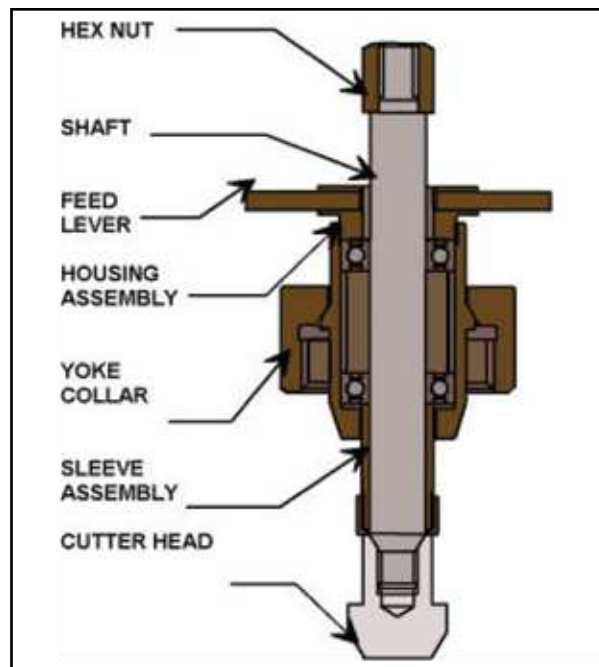
NOTE: Use only dieformed graphitic seal rings and woven graphitic wiper rings for best packing performance.
See below for correct size.

REPACKING TOOL	SIZE CODE	PACKING RINGS		WIPER RINGS	
		OD X ID X HT	QTY	OD X ID X HT	QTY
T3-RP-1	3C 3D 5C 5D	3/4 X 1/2 X 1/4	2	3/4 X 1/2 X 1/8	2
T5-RP-1	5E 5F 5G 6E 6G 6H 7E	1 X 5/8 X 3/8	2	1 X 5/8 X 3/16	2
T7-RP-1	7F 7G 7H 7J 8F	1 1/4 X 3/4 X 1/2	2	1 1/4 X 3/4 X 1/4	2
T8-RP-1	8G 8H 8J 8K 9G 9H 10H	1 3/8 X 7/8 X 1/2	2	1 3/8 X 7/8 X 1/4	2
T9-RP-1	9J 9K 9L 10J	1 3/4 X 1 1/8 X 3/8	3	1 3/4 X 1 1/8 X 5/16	2
T10-RP-1	10K 10L 10M	1 7/8 X 1 1/4 X 5/8	2	1 7/8 X 1 1/4 X 5/16	2

C. SEAT REFACING

1. Disassemble valve
2. Move the feed lever of the reseating tool high on the housing assembly to prevent the cutter from contacting the seat during assembly and open the sleeve assembly 90% open.
3. Insert refacing tool into the body cavity carefully to prevent damage to the bonnet sealing surface.
4. Screw the yoke collar onto the body threads and hand tighten.
5. Press down on the shaft to insure that the cutting head is resting on the seat.
6. Bring feed lever down to just above the race bearing.
7. Pull up on the shaft to insure that some “play” exists.
8. **DO NOT FEED CUTTER WITHOUT ROTATING SHAFT. (Figure D)**
Attach socket wrench to hex nut at the top of the shaft and begin to rotate shaft in clockwise direction. While rotating the shaft, move the feed lever clockwise until cutter begins to cut. Continue to rotate shaft while feeding feed lever to provide smooth continuous cutting. Note position of feed lever when cutting starts to occur. Cut no more than one-quarter turn of feed lever, then check. Remove as little metal from the seat as needed to remove damage.
9. Clear body of chips with solvent and a rag. Check seat for complete removal of cuts or indications. If the seat is not clean, repeat steps 8 and 9 until the seat is clean.

FIGURE D



D. DISC REFACING

Chuck the retainer portion of the stem assembly in a lathe and center to within .001". Use a single point carbide tool (Kennametal Grade K68 or equal) with a fine feed and cutting speed of 30-50 S.F.P.M. Machine the minimum amount of metal necessary to clean the surface to $29^{\circ} \pm 10$ min.

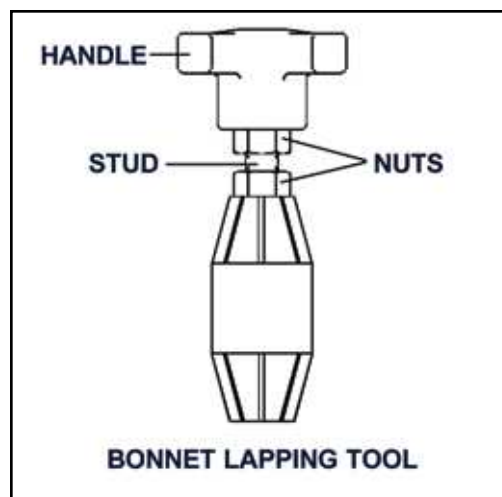
E. BONNET SEAT REFACING

1. Assemble Bonnet Lapping Tool as shown in Figure E.
2. Apply a small amount of Lapping Compound to the seating surface of the Bonnet Lapping Tool. Use compound 120 (coarse) for rough lapping, 280 (fine) for final lapping.
3. Apply slight downward pressure on the Bonnet Lapping Tool. Lap back and forth until a smooth finish on the Bonnet lip is achieved.
4. Clean parts thoroughly with solvent and a clean rag.

F. SEAT LAPPING

1. Assemble lapping tool as shown in Figure F.

FIGURE E



NOTE: SEE PAGE 14 FOR BONNET LAPPING TOOL PART NUMBERS.

2. Sleeve should be loose so that the disc can wobble easily. Secure sleeve in this position by tightening the hex nut.
3. Apply a small amount of lapping compound to the seating surface of the disc. Use compound 120 (coarse) for rough lapping, 280 (fine) for final lapping.
4. Maintain slight downward pressure on the stem. Lap back and forth for about two minutes or until a smooth finish on the disc and seat is achieved.

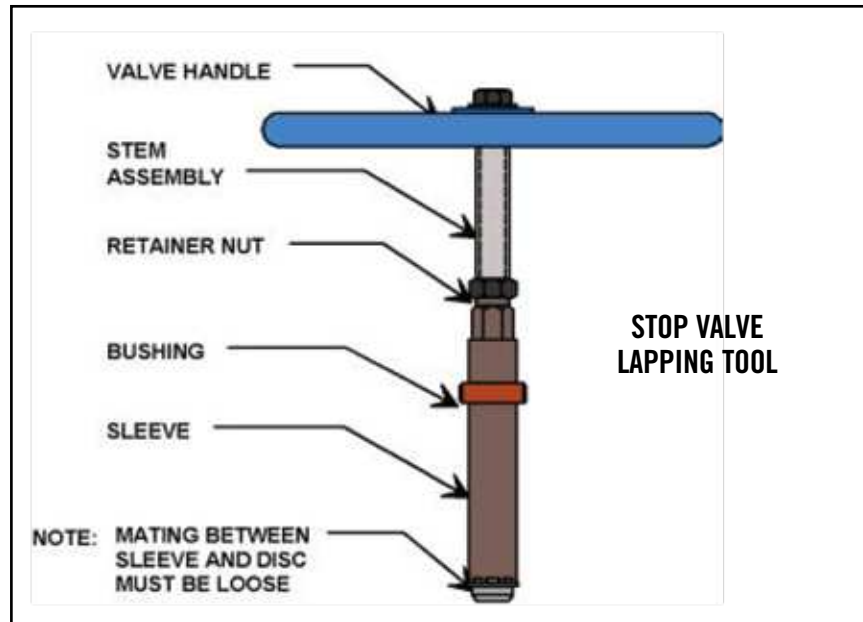
NOTE: Overlapping will result in full face contact between seat and disc. The goal is to maintain a 1/16" line contact.

5. Clean parts thoroughly with solvent and a clean rag.

G. REASSEMBLY

1. Clean all parts thoroughly with cleaning solvent.
2. Coat body/yoke threads with a nickel anti-seize lubricant.
3. Assemble the components in the following order:

FIGURE F



NOTE: SEE PAGE 14, FOR STOP VALVE LAPPING TOOL PART NUMBERS.

- a. Use repacking tool sleeve to hold packing inside of the bonnet chamber as bonnet is slid onto stem assembly.
- b. Screw packing gland to its highest point on the yoke bushing.
- c. Replace timing shims (if shims were provided originally) onto bonnet chamber and screw stem assembly into yoke to mid travel position. Keep timing shims flat on bonnet ledge.
- d. Spread yoke as described in section V.A.1 or 1A, Page 8. Place yoke assembly into body. Avoid contact between disc and body/bonnet seal surface as the yoke assembly is placed into body.
- e. Screw yoke onto body. Insure that stem is in mid travel and gland is at top of yoke bushing. Apply torque as specified in Table 2. - DO NOT OVER TORQUE!
- f. If yoke alignment must be changed add .030" thick shims for each 90° of desired rotation.
- g. Return clampbolt to normal position and tighten per Table 2.
- h. Place handle and fasteners onto stem and tighten.
- i. Cycle valve several times to seat packing and readjust packing gland. Tighten packing gland per Table 3.

VI. SUPPLEMENTARY INSTRUCTIONS

A. FACTORY MOUNTED MOTOR OPERATORS

Factory mounted operators should not be removed from the valve prior to installation. The torque switches have been set prior to hydro testing and should not require field adjustment.

B. MOUNTING OF CLAMPSEAL® VALVE TO MOTOR OPERATOR IN FIELD

This procedure applies where a valve is being mated with an existing operator:

1. Install valve per procedure in Section I, page 2.
2. Yoke arms should be oriented in the position shown in Figure B. This orientation will minimize yoke arm stresses.
3. Slide the motor operator over the valve stem adapter.
4. Coat mounting bolts with a nickel anti-seize lubricant. Bolt the operator to the valve yoke flange. Torque bolts to values for SA-193-B7 fasteners (23 ft-lbs for the 5/16" bolt normally found on small operators).
5. Reset operator limitswitches. The "open" limitswitch is set to de-energize the actuator 1/4 turn before the valve reaches backseat. The "close" limitswitch is set to insure that the actuator does not de-energize until the torque switch opens. Torque switch setting should not need adjustment.

DO NOT USE THE OPEN TORQUE SWITCH TO DE-ENERGIZE THE VALVE!

C. STORAGE

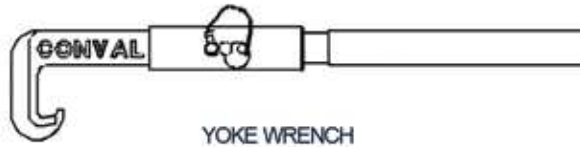
All valves are treated with rust-preventative, capped, and sealed in polyethylene bags to repel moisture. Valves should be stored in a weatherproof enclosure on pallets or shelving to isolate valve from moisture.

D. HANDLING

CLAMPSEAL® valves are extremely rugged and damaging them during handling is difficult. However, some care must be taken in handling. Do not drop them. Use yoke arm or body to lift valve. Do not lift by valve handle.

E. TORQUE TOOLS

The following torque tools are available:



VII. SERVICE TOOL CROSS REFERENCE

Globe Valve Size Code Tool Kit	Stop Tool Kit	Check Tool Kit	Combined Stop and Check Tool Kit	Stop Valve Seat Lapping Tool	Check Valve Seat Lapping Tool	Bonnet Lapping	Repacking Tool	Yoke Wrench	Yoke Torque Wrench	Gland Wrench	Refacing Tool
3C	TK3C-C-S-1	TK3C-C-C-1	TK3C-C-CS-1	C12-A-MA1	C23-A-MA1	C102	C8	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-3C
3D	TK3D-C-S-1	TK3D-C-C-1	TK3D-C-CS-1	C12-B-MA1	C23-A-MA1	C102	C8	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-3D
5C	TK5C-C-S-1	TK5C-C-C-1	TK5C-C-CS-1	C12-AA-MA1	C23-H-MA1	C103	C8	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-5C
5D	TK5D-C-S-1	TK5D-C-C-1	TK5D-C-CS-1	C12-D-MA1	C23-H-MA1	C103	C8	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-5D
5E	TK5E-C-S-1	TK5E-C-C-1	TK5E-C-CS-1	C12-C-MA1	C23-B-MA1	C104	C2	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-5E
5F	TK5F-C-S-1	TK5F-C-C-1	TK5F-C-CS-1	C12-C-MA1	C23-B-MA1	C104	C2	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-5F
5G	TK5G-C-S-1	TK5G-C-C-1	TK5G-C-CS-1	C12-L-MA1	C23-C-MA1	C105	C2	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-5G
6E	TK6E-C-S-1	TK6E-C-C-1	TK6E-C-CS-1	C12-CC-MA1	C23-U-MA1	C106	C2	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-6E
6G	TK6G-C-S-1	TK6G-C-C-1	TK6G-C-CS-1	C12-DD-MA1	C23-C-MA1	C107	C2	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-6G
6H	TK6H-C-S-1	TK6H-C-C-1	TK6H-C-CS-1	C12-DD-MA1	C23-C-MA1	C107	C2	C99	3/6-TORQUE-YW-1	C233-B-F25	C71-6H
7E	TK7E-C-S-1	TK7E-C-C-1	TK7E-C-CS-1	C12-P-MA1	C23-F-MA1	C108	C2	C100	7/10-TORQUE-YW-1	C233-B-F25	C71-7E
7F	TK7F-C-S-1	TK7F-C-C-1	TK7F-C-CS-1	C12-F-MA1	C23-J-MA1	C109	C4	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-7F
7G	TK7G-C-S-1	TK7G-C-C-1	TK7G-C-CS-1	C12-E-MA1	C23-V-MA1	C110	C4	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-7G
7H	TK7H-C-S-1	TK7H-C-C-1	TK7H-C-CS-1	C12-E-MA1	C23-V-MA1	C110	C4	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-7H
7J	TK7J-C-S-1	TK7J-C-C-1	TK7J-C-CS-1	C12-M-MA1	C23-K-MA1	C111	C4	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-7J
8F	TK8F-C-S-1	TK8F-C-C-1	TK8F-C-CS-1	C12-Y-MA1	C23-R-MA1	C112-B	C4	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-8F
8G	TK8G-C-S-1	TK8G-C-C-1	TK8G-C-CS-1	C12-H-MA1	C23-L-MA1	C113-B	C14	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-8G
8H	TK8H-C-S-1	TK8H-C-C-1	TK8H-C-CS-1	C12-G-MA1	C23-D-MA1	C111	C14	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-8H
8J	TK8J-C-S-1	TK8J-C-C-1	TK8J-C-CS-1	C12-G-MA1	C23-D-MA1	C111	C14	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-8J
8K	TK8K-C-S-1	TK8K-C-C-1	TK8K-C-CS-1	C12-N-MA1	C23-M-MA1	C114-B	C14	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-8K
9G	TK9G-C-S-1	TK9G-C-C-1	TK9G-C-CS-1	C12-Z-MA1	C23-P-MA1	C115-B	C14	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-9G
9H	TK9H-C-S-1	TK9H-C-C-1	TK9H-C-CS-1	C12-K-MA1	C23-N-MA1	C116-B	C14	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-9H
9J	TK9J-C-S-1	TK9J-C-C-1	TK9J-C-CS-1	C12-J-MA1	C23-E-MA1	C117-B	C15	C100	7/10-TORQUE-YW-1	C216-B-F25	C71-9J
9K	TK9K-C-S-1	TK9K-C-C-1	TK9K-C-CS-1	C12-J-MA1	C23-E-MA1	C117-C	C15	C100	7/10-TORQUE-YW-1	C216-B-F25	C71-9K
9L	TK9L-C-S-1	TK9L-C-C-1	TK9L-C-CS-1	C12-R-MA1	C23-T-MA1	C118-B	C15	C100	7/10-TORQUE-YW-1	C216-B-F25	C71-9L
10H	TK0H-C-S-1	TK0H-C-C-1	TK0H-C-CS-1	C12-X-MA1	C23-AA-MA1	C119-B	C14	C100	7/10-TORQUE-YW-1	C232-B-F25	C71-10H
10J	TK0J-C-S-1	TK0J-C-C-1	TK0J-C-CS-1	C12-T-MA1	C23-W-MA1	C120	C15	C100	7/10-TORQUE-YW-1	C216-B-F25	C71-10J
10K	TK0K-C-S-1	TK0K-C-C-1	TK0K-C-CS-1	C12-S-MA1	C23-G-MA1	C121-B	C17	C100	7/10-TORQUE-YW-1	C216-B-F25	C71-10K
10L	TK0L-C-S-1	TK0L-C-C-1	TK0L-C-CS-1	C12-S-MA1	C23-G-MA1	C121-C	C17	C100	7/10-TORQUE-YW-1	C216-B-F25	C71-10L
10M	TK0M-C-S-1	TK0M-C-C-1	TK0M-C-CS-1	C12-BB-MA1	C23-Y-MA1	C121-C	C17	C100	7/10-TORQUE-YW-1	C216-B-F25	C71-10M

NOTE: SEE PAGE 14 FOR SIZE CODE CROSS REFERENCE. * Optional snap-on torque handle made available through SNAP-ON.14

VIII. SIZE CODE CROSS REFERENCE

All CLAMPSEAL® valves are distinguished by a size code which defines tool and part interchangeability. The size code is stamped on all valve bodies just below the threads and directly above the round raised pad where the steel heat code is stamped. Size codes consist of a number followed by a letter. The number refers to the body forging size and the letter refers to the seat ring size. This table lists Conval's standard size codes for given configurations. Reference size code when ordering parts or tools. Always confirm the size code by inspecting the valve.

Y-GLOBE SW

ANSI CLASS	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00
900/1195	3D	5E	5F	5G	6H	7J	-	-	-
1500/2155	3D	5E	5F	6G	7H	8J	9K	-	-
2500/3045	3C	5E	5E	7G	7G	8H	10K	-	-
3500/4095	5D	5D	6E	8G	8G	9H*	-	-	-
4500	5C	6E	7E	-	10H	-	-	-	-

Y-GLOBE BW

ANSI CLASS	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00
900/1195	3D	5E	5F	5G	6H	7J	8K	9L	10M
1500/2155	3D	5E	5F	6G	7H	8J	9K	10L	10L
2500/3045	3C	5E	5E	7G	7G	8H	9J	10K	10K
3500/4095	5D	5D	6E	7F	8G	8G	9H	10J	10J
4500	5C	6E	6E	-	7E	8F	9G	10H	10H

ANGLE SW

ANSI CLASS	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00
900/1195	3D	5E	5F	5G	7H	8J*	-	-	-
1500/2155	3D	5E	5F	7G	7H	8J	-	-	-
2500/3045	3C	5E	5E	7G	8H	-	-	-	-
3500/4095	5D	5D	7F	8G	8G*	-	-	-	-

ANGLE BW

ANSI CLASS	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00
900/1195	3D	5E	5F	5G	7H	8J	8J	-	-
1500/2155	3D	5E	5F	7G	7H	8J	8J	-	-
2500/3045	3C	5E	5E	7G	7G	8H	8H	-	-
3500/4095	5D	5D	7F	7F	8G	8G	8G	-	-

VERTICAL STEM SW

ANSI CLASS	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00
900/1195	3D	5E	5F	7G	7H	7J*	-	-	-
1500/2155	3D	5E	5F	7G	7H	8J*	-	-	-
2500/3045	3C	5E	5E	7G	7G	8H*	-	-	-
3500/4095	5D	5D	7F	8G*	8G*	-	-	-	-

VERTICAL STEM BW

ANSI CLASS	0.50	0.75	1.00	1.25	1.50	2.00	2.50	3.00	4.00
900/1195	3D	5E	5F	7G	7H	7J*	7J*	8J*	-
1500/2155	3D	5E	5F	7G	7H	8J*	8J*	-	-
2500/3045	3C	5E	5E	7G	7G	8H*	8H*	-	-
3500/4095	5D	5D	7F	7F	7F	8G*	8G*	-	-

* Indicates recent change required by ANSI B16.34 (1988) or indicates recent introduction of #8 vertical stem forging.



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