

# HD Series Pilot Operated Regulating Valve – PTRP Temperature Pilot

## Installation Operation & Maintenance Manual



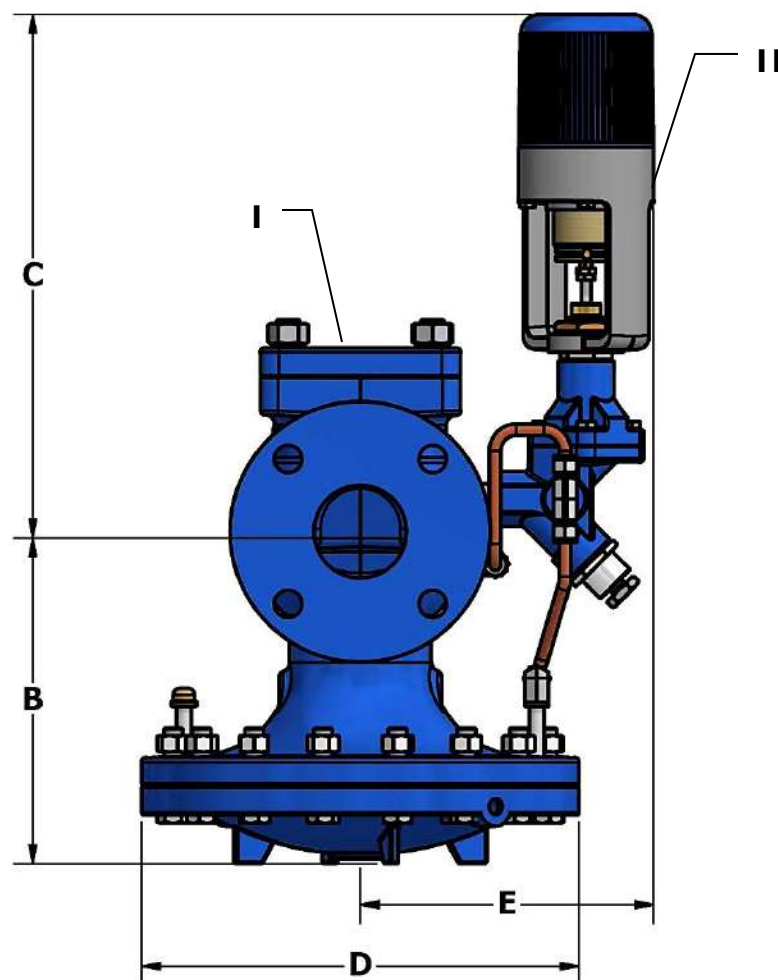
## FOR HARSCO



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## HD Specifications



**Figure 1: HD Pressure Regulating Valve with  
PTRP-91 Non-Indicating Pilot**

Item	Description
I	Main Valve Assembly
II	Pilot Assembly

### HD Valve Pressure-Temperature Ratings

PMO Max. Operating Pressure	300 PSIG
NPT	450 PSIG @ 650°F
150# FLG	150 PSIG @ 566°F
300# FLG	450 PSIG @ 650°F

### HD Inlet Pressure Range for Pilot Selection

Inlet Pressure	Pilot Selection
15-300 psig	Standard PTRP Pilot & Standard Main Valve
Under 15 psig	Low Pressure PTRP Pilot & Low Pressure Main Valve

### Temperature Ranges

Range Code	Nominal Range (°F)	Recommended Working Span (°F)
01	20-70	40-65
02	40-90	65-85
03	30-115	85-110
04	50-140	110-135
05	75-165	135-160
06	105-195	160-190
07	125-215	190-210
09	155-250	210-245
10	200-280	245-275
11	225-315	275-310
12	255-370	305-365
13	295-420	365-415
14	310-440	415-435

Size	(A) Face to Face			B	C	D	E	F *	Weight (lbs)		
	NPT	150#	300#						NPT	150#	300#
1/2"	4 3/8			5 1/2	10	6 1/2	7 3/4	0.143	18		
3/4"	4 3/8			5 1/2	10	6 1/2	7 3/4	0.143	18		
1"	5 3/8	5 1/2	6	6 1/4	10	7	7 3/4	0.149	23	40	45
1 1/4"	6 1/2			7 3/8	10	8 3/4	8 1/4	0.175	43		
1 1/2"	7 1/4	6 7/8	7 3/8	7 3/8	10	8 3/4	8 1/4	0.175	43	55	60
2"	7 1/2	8 1/2	9	8 1/4	10	10 7/8	8 1/2	0.202	65	75	85
2 1/2"		9 3/8	10	9	10	11 3/4	8 1/2	0.209		100	105
3"		10	10 3/4	8 7/8	10	13 1/4	9 1/2	0.237		130	145
4"		11 7/8	12 1/2	10 7/8	10	14 3/4	10 1/2	0.237		215	235
6"		15 1/8	16	14 1/8	10 1/2	19 3/4	11 3/4	0.326		420	470

All dimensions are in inches unless noted differently

\*For "F" dimension details, see page 11.

**For PTRP-94 Pilot with Indicating Dial:** Add 4" to C dimension to include dial thermometer height

Each Watson McDaniel Company Product is warranted against defects in material and workmanship for one year from date of shipment. This warranty extends to the first retail purchaser only. All defective material must be returned to the person from whom you purchased the Product, transportation prepaid, free of any liens or encumbrances, and if found to be defective will be repaired free of charge or replaced, at the warrantor's or seller's option. If the material is replaced, any replacement will be invoiced in the usual manner and after inspection of alleged defective material an adjustment will be made for depreciation caused by purchaser's use. In no event will Watson McDaniel Company be liable to do more than refund the original contract price. Incidental and consequential damages are excluded, whether under this warranty or otherwise. All implied warranties, including warranties of merchantability and fitness for a particular purpose, are disclaimed and excluded.

## **Principle of Operation**

The HD Pilot Operated Regulating Valve with PTRP Temperature Pilot is a mechanically operated device designed to regulate system temperature by modulating the flow of steam in response to temperature changes.

1. High pressure steam enters the valve and fills the chamber above the seat in the main body.
2. The high pressure steam moves to the pilot base where a stainless steel screen captures unwanted dirt and particles. This allows cleaner steam to pass through to the pilot base.
3. Turn the temperature adjustment screw to set the desired temperature. To adjust the temperature use the adjustment bar provided connected to the pilot. Insert the adjustment bar into the hole along the bottom of the adjustment screw. To increase the temperature, turn the adjusting screw from left to right up toward the upper end of the reference scale. To lower the control point, turn the adjusting screw from right to left down toward the lower end of the reference scale. The sensing bulb will measure the temperature of the fluid and will open or close the pilot depending on how close to the set temperature the bulb is measuring.
4. If the measured temperature is below the set temperature of the pilot, the pilot valve will be open.
5. The steam then travels through the pilot valve to the lower pilot chamber which flows to the external transmission tubing. This then fills the area under the main valve diaphragm.
6. The pressure then lifts the main valve disc off the seat ring which allows the upstream steam to flow to the downstream piping.
7. As the temperature measured by the sensing bulb rises to the set temperature of the pilot, the pilot valve will begin to close off.
8. As the pilot valve begins to close, this restricts the flow of steam to the lower pilot chamber, which then begins to close the main valve disc.
9. The pilot will throttle to maintain a constant temperature of the fluid the sensing bulb is measuring.

## Installation

1. Make sure steam supply is safely shut off. Fig. 2 piping hookup is a typical installation to be used as a guide for planning piping.
2. Valve should be installed in horizontal position with flow in direction as indicated by arrow on body. Main valve diaphragm to be in down position. **Caution:** When installing flanged valves make sure flange bolts are tightened evenly so as not to overstress and crack flanges.
3. Piping will need to be adequately sized to handle the flow capacity, velocity, and pressure.
4. Piping upstream should generally be 1-2 times larger than valve size and downstream side of valve is generally 2-3 times larger than valve, or equal to the inlet connection on the steam using equipment, to eliminate flow restriction.
5. An eccentric reducer at inlets will reduce the risk of water hammer by removing a potential condensate collection point.
6. Install a steam trap in a drip leg ahead of the pressure reducing valve to remove the condensate, insure proper operation, and increase valve life.
7. A 'Y' type strainer should be installed in the horizontal position before the pressure reducing valve to prevent any collection of condensate. Make sure sufficient clearance is allowed so strainer screen can be removed.
8. Assemble Pilot to Main Valve:
  - a) Remove pilot adaptor protector from main valve.
  - b) Place gasket on pilot adaptor making sure roll pin in pilot adaptor is inserted thru small hole in gasket.
  - c) Assemble pilot to adaptor making sure roll pin in adaptor is inserted in blind hole assembly in the pilot. Tighten bolts evenly.
9. Connect Sensing Bulb to System
  - a) Avoid sharp bends, twists or any kinks in the flexible capillary. It may be coiled on a 3" diameter or larger, but never less than 3". See Figure 2 below.
  - b) Install bulb in a location that avoids any hot or cold spots in the system. Make sure the entire bulb is exposed to the system fluid.
  - c) When the bulb is installed in a thermowell, a heat transfer compound must be packed into the well to ensure a fast transfer of heat from the system to the bulb.
  - d) Install a thermometer in the system as close to the sensing bulb as possible.

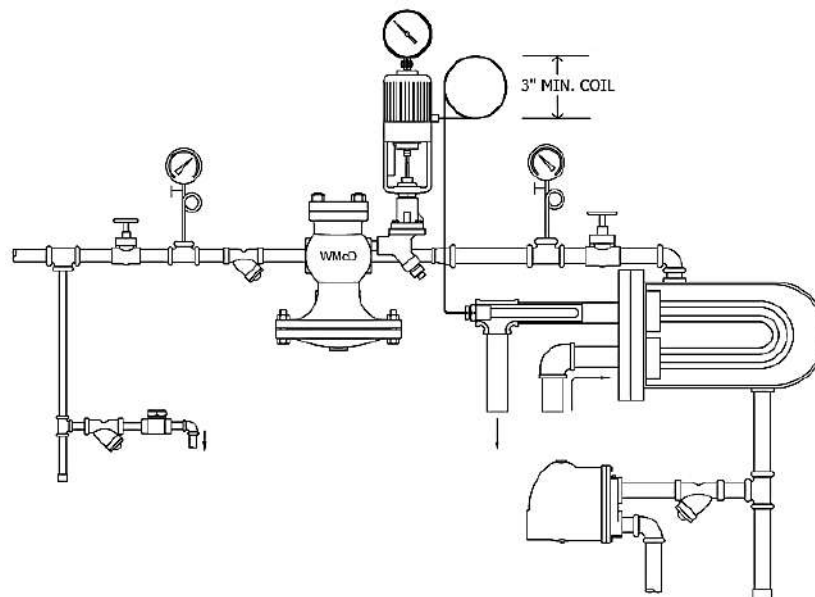


Figure 2: HD Valve Installation

## **Start up**

1. Make sure all lines have been blown down to remove initial dirt and scale from system.
2. Close all valves in installation.
3. The PTRP pilot will be factory set approximately to the field desired set temperature. Slight adjustments to the temperature adjustment screw may need to be made to dial in the set temperature, once the system is up and running. To adjust the temperature use the adjustment bar provided. Insert the adjustment bar into the hole along the bottom of the adjustment screw. To increase the temperature, turn the adjusting screw from left to right up toward the upper end of the reference scale. To lower the control point, turn the adjusting screw from right to left down toward the lower end of the reference scale.
4. Open valve ahead of steam trap or other drain valve to make sure all condensate is drained from inlet piping. If this is not done, serious damage to the piping system can occur as a result of water hammer.
5. Open downstream gate valve. Bypass valve, if installed, should be closed.
6. Open blowdown valve on pilot adapter block. When opening blowdown, be sure to support upper hex head with one wrench and open blowdown (turn counterclockwise) with another.  
**Caution:** Stand away from blowdown valve when opening, live steam will be present.
7. Verify that the bypass valve is closed. Open inlet gate valve slowly to allow steam to reach the regulator. Watch for possible water hammer. Once live steam is seen at the blowdown valve, close off blowdown valve.
8. Allow sufficient time for the system being heated to stabilize, then check system thermometer for the desired temperature. If necessary turn the adjusting knob up or down (1/4 turn at a time) to reach the system requirements.
9. Inspect all piping connections and valve for possible leaks and tighten as required. Check and retighten main valve diaphragm bolts.

## Maintenance

Main Valve Assembly		
Item	Description	Material
18	Pilot Adapter	Ductile Iron
19	Blowdown Valve	Stainless Steel
20	Screen, 40 Mesh	Stainless Steel
21	Nipple	Black Pipe, Sch, 80
22	Male Branch Tee	Brass
23	Tubing, Pilot to Body	Copper Tubing
24	Elbow, Tube to Pipe	Brass
25	Tubing, Pilot to Diaphragm	Copper Tubing
26	Main Valve Body	Ductile Iron
27	Spring	302 Stainless Steel
28	Gasket, Diaphragm Cover	Grafoil
29	Orifice Ass'y, Diaphragm	Brass (Stn. Stl. Wire)
30	Diaphragm, Main Valve	Phosphor Bronze
31	Diaphragm Cover	Ductile Iron
32	Set Screw	Stainless Steel
33	Name Plate	Stainless Steel
34	Diaphragm Plate	C.I. A126 Cl. B
35	Cap Screws	Steel
36	Nuts	Steel
37	Plug Stop	Steel Tubing
38	Stem Guide Ass'y	Brass
39	Seat Ring	402 S.S.
40	Disc & Stem Ass'y	Stainless Steel
41	Gasket, Cover	Grafoil
42	Cover Assembly	Ductile Iron
43	Nuts	Steel
44	Bleed Orifice, Male Branch Tee	Brass

Pilot Assembly		
Item	Description	Material
1	Dial Thermometer (Optl.)	Stainless Steel Case
2	Cap	
3	Temp. Adjusting Screw	Brass
4	Set Point Scale	
5	Jam Nut	
6	Yoke	
7	V-ring Packing	
8	Pilot Body	
9	Adjustment Bar	
10	Packing Nut	Brass
11	Bonnet Nut	Brass
12	Valve Stem	Stainless Steel
13	Valve Plug	Stainless Steel
14	Valve Seat	Stainless Steel
15	Capillary	Copper
16	Sensing Bulb	Copper

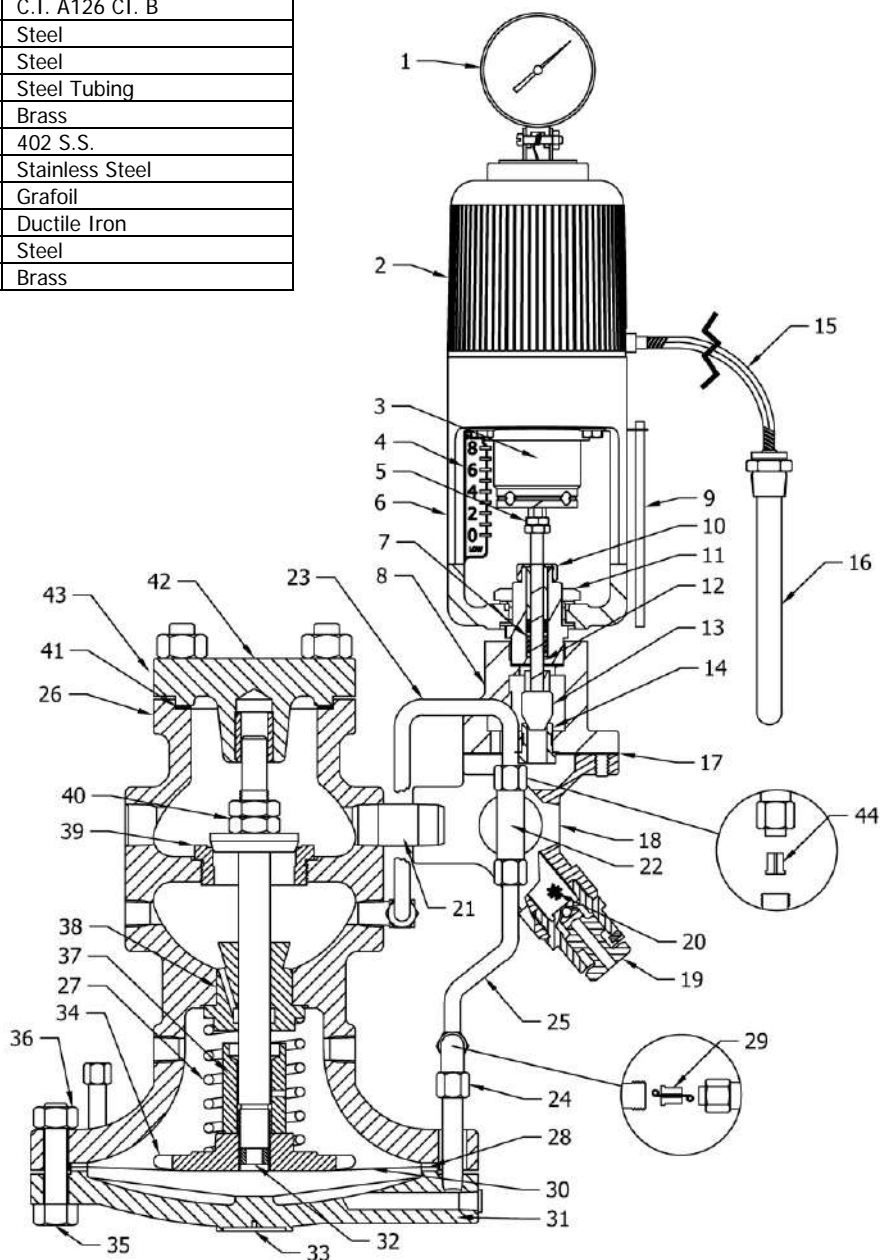


Figure 3: HD Regulating Valve Assembly



Proper maintenance is significant for reliable operation of the valve. Frequency of cleaning and maintenance performed are dependent on the conditions of the steam system.

### A. General Service Inspection

1. Inspect all connections for leaks and tighten as required.
2. Inspect and clean pilot screen.
3. Inspect and clean bleed and diaphragm orifice.
4. Blow down or clean the pilot and all pipe line strainers in the system.
5. Verify the pressure is properly set after blow down and readjust if necessary.

**Note:** At a minimum, these maintenance operations should be performed a few days after the valve has been initially installed and shortly after the start up during each heating season.

### Orifices

There are 2 different orifices located on the Valve. The Tee Bleed orifice is located on the Pilot and supplies a pressure relief path back to the main valve body. The end of the Tee with the orifice, which has an indicator mark, should be installed with the orifice side up as shown in Figure 6. The Elbow Diaphragm orifice is located outside the main valve body opposite of the diaphragm cover.

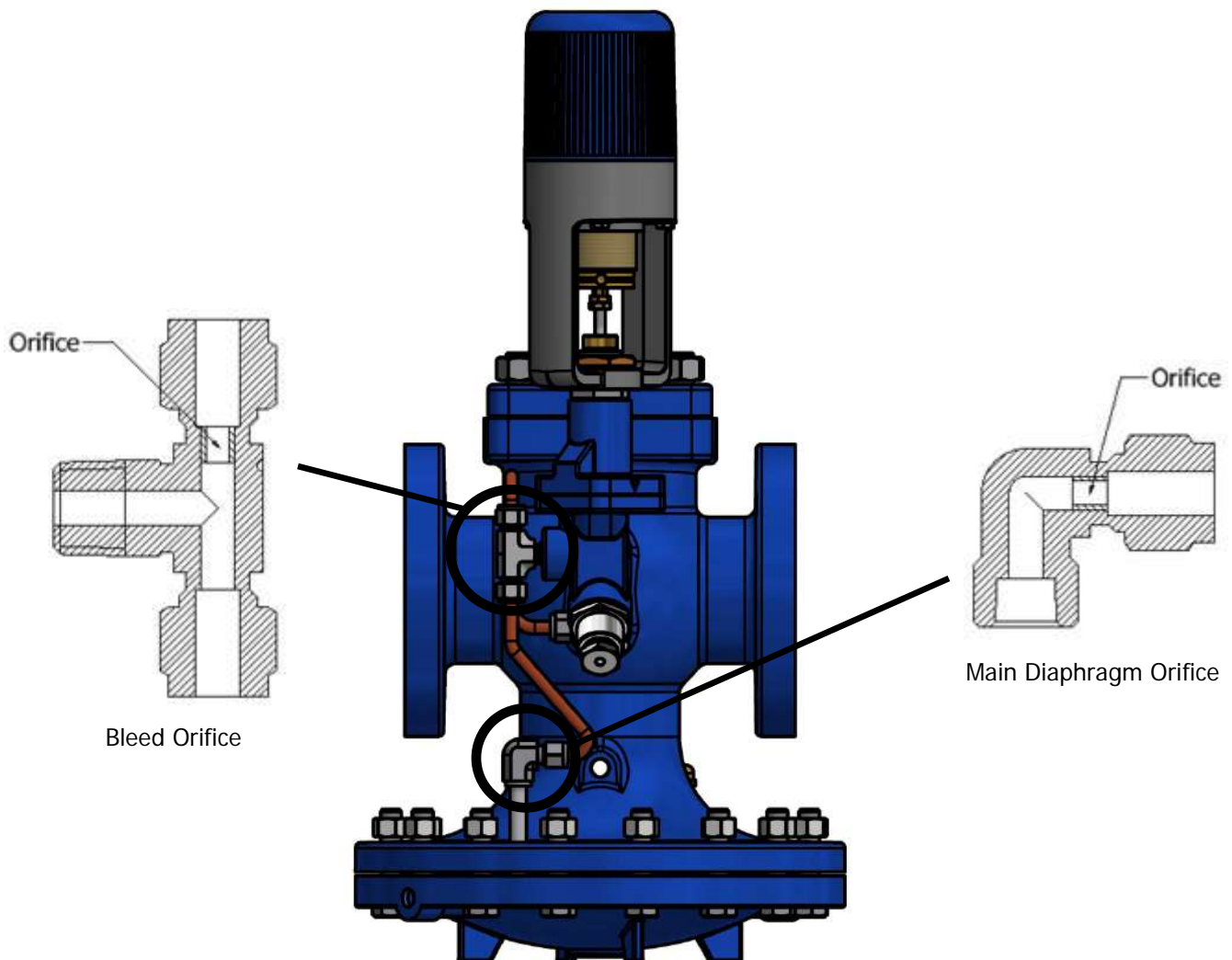


Figure 4: HD Main Valve Orifice Locations

## B. PTRP Temperature Pilot Servicing

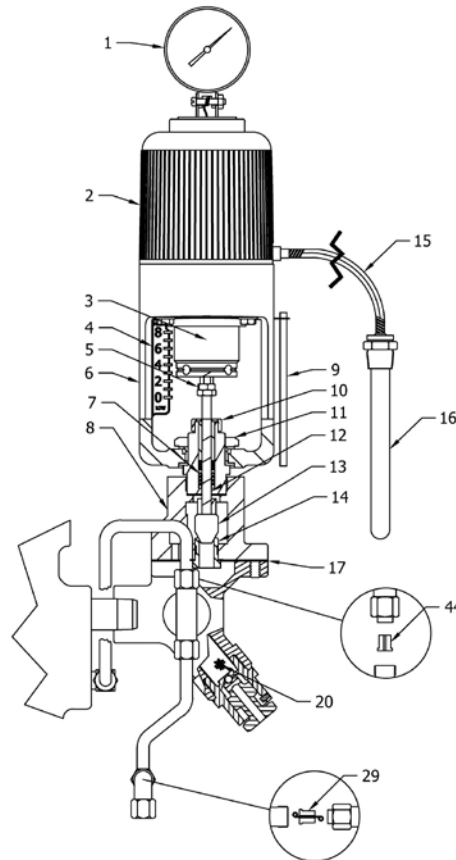


Figure 5: PTRP Pilot Cross Section

### PTRP Temperature Pilot Servicing

**CAUTION – Pilot must be cool before disassembly**

#### 1. Servicing pilot seat and disc assembly and replacing pilot valve body

- Shut down system as required.
- Remove sensing bulb from equipment. (7)
- Remove pilot assembly from pilot adapter by removing cap screws.
- Inspect, if any wear or damage is noted, replace complete assembly.
- Disconnect the pilot valve body from the actuator. See section 3, "Removing Actuator from Pilot Valve Body Assembly".
- Before reinstalling new pilot valve body assembly, inspect packing house bushing (10) for possible binding of pilot stem and excessive clearance between guide and stem. Replace only if necessary.
- Reassemble pilot valve body and actuator. See section 4, "Reassembling Actuator to Pilot Valve Body Assembly".
- Reassemble pilot to regulator. Inspect male branch tee orifice. (44)

#### 2. Replace Valve Stem Packing

- Remove actuator assembly from the pilot valve body. See section on "Removing Actuator from Pilot Valve Body Assembly"
- Loosen and remove both stem locknuts (5).
- Remove the packing nut (10) from the valve bonnet.
- Remove all old packing, adapters and spring (7) from the valve bonnet.



**DO NOT SCRATCH THE BORE OF THE PACKING HOUSING WITH SHARP TOOLS**

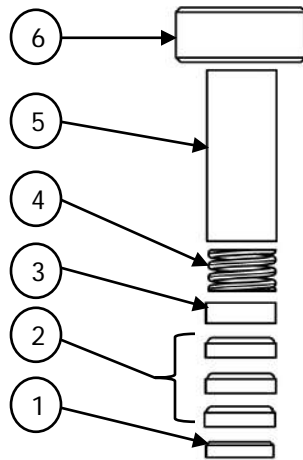
- e. Clean all surfaces of the packing housing and stem. Remove all accumulations of mineral deposits or other debris before rebuilding. A 0.4375 diameter reamer is ideal to remove deposits from bonnet (11), if the bonnet is removed from the body. A 0.45 diameter brass bonnet brush is also effective. Do not use abrasives on the valve stem (12) nor in the packing housing since scratches will cause leakage. The valve stem originally was polished to a 12 micro-finish and this polish should be preserved. If the stem is corroded, marred, or worn, it must be replaced.
- f. Blow all debris from the packing housing and the replacement packing before rebuilding.

**PACKING MUST BE CLEAN AND FREE OF FOREIGN MATERIAL**

- g. Install new packing as follows (see Figure 6)
  - 1. Male adapter with flat side in first.
  - 2. V rings must be carefully installed over the stem threads and into the packing housing bore to avoid snagging of the lips on the threads of the bore entrance. The clean edge on these lips is imperative for proper sealing.
  - 3. Female adapter with cavity against V rings and flat side out.
  - 4. Spring
  - 5. Packing spacer
  - 6. Packing nut
- h. Tighten packing nut all the way down onto the bonnet to push all rings into the packing housing and to obtain proper spring load on the assembly rings.

**FINGER TIGHTEN ONLY**

- i. Replace the stem locknuts and reposition and lock in place. See section on "Reassembling Actuator to Pilot Valve Body Assembly" and use the dimension shown in Figure 7 for setting locknut position.
- j. Reassemble Actuator to Pilot Valve Body as shown in section "Reassembling Actuator to Pilot Valve Body Assembly".

**Figure 6: Packing Assembly**

### 3. Removing Actuator from Pilot Valve Body Assembly

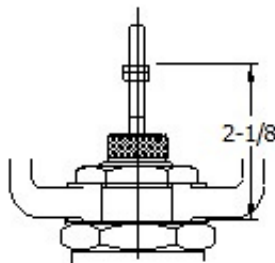
- a. Allow the sensing bulb on the actuator to cool to the bottom of the nominal range. Artificially cool with ice if necessary.
- b. Record the current actuator adjusting screw setting relative to the reference scale.
- c. Turn the actuator adjusting screw in (up) to reference number 8.
- d. Hold the hexagonal actuator stem with a 5/16" wrench. With a 3/8" wrench, hold the two stem locknuts as a wrench flat and loosen the valve stem from the hexagonal actuator stem.

**DO NOT DIRECTLY GRIP THE ROUND POLISHED PORTION OF THE VALVE STEM.**

- e. Remove the Bonnet Nut holding the actuator to the valve with a 1-1/2" wrench.
- f. Unscrew the valve stem from the actuator stem by turning the entire pilot valve body. If the pilot valve body is still in-line, then unscrew by gently turning the valve stem, gripping it ONLY by the 3/8" hex nuts. Do not directly grip the round polished portion of the valve stem.
  1. Make sure the valve plug is off of the valve seat while turning valve stem to prevent galling of the seating surface.
- g. The actuator and pilot valve body may now be separated.

### 4. Reassembling Actuator to Pilot Valve Body Assembly

- a. Unless already completed, install two locknuts onto valve stem.
  1. Thread locknuts loosely onto the valve stem.
  2. Push or pull the valve stem as appropriate to fully CLOSE the pilot valve.
  3. Set the topmost locknut to the dimension 2-1/8", shown in figure 7.



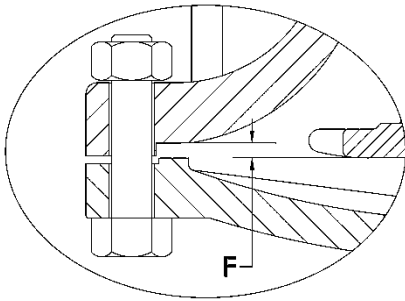
**Figure 7**

4. Tighten the lower locknut up against the upper locknut making sure that the nuts are tight enough against each other to prevent further turning about the valve stem.
- b. Allow the sensing bulb on the actuator to cool to the bottom of the nominal range. Artificially cool with ice if necessary.
- c. Record the current actuator adjusting screw setting relative to the reference scale.
- d. Turn the actuator adjusting screw in (up) to reference number 8.
- e. Place valve stem up through the Yoke and Bonnet Nut.
- f. Thread the valve stem into the actuator stem.
  1. Use a 5/16" wrench to hold or turn the actuator stem.
  2. Use a 3/8" wrench to hold the valve stem nuts to turn the valve stem.

**DO NOT DIRECTLY GRIP THE ROUND POLISHED PORTION OF THE VALVE STEM.**

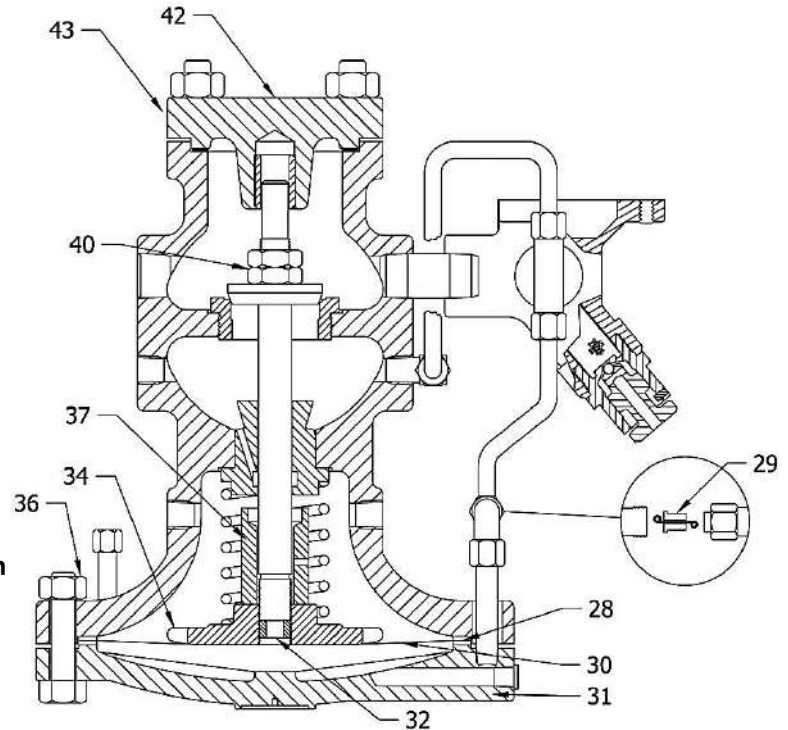
- If the valve plug can remain open relative to the valve seat, turn the valve stem into the actuator stem until the locknuts are tight against the actuator stem.
  - If the valve plug is closed against the valve seat, then gently turn the actuator down onto the valve stem until the actuator stem is tight against the locknuts.
- g. Use a 1-1/2" wrench to tighten the Bonnet Nut down onto the bonnet to hold the valve body assembly to the yoke.
  - h. Return the actuator adjusting screw to the previously recorded reference setting.

### C. Main Valve Servicing



See page 12 for further detail.

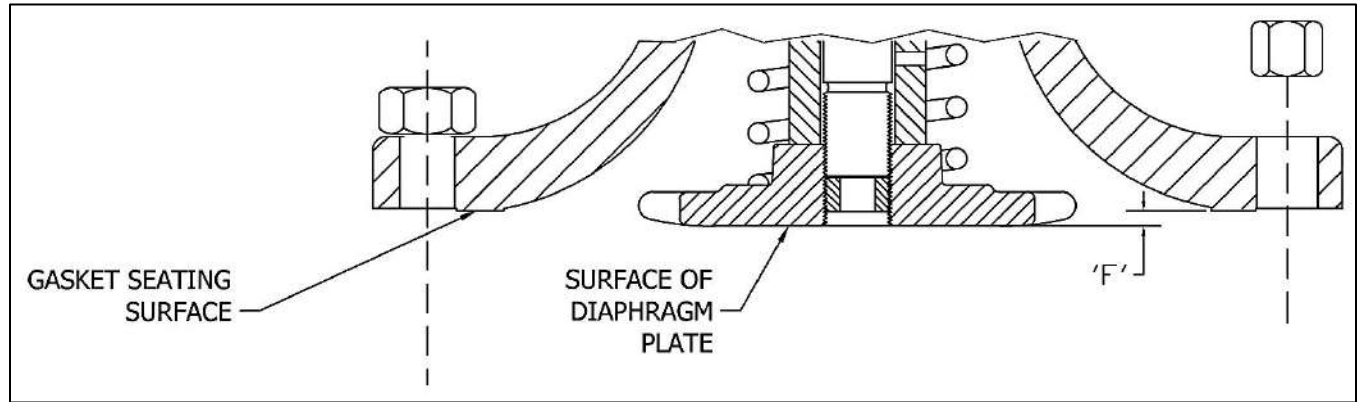
**Figure 8: HD Main Valve Cross Section**



#### **CAUTION:**

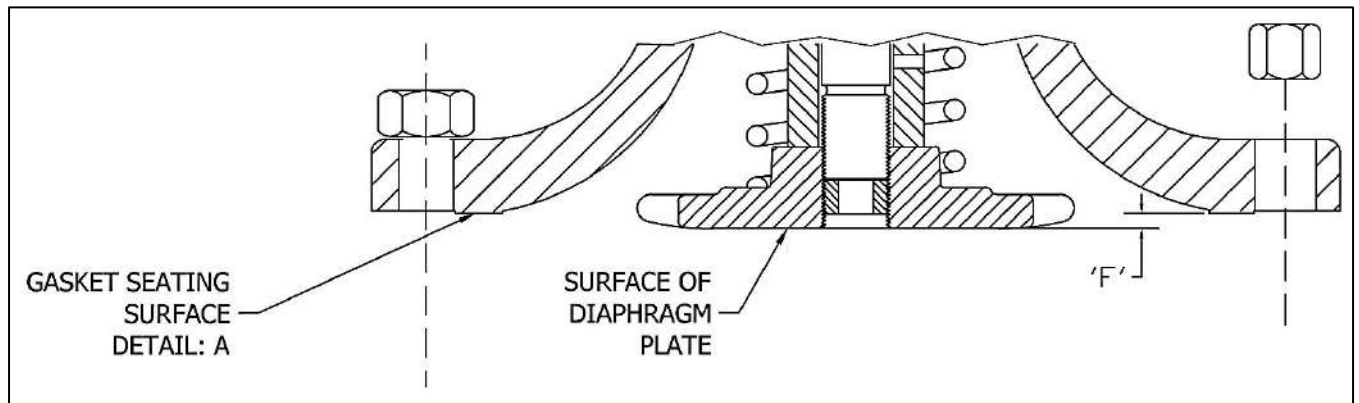
**Regulator must be cool before disassembly**

1. Servicing main valve diaphragms (30).
  - a. Shut off inlet gate valve and make sure downstream pressure is zero. Downstream gate valve could also be shut when pressure is at zero to prevent any downstream condensate from entering the valve.
  - b. Disconnect copper tubing to diaphragm chamber at 'A' check diaphragm orifice (29) for damage, etc. **CAUTION:** Some hot condensate may leak from line and diaphragm chamber.
  - c. Loosen main valve diaphragm nuts (36). **CAUTION:** Chamber filled with condensate which could be hot. First slightly loosen nuts, and then further loosen several nuts on opposite side from where you are standing. Pry cover from valve allowing condensate to drain from valve away from you. Gently pry diaphragm loose from body to drain condensate from body of valve.
  - d. Remove all bolts and diaphragm cover (31).
  - e. Inspect the two (2) metal diaphragms (30) for small cracks and wrinkles. Replace if necessary.
  - f. Clean diaphragm, diaphragm plate and gasket surfaces before reassembly
  - g. Make sure diaphragm plate (34) is securely fastened to stem with locking set screw. Check diaphragm plate setting. See dimension 'F' above. For further help on how to set the 'F' dimension, see page 11.
  - h. Valve stem assembly (40) can be checked for proper movement by pushing up on diaphragm plate. **CAUTION:** Condensate may be in upper portion of body.
  - i. Replace diaphragm gaskets (28) if necessary. Use only factory replacement gaskets.
  - j. Center diaphragms and gaskets on cover. Bolts will assist in centering.
  - k. Assemble making sure bolts are taken-up evenly. After system is started check bolts again for tightness.
2. Servicing main valve disc and seat.
  - a. Follow disassembly instructions as noted in diaphragm servicing instructions, a) above.
  - b. Loosen diaphragm plate set screw (32) and remove diaphragm plate (34).
  - c. Remove cover nuts (43) and cover (42).
  - d. Remove stem and disc assembly from valve and inspect disc and seat for wear. Minor wear can be corrected by lapping disc and seat together with 400 grit lapping compound. Inspect the disc and seat for signs of scale or dirt which could have caused leakage.
  - e. Check for body erosion around seat ring. Check seat ring for possible damage or excessive wear and any signs of scale or dirt which could have caused leakage. Replace if necessary. Replacement seats and discs should be lapped.
  - f. Reassemble as required. Make sure plug stop (37) is installed properly.



For valve sizes 1/2" through 1 1/2", gasket surface will be recessed.

'F' dimension taken from gasket surface to **center** of surface on the diaphragm plate.



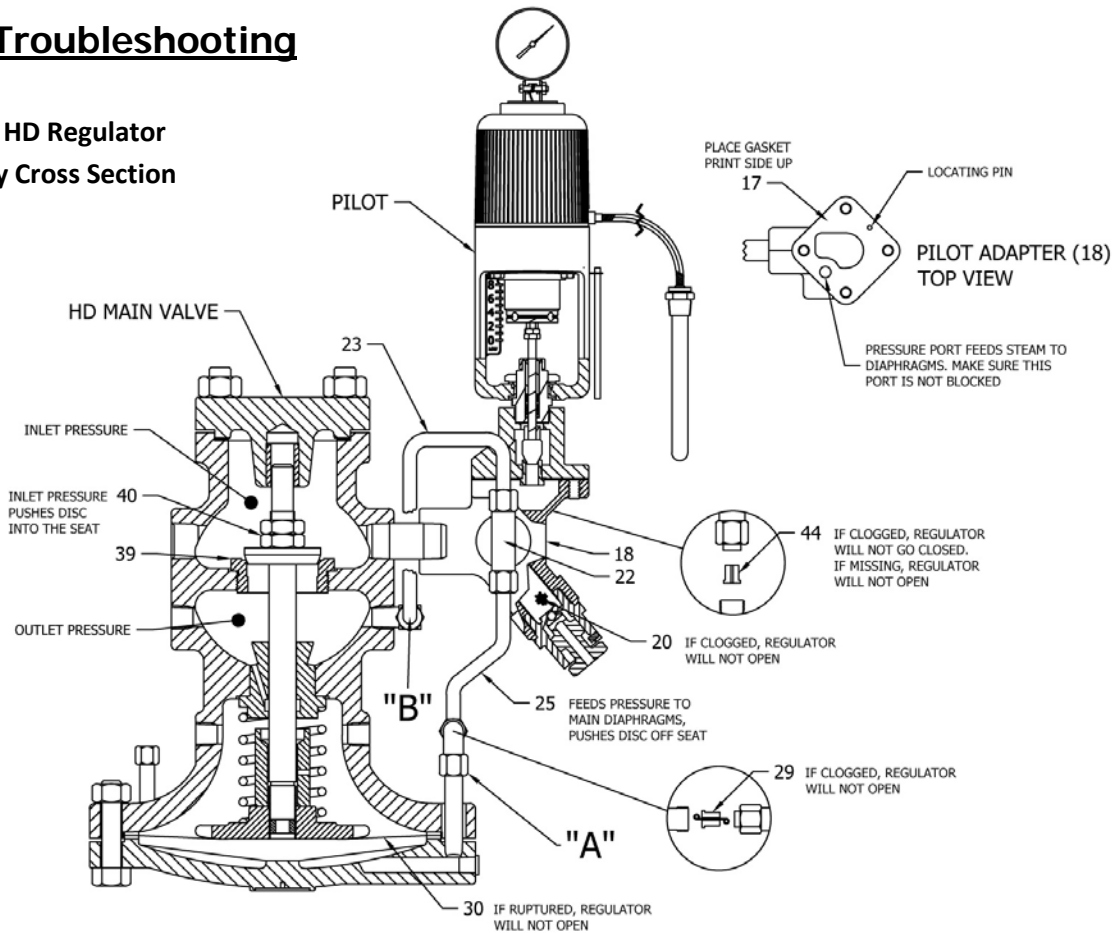
For valve sizes 2" through 6", gasket surface will be raised.

'F' dimension taken from gasket surface to **center** of surface on the diaphragm plate.

HD Valve Size	'F' Dimension
1/2"	0.143"
3/4"	0.143"
1"	0.149"
1 1/4"	0.175"
1 1/2"	0.175"
2"	0.202"
2 1/2"	0.209"
3"	0.237"
4"	0.237"
6"	0.326"

## Valve Troubleshooting

**Figure 9: HD Regulator  
Assembly Cross Section**



### REGULATOR WILL NOT COME UP TO TEMPERATURE

1. Shut off inlet gate valve to regulator and make sure downstream pressure is zero.
2. Make sure that the Pilot Gasket (17) is properly oriented on the Pilot Adapter (18); otherwise, the pressure port in the adaptor will be blocked and regulator will not open.
3. Check Pilot Strainer (20) for blockage as well as the upstream pipeline strainer.
4. Inspect Diaphragm Orifice (29) for blockage and Diaphragms (30) for rupture.
5. Check that the Bleed Orifice (44) at the Male Branch Tee (22) is not missing.

### TEMPERATURE OVERRIDES SET POINT: ISOLATE REGULATOR FROM PILOT FOR TESTING

1. Before isolating the regulator, open the blowdown valve located on the pilot adapter block. When opening blowdown, be sure to support upper hex head with one wrench and open blowdown with another. **Caution:** Stand away from blowdown valve when opening, live steam will be present. This may remove any dirt/debris from the pilot valve head and seat that is preventing the pilot from fully closing. If this does not resolve the issue, continue with the remaining steps.
2. Shut off inlet block valve to regulator and make sure downstream pressure is zero.
3. Adjust the pilot to the closed position. On Temperature pilot, turn the temperature adjustment screw to the lowest setting.
4. Disconnect the pilot tube (25) at the regulator diaphragm which is indicated as point "A" in the illustration above. Also disconnect the smaller pilot tube (23) at the side of the regulator body designated point "B" in the above illustration.
5. Stand clear of the tube connections and open the block valve upstream of the Main Valve only partially to limit the steam pressure to the regulator. Full line pressure is not necessary for this test.
6. Regulator seat test - With the long pilot tube disconnected at point "A" the regulator should be closed. If there is steam blowing out of the body side connection at point "B", the main valve and seat are leaking and require inspection for debris that is holding the valve off the seat or erosion of the sealing surfaces.
7. Pilot seat test - With the pilot closed there should not be any steam coming out of the long tubing at point "A". If there is steam flow, the pilot is not closing off and must be inspected for debris or seat erosion. Try running the adjustment screw in & out a few times to clear the debris. If that is not successful, the pilot must be cleaned, repaired or replaced.

## System Troubleshooting

PROBLEM	POSSIBLE	CAUSE CORRECTION
1. System will not come up to required temperature or valve will not open.	a) Valve undersized	a) Check capacity of valve against load requirements
	b) Pilot set point not adjusted properly	b) Readjust to required temperature
	c) Pilot range not correct	c) Check range of pilot versus required range
	d) Downstream piping undersized	d) Check velocity of steam in piping system
	e) Thermostatic bulb is located in a hot spot	e) Relocate bulb to more representative average temperature location or add agitation
	f) Inlet or outlet gate valve partially closed	f) Open valves fully
	g) Upstream pipeline strainer blocked	g) Clean strainer
	h) Pilot screen blocked	h) Clean or replace strainer screen
	i) Inlet pressure too low causing reduced capacity through valve	i) Increase inlet pressure or size valve to accommodate inlet pressure
	j) Main valve diaphragm orifice blocked	j) Inspect and check per valve troubleshooting diagram
	k) Main valve bleed orifice installed wrong, eroded, or missing	k) Inspect and check per valve troubleshooting diagram
	l) Main valve diaphragms flooded	l) Drain diaphragm chamber by opening drain plugs
	m) Pilot stem adjustment too long	m) See section 4 under Pilot Servicing
2. System temperature overrides set temperature or valve will not close.	a) Valve is extremely oversized	a) Check sizing against service conditions
	b) Bypass valve open	b) Close valve
	c) Pilot adjustment set too high	c) Readjust to required temperature
	d) Thermostatic bulb is in a cold spot	d) Relocate the bulb to more representative average temperature location or add agitation
	e) Bleed orifice blocked	e) Inspect and check per valve troubleshooting diagram
	f) Dirt in pilot seat or stem guide	f) Open blowdown valve on pilot adapter block to purge pilot chamber. If opening the blowdown does not remove dirt, inspect and clean pilot seat.
	g) Foreign object lodged between main valve disc and seat	g) Inspect and clean
	h) Main valve seat thread leaking	h) Check body in seat ring area for erosion
	i) Thermal assembly has lost pressure fill	i) Replace thermal actuator
	j) Pressure drop across valve is too high	j) Reduce inlet pressure or size valve for adequate pressure drop
3. Erratic control	a) Bent or binding pilot stem	a) Check stem for wear or deformation. Replace if necessary
	b) Packing binding pilot stem	b) Loosen packing nut to hand tight. Replace packing is necessary
	c) Poor bulb location	c) Relocate the bulb to more representative average temperature location or add agitation
	d) Sudden load changes requiring greater capacity than valve size can handle	d) Replace with properly sized valve
	e) Wide changes in valve inlet pressure more pronounced with single seat valve	e) Maintain more stable inlet pressure
	f) Oversized valve	f) Check sizing against service conditions



**HD Series Valve Capacities****Full Port** Regulating Valve - Capacities

FULL PORT CAPACITIES - (Steam lbs/hr)													
Inlet Pressure (PSIG)	Outlet Pressure (PSIG)	1"	1-1/2"	2"	3"	4"	Inlet Pressure (PSIG)	Outlet Pressure (PSIG)	1"	1-1/2"	2"	3"	4"
CV Factors		11	21	37	71	113	CV Factors		11	21	37	71	113
5	0	250	500	800	1600	2600	90	45	1950	3700	6600	12700	20200
	2	230	440	770	1500	2400		60	1700	3200	5700	10900	17400
								75	1200	2300	4100	7900	12600
7	0	325	600	1100	2100	3600	100	50	2100	4100	7300	14000	22200
	2	300	575	1000	2000	3100		60	2000	3800	6700	12900	20500
	3	275	525	900	1800	2800		80	1400	2700	4800	9200	14700
10	0	425	850	1500	2800	4600	125	60	2700	5200	9100	17500	28000
	2	400	800	1400	2700	4300		75	2400	4600	8200	15700	25000
	5	300	600	1000	2000	3200		100	1800	3500	6200	11900	19000
12	0	475	900	1600	3100	4900	150	75	3100	6000	10600	20400	32400
	4	400	800	1400	2700	4300		100	2700	5100	9000	17400	27700
	7	375	700	1200	2400	3800		125	1900	3600	6400	12300	19600
15	3	550	1000	1800	3500	5600	175	85	3700	7100	12500	24000	38200
	5	500	900	1700	3200	5200		125	2900	5600	9900	18900	30100
	8	400	800	1300	2600	4200		150	2100	4100	7300	14000	22200
20	5	625	1200	2100	4000	6400	200	100	4200	8000	14100	27100	43100
	10	550	1000	1800	3500	5600		125	3700	7100	12600	24100	38400
	12	500	950	1600	3200	5100		150	3100	6000	10600	20300	32300
25	7	775	1500	2600	5000	7900	225	120	4600	8700	15400	29500	47000
	10	700	1300	2400	4600	7300		150	4200	8000	14100	27200	43300
	15	600	1100	2000	3900	6200		175	3900	7400	13100	25200	40100
30	12	800	1500	2700	5200	8300	250	130	5100	9700	17100	32900	53400
	15	750	1400	2500	4900	7800		150	4700	9100	16000	30800	49000
	20	650	1200	2100	4100	6500		200	3500	6700	11900	22800	36200
40	18	1000	1900	3300	6400	10300	300	160	5920	11310	19220	38230	60840
	25	850	1600	2800	5400	8700		175	5625	10740	18925	36320	57800
	30	700	1400	2500	4700	7600		200	5155	9840	17340	33275	52960
50	20	1200	2300	4100	7800	12400							
	30	1100	2000	3600	6900	11000							
	40	800	1500	2700	5200	8300							
60	30	1350	2600	4600	8900	14200							
	35	1250	2400	4300	8200	13100							
	50	850	1600	2900	5600	8900							
75	35	1650	3200	5600	10800	17200							
	50	1350	2600	4600	8900	14100							
	60	1150	2200	3900	7400	11800							

**Note:** For inlet pressures in shaded area, use low pressure main valve.

# Reduced Port Regulating Valve - Capacities

## REDUCED PORT CAPACITIES - (Steam lbs/hr)

Inlet Pressure (PSIG)	Outlet Pressure (PSIG)	1"	1-1/2"	2"	3"	4"	Inlet Pressure (PSIG)	Outlet Pressure (PSIG)	1"	1-1/2"	2"	3"	4"
CV Factors		5.6	13.3	18.8	41.7	74	CV Factors		5.6	13.3	18.8	41.7	74
5	0	59	140	197	438	777	90	45	916	2177	3077	6825	12112
	2	53	128	181	401	712		60	789	1874	2648	5874	10425
7	2	79	187	265	587	1042	100	75	585	1389	1964	4357	7731
	3	74	177	250	554	983		50	1018	2419	3419	7584	13458
								60	940	2234	3158	7006	12432
10	0	117	279	395	876	1554	125	80	706	1676	2367	5254	9324
	2	115	274	387	858	1523		60	1290	3063	4329	9603	17041
	5	102	242	342	758	1346		75	1176	2793	3948	8757	15540
12	0	141	335	473	1051	1865	150	100	882	2095	2961	6568	11655
	4	133	316	446	990	1758		75	1527	3628	5128	11376	20187
	7	115	272	385	854	1515		100	1315	3123	4414	9791	17374
15	0	173	410	580	1287	2284	175	125	975	2316	3274	7261	12885
	5	166	395	558	1238	2198		75	1800	4272	6939	13396	23771
	8	149	354	500	1111	1972		125	1440	3421	4835	10725	19032
20	0	227	541	764	1696	3009	200	150	1060	2518	3558	7893	14008
	5	204	483	684	1517	2692		100	2037	4838	6838	15168	26916
	10	188	447	632	1401	2486		125	1836	4360	6164	13672	24262
25	0	282	670	948	2102	3730	225	150	1556	3695	5223	11584	20557
	5	269	640	905	2006	3561		100	2238	5360	7514	16667	29577
	10	235	559	790	1751	3108		125	1972	4684	6621	14686	26061
30	0	323	768	1085	2408	4273	250	150	1663	3950	5583	12384	21976
	5	305	726	1025	2275	4037		100	2511	5964	8431	18700	33184
	10	263	625	883	1958	3475		125	2352	5586	7896	17514	31080
40	0	420	998	1410	3128	5551	300	150	1764	4190	5922	13136	23310
	5	367	872	1232	2734	4852		100	3015	7160	10120	22450	39840
	10	311	739	1044	2317	4111		125	2865	6800	9615	21330	37850
50	0	539	1280	1809	4013	7121		150	2625	6235	8810	19545	34680
	5	470	1117	1579	3502	6216		100					
	10	353	838	1184	2627	4662		125					
60	0	611	1451	2051	4550	8074		150					
	5	573	1361	1924	4268	7573		100					
	10	390	926	1309	2904	5154		125					
75	0	780	1853	2619	5809	10308		150					
	5	657	1561	2207	4895	8687		100					
	10	529	1257	1777	3941	6993		125					

**Note:** For inlet pressures in shaded area, use low pressure main valve.