



Version

1.0.3

PHOENIX DYNAMOMETER COMPACT COOLING COLUMN

Operation and Maintenance User Guide



*Automation at Your
Fingertips*

PHOENIX DYNAMOMETER COMPACT COOLING COLUMN

Automation at Your Fingertips

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Table of Contents

1. Introducing the Compact Cooling Column	1
1.1. Unpacking.....	2
Upon receiving the cooling column, inspect the gauge(s) and armored sensor tube for damage.	2
1.2. Installation.....	2
1.3. Water Flow Requirements	3
2. Operating the Compact Cooling Column	4
3. Maintaining the Compact Cooling Column.....	5
3.1. Temperature Actuated Modulating Valve	5
3.2. Pressure Adjusting Valve	12
4. Troubleshooting the Compact Cooling Column	13
Notes:.....	14
Notes:.....	15
Notes:.....	16



1. Introducing the Compact Cooling Column

The Compact Cooling Column (3C) is a mechanical device used in place on a radiator to provide tempered water to internal combustion engines rated up to 1000 kW [1340 HP]

The Compact Cooling Column (3C) regulates the temperature and coolant pressure of the engine being tested by acting as a jacket-and-makeup water mixing chamber. A temperature sensor monitors water temperature as the water leaves the cooling column to return to the engine. When this temperature approaches the desired temperature which is adjustable from approximately 50-75 °C [120-165 °F], a thermostatic valve mounted on the cooling column, and connected to the cold water supply, opens to allow enough cold water to enter and mix with the hot water returning from the engine, and thereby, cool or temper the water to the desired temperature. The thermostatic valve opens just enough to maintain the desired temperature and thorough mixing of the water is assured by the internal component orientation and natural convection.

Since the tank is at a lower pressure than the cold water supply line the cold water entering displaces an equal amount of hot water, which is removed through a relief valve to a floor drain. In general, horsepower capacity of the Cooling Column is increased by reducing the temperature of cold makeup water, increasing the pressure of the makeup water, increasing Engine Jacket water temperature, and reducing Cooling Column tank pressure.



1.1. Unpacking

Upon receiving the cooling column, inspect the gauge(s) and armored sensor tube for damage.

1.2. Installation

The physical location of the Compact Cooling Colum (3C) is often dictated by the limitations of the test cell. The unit itself can be mounted either on a mobile base, the engine cart or the wall. The locations of water supply and drain pipes are typically considered in the early stages of the test cell design and should be kept near the location of the 3C.

Note: In the case where the supply and drain water pipes are retrofitted, make sure that are routed in such way that do not disturb test cell traffic. Also note that the drain pipe MUST have, at a minimum, a 75 mm [3"] ID and it must be vented to atmosphere to prevent back-pressure issues that will disturb the pressure maintained in the 3C and engine jacket.

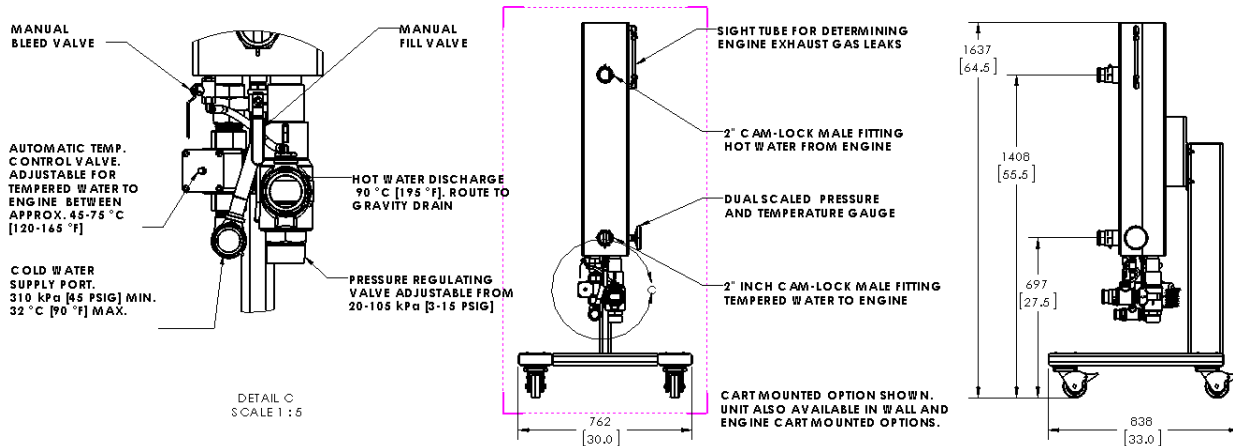
Only four (4) hose connections are required to properly install and use the 3C. Two are connecting the supply and drain water pipes, and the other two connect the 3C to the engine. All connection points on the 3C are equipped with male Cam-Lock fittings for a secure and expedient connection. All hoses are equipped with reusable female Cam-Lock fittings on one end. The bare ends of all hoses should be fitted on hose barbs and retained with heavy duty clamps.

Note: For permanent installations the flexible connections to the supply and drain water pipes can be substitute with rigid pipes. Please use unions near the 3C for future removal and servicing.

Note: End user to supply a mechanical on/off valve (ball valve) between the water supply pipe and the 3C.

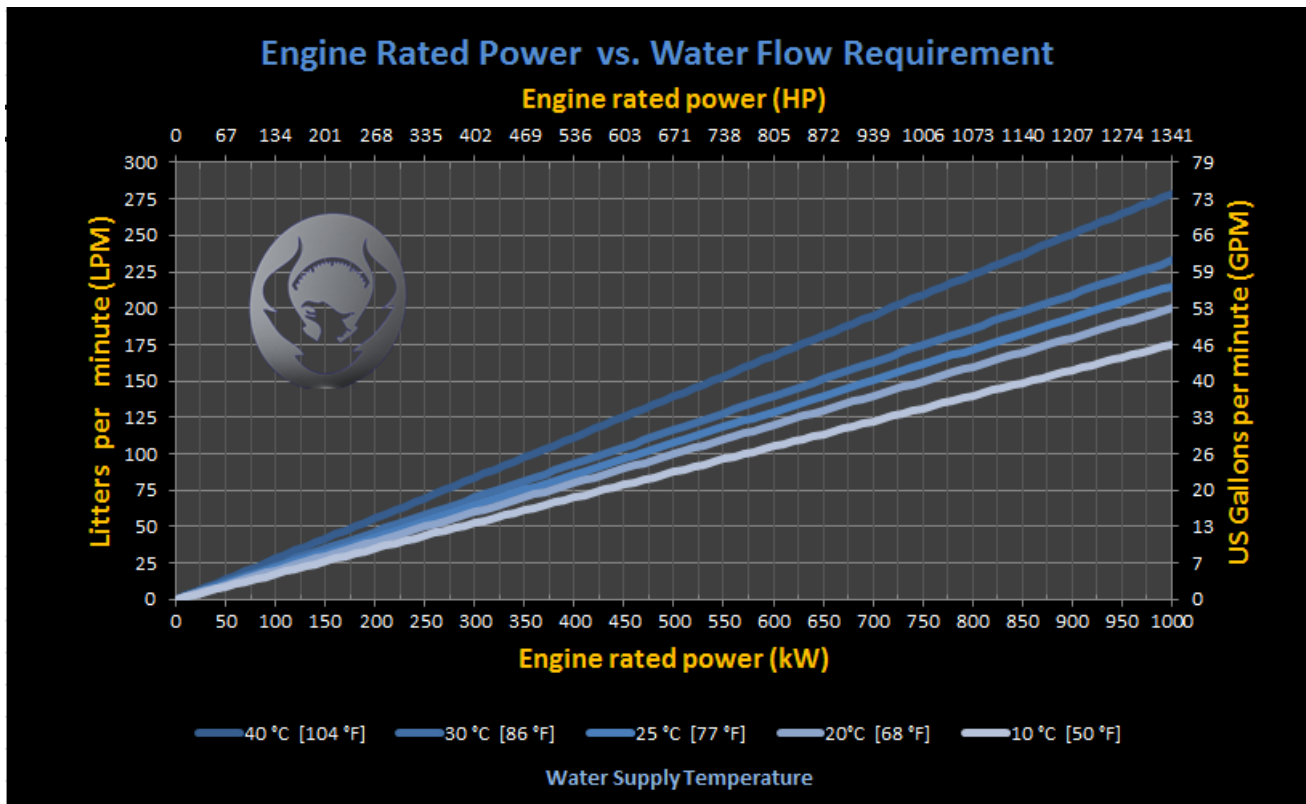
Hose Size	From	To	Notes
2"	*Hot water from engine.	Upper 2" port of 3C tank.	Use barb and clamp(s) for engine connection.
2"	Lower 2" port of 3C tank.	*Tempered water to engine.	Use barb and clamp(s) for engine connection.
2"	Water discharge port 3C.	Vented gravity drain.	Use barb and clamp(s) for drain pipe connection.
1-1/4"	Cold water supply pipe.	3C supply (make-up) port.	Use a shut-off valve between connection points. Use barb and clamp(s) for pipe connection.

* Hose diameters may be of different size; in all cases connection size to 3C remains 2".



1.3. Water Flow Requirements

The Water Flow Rate is directly proportional to the rated power of the engine and to the supply water temperature. As the engine power rating increases the water flow requirement increases as well. Similarly, as the water supply temperature increases the water flow requirement increases as well.



Flow characteristics are based on a water supply pressure of 4 bar approximately [60 psi].



2. Operating the Compact Cooling Column

Engine coolant temperatures reach 85 -110 °C [185 – 230 °F] and hot coolant can cause SEVERE injuries. Inspect all hoses frequently and replace them promptly when deterioration is detected. Double check hose connections for tightness, 100 kPa [15 psi] on a 2” hose results in 220 N [50 lbs.] of separating force.

Once all hoses are tightly secured in the appropriate locations, follow these steps to begin a test:

1. Open the Bleed Valve.
2. Open the Manual Fill Valve.
3. Allow the tank and engine to fill until water exits the Bleed Valve.
4. Close the Bleed Valve.
5. Start the Engine.
6. Let the Engine idle to expel all the entrapped air, which should be vented through the Bleed Valve.
7. Once fully bled, close the Bleed and Manual Fill Valve.
8. Advance the Engine throttle and apply a light load to the Engine.
9. When the Engine warms up, if necessary, adjust the water temperature at the thermostatic valve and the pressure with the screw under the protective cap of the pressure regulating valve. Make sure to tighten the lock nut once the desired pressure setting is achieved.

During a test, exhaust gas leaks to coolant will accumulate in the tank and become visible on the sight tube on the side of the cooling column. Accumulated gas can be removed with the bleed valve and the re-accumulation can then be timed after the engine is warmed up. This feature does not need to be used, as excess gas will not impede cooling, but will just be discharged with the hot waste water.

Note: Engines may be tested with or without their thermostats, although warm-up will take longer without a thermostat.

When the test is complete and the engine is shut down, open the manual fill valve for a few minutes to reduce the temperature of the process water. Then, close the manual fill valve, and disconnect the hoses from the engine. Also, vent the engine cooling circuit at the highest point possible to promote draining.



3. Maintaining the Compact Cooling Column

Engine coolant temperatures reach 85-110 °C [185-230 °F] and hot coolant can cause SEVERE injuries. Inspect all hoses frequently and replace them promptly when deterioration is detected. Double check hose connections for tightness, 100 kPa [15 psi] on a 2" hose results in 220 N [50 lbs.] of separating force.

Hoses must be fully inspected periodically. It is important to replace deteriorated hoses promptly and make sure all connections are tight before each test. If the Cooling Column is to be unused for a long period of time, open the relief valve fully to reduce compression set in its seal.

3.1. Temperature Actuated Modulating Valve

Refer to the original manufacturer's information below for proper maintenance of the Temperature Actuated Modulating Valve:





FANs 121, 125
Valves, Miscellaneous Section V
Repair Parts Bulletin V46, V47
Issue Date 0196

V46, V47, 246, and 247 Repair Parts and Service Instructions

Application Overview

The V46 pressure-actuated and V47 temperature-actuated water-regulating valves are used for water-cooled condensers, bypass service on refrigeration systems, engine cooling, and various industrial applications.

IMPORTANT: All Series V46 and V47 valves are designed for use **only** as operating devices. Where system closure, improper flow, or loss of pressure due to valve failure can result in personal injury and/or loss of property, a separate pressure relief or safety shutoff valve (as applicable) must be added by the user.

Adjustments

To raise the valve opening point on direct-acting valves, turn the adjusting screw counterclockwise. To lower the valve opening point, turn the range adjusting screw clockwise. See Figure 2. The closing point of the valve is not adjustable. Pressure-actuated valves close approximately 3 to 7 psi (21 to 48 kPa) below the opening point, and temperature-actuated valves close approximately 3 to 5°F (1.7 to 2.8°C) below the opening point.

If the compressor operates in high ambient temperatures, head pressures may remain high enough during off cycles to prevent the valve from closing completely. In such instances, the opening point of the valve should be raised just enough to cause the valve to close during compressor standby periods. This will also raise the throttling point.

The all-range pressure-actuated valve settings can be adjusted for both low pressure refrigerant ranges of R-134a and higher pressure refrigerant ranges of R-22 (R-502).

Manual Flushing

To clear any sediment that may accumulate, valves may be manually flushed by inserting screwdrivers under both sides of the main spring and lifting upwards to flush the valve. Manual flushing does not affect valve adjustments.

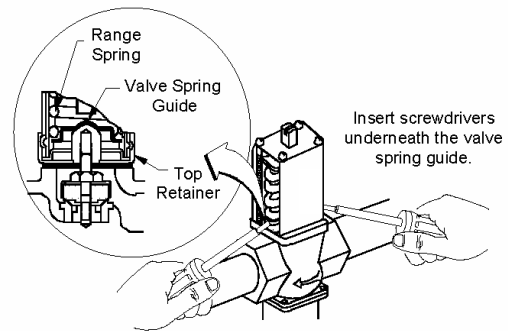


Figure 1: Manual Flushing

Inspection and Service

After long periods of operation, the valve seat and rubber disc may become worn, pitted, or wire drawn, preventing the valve from completely closing off when the pressure/temperature is below the setpoint.

WARNING: **Personal injury hazard.** Contents of liquid lines could be under pressure. Avoid possible personal injury by shutting off the liquid supply and relieving the pressure before servicing the valve.



To inspect and replace internal parts, follow the procedures in this section.

Note: Parts supplied in the renewal kit replace both V46 and V47 Series, and 246 and 247 Series valve assemblies.

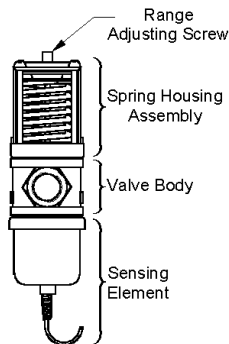


Figure 2: Valve Components



WARNING: Personal injury hazard.

The housing contains a compressed spring. Disassembly could cause the spring to fly out resulting in personal injury or damage. For valve sizes 1 in. and larger, do not remove the two screws on the sides of the spring housing.

1. Decrease the compression on the main spring by turning the range adjusting screw clockwise until it stops. Using excessive force to turn the screw beyond the stop point will strip the thread.
2. Remove the four screws holding the spring housing and remove the entire housing assembly. See Figure 2.
3. To improve the performance on 3/8 in. direct-acting valves, install the ISO-loss washer that is supplied with the 3/8 in. valve repair kit as follows:

Note: Reverse-acting 3/8 in. valves do not require the ISO-loss washer.

- a. Slightly squeeze the spring housing assembly to remove the spring housing.
- b. Remove the range adjusting screw, spring, and valve spring guide (Figure 4).
- c. Clean off any excess grease on the valve spring guide.
- d. Place the new ISO-loss washer over the guide plate.
- e. Replace the valve spring guide, spring, range adjusting screw, and spring housing.

Servicing 246, 247, 2 in., and 2-1/2 in. Valves



CAUTION: Equipment damage hazard.

To decrease the pressure in the sensing element on 247 and V47 valves, cool the bulb by submerging it in ice water. Do not remove the bulb from the ice water until the element is reinstalled.

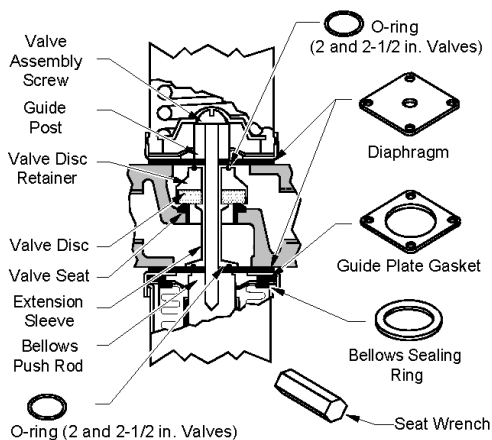


Figure 3: 246, 247, 2 in., and 2-1/2 in. Valves

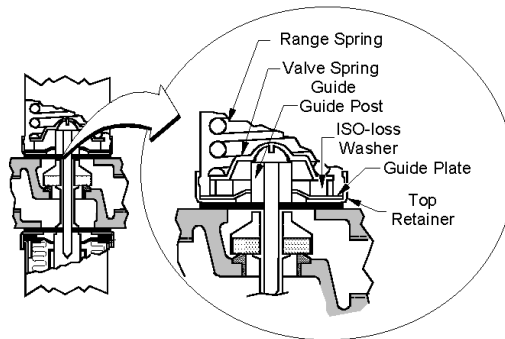


Figure 4: ISO-loss Washer



4. Remove the valve assembly screw (Figure 3).
5. Remove the guide post and old diaphragms (Figure 3).
6. Remove the sensing element and the diaphragms between it and the valve body (Figure 3).
7. Pull the disc, disc retainer, and extension sleeve assembly from the valve (Figure 3).
8. Using the seat wrench supplied with the kit, remove old valve seat and replace with the new valve seat (Figure 3). (Seat wrench not provided for 2 and 2-1/2 in. valves, use 1-1/2 and 1-15/16 in. hex stock, respectively.)
9. Replace the diaphragms between the sensing element and valve body (Figure 5). Use two diaphragms on 3/8 in., 1/2 in., and 3/4 in. valves and three diaphragms on 1 in. and larger valves.
10. On 1 in. and larger pressure valves and all temperature valves, replace the guide plate gasket and bellows sealing ring (Figure 5).
11. Assemble the sensing element to the valve body with the bellows push rod, new diaphragms, guide plate gasket, and bellows sealing ring in place.
12. Assemble the new disc, disc retainer, and extension sleeve.
 - a. On 2 and 2-1/2 in. valves, apply a small amount of grease to the grooves on the bottom of the new extension sleeve and the top of the new disc retainer. Place one O-ring into each groove.
 - b. Place the subassembly into the valve.
13. Place two new diaphragms on the spring housing end of the valve body.
14. Screw the valve assembly screw through the guide post and into the bellows push rod (Figure 3).
15. Place the spring housing assembly over the guide post and secure in place with the four housing screws.
16. Adjust the valve to desired opening point. Then manually flush the valve. See the *Manual Flushing* section.
17. Before leaving the installation, run the system through at least one complete operating cycle to be sure the valve is operating correctly.

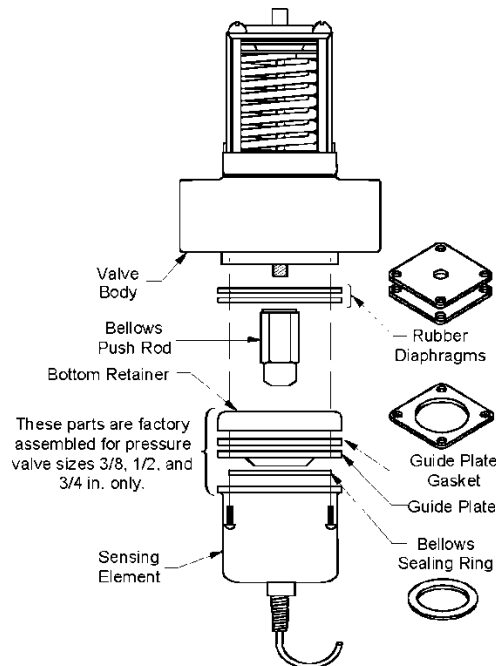


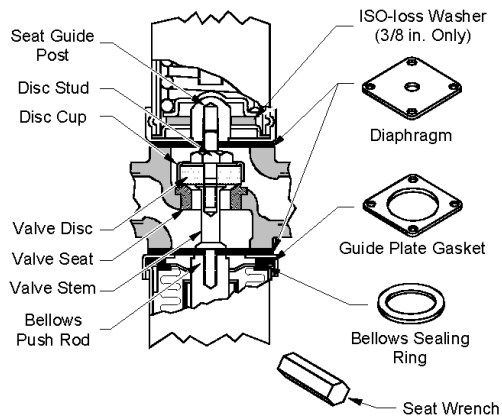
Figure 5: Guide Plate Gasket and Bellows Sealing Ring Identification



**Servicing V46 and V47
3/8 in. through 1-1/2 in. Valves**

CAUTION: Equipment damage hazard.
To decrease the pressure in the sensing element on V47 valves, cool the bulb by submerging it in ice water. Do not remove the bulb from the ice water until the element is reinstalled.

WARNING: Personal injury hazard.
The housing contains a compressed spring. Disassembly could cause the spring to fly out resulting in personal injury or damage. For valve sizes 1 in. and larger, do not remove the two screws on the sides of the spring housing.



**Figure 6: V46 and V47
3/8 in. through 1-1/2 in. Valves**

1. Decrease the compression on the main spring by turning the range adjusting screw clockwise until it stops. Using excessive force to turn the screw beyond the stop point will strip the thread.
2. Remove the four screws holding the spring housing and remove the entire housing assembly. See Figure 2.
3. To improve the performance on 3/8 in. direct-acting valves, install the ISO-loss washer that is supplied with the 3/8 in. valve repair kit as follows:

Note: Reverse-acting 3/8 in. valves do not require the ISO-loss washer.

- a. Slightly squeeze the spring housing assembly to remove the spring housing.
- b. Remove the range adjusting screw, spring, and valve spring guide (Figure 7).
- c. Clean off any excess grease on the valve spring guide.
- d. Place the new ISO-loss washer over the guide plate.
- e. Replace the valve spring guide, spring, range adjusting screw, and spring housing.

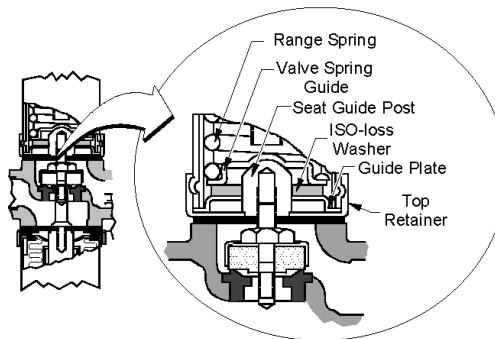


Figure 7: ISO-loss Washer

4. Remove the seat guide post (Figure 6).
5. Remove the rubber diaphragms (Figure 6).
6. Turn the disc stud counterclockwise to remove the valve stem assembly (Figure 6).
7. Remove the sensing element, bellows push rod, and diaphragms. See Figure 9.



8. Using the seat wrench supplied with the kit, remove old valve seat and replace with the new valve seat (Figure 6).
9. Assemble the new valve stem, disc, disc cup, and disc stud, and place into the valve body (Figure 6).
10. On 1 in. and larger pressure valves and all temperature valves, replace the guide plate gasket and bellows sealing ring (Figure 9).
11. If servicing a V47 or V46 valve other than low flow, place new diaphragms on the sensing element end of the valve stem assembly. Use two diaphragms on 3/8 in., 1/2 in., and 3/4 in. valves and three diaphragms on 1 in. and larger valves. Screw into place with the bellows push rod. Attach the sensing element to the valve body. See Figure 6.
12. If servicing a low flow valve, place the stem washer and new diaphragms on the sensing element end of the valve stem assembly. Use two diaphragms on 3/8 in., 1/2 in., and 3/4 in. valves and three diaphragms on 1 in. and larger valves. Screw into place with the bellows push rod. Attach the sensing element to the valve body. See Figure 8.
13. Place two new diaphragms on the spring housing side of the valve body. Screw into place with the seat guide post (Figure 8).
14. Place the spring housing assembly over the seat guide post and secure in place with the four housing screws.
15. Adjust the valve to desired opening point. Then manually flush the valve. See the *Manual Flushing* section.
16. Before leaving the installation, run the system through at least one complete operating cycle to be sure the valve is operating correctly.

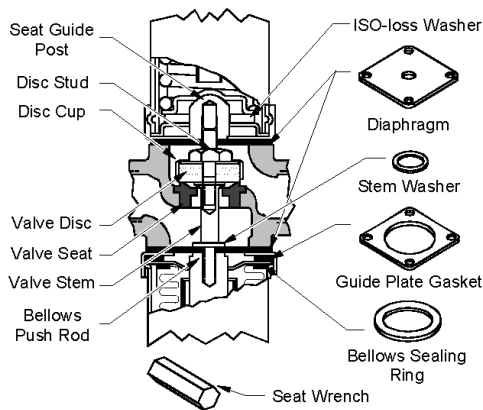


Figure 8: Low Flow Valves

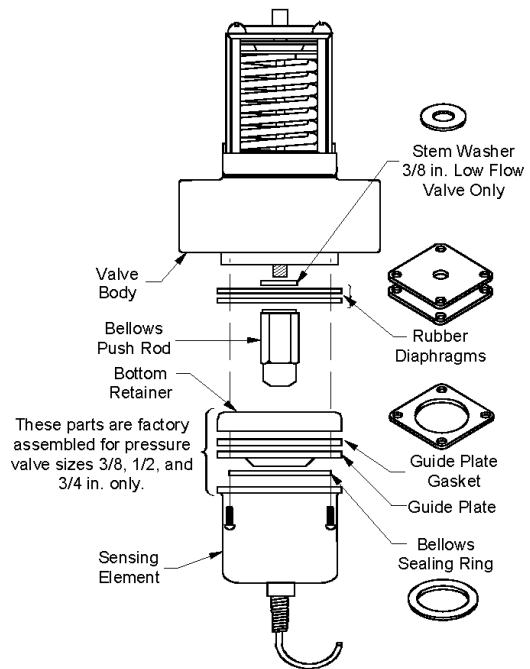


Figure 9: Guide Plate Gasket and Bellows Sealing Ring Identification



Table 1: Renewal Kits

Individual Part Description	Commercial Type: V46A, V46D, V47A, V47N Old Construction: 246P, 246T						Maritime and Navy Type: V46B, V46C Old Construction: 246MP, 246NP						Diaphragm Kits for All Types		
	STT14A-600R 3/8 in.	STT14A-603R 3/8 in. Low Flow	STT15A-602R 1/2 in.	STT16A-601R 3/4 in.	STT17A-609R 1 in.	STT17A-610R 1-1/4 and 1-1/2 in.	STT18A-600R 2 in.	STT18A-601R 2-1/2 in.	STT14A-601R 3/ in.	STT15A-603R 1/2 in.	STT17A-613R 3/4 in.	STT17A-611R 1 in.	STT17A-612R 1-1/4 and 1-1/2 in.	STT18A-602R 2 and 2-1/2 in.	DPM17A-600R 1, 1-1/4, 1-1/2 in.
Seat Guide Post	1	1	1	1	1	1			1	1	1	1	1		
Disc Stud	1	1	1	1	1	1			1	1	1	1	1		
Disc Cup (Retainer)	1	1	1	1	1	1			1	1	1	1	1		
Valve Disc	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Valve Seat	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Valve Stem	1	1	1	1	1	1			1	1	1	1	1		
Rubber Diaphragm*	4	4	4	4	5	5	5	5	4	4	4	5	5	5	5
Guide Plate Gasket	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bellows Sealing Ring	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Valve Assembly Screw							1	1						1	
Guide Post							1	1						1	
Valve Disc Retainer							1	1						1	
Extension Sleeve							1	1						1	
Seat Wrench	1	1	1	1	1	1			1	1	1	1	1		
Sensing Element	Contact Application Engineering at (414)-274-5535														
Stem Washer		1													
ISO-loss Washer**	1	1							1						
O-ring Seals							2	2							

* 3/8, 1/2, and 3/4 in. valves require two diaphragms on spring end and two diaphragms on sensing element end. 1 through 2-1/2 in. valves require two diaphragms on spring end and three diaphragms on sensing element end.

** Reverse-acting 3/8 in. valves do not require an ISO-loss washer.

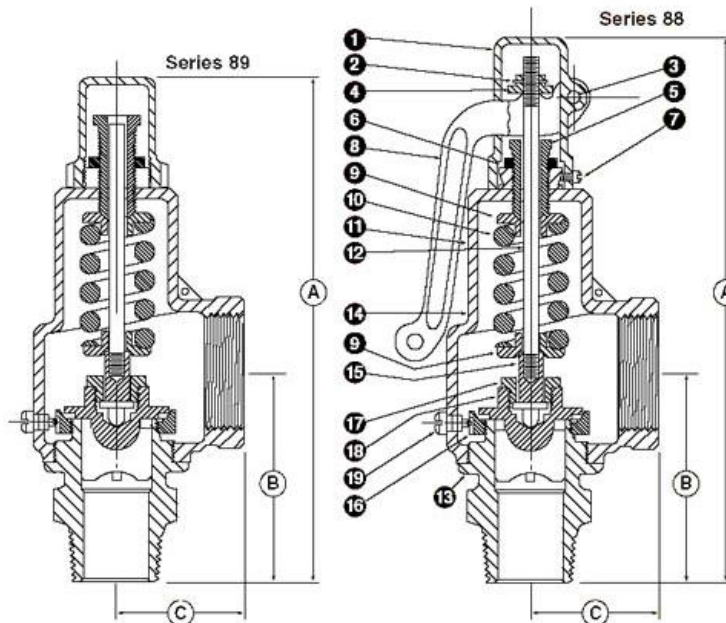


3.2. Pressure Adjusting Valve

Due to the low operating pressure this pressure adjusting valve is virtually maintenance free. In the unlikely event that components need to be replaced please refer to the component diagram below.

PARTS IDENTIFICATION & MATERIALS		
ITEM	PART NAME	MATERIAL
1	HOOD	BRONZE
2	COTTER PIN	STEEL *
3	LIFT LEVER PIN	BRASS
4	LIFTER NUT	BRASS/STEEL *
5	PRESSURE SCREW	BRASS
6	LOCK NUT	BRASS
7	HOOD SCREW	BRASS
8	LIFT LEVER	BRONZE
9	SPRING PLATE	BRASS/STEEL *
10	SPRING	STAINLESS STEEL
11	NAME PLATE	BRASS/BRONZE
12	SPRING POST	BRASS/STEEL
13	BODY	BRASS
14	BONNET	BRASS/BRONZE
15	SPRING PLATE SUPPORT	BRASS
16	REGULATOR RING	BRASS
17	SPRING PLATE	BRASS
18	DISK	BRASS/BRONZE
19	REGULAR SCREW	BRASS

*STEEL PLATED





4. Troubleshooting the Compact Cooling Column

In the event that you may have trouble with the operation of the 3C please refer to the troubleshooting guide below. If you are still unsuccessful in properly operating the 3C, please call our service department at (818) 746-3649 between the hours of 7:30 and 17:30 CST.

Symptom	Possible Cause(s)	Remedy
3C drains with no entering water	Manual fill valve open by jammed debris.	Clean the valve throat of any foreign objects or debris.
	Pressure relief valve seal damaged or worn.	Replace.
Overheating/Not allowing cold makeup water in.	Temperature actuated modulating valve failure.	Replace the actuator, (it is difficult), or the entire valve assembly.
	Air bind (vapor lock) in engine or connecting hoses.	Bleed air more thoroughly upon startup and warm-up.
Thermostatic valve opens but water overheats.	Temperature actuated modulating valve adjustment too high.	Readjust valve to a lower temperature setting.
	Low pressure or high temperature of cold water supply.	Supply water pressure should be 4 bar [60 psig] minimum at the 3C inlet. The temperature should be less than 40 °C [100 °F].

