ANGELERY HOT WATER GENERATORS

Installation, Operation and Maintenance Instructions

Section 1 - Angelery Hot Water Generator
Section 2 - Temperature Regulator Type CXT-S Valve
Section 3 - Angelery Safety System

INDEX AND GENERAL INFORMATION

SECTION ONE - ANGELERY HOT WATER GENERATOR

This section covers the installation, operation and maintenance of the Angelery Series A, B and C generators. On the Steam to Water Heat Exchanger the steam is the primary or tube side fluid. Water is the secondary or shell side fluid.

Series A, B and C differ in shell diameter and coil design only. Otherwise all are alike functionally and in design.

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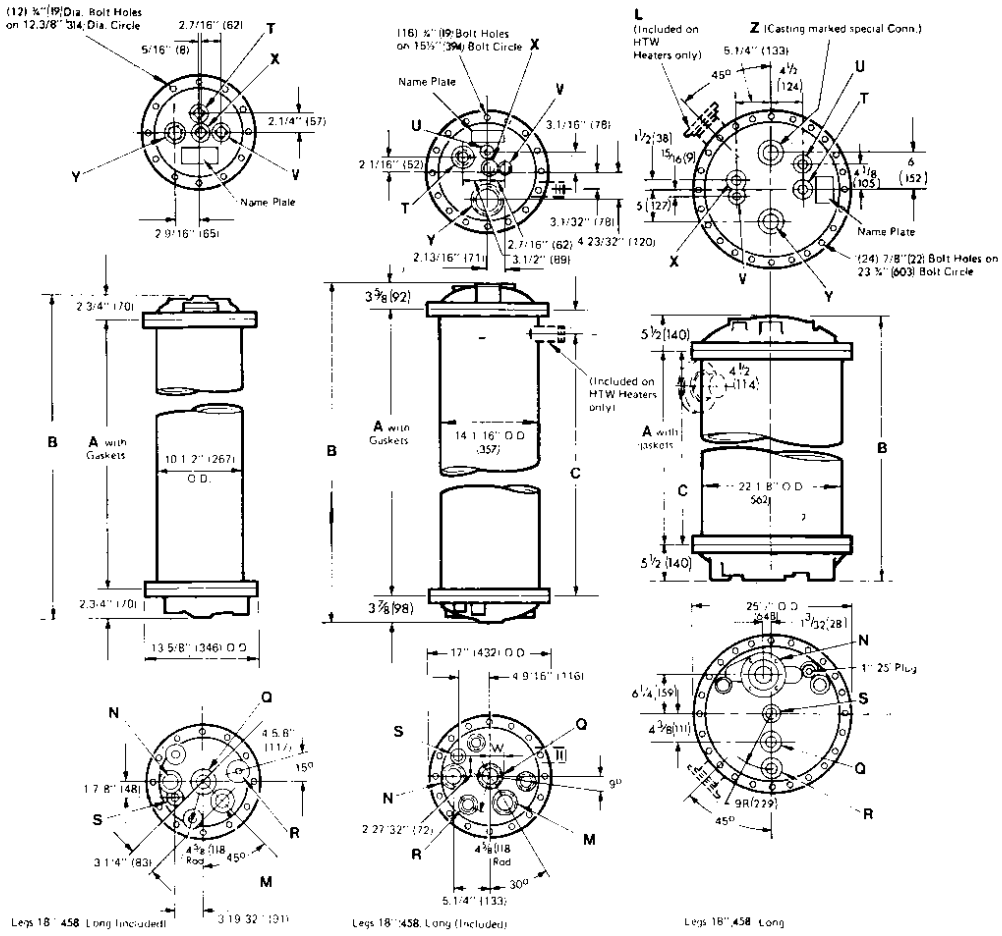
DIMENSIONAL DATA

Dimensions in inches (mm)



Series 1001A—1005A **Series 1004B—1016B** **Series 2010C—2034C**

Figure 1 – General Dimensions

Connection Sizes

Connections		Series 1001A-1005A		Series 1004B-1016B		Series 2010C-2034C	
		mm	in	mm	in	mm	in
Water Outlet (HTW Units only)	L	—	—	50	2	80	3
By-pass (if required)	M	50	2	50	2	—	—
Steam or HTW Inlet	N	32	1¼	50	2	80	3
Drain	Q	32	1¼	50	2	50	2
Tapping for Legs	R	25	1	32	1¼	50	2
Condensate or HTW Outlet	S	20	¾	25	1	40	1½
Relief Valve	T	25	1	25	1	25	1
Thermometer	U	—	—	20	¾	25	1
Thermostat	V	25	1	25	1	25	1
Water Inlet (Standard)	X	25	1	32	1¼	40	1½
Water Outlet (Standard)	Y	32	1¼	65	2½	65	2½
Water Outlet (Special)	Z	—	—	—	—	50	2

Series 1001A-1005A

Heater Number	Dimensions A mm	A in	B mm	B in	C mm	C in	Heating Surfaces m^2	Heating Surfaces sq. ft.	Shell Volume litres	Shell Volume Gals.	Approx. Weight kg.	Approx. Weight lb.
1001 & 1001 HTW	657	25 7/8	797	31 3/8	—	—	·46	5	18	4	80	176
1002 & 1002 HTW	657	25 7/8	797	31 3/8	—	—	·92	10	18	4	84	186
1003 & 1003 HTW	886	34 7/8	1026	40 3/8	—	—	1·3	15	36	8	100	221
1004 & 1004 HTW	1115	43 7/8	1259	49 3/8	—	—	1·8	20	43	9½	116	256
1005 & 1005 HTW	1344	52 7/8	1488	58 3/8	—	—	2·3	25	50	11	132	192

Series 1004B-1016B

1004	632	24 7/8	822	32 3/8	—	—	1·8	20	55	12	133	294
1004 HTW	759	29 7/8	949	37 7/8	664	26 1/8	1·8	20	59	13	149	328
1005	759	29 7/8	949	37 7/8	—	—	2·3	25	59	13	149	328
1005 HTW	860	33 7/8	1051	41 3/8	765	30 1/8	2·3	25	68	15	156	344
1006	860	33 7/8	1051	41 3/8	—	—	2·7	30	68	15	156	344
1006 HTW	987	38 7/8	1178	46 3/8	892	35 1/8	2·7	30	77	17	169	373
1007	987	38 7/8	1178	46 3/8	—	—	2·2	35	77	17	169	373
1007 HTW	1089	42 7/8	1280	50 3/8	994	39 1/8	2·2	35	82	18	176	388
1008	1089	42 7/8	1280	50 3/8	—	—	3·7	40	82	18	176	388
1008 HTW	1216	47 7/8	1407	55 3/8	1121	44 1/8	3·7	40	95	21	190	418
1009	1216	47 7/8	1407	55 3/8	—	—	4·1	45	95	21	190	418
1009 HTW	1318	51 7/8	1508	59 3/8	1222	48 1/8	4·1	45	105	23	200	440
1010	1318	51 7/8	1508	59 3/8	—	—	4·6	50	105	23	200	440
1010 HTW	1387	54 5/8	1578	62 1/8	1292	50 7/8	4·6	50	114	25	213	470
1011	1445	56 7/8	1635	64 3/8	—	—	5·1	55	114	25	213	470
1011 HTW	1546	60 7/8	1737	68 3/8	1451	57 1/8	5·1	55	123	27	227	500
1012	1546	60 7/8	1737	68 3/8	—	—	5·5	60	123	27	227	500
1012 HTW	1673	65 7/8	1864	73 3/8	1578	62 1/8	5·5	60	136	30	240	530
1013	1673	65 7/8	1864	73 3/8	—	—	6·0	65	136	30	240	530
1013 HTW	1775	69 7/8	1965	77 1/8	1680	66 1/8	6·0	65	145	32	254	560
1014	1775	69 7/8	1965	77 1/8	—	—	6·5	70	145	32	254	560
1014 HTW	1902	74 7/8	2092	82 3/8	1807	71 1/8	6·5	70	159	35	268	590
1015	1902	74 7/8	2092	82 3/8	—	—	6·9	75	159	35	268	590
1015 HTW	2003	78 7/8	2194	86 3/8	1908	75 1/8	6·9	75	168	37	281	620
1016	2003	78 7/8	2194	86 3/8	—	—	7·4	80	168	37	281	620
1016 HTW	2130	83 7/8	2321	91 3/8	2035	80 1/8	7·4	80	182	40	295	650

Series 2010C-2034C

2010	762	30	1041	41	—	—	4·6	50	150	33	339	748
2010 HTW	864	34	1143	45	749	29½	4·6	50	173	38	352	775
2012	864	34	1143	45	—	—	5·5	60	173	38	352	775
2012 HTW	991	39	1270	50	876	34½	5·5	60	195	43	363	801
2014	991	39	1270	50	—	—	6·5	70	195	43	363	801
2014 HTW	1092	43	1372	54	978	38½	6·5	70	218	48	375	827
2016	1092	43	1372	54	—	—	7·4	80	218	48	375	827
2016 HTW	1219	48	1500	59	1130	44½	7·4	80	241	53	387	853
2018	1219	48	1500	59	—	—	8·3	90	241	53	387	853
2018 HTW	1321	52	1600	63	1207	47½	8·3	90	264	58	339	879
2020	1321	52	1600	63	—	—	9·2	100	264	58	399	879
2020 HTW	1422	56	1702	67	1308	51½	9·2	100	286	63	412	908
2022	1448	57	1727	68	—	—	10·2	110	286	63	412	908
2022 HTW	1549	61	1829	72	1448	57	10·2	110	309	68	425	938
2024	1549	61	1829	72	—	—	11·1	120	309	68	425	938
2024 HTW	1676	66	1956	77	1575	62	11·1	120	331	73	440	970
2026	1676	66	1956	77	—	—	12·0	130	331	73	440	970
2026 HTW	1778	70	2057	81	1676	66	12·0	130	355	78	454	1000
2028	1778	70	2057	81	—	—	13·0	140	355	78	454	1000
2028 HTW	1905	75	2184	86	1803	71	13·0	140	377	83	467	1030
2030	1905	75	2184	86	—	—	13·9	150	377	83	467	1030
2030 HTW	2007	79	2286	90	1905	75	13·9	150	400	88	481	1060
2032	2007	79	2286	90	—	—	14·9	160	400	88	480	1060
2032 HTW	2134	84	2413	95	2032	80	14·9	160	423	93	495	1090
2034	2134	84	2413	95	—	—	15·8	170	423	93	495	1090
2034 HTW	2235	88	2514	99	2133	84	15·8	170	447	98	508	1120

SECTION ONE

PRINCIPLE OF OPERATION

Cold Water (secondary fluid) enters the Angelery Hot Water Generator through the inlet connection in the upper head, flows downward through the cold water leg of the Compensator unit, and is discharged into the shell below the level of the lowest coil. The water then flows upward through the shell, passing over the coils (heating surface), and is discharged through the hot water outlet connection.

Steam (primary fluid) enters the steam inlet connection in the lower Heater head and is fed through the steam riser to the inlet of each coil. Condensate leaves through the outlet of each coil, enters the condensate return, and leaves the Heater through the condensate outlet.

As noted above, the water being heated (secondary fluid) flows through the Heater shell from bottom to top. In addition, heated water, being of less density than cold water, migrates to the top of the shell by convection, These actions result in the hottest water being at the top of the heater - at the Heater outlet and at the hot water inlet of the Compensator unit (see Figure 3).

The flow of cold water, entering the Heater and flowing down through the cold water leg of the Compensator unit through the orifice, draws hot water down through the hot water leg, and pushes cold water through the by-pass and into the hot water leg.

The thermal element "reads" the average temperature of water in the hot water leg at any given moment and signals the steam flow regulator or control valve to open or close as necessary to maintain the required heater outlet temperature. With no demand or load on the Heater, the thermal element "reads" only the temperature of the water at the Heater outlet and, if the water is at the required temperature, signals the steam flow regulator or control valve to close.

The Compensator, therefore, is constantly working to load conditions and changes, as well as changes in the temperature of the entering cold water, and provides feed-forward temperature control at all times.

However, the moment that there is a demand for hot water (an increase in load), entering cold water mixes with the hot water in the Compensator hot water leg, cooling the thermal element so that it signals the regulator or control valve to open. The need for heat flow (steam) to the Heater elements coils is satisfied at once and the Heater outlet temperature does not fall below that required.

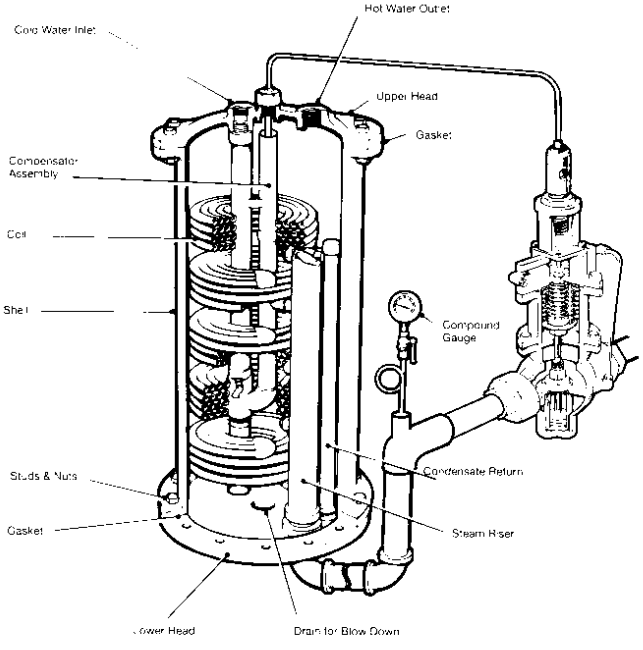


Figure 2

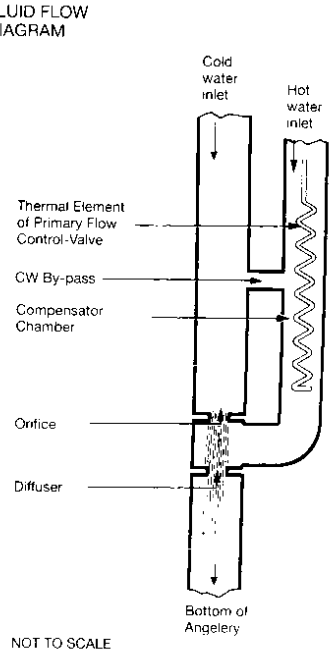


Figure 3

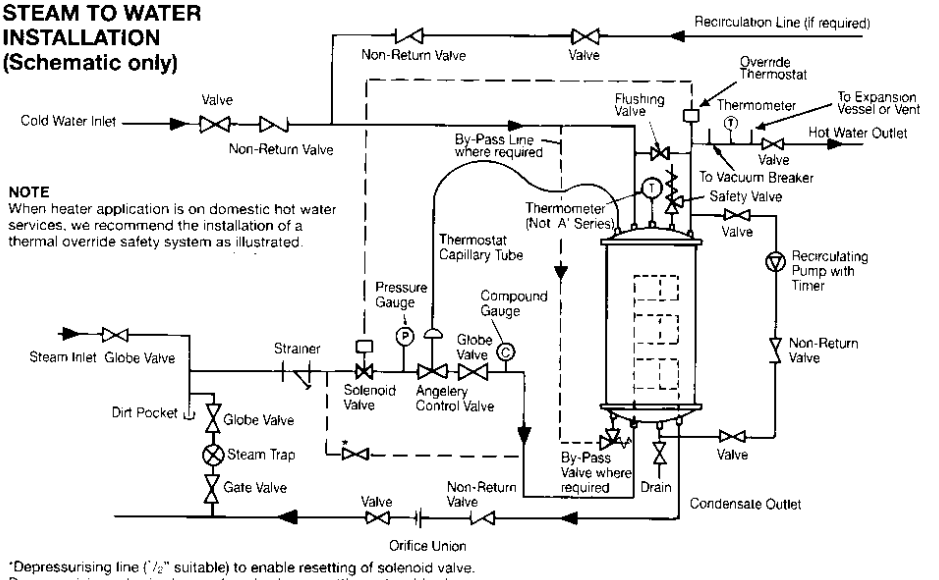
INSTALLATION

1. The dimensions for all Heater Models in the range are shown in Figure 1.
2. If possible, for easy in situ maintenance, locate the Heater where there is at least 600mm (24in) clearance all round the Heater and where the head room clearance distance is at least equal to the dimension "B" given for the Heater Model.
3. Assemble the legs and floor flanges (shipped with the Heater) to the lower Heater head.
4. Mount the Heater upright. It is suggested that the floor flanges be secured to the floor. However, another means for securing the Heater may be used. (The use of piping to the Heater for securing the Heater is not recommended unless the piping includes ample provision for expansion).
5. Make the piping connections in accordance with Figure 4 as per the following :
   a) The recommended pipe jointing method is screwed or flanged.
   b) For connection sizes and exact locations, see Fig 1. Also note that the connections are identified on the Heater heads.
   c) Locate the unions or flanges in all piping to the upper Heater head clear of the outside diameter of the head flange so that the Heater shell may be removed easily.
   d) Include all of the stop and check valves and other items shown in Figure 4.
   e) Piping between the Regulator or Control Valve and the lower head should be as short as possible with the Regulator or Control Valves mounted minimum 300mm (12in) above the lower head flange. Include a compound gauge as shown. Also, include sufficient unions or flanges to allow easy removal of regulator or Control Valve.
   f) If the Regulator or Control Valve is larger than the Heater steam inlet connection, use the larger size piping and reduce to the Heater inlet size as close to the Heater connection as practical. If the Regulator or Control Valve is smaller than the Heater connection, expand the piping to the Heater connection size immediately after the Regulator or Valve.
   g) Include the external by-pass line if required (See fig 4).
   h) Include an orifice union in the condensate drain line (See fig. 4)
   i) Where required include recirculation line (See figure 4)
   j) Where Angelery Heaters are installed on closed systems it is necessary to install an anti-vacuum valve in the position indicated in Figure 4 to protect the copper liner from collapsing.
6. Install the required relief valve in the upper Heater head. Install thermometer in the upper Heater head or in the hot water outlet piping see Figure 4.
7. After the Regulator or Controller has been installed, assemble thermal element into its proper connection (marked "Thermostat") in the upper heater head.

IMPORTANT

8. Before making final connections, **blow out all piping thoroughly.**
9. It is recommended that, after all piping connections have been made, the heater be field insulated.

STEAM TO WATER INSTALLATION (Schematic only)



NOTE
When heater application is on domestic hot water services, we recommend the installation of a thermal override safety system as illustrated.

*Depressurising line ('⅛" suitable) to enable resetting of solenoid valve. Depressurising valve is always closed unless resetting solenoid valve.

Figure 4 Steam Primary Application

SECTION ONE

OPERATING PROCEDURES

1. With all the connecting piping cleaned out, all connections made as per Figure 4, and thermal element in place on the upper Heater head, open the stop valve in the cold water inlet line and hold the relief valve in the upper heater head open to allow air to come out (otherwise an air pressure pocket will be built up and the Heater will not fill). When water flows out of the relief valve, the Heater is full.

2. Temporarily set the safety system's temperature switch to its high temperature limit.

3. Open the stop valve in the hot water outlet line. Open a hot water demand in the building or process to ensure a flow of water through the Heater whilst making sure the circulating pump is running. For best results in adjusting the temperature control, a water flow of 10% to 25% of Heater rating is desirable.

   NOTE : Flushing valve to be used in routine maintenance only.

4. Slowly open all shut-off valves in the steam input line.

5. Follow the instructions outlined in Section 2 or instructions furnished with the temperature Regulator or the Temperature Controller and Control Valve:

   a) Introduce steam to the Heater

   b) Adjust the Temperature Regulator or Controller until the outlet hot water is being held steady at the desired temperature.

   c) Close the hot water demand opened in step 3.

6. Adjust the Safety Steam to its proper setting in accordance with instructions in Section 3.

7. The heater installation is now set for operation.

8. To **shut down** the system:

   a) Close all shut-off valves in the steam input line (including any in the Safety System).

   b) In this order, close the stop valves in (1) the hot water outlet line, (2) the recirculation line, if any, and (3) the cold water inlet line.

   c) If the system includes an accumulator, do not shut-off the cold water until the Heater has cooled down. If the system is allowed to cool while shut-off, the Heater liner might collapse due to formation of a vacuum.

9. For draining the Heater, see the instructions included under "Routine Maintenance".

10. To start-up again , with the shell filled as recommended in 1, open shut-off or stop valves in the following order.

    1) Stop valve in the cold water inlet line.

    2) Any shut-off valve in the recirculation line.

    3) Stop valve in the hot water outlet line.

    4) Shut-off valves in the steam inlet line.

11. After each start-up, check the temperature control. If any adjustment is necessary, proceed as instructed in 4, 5 and 6.

ROUTINE MAINTENANCE

The constant flexing of the coils under varying load conditions tends to provide a descaling action and prevents a build-up of brittle scale. A periodic blowdown (draining) is required to remove scale deposits.

Where the load is constant or the change of the load is not of sufficient magnitude to create adequate movement, the coils need to be thermally shocked as described in the Operating and Maintenance instruction, Page 10. The timing of the blowdown in hard water cases to be assessed by the user.

Drain the heater as follows:

1. Close all shut-off valves in the steam inlet line (also in the Safety System)

2. In this order, close the stop valves in (1) the hot water outlet line, (2) the circulation line, if any, and (3) the cold water inlet line.

3. Carefully open the relief valve on the upper heater head to relieve pressure in the heater shell. If water continues to flow from the relief valve, one of the water shut-off or stop valves either leaks or is not shut-off tight. This must be remedied until there is no more flow through the relief valve.

4. With the relief valve being held open (to prevent creating a vacuum), open the drain valve and drain the heater completely.

5. To refill the Heater and place it back in operation close the drain valve and proceed as instructed in 1, 10 and 11 in "Operating Procedures"

6. Check the temperature control. Make any necessary adjustment as detailed 4, 5 and 6 in "Operating Procedures"

Note : In particularly hard water areas, the thermostat element needs to be checked and scale build up removed, as this may result in giving an incorrect reading

TROUBLESHOOTING

Symptom	Probable Cause and Remedy "Corrective Maintenance" Item No
A. Heater does not maintain required temperature at rated capacity	1, 2, 15, 18, 19, 20
B. Heater overheats	1, 6, 8, 11
C. Hot water outlet temperature fluctuates widely	2, 5, 8, 11, 16, 17, 18, 19, 20
D. insufficient water through heater	3, 10
E. Excess condensate being returned from Heater	18
F. Steam being discharged into condensate drain	11, 14, 20
G. Pressure relief valve pops	4, 12, 13
H. Loud banging in Heater or in steam or condensate piping (not to be confused with a normal clicking noise)	7, 8, 9

CORRECTIVE MAINTENANCE

Refer to "Troubleshooting" above. The following are probable causes and remedies for incorrect action of the Heater.

1. Thermometer or gauges read wrong. Check by replacing the thermometer and/or each gauge with one which is known to be correct.

2. Steam pressure is too low. Check the supply pressure gauge ahead of the temperature (steam flow) regulator or control valve. If the reading is low, adjust the steam supply pressure to that which is required. If there is a restriction in the steam supply line, the gauge reading will drop excessively when the heater calls for full steam even though the pressure appears to be normal when the load is light. If the steam supply pressure is correct, the compound gauge pressure readings should reach design pressure for steam in the coils as the Heater temperature drops. If it does not, check the operation of the temperature regulator or control valve.

3. Water pressure is too low. Check and correct, if necessary, the water pressure to the heater.

4. Static pressure of water exceeds design pressure. Make corrections necessary to bring water pressure below that for which relief valve is set. Check spring reset.

5. Thermal element is in wrong location. The thermal element is to be inserted in the upper Heater head connection marked "Thermostat".

6. Inlet water is preheated too hot. Reduce the preheating to a temperature at least 5°C (10°F)under the desired Heater outlet temperature.

7. No check valve in the condensate drain line. Lack of this check valve can allow condensate (and live steam, if present) to be drawn back into the heater from the condensate header. This can result in high back pressure, water hammer, and, if live steam is present, overheating. Install a check valve in the condensate drain line as indicated in Fig. 4.

8. Steam line is not properly trapped. Install a trap as indicated in Figure 4.

9. Incorrect location of steam regulator or control valve. The valve should be a minimum of 300mm (12 inches) above the lower heater head flange, and the piping between the valve and lower heater head connection should be as short as possible.

10. No cold water by-pass line to the bottom of the Heater (when required by operating conditions). Install same if necessary.

11. Leaking valve in by-pass line (if any) around the steam flow regulator or control valve. Maintain the valve to shut tight.

12. Lack of expansion capability in the hot water system. Insert an expansion tank - see Fig. 4.

13. Insufficient shock absorbers. Insert shock absorbers (water hammer arresters) in both the cold and hot water systems as required to eliminate shock waves.

14. Lack of or too large an orifice union. Check for orifice size required and install the correct union in the condensate drain line as shown in Figure 4.

15. Condensate is backing up into the Heater because of a restriction in the condensate drain line such as an undersized orifice union. Make the necessary correction.

16. The steam flow regulator or control valve does not close. Check the instructions for the regulator or valve.

17. The steam flow regulator or control valve does not open Check the instructions for the regulator or valve.

18. There is a leak in the Heater coil(s), steam riser, or condensate return. To verify a leak in the coils, etc., shut off the steam supply and break a connection in the condensate drain line. Condensate will drain from the coils initially, but the flow should stop after a few minutes. If the flow continues water is leaking from the pressurised shell side to the tube side of the Heater. Dismantle, inspect, repair, and reassemble the Heater as outlined below.

19. The heater coils are scaled up. Descale the Heater by thermal shock in the manner outlined below. (note - should scale deposit be excessive, chemical descaling is recommended to prevent physical damage to the coils).

20. The heater is being utilized at a rate higher than its design capacity. Contact BSS representative for advice in remedying this problem.

A. Descaling by Thermal Shock

Where, under certain conditions of continuous steady usage, the water is so hard or alkaline that normal flexing of the coils (see "Routine Maintenance") and routine blow down (draining the Heater shell) will not remove scale build-up on the coils, the heating surfaces (coils) may be thermally shocked, without damage to any part of the Heater, to dislodge scale solids.

Proceed as follows

A1. Drain the Heater as detailed in 1 to 4 under "Routine Maintenance". However, instead of holding the relief valve open as recommended in 4, remove the relief valve from the upper Heater head and then open the drain valve. Leave the drain valve open until instruction A7 below. Remove thermal element.

A2. Open up flushing valve or connect a source of cold water (for example a hose) to the relief valve connection or piped in water.

A3. Open the shut-off valve(s) in the steam inlet line and allow steam to the Heater. After about 30 seconds or until steam is blowing out of the condensate drain line, close the condensate drain line stop valve. Leave the steam valve open for about 2 minutes longer, then close the steam shut-off valve(s).

A4. Inject a flow of cold water through the relief valve connection or piped in water. Then shut-off the water flow and open the condensate drain line stop valve.

A5. Repeat instructions 3 and 4 several times until the water coming from the Heater drain appears to be relatively free of solids.

A6. Remove the cold water source from the relief valve connection. Open the stop valve in the main cold water inlet line and allow a complete flushing of the Heater shell. Visually check that the coils are free from scale.

A7. After the Heater shell has been completely drained, close the Heater drain valve, replace the relief valve and place the Heater back into operation as detailed in 1, 10 and 11 under "Operating Procedures" Page 8.

A8. If water conditions are so severe that thermal shocking does not remove scale deposits contact NK representative

B. Dismantling See Fig's 8,9 or 10.

No special tools are required. However, a block and tackle, or ratchet or winch hoist etc. is recommended for lifting off the upper Heater head and shell.

B1. Drain the heater as detailed in 1 to 4 under "Routine Maintenance".

B2. Disconnect the external piping to the upper Heater head. Remove the thermal element, being careful not to damage the element capillary.

B3. Unscrew the studs holding the upper head to the shell.

B4. Lift off the upper head - **straight up** - being very careful not to hit the COMPENSATOR ASSEMBLY against the coils, Remove the upper head gasket if it is damaged.

B5. Unscrew the studs holding the shell to the lower head.

B6. Lift the shell - **straight up** - being very careful not to touch or rub the shell against the coils. Remove the lower head gasket if it is damaged.

B7. Examine the coils, steam riser, and condensate return for obvious damage.

B8. Disconnect any external pipework from steam and condensate connections. Fit test pump to either of the above connections. Fit shut-off valve to the other connection. Pump to specified pressure as shown on the nameplate. (To facilitate filling, the heater can be filled via a hose, when the heater is in a horizontal position, therefore any air trapped in the coils will disperse more rapidly.) Any leak in the coils will quickly be visible. Note where leaks may be and shut-off the supply.

B9. **If a coil must be replaced**, disconnect the unions using a single open end wrench, disconnect the unions holding the coils to the steam riser and condensate return. Be careful not to damage the spud threads (See Fig. 6).

B10. **If either the steam riser or condensate return has to be replaced,** it is recommended that the Heater be returned to the manufacturer for a replacement. (NK has the proper factory facilities with pressure testing equipment, ready access to any needed additional parts and the expertise necessary to provide a guaranteed replacement).

If, however, returning the Heater to the manufacturer is impractical, field replacement may be made but cannot be guaranteed by the manufacturer. If this decision is made, proceed as follows:

a) Remove all coils as detailed in B9. Examine and replace as necessary

b) Remove the damaged riser or condensate return and replace as necessary

C. Assembly

No special tools are required. Again a block and tackle, ratchet or winch hoist etc, is recommended for lifting.

C1. **If either the steam riser or condensate return must be replaced:**

a) Use pipe joint compound or Teflon tape on the threads and screw the replacement steam riser or return into the lower Heater head.

b) Turn the riser or return in until it is leak tight, **but carefully line up the spud centres with the raised indicators on the bosses in the head casting,** as shown in Fig. 5.

C2. **If a coil must be replaced:**

a) See figure 6. A coil gasket is required for each coil union in a Model B & C Heater (see figs. 8, 9 and 10 for the difference between Model A, Model B and Model C). It is recommended that coil gaskets be replaced whenever a coil is reassembled to a riser or return even though the coil is not being replaced. Snap the gasket into the riser or return spud.

b) Before attempting to assemble coils to the riser or return spuds, apply a lubricant to the back of the union nuts and shoulders in the coil tailpieces. Rotate the nuts to spread the lubricant.

c) Assemble the coil union to the condensate return first. Do not tighten. Assemble the other coil union to the steam riser, making sure the tailpiece remains perfectly horizontal after tightening.

Note *Never use a hammer or pipe grips to tighten the union nut, deformation and subsequent leaking may result. Always use correct size open-end spanner*

d) Space the coil tubes evenly throughout the Heater, with each tube space at least 15mm ($^1/_2$") wide. It is especially important that no tubes rest on any coil unions. A spacing tool may be made up similar to that shown on Fig. 7. Insert the tool flat between the coil tubes and twist the tool until the desired spacing is obtained.

e) Test for leaks detailed in B8.

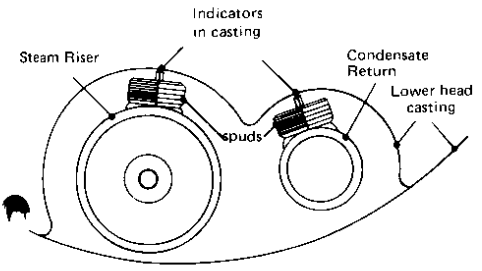


Figure 5 Steam Riser and Condensate Return Alignment.

C3. Examine the upper and lower head gaskets carefully. If they are damaged in any way, they should be replaced. Be sure to clean any old gasket material from the mating surfaces.

C4. Place the lower head gasket on the lower head flange.

C5. Lower the shell over the coil/riser/return assembly - **straight down** - to its original position, being very careful not to touch or rub the shell against the coils.

C6. Assemble the lower head/shell studs and nuts. Cross tighten in order to obtain uniform seating. Then progressively tighten the nuts to ensure a tight seal.

C7. Place the upper head gasket on the upper shell flange.

C8. Lower the upper head and compensator assembly - **straight down** - to its original position on the shell being very careful not to hit the compensator assembly against the coils.

C9. Align the upper and lower heads: the **raised arrows** on each of the head flanges **must line up with each other. This is extremely important.**

C10. Reassemble the upper head/shell stud nuts in the same manner as in C6.

C11. Reconnect all external piping. Replace the thermal element in its proper connection (marked "Thermostat")

C12. Refill and place the Heater back into operation as detailed in 1, 10 and 11 under "Operating Procedures" page 8.

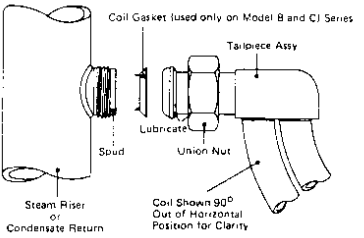


Figure 6 Assembly of coil to Steam Riser or Condensate Return

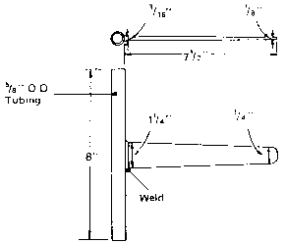


Figure 7 Coil Spacing Tool

SECTION ONE

RECOMMENDED SPARE PARTS

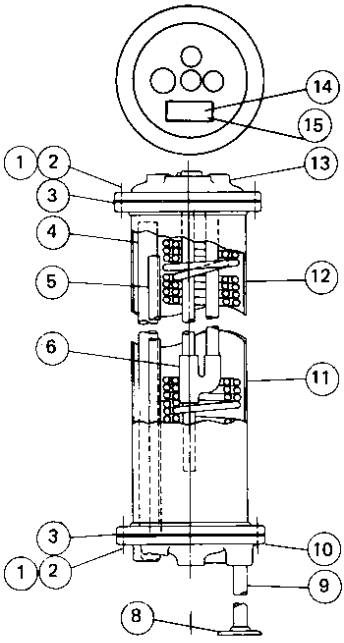


Figure 8 - Angelery Hot Water Generator Models 1001A-1005A Assembly & Parts List

Item No.	Qty	Description
1	24	Bolts
2	24	Nuts
3	2	Gasket
4	1	Steam Riser Assembly
5	1	Condensate Return Assembly
6	1	Compensator Assembly
8	3	Floor Flange
9	3	Leg
10	1	Lower Head Assembly
11	A	Coil Assembly
12	1	Shell Assembly
13	1	Upper Head Assembly
14	1	Nameplate
15	4	Drive Screw

A - Number of coils required is indicated in the last 2 digits of the model number, i.e.,

1001A 1 coil required
1002A 2 coils required
1005A 5 coils required

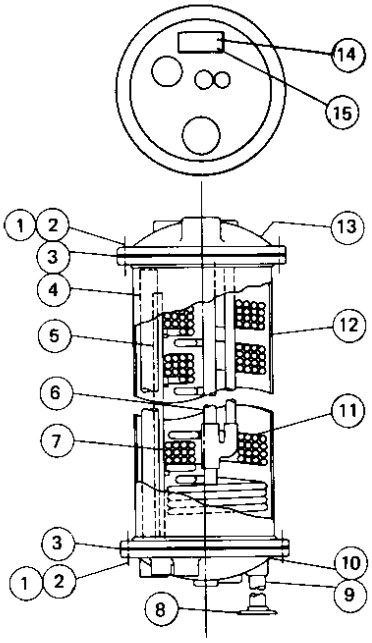


Figure 9 - Angelery Hot Water Generator, Models 1004B to 1016B Assembly and Parts List

Item No.	Qty	Description
1	32	Bolts
2	32	Nuts
3	2	Gasket
4	1	Steam Riser Assembly
5	1	Condensate Return Assembly
6	1	Compensator
7	2 per coil	Coil Gasket (See Fig. 6)
8	3	Floor Flange
9	3	Leg
10	1	Lower Head Assembly
11	A	Coil Assembly
12	1	Shell Assembly
13	1	Upper Head Assembly
14	1	Nameplate
15	4	Drive Screw

A - Number of coils required is indicated in the last 2 digits of the model number, i.e.,

1004B 4 coils required
1005B 5 coils required
1016B 16 coils required

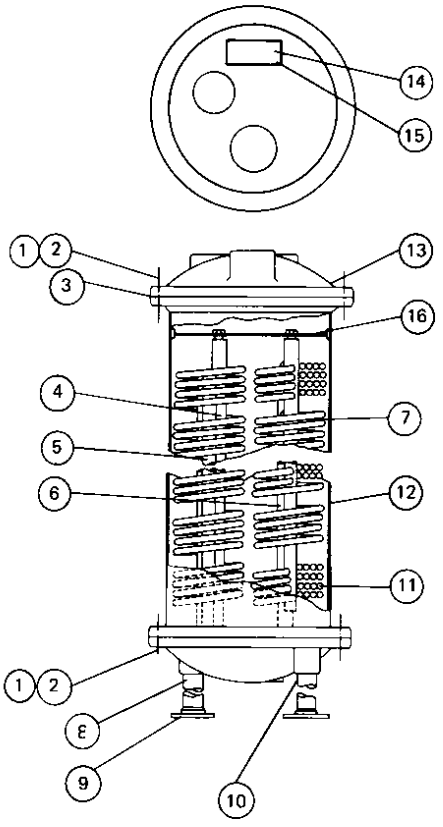


Figure 10 - Angelery Hot Water Generator, Models 2010C - 2034C Assembly and Parts List

Item No.	Qty	Description
1	48	Bolts
2	48	Nuts
3	2	Gasket
4	2	Steam Riser Assembly
5	2	Condensate Return Assembly
6	1	Compensator Assembly
7	2 per coil	Coil Gasket (See Fig. 6)
8	3	Leg
9	3	Floor Flange
10	1	Lower Head Assembly
11	A	Coil Assembly
12	1	Shell Assembly
13	1	Upper Head Assembly
14	1	Nameplate
15	1	Drive Screw
16	1	Support Spider

A - Number of coils required is indicated in the last 2 digits of the model number, i.e.,

2010C 10 coils required
2020C 20 coils required
2034C 34 coils required

SECTION TWO - TEMPERATURE REGULATOR TYPE CXT-S

Principle of Operation

The temperature being controlled by the regulator is sensed by the spiral of a liquid-filled thermal element. At the valve end of the element's capillary, is a bellows, which is contained by the temperature adjustment sleeve. A drop in temperature at the sensor causes the bellows to contract, allowing internal pressure to raise the pilot plug, thereby decreasing the differential pressure across the actuator bellows, compressing it against the opposing servo spring. The lower valve stem now lifts off the lower pilot seat. This equalizes the pressure across the disc seat. Further bellows compression lifts the plug assembly, allowing steam to pass through the valve. For a rise in temperature at the sensing spiral sensor, a reverse process closes the valve. The equalization of pressure across the disc seat prior to stroking the valve, inhibits flow directly over the seat, thereby eliminating velocity effects such as wire drawing and contributes to a wider range with a 50:1 turn-down ratio.

DIMENSIONS

	Nominal Valve Size							
	3/4in - 1in		1 1/4in		1 1/2in		2in	
	in	mm	in	mm	in	mm	in	mm
A	18	457	18	457	18 1/2	470	20	508
B	11	279	11	279	11 1/4	286	13	330
C	5	127	5	127	5	127	5	127
D	3 1/8	79	3 1/8	79	3 7/16	87	5	127
E	8 3/4	222	9	229	9 1/4	235	10	254
Wgt	25lb	11.3kg	27lb	12.2kg	30lb	13.6kg	40lb	18.1kg

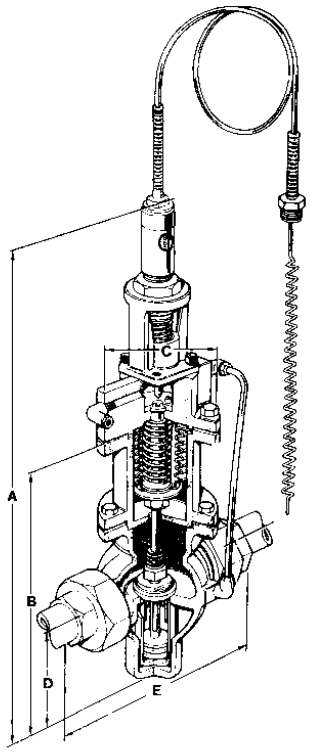


Figure 1. Dimensions for Temperature Regulator,

INSTALLATION

1. Refer to Figure 1 for dimensions. Install the Regulator in accordance with Figure 2 and the following instructions 2 to 9.

2. Ensure that the steam line is correctly trapped to prevent accumulation of condensate upstream of the Regulator. **THIS IS MOST IMPORTANT.**

3. Blow down all the pipe lines before installation of the Regulator to clear the lines of all scale and dirt which could cause faulty operation of the Regulator.

4. Refer to Figure 2 and install a "Y" type steam strainer and pressure gauge upstream of the Regulator and a compound pressure gauge on the downstream side. The by-pass valve (optional) should be a manually operated metal seat regulating valve. Shut-off valves should be metal seat globe or parallel slide pattern.

5. **FOR OPTIMUM PERFORMANCE** install the Regulator as follows:

   a) It is essential that the Regulator is installed **upright,** in any other position condensate could collect in the Pilot Valve and result in erratic operation.

   b) Fit the Regulator minimum 300mm (12 inches) above the lower flange of the Angelery Heater to prevent excessive accumulation of condensate in front of, or immediately after the Regulator. It should be located adjacent to heater to enable the thermal element capillary (2400mm long) to be connected between Angelery heater and the Regulator pilot.

6. Install the Regulator with the arrow on the body pointing in the direction of the flow.

7. Handle the Regulator with care during installation to prevent damage to the external tubing etc.

8. Protect the thermal element from damage when removed from the Regulator or Angelery Heater and do not make sharp bends in the capillary which could result in fracture and leakage of liquid from the thermal element assembly rendering it inoperative.

9. The system should incorporate a Safety System using the solenoid valve shown in Figure 2.

   a) Install the system in accordance with instructions in Section 3.

   b) Set the thermostat to operate at 10°C (20°F) above the desired Heater hot water outlet temperature before proceeding with any further adjustment or operation.

When the Regulator has been installed in the steam line and all connections tightened leakproof, fit the thermal element assembly to the Regulator and Angelery Heater as shown in Figure 2, with the bellows end in the Regulator Pilot Adjustment Sleeve and the bulb coil in the thermal element connection in the Angelery Heater.

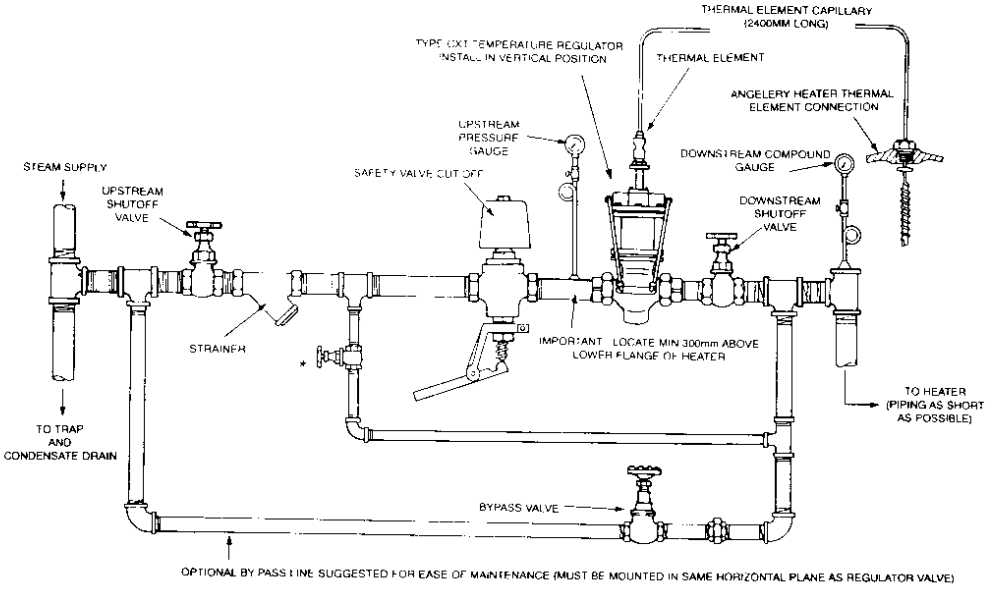


Figure 2. Schematic showing recommended installation for temperature regulator type CXT-S

** Depressurising line (1/2" suitable) to enable resetting of solenoid valve. Depressurising valve is always closed unless resetting solenoid valve.*

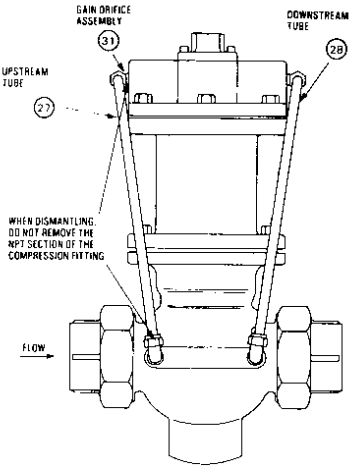


FIGURE 3 LOCATION OF GAIN ORIFICE ASSEMBLY

COMMISSIONING AND ADJUSTMENTS

A1. Open all valves on the secondary side to ensure that the heater and system is full of water.

A2. Energise circulating pumps, check that rotation of pump is correct and vent the system until free from air.

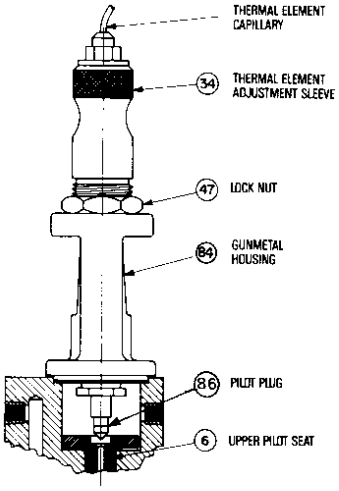


FIGURE 4 – SUPERSTRUCTURE ASSEMBLY ①

A3. Energise and check correct functioning of safety system by adjusting the thermostat. When satisfied with the operation, return the thermostat to its original setting thus energising the solenoid coil. Lift the valve core into the magnetic field by resetting the lever. Return the lever to its lowest position to leave the safety system in the open position and fully operational.

A4. Run locknut (47) up as high as it will go and turn adjustment Sleeve (34) down **BY HAND - DO NOT USE A SPANNER** - until the Pilot Plug seats, when the sleeve (34) becomes more difficult to turn by hand. Leave Locknut (47) at the top of the Sleeve Thread.

A5. **SLOWLY** open all shut-off valves - except the by-pass valve - to allow steam to the Regulator.

A6. Slowly open hot water outlets in the building or process to ensure a flow of water through the Heater. For best results in adjusting the Pilot, a water flow of 10% to 25% of the Heater rating is desirable.

A7. Rotate the Adjustment Sleeve (34) anti-clockwise until the Regulator Valve opens (indicated by the sound of steam flow through the Regulator).

A8. Wait until the temperature of the Heater hot water outlet stabilises at one steady reading. If necessary reset the Adjustment Sleeve (34) to obtain the desired hot water temperature at the Heater outlet. One full turn of the Adjustment Sleeve will change the water outlet temperature by approximately 35°C (60°F). To adjust the temperature at the Heater Outlet proceed as follows :

If the temperature is too low, rotate the Adjustment Sleeve anti-clockwise

If the temperature is too high, rotate the Adjustment Sleeve clockwise.

After each adjustment wait until the temperature stabilises before making any further adjustment.

A9. When the heater outlet remains steady at the desired temperature, tighten the Locknut (47) against the Superstructure Housing (84) to hold the adjustment Sleeve (34) in situ.

ROUTINE MAINTENANCE

RM1 MONTHLY

a) Check the total Regulator / Heater operation during a period of low water usage and a period of high water usage. If the temperature control is poor and/or if the Regulator is not operating correctly, check the possible causes listed in the section TROUBLESHOOTING.

b) Check the Regulator carefully for leakage. If leaking, tighten the necessary bolts or compression fittings, replace gaskets as necessary etc. For dismantling instructions refer to pages 19, 20, 21.

RM2 QUARTERLY

a) Clean the steam strainer in the steam line (See Fig 2).

b) In particularly hard water areas, the thermostat element needs to be checked and scale build-up removed, as this may result in giving an incorrect reading.

TROUBLESHOOTING

T1. *Note :* *Before undertaking any troubleshooting check that the Temperature Pilot adjustment is correct as detailed in Commissioning and Adjustments, instructions A4 to A9.*

a) Check all connections and pipework are in accordance with Figure 2 and correctly assembled as detailed in steps 1 to 9 under INSTALLATION on Page 15.

b) Check that the Regulator is installed with the flow arrows on the valve body pointing in the direction of flow.

c) Check both the upstream and downstream shut-off valves are fully open and the by-pass valve (if fitted) is fully closed.

d) Check the Thermal Element is properly installed in the Regulator Adjustment Sleeve (34) and in the correct connection in the Heater.

If any adjustments or alterations have been carried out during the above checks, before proceeding any further, check the operation of the Regulator to ascertain if the fault has been rectified.

IF THE SYSTEM OVERHEATS

A. THE BY-PASS VALVE (IF FITTED) MAY LEAK

T2 Check by closing the upstream and downstream shut-off valves and by carefully removing the downstream compound pressure gauge. If steam flows out the gauge connection hole, it is possible that the By-pass valve leaks and must be repaired or replaced.

or

B. REGULATOR VALVE DOES NOT CLOSE

T3 Close all steam line shut-off valves.

T4 Refer to Figure 3. Carefully disconnect and remove the downstream side tubing assembly (do not remove the NPT sections of the compression fittings which are screwed into the Valve top and body).
Crack each connection to allow any trapped pressure to dissipate before completely disconnecting the tubing.

T5 Run Locknut (47) up as high as it will travel and turn the Adjustment Sleeve (34) down by hand (do not use a spanner) until the Pilot Plug seats indicated by the sleeve (34) becoming more difficult to turn by hand. Leave the Locknut (47) at the top of the Sleeve Thread.

T6 Slowly open all steam line shut-off valves (not the by-pass valve) to allow steam to the Regulator.

T7 Check the steam escaping from the Regulator. If the Regulator is operating correctly, there should be no steam escape from either tubing assembly opening except, possibly a small wisp from the lower or valve body aperture. However :

a) If there is no steam escape from either opening except for the small wisp indicated above, the Regulator pilot and valve are operating correctly and the fault lies in the Thermal Element which must be replaced to solve the problem.
No further checking should be necessary.

b) If steam escapes through the upper tubing assembly opening in the Valve Top, the problem is at the Pilot Plug (See Figure 4). Proceed to dismantle and repair the Temperature Pilot as detailed in Steps DR4 through DR13 under Dismantling/Assembly. Refer to pages 19, 20 and 21.

c) If steam escapes through the lower tubing assembly opening in the Valve body, the problem is at the Main Valve Seat or Inner Pilot. Proceed to dismantle and repair as necessary per steps DR14 through DR28 under Dismantling/ Assembly.
If steam escapes through both tubing assembly openings, first correct any problems at the Pilot Plug per (b) above. If, after correction, steam continues to escape from the lower Valve body opening, correct the problems at the Main Valve Seal or Inner Pilot.

T8 When the necessary corrections have been made and test checks show that the operation is correct, replace the tubing assembly and put the Regulator back into service by slowly closing the by-pass valve. If necessary re-adjust the Temperature Pilot to hold the desired Heater outlet water temperature per steps A1 through A9 under Commissioning and Adjustment on Page 16.

SECTION TWO

IF THE SYSTEM WILL NOT MAINTAIN THE DESIRED TEMPERATURE

A. STEAM PRESSURE IS TOO LOW

T9. Check the upstream steam pressure to the Regulator

a) If it is too low, rectify the fault in the steam supply system.

b) If the upstream steam pressure drops as the Regulator opens, there is probably a partially closed valve in the upstream steam line or the strainer is blocked. Make the necessary correction.

B. NO STEAM TO THE TEMPERATURE PILOT

T10. Check there is no restriction of steam flow to the Temperature Pilot. Thoroughly clean out the Gain Orifice Assembly (See Figure 3) and the connection holes in the valve top and body.

C. STEAM TRAP (IF FITTED) IN HEATER CONDENSATE LINE IS NOT OPERATING CORRECTLY OR ORIFICE UNION MAY BE BLOCKED

T11. A steam trap malfunction in the Heater condensate discharge line will cause condensate to build up in the Heater and prevent free flow of steam through the heater. If the downstream pressure gauge shows pressure but the system does not heat adequately, the stream trap is normally at fault. To check, isolate the steam supply and carefully break the condensate connection before the trap to allow condensate to bleed off or to run out into a floor drain. Re-pressurize valve as detailed in A5, Page 16. If the heater hot water temperature remains low, the trouble is elsewhere, but if the temperature rises to its correct setting, the problem is the trap which must be repaired or replaced.

D REGULATOR VALVE FAILS TO OPEN

T12 Close the upstream and downstream valves. Provided a By-pass valve is fitted, the Heater may be kept in operation by slowly opening and adjusting the By-pass valve to maintain a steam supply to the Heater.

T13 Refer to figure 4. Run the Locknut (47) up as high as it will go and turn the Adjustment Sleeve (34) down by hand (do not use a spanner) until the Pilot Plug seats - indicated by the Sleeve (34) becoming more difficult to turn by hand. Leave the Locknut (47) at the top of the Sleeve (34) thread.

If the By-pass valve has been opened, shut it off to cut-off steam supply to the Heater and then slowly open both steam, shut-off valves to allow steam to the Regulator.

T14. Slowly slacken-off (turn anti-clockwise) the Adjustment Sleeve (34) until the Regulator opens.

T15 If the Regulator fails to open, check the operation of the Pilot Plug and make any necessary corrections as detailed under DR4 through DR13 in Dismantling / Assembly instructions.

T16 If the Temperature Pilot and Pilot Plug are operating correctly following step T15 and the valve still fails to open, the problem, is due to one of the factors listed from T17 through to T20.

T17 The safety system Solenoid Valve does not open. Check the operation of the system as detailed in A3 in Commissioning and Adjustment on Page 16. When the fault is established repair or replace as necessary.

T18 There is a leak from the valve bellows (10)

Refer to Figure 9 and remove the bellows as per steps DR14 through DR23 in the Dismantling / Assembly section. Examine the bellows thoroughly for leaks and if any are found the entire Bellows Assembly must be replaced (See Figure 9)

T19 The problem is in the Main Valve Assembly.

Refer to Figures 7 and 11 and remove the Assembly. Make any corrections as detailed per steps DR14 through DR28 under Dismantling/Assemby section.

T20 When all necessary corrections have been made, refit the Regulator and adjust the Temperature Pilot to hold the desired outlet water temperature of the Heater as detailed in instructions A1 through A8 in the Commissioning and Adjustment Section on Page 16.

IF THE TEMPERATURE FLUCTUATES WIDELY OR OPERATION IS SLOW AND SLUGGISH

T21 If the temperature fluctuations tend to follow load changes, the symptoms may be:

a) Overheating only under light or no-load conditions whilst maintaining relatively good temperature control under heavier load conditions.

or

b) The system is unable to hold the desired temperature under heavy load conditions but may control relatively well at light or no-load conditions.

Both these problems are dealt with under steps T2 through T8 or through steps T9 to T19 respectively.

T23 If the temperature fluctuations are rapid and do not follow load changes, they may be caused by one or more of the following :

a) Incorrect Temperature Pilot adjustment. See Steps A1 through A8 under Commissioning and Adjustment on Page 16.

b) Gain orifice omitted from assembly, see Figure 3.

c) The Safety System Solenoid Valve may not be opening fully. See step T17 on page 18.

d) If the installation includes a trap in the Heater condensate discharge line, the trap may be faulty. See step T11 on Page 18.

e) A restriction in the steam supply line, e.g. a partly closed valve, a blocked strainer etc., which results in the supply pressure fluctuating or falling below the design pressure of the system.

DISMANTLING / ASSEMBLY

Refer to Figures 7 and 11.

DR1 Close both upstream and downstream steam shut-off valves. If a By-pass is fitted the Heater may be kept in operation by slowly opening the By-pass valve.

DR2 Refer to Figures 4 and 7.

Slacken Locknut (47) and unscrew the Thermal Element Adjustment Sleeve (34) to remove the Sleeve and Thermal Element (2) from the Regulator - do not disconnect the Element from the Sleeve. Place the Sleeve and Element out of harms way.

DR3 Leave the Regulator fitted in the steam line if it is fully accessible. (If not, remove the Regulator from the line and secure it in a bench vice to facilitate servicing).

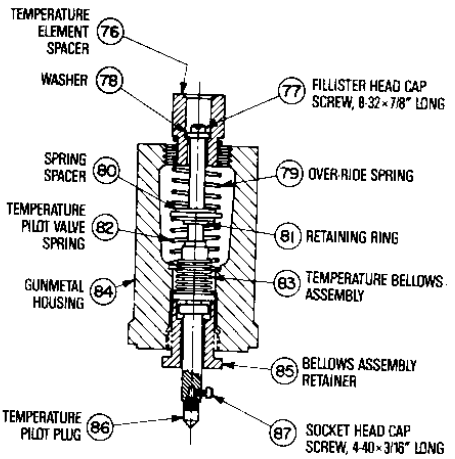


FIGURE 5 – TEMPERATURE PILOT ASSEMBLY

DR4 Carefully relieve any trapped pressure by releasing and removing Screws (4) and remove Temperature Superstructure Assembly (1)

DR5 Refer to Figure 5 and remove the Temperature Pilot Plug (86) by loosening the Socket Head Cap Screw (87) and unscrewing the plug (86).

DR6 Clean the Plug (86) thoroughly and inspect for wear. If worn so that it will not seat correctly, it must be replaced. If the Plug (86) is satisfactory refit the Plug to the Pilot Assembly.

DR7 Press down on the Temperature Element Spacer (76). If it moves up and down freely, no further dismantling, cleaning or replacement is necessary and you should proceed with step DR14. However, if the Temperature Element Spacer binds or moves roughly, proceed with steps DR8 through to DR13.

DR8 If, when the Valve was in operation, steam was escaping through the Temperature Superstructure housing (84) the Temperature Bellows Assembly (83) has been damaged and must be replaced (See Figure 5).

DR9 If in step DR7 the Temperature Bellows Assembly (83) moves freely, proceed to step DR13. If it does not move freely, proceed with step DR10.

DR10 Carefully remove the Screw (77) whilst preventing the Bellows Assembly (83) from rotating by holding the lower end of the Assembly (above the Pilot Plug (86)) with Pliers. Lift out the Washer (78), the Temperature Element Spacer (76) and both Springs (79) and (82) complete with Spacer (80). Clean all parts thoroughly.

DR11 Remove the Retaining Ring (81) and the Bellows Assembly Retainer (85). Clean thoroughly and polish bore. Remove Temperature Bellows Assembly (83) and polish sliding surfaces.

DR12 Reassemble complete superstructure assembly in reverse order (refer to Figure 5)
Do not forget Retainer Ring (81)
When tightening screw (77), hold lower end of Temperature Bellows Assembly (83) with pliers. Do not overtighten and twist or damage bellows.

Finally, depress the spacer to ensure that the assembly moves and returns freely.

DR13 If not complete in the preceding step, reassemble the Pilot Plug (86) on to the Temperature Bellows Assembly (83) and tighten the Cap Screw (87) to hold the Plug in place.

If no further correction to the Valve is required, proceed to step DR38. If, however, further correction is required proceed with step DR14.

DR14 Carefully relieve any trapped pressure in the upstream and downstream tubing assembly and remove both assemblies. Leave the NPT sections of the compression fittings screwed into the valve top and body (see Figure 3)

SECTION TWO

DR15 Refer to Figure 7, remove Screws (8) and Valve Top (23). From the Valve Top (23) remove Screws (25) and Upper Pilot Seat Retaining Ring (26). Lift out the Upper Pilot Seat (6).

DR16 Clean Upper Pilot Seat (6) thoroughly. If it is worn so that the Pilot Plug (86) (see figure 5) will not seat correctly, the Seat (6) must be replaced.

DR17 Thoroughly clean the inside of the Isolation Tube which is fitted to the bottom of the Valve Top (23). All dirt and scale must be removed.

DR18 Refit the Seat (6), Retaining ring (26) and Screws (25) back into the Valve Top (23).

DR19 Remove the top Bellows Gasket (9) and lift out the Servo Spring (11).

DR20 See Figure 7. Remove screws (8) from Bellows Housing (50). Lift Bellows Housing straight up from the valve body (45). In so doing the entire inner valve assembly down to and including the bottom piston will be removed.

DR21 Refer to Figures 9, 10 and 11 and dismantle the inner valve assembly.

a) Hold the Valve Plug Shaft (43) with a pair of pliers - firmly but carefully to prevent scoring the shaft - and using a spanner, unscrew the Valve Stem Retaining Nut (19)from the Shaft (43).

b) Insert a 1/8" diameter tool steel rod through the hole near the top of Valve Stem (44). Grip the connecting Shaft (51), firmly with a pair of pliers and unscrew valve stem. The Bellows assembly can now be removed from the Bellows Housing.

c) Hold the Stem Pilot Coupler (12) in a vice. Using a deep socket spanner inserted over the Upper Valve Pilot Stem (46) - inside the Bellows (10) screw the Stem (46) off the Coupler (12).

DR22 Clean all parts thoroughly. All dirt and/or scale must be removed from the outer surfaces of the Top Piston (40) and the Bottom Piston (42) and from the surface of the Upper Valve Pilot Stem (46).

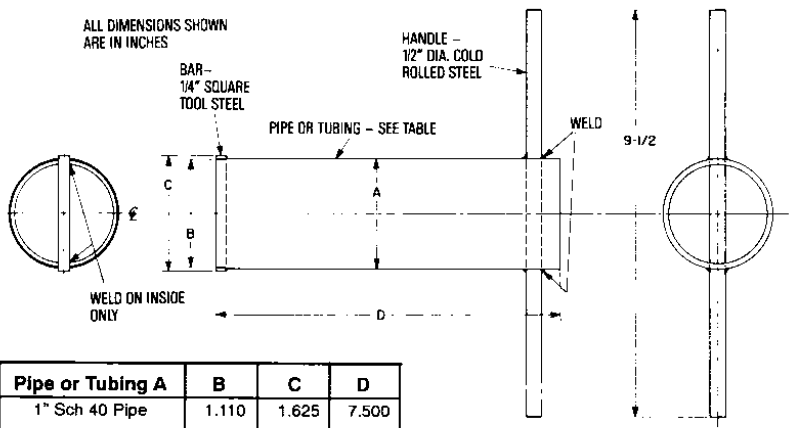
DR23 Inspect the Upper Valve Pilot Stem (46). If it is scored or damaged preventing free movement in the Isolating Tube or if it will not seal correctly on the bottom of the Upper Pilot Seat (6), it must be replaced. If a leak is also found in the Bellows Assembly, the entire Bellows Assembly (Figure 9) must be replaced (See T18 under Troubleshooting on Page 17).

DR24 Inspect the Valve Stem (44). If it is damaged so that it will not seat properly on the Lower Pilot Seat (18) or it does not move freely in the Nut (19) it must be replaced (See Figure 10).

DR25 Inspect the outer surfaces of the Top Piston (40) and the Bottom Piston (42). If they are scored or damaged to prevent them moving freely up and down in the Seat Cage (41) they must be replaced (See Figure 11).

DR26 Inspect the Lower Pilot Seat (18). If it is worn, preventing the Valve Stem (44) from seating correctly, it must be replaced. To carry out the replacement :

a) Insert a rod up through the Valve Plug Shaft (43) and push out the Seat (18).
Or drill out (3/8" drill).



Regulator Size	Pipe or Tubing A	B	C	D
3/4 - 1"	1" Sch 40 Pipe	1.110	1.625	7.500
1 1/4"	1 1/4" Sch 40 Pipe	1.420	2.000	7.500
1 1/2"	1 1/2" Sch 40 Pipe	1.670	2.375	8.000
2"	2 1/2" OD x 0.12 Wall seamless tubing	2.400	2.625	8.000

FIGURE 6 – SEAT CAGE TOOL

b) Press a new Seat (18) into the Plug Shaft (43).

DR27 Inspect the Disc Seat (38). If it is worn so that it will not seat correctly with the Seat Cage (41), it must be replaced. To carry out the replacement:

a) Insert a 3mm (1/8") diameter tool steel rod through the holes at the top of the Valve Plug Shaft (43). Using a spanner on Disc Retainer (37) turn the Retainer off the shaft (43).

b) Lift the Disc Seat (38) and Seat Retainer (39) assembly off the shaft (43).

c) Prise the Disc Seat (38) off the Seat Retainer (39). (There is no Seat Retainer fitted in a 3/4" and a 1" Regulator).

d) Press a new Disc Seat (38) on to the Seat Retainer (39)

e) Reassemble the Seat Retainer (39) and Disc Seat (38) assembly and the disc Retainer (37) back on to the Shaft (43)

DR28 Thoroughly clean and inspect the seating and inner surfaces of the Seat Cage (41). If the Cage (41) has to be removed from the Valve Body (45), make up a tool as shown in Figure 6.

Insert the tool into the slots on the top of the Cage (41) and unscrew the Cage from the Valve Body. If the Seating Surface around the top of the Cage is worn or damaged preventing the Disc Seat from seating correctly, or if the inner surfaces of the Cage are scored or damaged so that the Pistons (40) and (42) do not move up and down freely, then all worn and damaged parts must be replaced.

ASSEMBLY

Refer to Figure 7

DR29 Reassemble the Seat Cage (41) back into the Valve body. Use Jointing Compound - Boss White etc. on the Cage threads. Use the tool in Figure 6 (See step DR28) to tighten the Cage into place.

DR30 Refer to Figure 7, and the item numbers quoted on the drawing. Reassemble the inner valve assembly as follows:

a) See Figure 9. Hold the Stem Pilot Coupler (12) in a vice and screw the Upper Pilot Valve Stem (46) on to the Coupler (12) within the Bellows (10). Use a deep socket spanner to nip up tight. Loctite 648 to be used.

b) Clean all gasket faces on Bellows and Bellows Housing. Fit new Bellows Gasket (9) into recess on top of Bellows Housing. Insert Bellows assembly (Figure 9) into Bellows Housing (50) with connecting shaft (51) extending through central hole in bottom of housing.

c) Assemble the Valve Stem (44) (See Figure 10) to the bottom of Connecting Shaft (51). Hold Connecting Shaft tightly with a pair of pliers. Insert a 1/8" diameter tool steel rod through hole near top of Valve Stem (44), and tighten stem into shaft using Loctite 648.

d) Assemble the Valve Stem Retaining Nut (19) (See Figure 10) on to the Valve Plug Shaft (43) (See Figure 11). Hold the shaft (43) with a pair of pliers firmly and carefully without damaging the Shaft - and turn the Nut (19) on to the Shaft (43) tight enough to hold but without using force - Using Loctite 648

DR31 Clean gasket surfaces on valve body (45) and Valve Top (23). If necessary use a wire brush or emery cloth.

DR32 Fit a new Bellows Gasket (9) into the Valve Body gasket recess.

DR33 Carefully insert the entire inner valve assembly, complete with Bellows Housing, straight down into the valve body and into the seat cage. Locate Bellows Housing in Valve Body recess, and replace screws (8) through holes in Bellows Housing into Valve Body. Tighten evenly all round to make a leak tight joint.

DR34 Insert the Servo Spring (11) into the Bellows (10) and fit a new Bellows Gasket (9) on the Bellows (10) gasket surface.

DR35 Carefully replace the Valve Top (23) - as assembled in step DR18 - on to the Bellows Housing so that the Isolation Tube (assembled to the Top (23)) fits down over the Upper Valve Pilot Stem (46) within the Bellows (10).

DR36 Replace Screws (8) in the Valve Top (23). Tighten evenly all round to ensure that it does not leak.

DR37 Reassemble the upstream and downstream Tubing Assemblies (See Figure 3) to the Valve Body (45) and Valve Top (23). Make the compression fittings leak tight.

DR38 Clean the gasket surfaces on the temperature Superstructure Assembly (1) and Valve top (23). If necessary, use a wire brush or emery cloth. Fit a new Temperature Regulator Gasket (5) on the Valve Top (23).

DR39 Fit the temperature Superstructure Assembly (1) (See DR12) on to the Valve Top (23). tighten screws (4) evenly to make the assembly leak tight.

DR40 Refer to Figures 4 and 7. Reassemble the Thermal Element Adjustment Sleeve (34) and Thermal Element (2) on to the Temperature Superstructure Assembly.

DR41 Fit the Regulator back into the system as per steps detailed in Installation on Page 15.

DR42 Check the temperature Pilot Adjustment per steps A1 to A7 detailed in ADJUSTMENT on page 16.

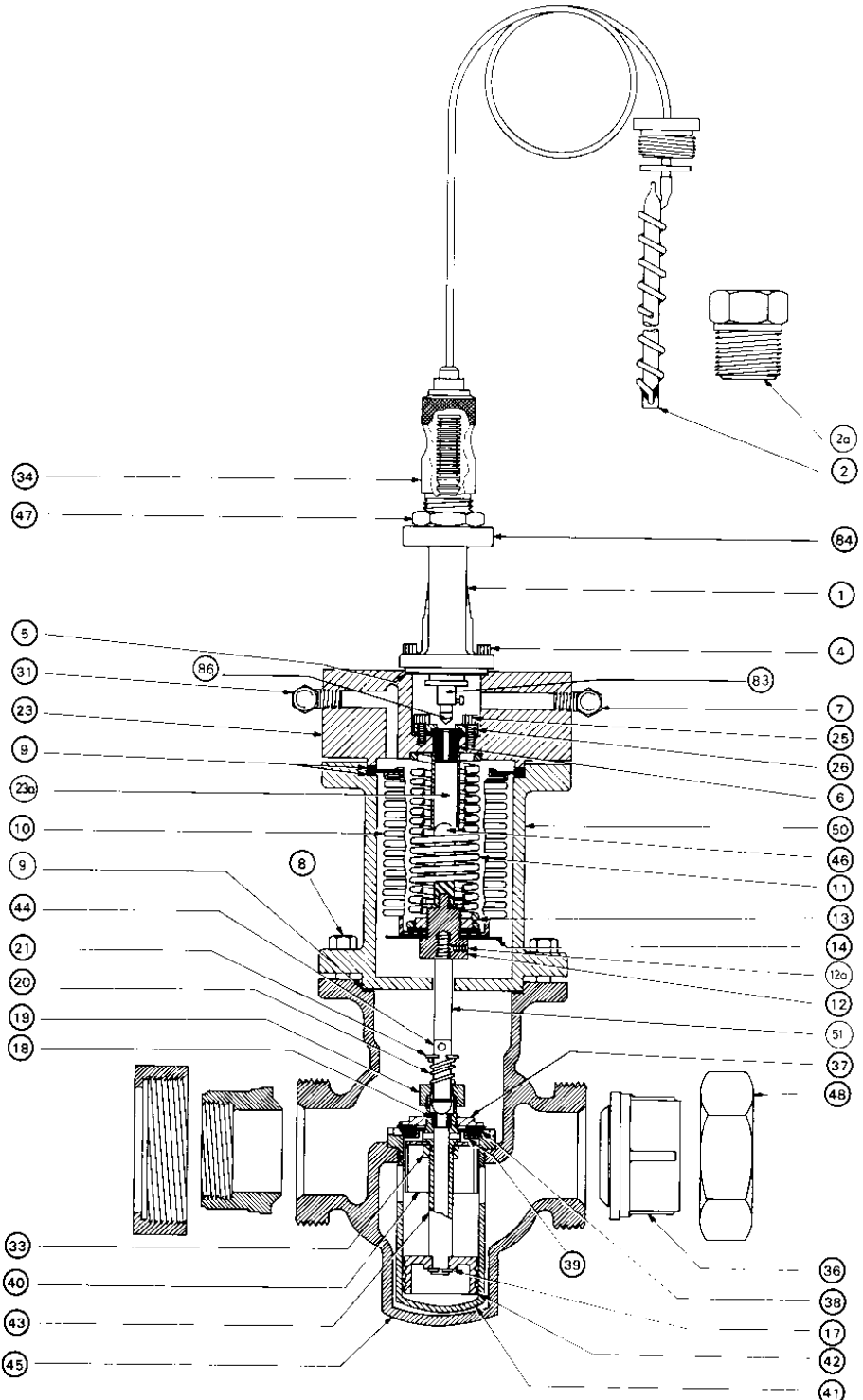


FIGURE 7 — TEMPERATURE REGULATOR, ASSEMBLY DRAWING

PARTS LIST

ITEM NO	NO REQ'D	NAME	SEE FIG NO.
1	1	Superstructure Assembly	8
2	1	Thermal Element	7
2a	1	Thermal Element Bush	7
4	4	Socket Head Cap Screw 10-24 x 3/4" LG	8
5	1	Temperature Regulator Gasket	8
6	1	Upper Pilot Seat	7
7	3	Compression Fitting 1/8" BSP x 5/16"	7
8	12	Set Screw 3/8" - 16 x 1" LG	7
9	3	Bellows Gasket	9
10	1	Bellows	9
11	1	Main Spring	7
12	1	Stem Pilot Coupler	9
12a	1	Grub Screw	7
13	1	Retaining Nut	9
14	1	Bellows Support Plate Assembly	9
17	1	Bottom Piston Retaining Ring	11
18	1	Lower Pilot Seat	11
19	1	Valve Steam Retaining Nut	10
20	1	Lower Pilot Pre Load Spring	10
21	1	Pre Load Spring Retaining Ring	10
23	1	Valve Top and Isolation Tube Assembly	7
23a	1	Isolation Tube	7
25	2	Socket Head Cap Screw 10 - 24 x 3/8" LG	7
26	1	Upper Pilot Seat Retaining Ring	7
27	1	CXT-S Upstream Tubing (not shown)	3
28	1	CXT-S Downstream Tubing (not shown)	3
30	1	Valve Nameplate (not shown)	
31	1	Gain Orifice Compression Fitting	7
33	1	Top Piston Retaining Nut	11
34	1	Thermal Element Adjusting Sleeve	7
36	2	Union Tail Piece	7
37	1	Disc Retainer	11
38	1	Disc Seat	11
39	1	Seat Retainer	11
40	1	Top Piston	11
41	1	Seat Cage	11
42	1	Bottom Piston	11
43	1	Valve Plug Shaft	11
44	1	Valve Stem	10
45	1	Valve Body	7
46	1	Upper Pilot Stem	9
47	1	Locknut	7
48	2	Union Nut	7
50	1	Bellows Housing	7
51	1	Connecting Shaft	7
76	1	Temperature Element Spacer	5
77	1	Fillister Head Cap Screw	5
78	1	Washer	5
79	1	Over-Ride Spring	5
80	1	Spring Spacer	5
81	1	Retaining Ring	5
82	1	Temperature Pilot Valve Spring	5
83	1	Temperature Bellows Assembly	5
84	1	Gunmetal Housing	8
85	1	Bellows Assembly Retainer	5
86	1	Temperature Pilot Plug	5
87	1	Socket Head Cap Screw 4-40 x 3/16" LG	5

SECTION TWO

RECOMMENDED SPARE PARTS

For up to five of the same valve size it is recommended that the following spare parts be retained for maintenance replacement purposes.

Note : *The number in brackets refers to the item shown in Figure 7.*

Recommended Quantity	Item	Product Code
1 off	Thermal Element (2)	40030520
2 off	Seat & Gasket Set Comprising	Regulator Size
	1 - Temperature Regulator Gasket (5)	3/4" : 40050030
	1 - Upper Pilot Seat (6)	1" : 40050041
	3 - Bellows Gaskets (9)	11/4" : 40050052
	1 - Lower Pilot Seat (18)	11/2" : 40050063
	1 - Disc Seat (38)	2" : 40050074
1 off	Bellows (10)	40050085

Note : *For simplicity and ease of maintenance, a complete Internal Assembly comprising Fig 9, 10 and 11, with the exception of item 41 Seat Cage, is available ex-works. Alternatively, the individual sub assemblies can be supplied. A refurbishing service for customers' own Internal Assembly is also available by prior arrangement.*

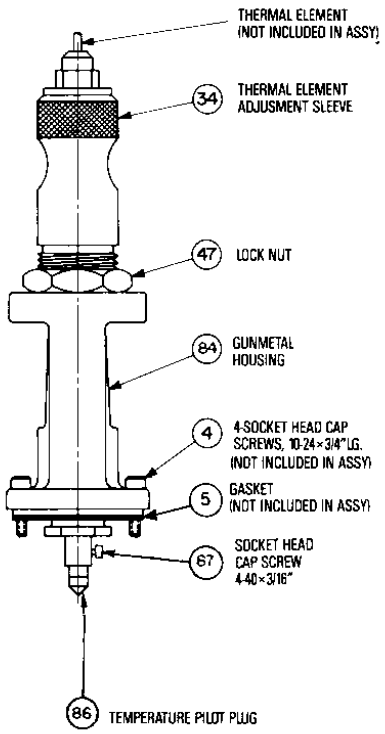


FIGURE 8 – SUPERSTRUCTURE ASSEMBLY ①

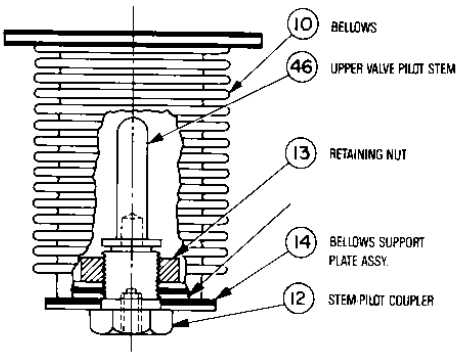


FIGURE 9 – BELLOWS ASSEMBLY

Product Codes ¾in: 400-50115, 1in: 400-50126, 1¼in: 400-50137, 1½in: 400-50148, 2in: 400-50159.

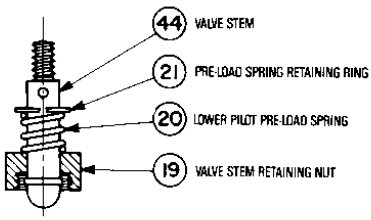


FIGURE 10 – LOWER PILOT ASSEMBLY

Product Codes ¾in: 400-50170, 1in: 400-50181, 1¼in: 400-50192, 1½in: 400-50200, 2in: 400-50211.

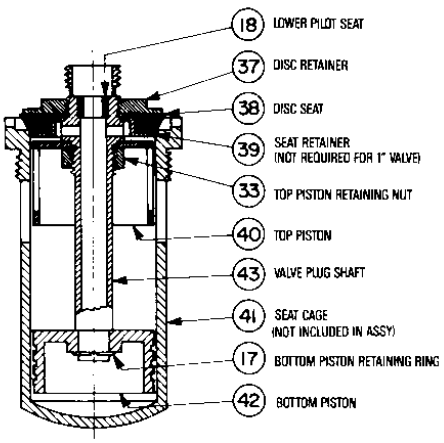


FIGURE 11 – MAIN VALVE ASSEMBLY
(Item 41 not included)

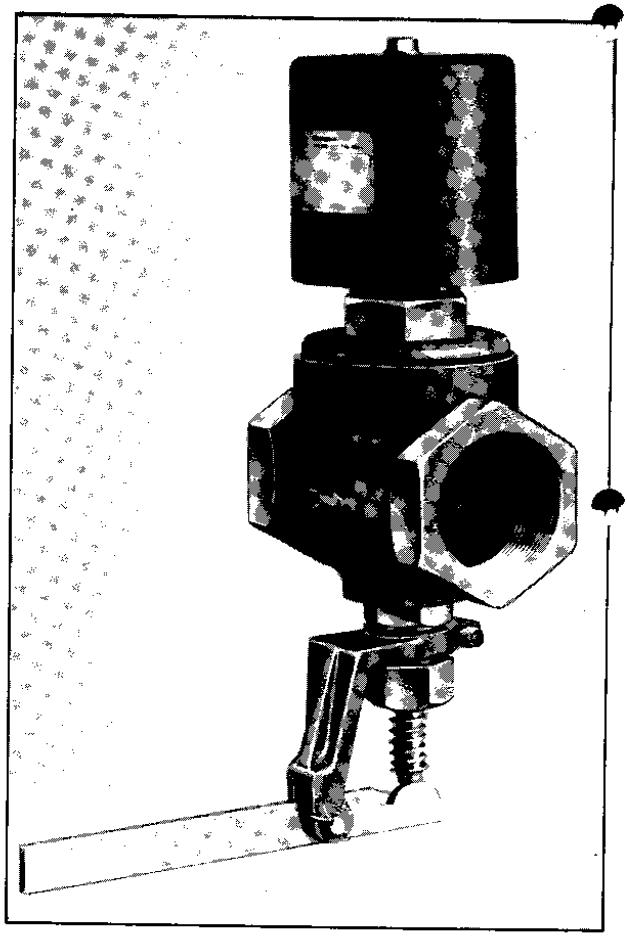
Product Codes ¾in: 400-50222, 1in: 400-50233, 1¼in: 400-50244, 1½in: 400-50255, 2in: 400-50266.

MAXIMUM STEAM CAPACITIES

(Kilograms per hour / pounds per hour)

INLET PRESSURE		OUTLET PRESSURE		NOMINAL VALVE SIZE									
				3/4"		1"		1 1/4"		1 1/2"		2"	
BARG	PSIG	BARG	PSIG	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr
		0-0.5	0-7.5	340	750	425	937	647	1426	924	2037	1608	3544
2.1	30	0.7	10	327	720	408	900	621	1369	887	1956	1544	3403
		1.0	15	293	645	366	807	557	1228	796	1754	1384	3052
		0-0.9	0-12.5	415	916	520	1146	791	1744	1130	2492	1966	4335
2.8	40	1.0	15	402	887	503	1109	766	1688	1094	2412	1903	4196
		1.4	20	370	816	463	1021	705	1554	1007	2220	1752	3863
		1.7	25	330	727	412	909	627	1383	896	1976	1559	3437
		0-1.2	0-17.5	492	1084	615	1355	935	2062	1336	2946	2325	5126
		1.4	20	479	1055	598	1319	910	2007	1300	2867	2363	4988
3.5	50	1.7	25	448	987	560	1234	851	1877	1216	2682	2117	4667
		2.1	30	410	904	513	1130	780	1719	1114	2456	1938	4273
		2.4	35	363	800	454	1000	690	1522	987	2175	1716	3784
		0-1.6	0-22.5	567	1250	709	1564	1080	2381	1543	3401	2684	5918
		1.7	25	554	1222	693	1528	1055	2325	1507	3322	2622	5780
4.1	60	2.1	30	524	1156	655	1445	997	2199	1425	3142	2480	5467
		2.8	40	446	983	557	1229	848	1870	1211	2671	2108	4647
		3.1	45	380	838	475	1048	748	1650	1069	2357	1861	4102
		0-2.0	0-29.5	644	1420	805	1774	1224	2699	1749	3856	3043	6709
		2.1	30	630	1390	788	1737	1199	2644	1713	3777	2981	6572
4.8	70	2.8	40	567	1250	709	1562	1078	2377	1540	3395	2679	5907
		3.5	50	479	1056	599	1320	911	2009	1302	2870	2265	4993
		3.8	55	422	930	527	1162	802	1769	1146	2527	1994	4396
		0-2.2	0-32.5	719	1586	899	1983	1368	3017	1955	4310	3402	7500
5.5	80	2.8	40	678	1494	847	1867	1289	2841	1841	4058	3203	7062
		3.5	50	606	1336	758	1670	1152	3541	1647	3630	2865	6317
		4.5	65	461	1017	577	1272	878	1936	1254	2765	2183	4812
		0-2.9	0-42.5	871	1920	1089	2401	1657	3654	2368	5220	4120	9082
6.9	100	3.5	50	830	1830	1037	2287	1579	3481	2255	4972	3924	8652
		4.5	65	723	1594	904	1992	1375	3031	1965	4331	3418	7535
		5.5	80	567	1250	709	1563	1079	2378	1541	3398	2682	5912
		0-3.8	0-55	1061	2340	1326	2924	2018	4449	2883	6356	5017	11060
8.6	125	4.5	65	1005	2216	1257	2771	1912	4216	2732	6024	4754	10481
		5.5	80	900	1984	1125	2480	1712	3774	2446	5392	4256	9382
		6.9	100	699	1540	874	1926	1329	2931	1899	4187	3304	7285

2 WAY ACHL SERIES MANUAL RESET SOLENOID VALVES



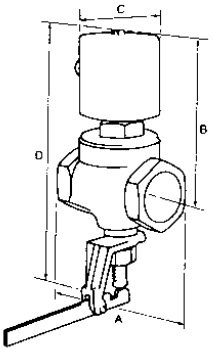
APPLICATION
Safety shut off for use with steam giving on/off control with no voltage release safety feature for non-aggressive media compatible with the materials of construction. For positioning of valve see Figure 2, Page 15.

FEATURES
Lever reset operation.

TECHNICAL SPECIFICATION

Function:	Normally closed, energize and manually reset to open
Ambient Temperature:	-10°C to +50°C
Materials:	Body: Bronze, cast iron Internals: stainless steel, copper alloy
Seals:	Standard : Metal
Coil Voltage:	212 Volt DC
Voltage Tolerance:	± 10%
Duty Cycle:	100% continuously rates
Protection Class:	IP65 with plug to DIN 43650 ACHL3-7 IP50 with metal enclosure ACHL9-15 Plug supplied as standard.
Coil Insulation:	Class F or H
Maximum Body Pressure:	250 Psi

Dimensions



Dimensions in millimetres (inches)

Nom Size		A	B	C	D
mm	In				
25	1	106 (4.17)	112 (4.41)	*75 (2.95)	196 (7.72)
40	1 1/2	118 (4.65)	116 (4.57)	*75 (2.95)	221 (8.70)
50	2	146 (5.75)	120 (4.72)	101 (3.98)	233 (9.17)
65	2 1/2	260 (10.24)	137 (5.39)	134 (5.28)	273 (10.75)
100	4	292 (11.50)	285 (11.22)	190 (7.48)	577 (22.72)

** Includes Plug*

Material (SEAT)	Temperature Range
Metal	-50°C to +180°C

GENERAL INSTALLATION AND SERVICING INSTRUCTIONS

1. INSTALLATION

WARNING
Before fitting valve it is important that the following four point check is carried out to ensure that the valve is suitable for the application. The use of this valve in an unsuitable application may lead to injury or damage to persons or property.

1.1 4 Point Check

Voltage, Frequency
Environment and coil housing suitability
Medium - are materials of construction of valve compatible with medium of application. Medium should be free from foreign matter.
Pressure (minimum and maximum)

1.2 Mechanical

1.2.1 Care should be taken that all foreign matter has been removed from connecting pipework before valve is installed.
1.2.2 Ensure that sufficient clearance is left for installation and service of the valve.
1.2.3 Apply sealant compounds to male threads only, if applied to valve threads it may enter valve and cause malfunction.
1.2.4 If P.T.F.E. (Teflon) tape or compound or similar lubricant is used on threads use extra care when tightening due to reduced friction and danger of over tightening. Pipework must be suitably aligned and supported to avoid straining joints.
1.2.5 Valve must be installed so that flow is in the direction as indicated on the valve body.
1.2.6 **CAUTION**. Use the correct size of spanner on the flats on the valve body. Do not use the solenoid housing as a lever. Do not over tighten pipe connections.
1.2.7 Install valve with solenoid / actuator vertical above pipeline, unless stated otherwise in catalogue.
1.2.8 LEVER/PUSH BUTTON OPERATED VALVES: Provision must be made to relieve or vent high inlet pressure prior to opening the valve to avoid damaging the operating mechanism.

1.3 Electrical

1.3.1 All wiring must comply with the applicable codes of practice in particular the valve must be correctly earthed.
1.3.2 Isolate power supply before commencing wiring to prevent electric shocks and valve damage.
1.3.3 The solenoid housing can be rotated to suit conduit orientation by loosening the top nut and re-tightening.
1.3.4 Never energise and a.c. coil when removed from the valve as it will burn out.

1.4 Temperature

1.4.1 **WARNING** : it is normal for the covers of solenoid valves to reach temperatures which can cause burns. The actual temperatures reached depend on the relative medium and ambient temperatures.
1.4.2 Although Alcon Valves are built to withstand high temperatures the normal precaution should be taken to mount the solenoid / actuator away from hot surfaces.
1.4.3 In case of doubt consult the manufacturers for advice.

1.5 Valves for use in potentially explosive atmospheres

Where valves are to be installed in potentially explosive atmospheres it is most important that the correct type of solenoid enclosure is used e.g. EExd type. Installation and maintenance must comply with BS5345.

2. SERVICING

2.1 Regular checks on current functioning and condition of elastomers is recommended. This is particularly important where extremes of temperature, rapid cycling, aggressive media, etc. are features of the application.

2.1.1 Isolate the electrical supply and relieve valve body pressure before carrying out any work on the valve.
2.1.2 Clean and inspect all parts for wear and replace if necessary with manufacturers recommended parts.

2.2 When fitting a new coil make sure that all solenoid components are replaced in the order in which they are removed. Tighten coil retaining nut to 11N.m. (8lbf.ft).

2.3 On completion of any servicing and prior to recommissioning, the valve connection pipework should be fully checked for leaks and correct valve operation.

IMPORTANT
Where media contains solids
To ensure a trouble free operation a pipeline strainer having a 40 mesh filter should be fitted on the inlet side of the valve.

BOILER THERMOSTAT TKR

The TKR is a stem type thermostat for controlling the temperature of automatically fired boilers and similar plant. This thermostat is approved by the British Standards Institute and conforms with the requirements of BS3955, the British Gas Corporation and DOBETA.

Physical Characteristics

The temperature sensitive element of the switch is a liquid phial connected by a capillary tube to a capsule in the head of the instrument. Changes of temperature sensed by the phial are communicated hydraulically to the capsule which actuates a micro-gap switch. The action is specially designed to give long life and to be radio and television interference free.

The switch is enclosed in a die cast metal casing. The adjusting knob is located on the outside of the casing. The temperature scale is marked on this knob so that the setting is clearly visible whether the instrument is mounted horizontally or vertically. Details of scale range are given below. The button for hand reset operation is located adjacent to the adjusting knob.

Type

The TKR is fitted with a thermally operated single pole changeover switch. The contacts which open when the set temperature is reached can only be closed again by manual depression of the reset button.

Installation

The thermostat is supplied with a separate corrosion resisting bronze pocket screwed 1/2" BSPT (taper thread) and rated at 17.5 kg/cm² (250lbf/in²) maximum working pressure. The thermostat may therefore be removed if necessary without draining the system. The TKR has one cable entry at the lower end of the casing, and it is recommended that a short length of flexible conduit is used for final connection to the thermostat to avoid imposing a strain on the head of the instrument.

Technical Data

The design, data and dimensions may be liable to alteration without notice

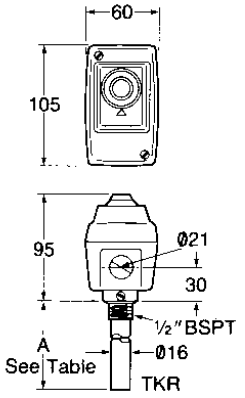
Type	Reset Action	Scale Range	Approx Weight		Pocket Length A (See Dimensions)	
		Limit °C	Kg	lb oz	mm	in
Limit thermostats TKR3501	Hand	25-95	0.8	1 9	162	$6\ ^{5}/_{16}$

Approximately total test differential 6°C (10°F)

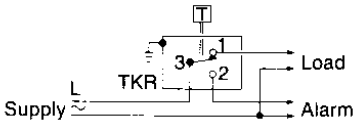
Switch Ratings

Contacts	Function (Control or Limit)	Load Current	Voltage
3 and 1	break circuit on rise of temperature	10A Resistive 2.5A Inductive 15A Motor Starting	250V ac
3 and 2	make circuit on rise of temperature	2A Resistive 0.5A Inductive No rating for motor starting	250V ac

Dimensions (in millimetres)



Connection diagrams



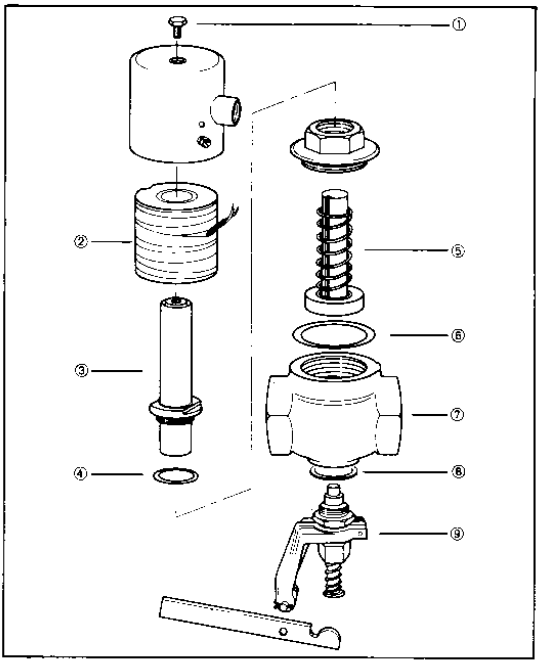
PARTS REFERENCE

No.	Component	Spares Kit ACHL 4
1	Locknut	
2	Coil	x
3	Flange Assembly	x
4	Flange Gasket / O Ring	x
5	Plunger Assembly	x
6	Body Gasket / O Ring	x
7	Body	
8	Gasket	x
9	Hand Reset Assembly	x

When ordering, please specify valve types and voltage

Valve Notes

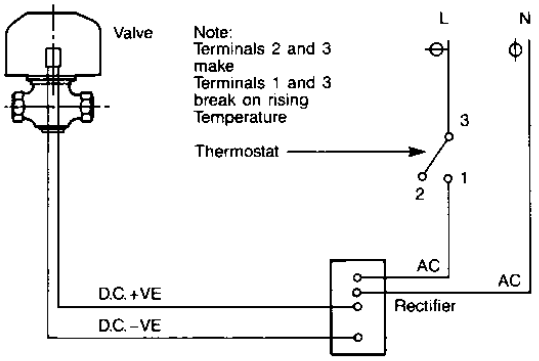
M.O.P.D.	Maximum operating pressure differential.
Kv	M3/hr of water at 1 bar pressure drop
Mounting	Solenoid vertical
Pipe Connection	BSP
PSU2	Supplied with separate rectifier for AC supply.



VALVE INFORMATION

Pipe Size	Orifice mm	KV m^3/hr	Max Pressure Bar (psi)	MOPD Bar	Coil Power Watts DC	Media Temp	Seal Material	Weight Kg (lb)	Body	Valve Type	Notes
1"	22.2	9.48	8.6	1.0	11	-50°C to +180°C	Metal	1.9 (4.2)	Bronze	ACHL7M	PSU2
1 1/2"	38.1	23.16	8.6	1.0	22			3.1 (6.8)	Bronze	ACHL9M	PSU2
2"	50.8	47.28	8.6	1.0	22			3.7 (8.2)	Bronze	ACHL10M	PSU2
2 1/2"	76.0	64.26	7.0	1.0	22			7.8 (17.2)	Bronze	ACHL11M	PSU2
4"	102.0	167.10	5.2	1.0	22			40.5 (89.3	Cast Iron	ACHL13M	PSU2

WIRING DIAGRAM



Note : *On AC supply where media is above 80°C a separate rectifier (PSU2) is to be used.*
Kv to Cv multiply Kv rating by 1.6 = USgall/min. If the inlet pressure on the seat area exceeds 18kg the inlet pressure must be removed to open the valve. Pipeline strainer recommended for all applications. Alternative enclosures i.e. Exd flameproof are available.

Technical Data

Standard Voltage: 240V 50Hz AC Input = 212V DC Output
Note : Ensure electrical circuit is properly earthed.

Duty :	Continuous, 100% in 70°C ambient
Protection :	IP 50 Dustproof
Operating Range :	+10 or -10% of rated voltage.
Power Consumption :	N/A
Temperature Range :	-10 +80°C ambient