

Installation and Maintenance Manual

Instantaneous Hot Water System HeatMax

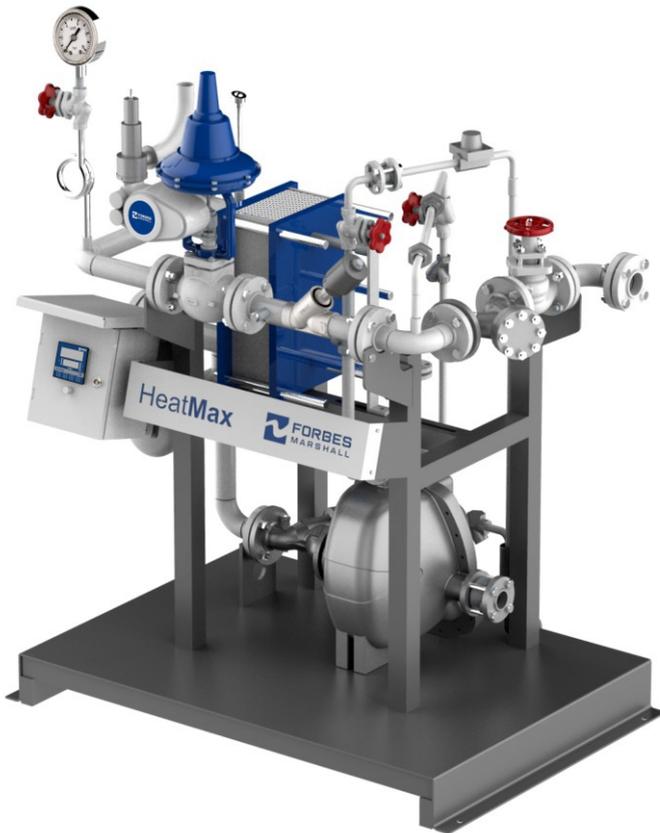


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PLEASE NOTE - Throughout this manual this cautionary symbol is used to describe a potential damage or injury that might occur if the safety considerations are overlooked. This symbol denotes CAUTION, WARNING or DANGER.



1. Preface:

This manual is intended for anyone using, commissioning, servicing, or disposing the below mentioned products safely and efficiently.

HeatMax - Instantaneous Hot Water System

PLEASE NOTE:

Throughout this manual the following cautionary symbol is used to describe a potential damage or injury that might occur if the safety considerations are overlooked.

2. Important Safety Notes:



Read this section carefully before installing/operating/maintaining the product. The instructions listed in this manual are provided for personnel and equipment safety.

Furthermore, Forbes Marshall accepts no responsibility for accidents or damage occurring as a result of failure to observe these precautions. Note that the product is designed to perform for non-contaminated fluids only. A contamination in the form of chemical, foreign particle etc. can lead to problem with product performance and life of the product. If these products in compliance with the operating instructions are, properly installed, commissioned, maintained and installed by qualified personnel (refer Section 2.7) the safety operations of these products can be guaranteed. General instructions for proper use of tools and safety equipments, pipeline and plant construction must also be complied with. This product is designed and constructed to withstand the forces encountered during normal use.

Use of the product for any purpose other than as intended use could cause damage to the product and may cause injury as fatality to the personnel.

Before installation or maintenance, always ensure that all primary steam and condensate return lines and water lines are isolated. Ensure any residual internal pressure in the system on connecting pipe work is carefully relieved.

This system is designed and constructed to the specific parameters. To achieve the best results from this system ensure that the parameters are adhered to.

Customer to provide Canopy/Roof to protect the system from the weather

Lifting : The HeatMax system should be lifted by forklift truck, from base frame only and not using any other components of the system. The system must be placed in position and securely bolted to the floor.

Note: Sufficient space should be provided around the system to have better access for maintenance.

2.1 Intended use:

Check if the product is suitable for intended use/ application by referring to the installation and maintenance instructions, name plates and technical information sheets

- I) The product is suitable for use as defined in the technical information sheet. In case the need arises to use the product on any other fluid please contact Forbes Marshall for assistance
- II) Check for the suitability in conformance to the limiting conditions specified in technical information sheet of the product.
- III) The correct installation and direction of fluid flow has to be determined.

iv) Forbes Marshall products are not intended to resist external stresses, hence necessary precautions to be taken to minimize the same.

2.2 Accessibility and Lighting:

Safe accessibility and working conditions are to be ensured prior to working on the product.

2.3 Hazardous environment and media:

The product has to be protected from hazardous environment and check to ensure that no hazardous liquids or gases pass through the product.

2.4 Depressurizing of systems and normalizing of temperature:

Ensure isolation and safety venting of any pressure to the atmospheric pressure. Even if the pressure gauge indicates zero, do not make an assumption that the system has been depressurized.

To avoid danger of burns allow temperature to normalize after isolation.

2.5 Tools and consumables:

Ensure you have appropriate tools and / or consumables available before starting the work. Use of original Forbes Marshall replacement parts is recommended.

2.6 Protective clothing:

Consider for the requirement of any protective clothing for you/ or others in the vicinity for protection against hazards of temperature (high or low), chemicals, radiation, dangers to eyes and face, noise and falling objects

2.7 Permits to work:

All work to be carried out under supervision of a competent person. Training should be imparted to operating personnel on correct usage of product as per Installation and Maintenance instruction. "Permit to work" to be complied with (wherever applicable), in case of absence of this system a responsible person should have complete information and knowledge on what work is going on and where required, arrange to have an assistant with his primary goal and responsibility being safety. "Warning Notices" should be posted wherever necessary.

2.8 Handling:

There is a risk of injury if heavy products are handled manually. Analyze the risk and use appropriate handling method by taking into consideration the task, individual, the working environment and the load.

2.9 Freezing:

Provision should be made to protect systems which are not self-draining, against frost damage (in environments where they may be exposed to temperatures below freezing point) to be made.

2.10 Product Disposal:

It is necessary to dispose this product only in accordance with local regulations at the authorized, qualified collecting point specified for equipment's and its parts—Please refer the part details mentioned in the material table of this manual. Please follow all waste disposal guidelines (Management & Handling) as published by local governing authorities in India & abroad

2.10 Returning products:

Customers and Stockist are reminded that, when returning products to Forbes Marshall they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk.

This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

3. Brief Product Information:

3.1 General Information

Forbes Marshall HeatMax is a compact, versatile & ready to install, Instantaneous Hot Water System. HeatMax is highly efficient & low maintenance steam to water heat transfer solution that delivers effective heat transfer, accurate temperature control, efficient condensate removal and recovery.

Forbes Marshall HeatMax is designed to generate hot water using low pressure steam. This system is designed and constructed always for specific parameters.

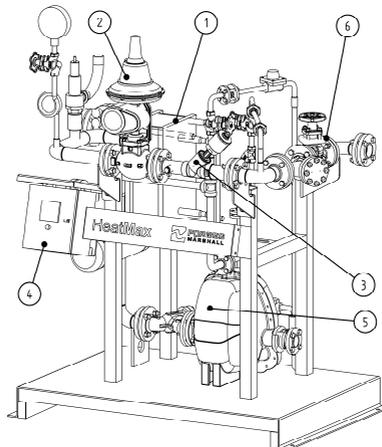


Figure 1: HeatMax

3.2 Core components of HeatMax

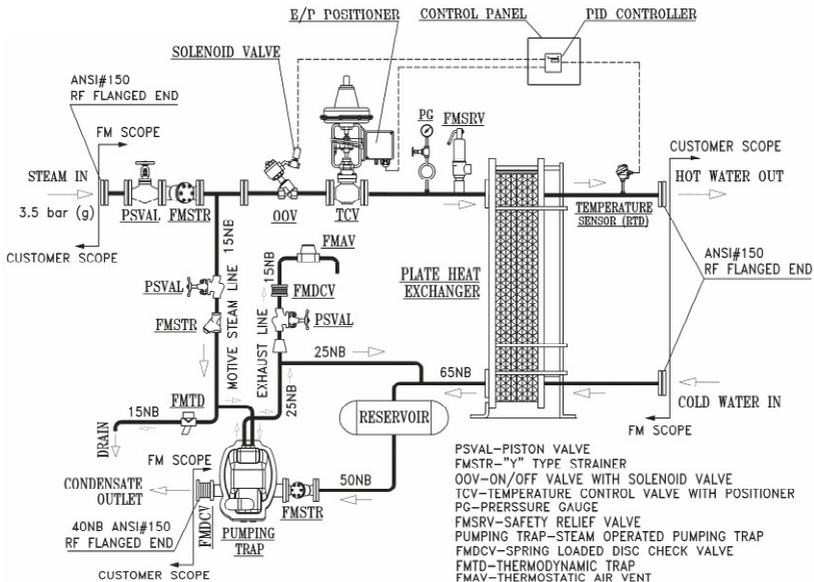
- i. Plate Heat Exchanger
- ii. Pneumatically actuated temperature control valve with electro-pneumatic positioner
- iii. Pneumatically actuated overheat protection on-off valve with solenoid valve
- iv. Fully functioned PID Controller & fast acting Temperature Sensor (PT100)
- v. Steam operated pumping trap for condensate removal and recovery.
- vi. Pipeline ancillaries.

3.3 Pressure and Temperature Limits:

Design Condition	: ASME Class 150
Maximum Saturated Steam Supply Pressure	: 50.8 psig
Minimum Saturated Steam Supply Pressure	: 29.0 psig
Maximum Steam Temperature	: 302 °F
Maximum Water Pressure	: 87.0 psig
Maximum Water Temperature	: 203 °F
Maximum Cold Hydrotest Pressure	: 113.1 psig

Note: For additional information about any particular components used in this system, refer the relevant product specific technical information sheet (TIS).

P&ID for HeatMax:



3.4 Materials:

Sr. No.	Description	Material		Remark
1	Piston Valve	Body/Bonnet	ASTM A216. Gr. WCB	Size-50NB to 100NB
			ASTM A 105N	Size-15NB to 40NB
		Piston	ASTM A276 Type 304	Size-15NB to 50NB
			ASTM A 351 CF8	Size-65NB to 100NB
	Packing	Stainless Steel Reinforced Graphite		
2	" Y " Type Strainer	Body	IS 210 Gr. FG260	
		Screen	IS 210 Gr. FG260	
3	Pneumatic Actuated Globe Valve with Electro-Pneumatic Positioner	Body	ASTM A216 Gr. WCB	
		Bonnet	ASTM A351 CF8	
		TRIM	ASTM A276 SS316 NITRIDED	
		Packing	Graphite	
4	Pneumatic Actuated On-Off Globe Valve with Solenoid Valve	Body	ASTM A216 Gr. WCB,	Size-65NB to 100NB
		Bonnet	ASTM A351 CF8	
		TRIM	ASTM A276 SS316 NITRIDED	
		Packing	Graphite	
	Piston Actuated On-Off Valve with Solenoid Valve	Body/Bonnet	AISI 316L	Size-25NB to 50NB
		TRIM	SS316	
	Packing	PTFE		
5	Safety Relief Valve	Bonnet	IS210 Gr. FG260	
		Seat/Seat Ring/Valve	Gun Metal	
		Spring	Stainless Steel	
		Heat Transfer Plate	SS316	
6	Plate Heat Exchanger	Gasket	EPDM	
		Frame & Pressure Plate	IS 2062 Gr. B	
		Stud/Nut/Washer	IS 1367 CLASS 8.8/8.0 Zn Plated	
		Tightening Bolt/Nut	IS 1367 CLASS 8.8/8.0 Zn Plated	
		Carrying Bar	SS 304	
7	Steam Operated Pumping Trap	Body	ASTM A515/516 Gr. 70 / SG Iron	
		Cover	ASTM A515/516 Gr. 70 / SG Iron	
		Cover Gasket	Stainless Steel Reinforced Graphite	
		Internal Mechanism	Stainless Steel	
8	Check Valve (FMDCV)	Body	ASTM A351 CF8M	
		Spring:	SS316	
9	Thermodynamic Trap	Body/Cap/Disc/STR Cap	ASTM A 743 Gr- CA40	
		Strainer Screen	ASTM A 240 Type 304	
10	Thermostatic Air Vent	Body	ASTM A105	
		Internals	Stainless Steel	
11	Pressure Gauge - Bourdon Type	Bourdon Tube & Socket	SS316	
		Movement & Case	SS304	
		Syphon-Pig Tail	ASTM A106 Gr.B	
12	RTD (PT-100)	Sheath /Thermowell	SS316	
		Head	Die Cast Aluminium	
		Insulation	Mg O	
13	Pipe		ASTM A106 Gr. B	
14	Flange		ASTM A515/516 Gr. 70	
15	Bolt		ASTM A 193 Gr. B7	
16	Nut		ASTM A 194 Gr. 2H	
17	Gasket	Spiral Wound Gasket	SS304(ID Ring) x SS304+Graphite x CS (OD Ring)	
18	Support Frame	Base Plate/Brackets	IS 2062 Gr. B	
		Square/Rectangular Tube	IS4923 Gr. 240	

3.5 Battery Limit End Connections:

Steam Inlet	Flanged end as per ASME B16.5, Class 150, SORF with mating Flanges	Flange Material - ASTM A515/516 Gr. 70
Condensate Outlet		
Water Inlet		
Water Outlet		

3.6 HeatMax Models:

Models	Heat Load (kW)	Steam Line (in)	Water Flowrate (US gpm)	Torque Range (in)
25HEATMAX	17.43 to 75.54 kW	0.98 in	13.21 to 95.10 gpm	0.98 / 1.57 / 1.97 / 2.56 in
40HEATMAX	76.13 to 191.77 kW	1.57 in	13.21 to 241.76 gpm	0.98 / 1.57 / 1.97 / 2.56 / 3.15 / 3.94 in
50HEATMAX	192.35 to 302.73 kW	1.97 in	18.05 to 381.73 gpm	0.98 / 1.57 / 1.97 / 2.56 / 3.15 / 3.94 in
65HEATMAX	302.99 to 465.02 kW	2.56 in	28.62 to 585.58 gpm	1.57 / 1.97 / 2.56 / 3.15 / 3.94 in
80HEATMAX	465.78 to 755.40 kW	3.15 in	44.03 to 616.40 gpm	1.57 / 1.97 / 2.56 / 3.15 / 3.94 in
100HEATMAX	756.03 to 1,197.09 kW	3.94 in	71.33 to 616.40 gpm	1.97 / 2.56 / 3.15 / 3.94 in

Note:

1. The heat load has been calculated based on a steam inlet pressure of 3.5 bar(g) and 0 bar(g) backpressure
2. Difference between Water Inlet & Outlet temperature is Minimum 3 °C & Maximum 35 °C
3. Maximum Water Outlet Temperature is 95 °C
4. # For water flowrates from 70.5 m³/hr to 140 m³/hr, system with water bypass arrangement will be provided. Water Inlet/Outlet sizes will be as per required Water Flowrate
5. For operating conditions other than mentioned above, pls consult Forbes Marshall

3.7 Electric and Pneumatic Supply:

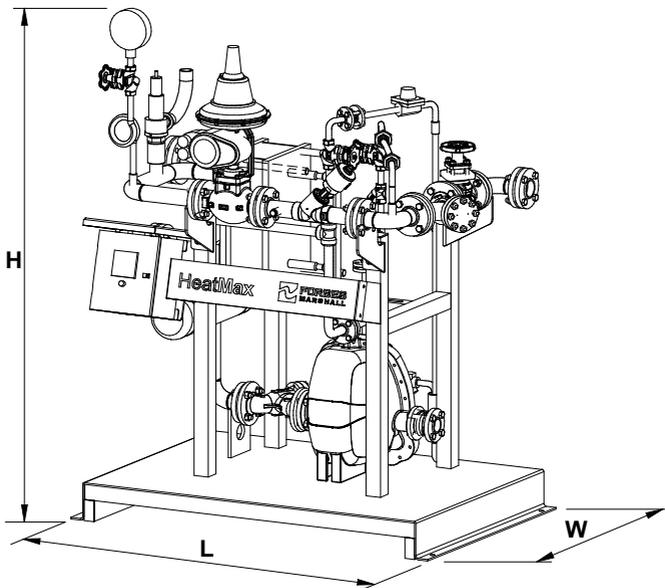
Power Supply: 230VAC / 50Hz
 Instrument Air Supply: ≈ 58–87 psig

3.8 Controller Options:

1. Weather Proof (Standard)
2. Flame Proof – Gas Group IIA/IIB,T3
3. Weatherproof with RS485 Modbus RTU Communication
4. Flameproof with RS485 Modbus RTU Communication
5. PLC based Forbes Marshall Intelligent HeatMax

3.9 Overall Skid Dimensions & Weight :

HeatMax Size	Overall Dimensions, (inches) (Approx)	Weight (lb)
25NB,40NB,50NB	59.06" × 39.37" × 82.68"	2204.62 lb
65NB,80NB,100NB	74.80" × 51.18" × 94.49"	3306.93 lb



4. **Product Working Principle:**

Forbes Marshall HeatMax provides instantaneous temperature controlled hot water using steam as the heating medium. The plate heat exchanger is used to heat the water using low pressure steam. Forbes Marshall HeatMax control system is designed to provide precise & accurate temperature control by using specifically selected Forbes Marshall Control Valve for steam application. The steam flowrate is modulated to exactly match the heat demand by using Electro-pneumatic Positioner, fully functioned PID Controller & fast acting Temperature Sensor. Precisely matched control instrumentation ensures full utilization of the useful energy in the steam within the system.

Fail-safe overheat protection:

Forbes Marshall HeatMax is equipped with a pneumatically actuated, fail-safe, on-off valve for overheat protection that will automatically isolate the steam supply if pre-set hot water outlet temperature is exceeded.

Efficient Condensate Removal and Recovery:

The innovative Forbes Marshall Steam Operated Pumping Trap used to remove condensate from the plate heat exchanger under all operating conditions, even under stall condition.

Condensate removal is essential, to keep the plate heat exchanger heating area free from condensate. Thus steam consumption is less due to high heat transfer area and high thermal efficiency in a plate heat exchanger.

5. Installation Guidelines:



Note: Before starting any installations observe the 'Important Safety notes' in section 2. Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended installation.

Weld the respective mating flanges to the steam inlet, condensate outlet, water inlet and water outletplant piping.

5.1 Steam and condensate connections

- a. The steam supply to Forbes Marshall HeatMax should be always clean & dry.
- b. All connecting pipework should always be free from external stresses & adequately supported.
- c. Forbes Marshall HeatMax unit must not be operate above the maximum pressure & temperature of steam & water indicated on the name plate.
- d. Correctly sized Safety Valve is strongly recommended to install on water side of system, to protect the plate heat exchanger from high pressure failure.
- e. Use of Strainer with appropriate filtration element based on the water quality is strongly recommended to avoid choking of plate heat exchanger or damage of the system component like valve internals, pumps.
- f. Connect the Steam Inlet Line, Condensate Outlet Line, Water Inlet Line & Outlet Line as indicated in respective general arrangement drawing for HeatMax unit.

5.2 Air supply

Connect a instrument air supply (4 to 6 bar(g)) to the Air Manifold to supply air to Air Filter Regulator mounted on the control valve & overheat protection on-off valve.

5.3 Electrical Supply

Power supply to be given to Control Panel as indicated on the name-plate & as per the wiring diagram provided in Control Panel for HeatMax unit.

All electrical wiring and connections should be carried out in accordance with National regulations and Standards.

Connecting the signal and power cables :



DANGER! Cables may only be connected when the power is switched off.

DANGER! The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

WARNING! Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

6. Startup and Commissioning:

6.1 Precautions

- a) Ensure that all connections are properly made and that all valves are closed.
- b) Use gasket in between all flange joints and tighten all the Nut / Bolts with Spanner to ensure the leak proof flange joint.
- c) For pressure gauge, ensure that water is poured in SYPHON
- d) Being steam systems it is very important that the pressure is built up slowly to avoid possible damage to any sensitive equipment

6.2 Flushing of lines:

- a) As part of pre-installation all fluid handling equipment particularly piping should be thoroughly cleaned of scale and the internal debris which accumulates during construction.
- b) This is accomplished by blowing or flushing with air, steam, water and other suitable medium.

Note: For a detailed procedure on flushing of lines, please visit Forbes Marshall website.

6.3 Commissioning procedure:

- a) Set the air supply to Control valve & On-off valve at 4 bar(g) by using AFR.
- b) Ensure that all electrical connections are secure and as per installation drawing.
- c) To ensure free movement of the control valve stem, an initial valve stroke check should be carried out by giving manual signal command from PID / On-off controller.
- d) Open water isolating valves Upstream/downstream of the HeatMax, if fitted
- e) Start the main water circulation & check for any leakage in water circulation loop.
- f) If water circulation is okay & switch on the power supply to the system control panel.
- g) Check the PID / On-off controller for actual temperature & set point temperatures.

Note: Ensure the temperature setting is suitable for the application. If this needs to be altered, refer to the PID Controller Set-up Manuals.

- h) Gradually open main steam inlet valve & ensure that there is no leakage in steam & condensate loop.
- I) Ensure that the isolation valve in motive steam line to pumping trap is fully open.
- j) Check process temperature is within the acceptable limits of the set point & if not, then fine tune the PID setting in controller.

Setting for Overheat Protection:

- a) PID controller (second set point) for Overheat Protection should be set at a suitable level to protect plant, process and personnel. Refer PID Controller Set-up Manuals for details.
- b) Ensure that there is sufficient difference between the process set point and the overheat protection set point, to avoid any unwanted overheat tripping.
- c) Forbes Marshall would strongly recommend that only a suitably trained controls engineer adjust these parameters in PID Controller
- d) Check operation of condensate pumping trap. When the HeatMax is operational, the pumping trap will discharge condensate under all pressure conditions into the return line. If it fails to operate, refer the trouble shooting section in Pumping Trap user manual.

7. Maintenance Guidelines:

Warning: Read Section 2-Important Safety information, before proceeding for any maintenance work

Note: For a detailed maintenance procedure for each product of the HeatMax, please refer to the user manuals of the respective product.

7.1 Precautions

- a) Before undertaking any maintenance on the HeatMax, it must be isolated and any pressure should be allowed to safely normalize to atmosphere. The unit should then be allowed to cool. With suitable isolation, repairs can be carried out with the HeatMax in the line.
- b) When re-assembling, make sure that all joint faces are clean. Once completed open isolation valves slowly and check for leaks.

7.2 Plate Heat Exchanger Maintenance:

Cleaning:

- a) There is always risk of scale formation on open system with continual make-up water. The extent of scale formation is will depends on the water quality, which varies from area to area & expert advice from a water treatment specialist should be sought. Plate and frame type heat exchangers are designed for both manual cleaning and cleaning-in-place operations.
- b) Never use a steel brush or steel wool on the plates. Be careful not to scratch the gasket surfaces.
- c) The gaskets must be wiped dry with a cloth. Solid particles adhering to the gaskets cause damage and result in leakage when the unit is put back in operation..
- d) Never open the unit when hot, under pressure, holding liquid or operating.

Caution:



Do not use chlorine or chlorinated water to clean stainless steel. Chlorine is commonly used to inhibit bacteria growth in cooling water systems. It reduces the corrosion resistance of stainless steel. The “protection layer” of these steels is weakened by chlorine and makes them more susceptible to corrosion. This increase in susceptibility to corrosion is a function of time and the chlorine concentration.

Do not use hydrochloric (muriatic) acid for cleaning stainless steel plates.

Refer Plate Heat Exchanger Installation & Maintenance Manual for more details.

7.3 Routine and Preventive Maintenance:

Note: Frequency of cleaning & inspection will depend on the quality of steam & water, which varies from area to area. Below mentioned frequency for checking various parameters are just for guidelines..

SR. NO.	PARAMETERS TO BE CHECKED	FREQUENCY FOR CHECKING VARIOUS PARAMETERS					
		Daily	Weekly	Monthly	Quarterly	Half	Annually.
1	Visual inspection for leakages	Y					
2	Cleaning of all Strainers in Steam & Condensate Line				Y		
3	Pressure gauge calibration						Y
4	Safety relief valve testing				Y		
5	Cleaning & overhauling of safety relief valve						Y
6	Manually Operate the Piston Valve			Y			
7	Lubrication of piston valves				Y		
8	Visual inspection & cleaning of threads on piston valve stem				Y		
9	Clean internals of On-off valve & Control						Y
10	Valve Clean internals of pumping trap						Y
11	Clean plates heat exchanger plates						Y

7.4 In addition to the preventive maintenance, follow the points below to keep the system in working condition:

- a) Strainer must be cleaned from time to time.
- b) Valve mountings such as actuators, hand wheels, hood must not be used to take external forces e.g. they are not designed for use as climbing aids, or as connecting points for lifting gear.
- c) Suitable material handling and lifting equipment's should be used...
- d) Handling and warning must be carried out by expert personnel or all activities must be supervised and checked.
- e) Remove flanges cover if present.
- f) The interior of valve and piping line must be free from foreign particles.
- g) Note installation position with reference to flow, see mark on.
- h) Lay pipelines such that damaging transverse, bending and torsional forces are avoided.
- i) Protect system components from dirt during construction work
- j) Connection flanges must mate exactly.
- k) Connecting bolts for pipe flanges should be mounted preferably from the counter flange side (Hexagon nuts from the component side)
- l) For application outside or in adverse environments like corrosion promoting condition (sea water, chemical vapors etc.), special constructions or protection measures are recommended.

8. Troubleshooting:

For detailed troubleshooting of each product of the HeatMax, please refer to the user manuals of the respective product.

9. Available Spares:

For available spares, please refer each product manual.

10. Warranty Period:

As per the ordering information and agreement in the contract.



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