

Thermax Pressure Reducing Station

User Manual



1 Important Safety Instructions to the Users

- This manual presents information that will help to install, operate and maintain the equipment properly. It is expected that the contents be carefully read before handling the equipment.
- All safety instructions and warnings given in these mounting and operating instructions, particularly those concerning installation, start-up and maintenance, must be strictly observed.
- To ensure appropriate use, only use the TPRS in applications where the operating pressure and temperatures do not exceed the specifications used for sizing at the ordering stage.
- The manufacturer does not assume any responsibility for damage caused by external forces or any other external factors.
- Any hazards that could be caused in the TPRS by the process medium, operating pressure or by moving parts are to be prevented by taking appropriate precautions.
- A good installation is a permanent asset while a bad one can be a constant source of trouble. It can cost much more to correct a bad installation than to put a new one.
- The TPRS is a product of many years of knowledge, field experience & engineering effort, to provide long life & excellent service to the users. This unit will provide continued trouble-free service, if instructions on installation, operation and maintenance are properly followed.
- It is expected that the personal involved in Installation, Operation & Maintenance possess necessary qualification, competence, license & authority (if applicable) only should handle the product. It is solely the responsibility of the equipment owner & user to ensure that all applicable statutory (if applicable) norms are adhered to during Installation, Operation & Maintenance of this equipment.
- The mechanical devices supplied as a part of the unit are chosen because of their known ability to perform, with

proper operating techniques and maintenance procedures. Tampering with the safeties & controls or bypassing any of these is not permissible at any time.

- Any "Automatic" features included in the design do not relieve the attendant of any responsibility. Such features may free him of certain repetitive chores and give him more time to devote to the proper upkeep of the equipment.
- No amount of written communication can replace intelligent thinking & reasoning.

The following symbols/terms have been used in this manual at the end of some chapters for the attention of the users:



This is a symbol of "warning" to the equipment user & provides information about practices or circumstances that should never be allowed as can lead to personal injury or death, property damage, or economic loss.



This symbol is for hot surface areas where there is a chance of temperatures above ambient temperatures which causes injuries.



This symbol is to avoid hand/fingers getting crushed with the flange joints/pipes.



Avoid injuries while working in steam leaking areas.



This is a symbol of "Caution" to the equipment user & provides information about the care to be taken on the actions or procedures, which if not performed correctly, may lead to personal injury or incorrect function of the instrument or connected equipment.



Recommended Action

2 Abstract

Thank you for choosing sustainable solutions in energy and environment which help in conserving resources and preserving the future. This manual describes the principle of operation, instructions for installation, operation & maintenance of pneumatic type Thermax Pressure Reducing Station (TPRS) supplied by Thermax Ltd. The General Instructions which

are not detailed out in this document, are to be performed in accordance with standard and safe acceptable practices as may be required by local codes, specifications and/or regulations. The instruction contained within this manual must be read before undertaking any work on the equipment supplied. For any queries, please contact Thermax Limited.

3 Product Identification

The product specifications and details are mentioned in the name plate details, please refer the figure 3.1A for template.



For all maintenance, service & spares requests, it is important to mention the serial identification number as mentioned in the name plate details of your product to Thermax Ltd.

PRESSURE REDUCING STATION	
MODEL :	
DESIGN PRESSURE (Kg/cm ²) :	
INI FT PRESSURE (Kg/cm ²) :	
OUTLET PRESSURE (Kg/cm ²) :	
STATION SIZE :	
SR.NO :	

IN

THERMAX

RIFOX

figure 3.1A

4 General Guidelines for Steam Usage

When water is heated, its temperature rises (region A – B) as shown in figure 4.1A. As its temperature reaches the boiling point, its phase changes to steam (region B – C), with no rise in temperature, and it boils at its saturation temperature. Note that a large amount of heat is added with no rise in temperature, but a change in phase. This steam is called **saturated steam**.

The Bell Curve as per figure 4.1A shows this, with each line representing a constant pressure. The total energy in saturated steam is the sum of the enthalpy of water and the enthalpy of evaporation.

$$hg = hf + hfg$$

Where:

hg = Total enthalpy or Total heat of saturated steam (kJ/kg)

hf = Enthalpy of Water (Sensible heat) (kJ/kg)

hfg = Enthalpy of Evaporation (Latent heat) (kJ/kg)

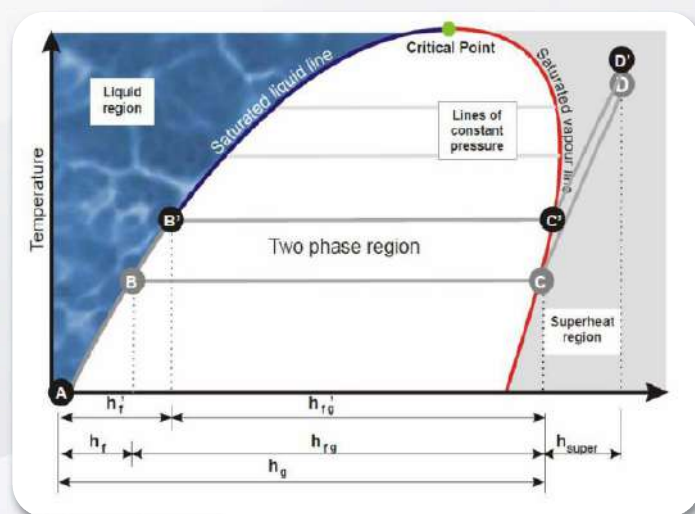
4.1 The Physics of Pressure Reduction

Steam imparts heat to the process by condensing into water, thus giving off its latent heat. Thus, the work done by steam in a process is primarily done by latent heat (hfg).

In the figure 4.1A, follow the higher-pressure line A'-B'-C'-D' on the curve. The total energy in saturated steam at the higher pressure still remains hg, but the hf' increase and the hfg decreases. Hence, lower the pressure of steam, the higher the latent heat content (hfg) or the Enthalpy of Evaporation. This is why we use steam at lower pressures.

So, to conserve fuel, if the process demands a certain Delta Temperature (DT/Temperature difference) for efficient heat transfer, then we have to find out the lowest pressure that satisfies the temperature demand.

Figure 4.1A



4.2 What Is Superheated Steam?

When more heat is added to saturated steam in the region B-C, its temperature rises further to reflect the amount of heat added (refer figure 4.1A).

Steam in the region C – D is called superheated steam. Thus, superheated steam is steam that is at a temperature higher than its boiling point (or saturation temperature) at the given pressure (refer figure 4.1A).

For example, saturated steam at a pressure of 32 bar g has a temperature of 238.5°C. If further heat is added to this, its temperature could be 300°C at a pressure of 32 bar g.

4.3 The Need for A PRS

- Thermax Pressure Reducing Stations are an integral part of any steam system used for process heating. They are used to reduce the pressure to increase the latent heat and correspondingly reduce the temperature of steam.
- Usually, high pressure (HP) steam is generated at a central location & gets distributed. At the usage points, the pressure gets reduced through TPRS according to the requirement of each process. Along with this, the TPRS also helps to maintain the stable pressure required to the process in varying flow conditions, until there is no major fluctuation in pressure and flow at the inlet of TPRS.

4.4 Why Can't Steam Be Generated at Low Pressure?

- Most modern boilers operate at relatively high pressure. A typical process boiler operates at 10.5 to 17.5 kg/cm2(g). The operating pressure of a boiler determines various parameters like water holding capacity, steam space, water level etc and importantly, the dryness fraction of the saturated steam.
- Steam at high pressure (HP) has a relatively higher density, or low volume than at atmospheric pressure. This means that the higher the pressure, the smaller the bore of pipe work required for distribution of a given mass of steam.
- The advantage is the boiler size stays small as HP steam has low volume. Also, HP boilers rarely have problems like reduced output and 'carryover' of boiler water.
- Wet steam is most likely to be produced at lower pressures which correspond to lower temperatures. Therefore, it is energy efficient to produce and distribute HP steam and reduce pressure upstream of any items of plant designed to operate at a lower pressure.

4.5 What Are the Economic Benefits of Pressure Reduction?

- Low pressure steam has a higher latent heat and can tend to reduce the amount of steam produced by the boiler.
- Another reason is that all steam equipment, whether process or utilities, have a MAWP – Maximum Allowable Working Pressure. The boiler as we have learnt supplies steam at a high pressure for its advantages. A PRS is used so that safe working pressures are not exceeded downstream of the CV and the process /utilities can be designed for lower steam pressure applications, thus avoiding the higher thickness pipes/metal plates/reactor vessels. These heavy utilities would otherwise consume a large portion of heat from steam, resulting into higher steam consumption.
- Less flash steam is lost if the plant is operated on LP steam. Reduced pressure will lower the temperature of the

downstream pipe work and reduce radiation losses.

- The temperature of saturated steam varies with the pressure, so this also provides a simple method of controlling temperature of steam going to a process. You can see this in the paper industry on driers and also in heat exchangers, sterilizers and autoclaves, in various industries.

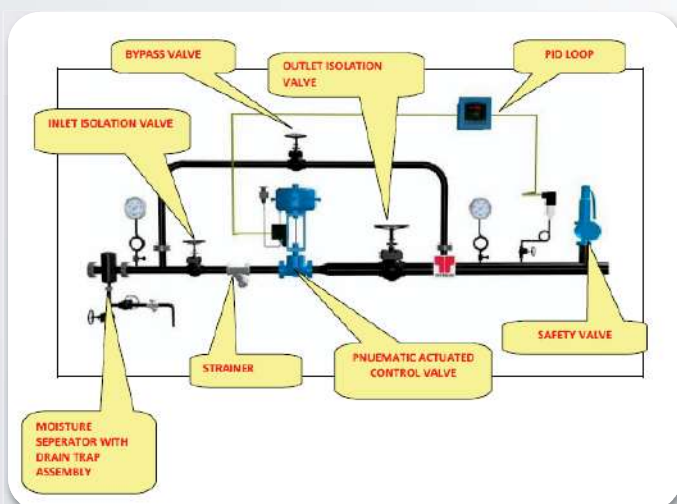
- For the same output, LP steam equipment may be larger, but is still cheaper as it follows a lower design specification.
- Plants are normally built in stages. Starting with the HP stage, we flash HP condensate and use the LP flash steam in the LP stage. This saves energy. At times, the flash steam being generated is not enough and a PRS is used to maintain continuity of supply in the LP system.

5 Working Principle and System Configuration

5.1 TPRS With Control Valve (CV)

The figure 5.1A shows the general arrangement of a typical TPRS with the control valve.

Figure 5.1A:



This control valve controls the flow of the steam with respect to the feedback provided by the Pressure transmitter installed at the downstream of control valve and this PT signals 4-20 mA.

With respect to the existing pressure, it becomes input signal to the PLC or PID controller which controls the opening/closing of the valve precisely to suit the process requirement against set point.

In addition to that, a positioner and instrument air supply is also required for the CV. This obviously makes the system very accurate even under varying load conditions.



The Moisture Separator at the inlet ensures that any water carryover traveling with the steam does not cause damage to the rest of the TPRS, and provides dry steam to the process.

The inlet isolation valve can be used to shut-off steam supply to the control valve. The strainer removes dirt, welding slag and other particles that could damage the seat and plug of the CV.

Inlet and outlet pressure gauges are used to check generation pressure, configure the set pressure and check control valve operation. These gauges are provided with pig tail siphons to cool the steam, and isolating valves for removal / isolation of the gauge.

Eccentric reducers and expanders are recommended to decrease and increase line sizes within the TPRS.

A suitably sized safety valve is required to ensure that the outlet steam pressure does not exceed the setpoint, even if the CV fails. This would normally be set to blow at 10% above the set pressure, and should have the capacity to discharge the maximum flow of the TPRS.



Safety valve exhaust line to be connected and routed to a safer location.



The entire TPRS station to be insulated as per the specification provided in the P&I drawing.

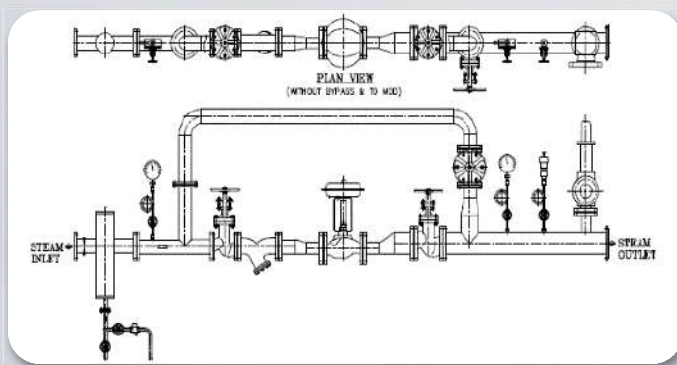


Pneumatic air pressure to CV should be adjusted through provided AFR (Air Filter Regulator) as specified on the actuator and the pneumatic air to the control valve should be of instrument air quality as per "ISO 8573- 1:2001" norms.

5.2 Reference Drawings

The site reference drawings which have been submitted by Thermax Ltd. are to be preserved and referred during installation. Figure 5.2A represent general arrangement of the TPRS for representation only.

Figure 5.2A



6 Unloading Receiving and Inspection

The TPRS components are supplied in semi assembled condition, duly packed in polythene sheets & wooden cases/ boxes for assembly & installation at site.



Ensure that the wooden cases should not be dropped or turned to any other position other than marked on the cases.

At the time of receipt at site, a thorough visual inspection of the product should be made for evidence of damage during shipment. Packaging slip should be referred for checking the items supplied for the system.

On receipt of the consignment at site, check that all the cases have been received per delivery documents & packing slip.

By careful inspection, determine whether any damage/loss has occurred in transit, in spite of proper checking and loading of each component/equipment, at our factory before dispatch.

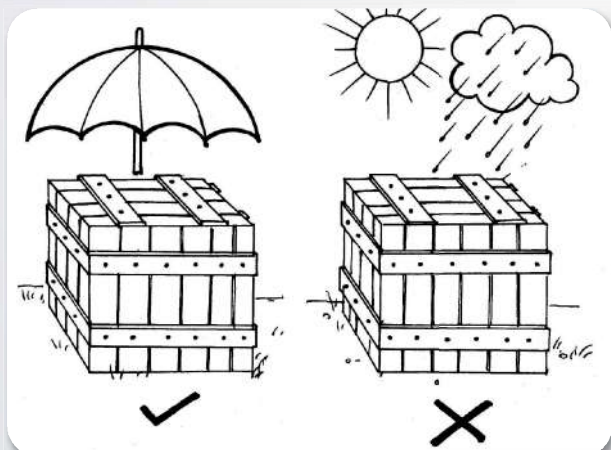
In the event of any damage is noted, the Company should be notified at once so they can start claims procedure for repairs or replacements as per applicable clauses of contract.

7 Storage

The place of storage of these equipment should be

- Dust free, clean, dry and well ventilated
- Silica gel packed in cloth bag shall be placed inside the electrical panels for absorbing moisture.

Figure No 7.1A: Material should be stored under roof.

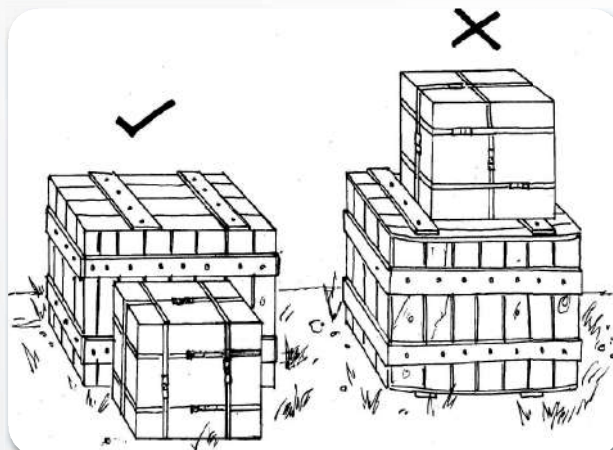


- Do not pile up cases.

- The silica gel shall be inspected periodically for colour change. Re-charging of silica gel shall be carried out, as and when required.

A) All the material should be stored under roof and should be protected from rain, water or direct sunlight.

Figure No 7.1B: Do not pile up cases.



- Do not store heavy material on soft soil.
- Parts should not be stored under corrosive atmosphere.
- Periodically the unit should be inspected to make sure no damage, such as corrosion, is taking place.

8 Installation Guidelines

The TPRS assembly should be installed at the elevation of 1 to 1.2 meters from the floor level for the ease of operation & maintenance (O&M). Where this is to be installed at higher elevation then provide platform with railing & stair case for the safety during O&M. The following guidelines are to be followed during installation of TPRS:

- Assemble the entire TPRS on ground, start assembling with bypass line first without control valve pressure gauge assemblies with siphon and gauge cock. And then followed by strainers, isolation valves & CV.
- Flush the assembled components with compressed air.
- Install the assembled TPRS in the steam pipe line.

- Ensure that the Pressure Transmitter is installed above the syphon as mentioned in the figure 5.2A.
- Note that control valve is fitted with EPDM diaphragm having temperature limitation. Hence it should not come in contact with heat. Therefore, it is necessary to do the insulation to the body of the control valve.
- Ensure that the TD trap drain module is connected to the moisture separator.
- Ensure that all the valves /strainers are fitted as per the flow direction and arrow indicated on them.



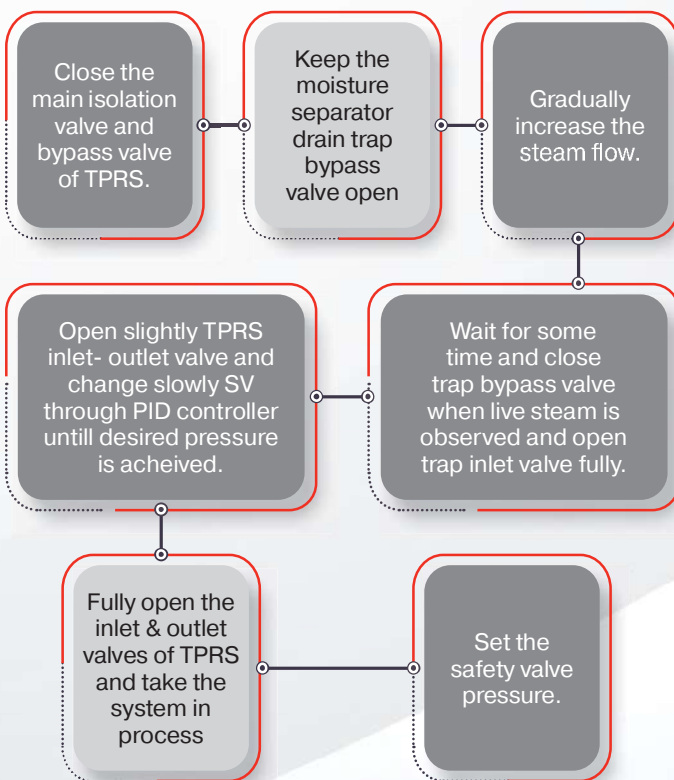
WARNING

- The statutory IBR regulations to be followed strictly during the installation of the TPRS.
- The IBR certificates copies are to be preserved and used for cross checking the components with IBR certificates.
- Hydro test at the pressure of 1.5 times of design pressure is mandatory before charging the TPRS. Safety valve to be made dummied during the Hydro test.
- Specifications of Gaskets and fasteners to be used as recommended/supplied by Thermax. (Note: As per design calculations, HT Bolts and metallic spiral wound gaskets are not required until specified by Thermax).
- The orientation of the TPRS station should be ensured as per the figure 5.2A (refer the GA drawing in detail). Any changes in the orientation requires proper Thermax approval.
- The TPRS to be supported properly as per figure 5.2A (refer the GA drawing in detail)

9 Control Panel & Instruments

- TPTL Con+, Control panel will be delivered along with TPRS. The controller is pre-programmed at factory, it has fixed tuning parameters. These settings are normally sufficient for general usage of TPRS. 240V, 1 Phase, with proper earthing (voltage to neutral & earth to be less than 3V) UPS power supply to be provided by customer at site.
- Pressure Transmitter (PT) will be supplied for measuring the pressure at the outlet of TPRS to regulate the control valve and signals from the PT and control valve to be transmitted via 1.5 sq mm shielded cable. This cable needs to be provided by customer with proper gland packing and cable tray. In case of flame proof PT, special cable will be supplied by Thermax and same to be installed by customer at site.

10 System Operation



- System needs to be flushed thoroughly before starting of the unit.



- In general, valve can be mounted at any stress-free positions, preferred being horizontal. For larger sizes (say 4" and above), suggested only horizontal position.

- Proper insulation / care should be taken on steam pipe line to ensure that the temperature on the E/P positioner, control valve diaphragm & PT does not exceed 80 degree Celsius.
- All electrical connections are to be clearly identified & signal to IP / Positioner (4 – 20mA only).
- **Disclaimer:** This manual represents standard offering of our TPRS, please refer separate manual for non-standard TPRS applications.

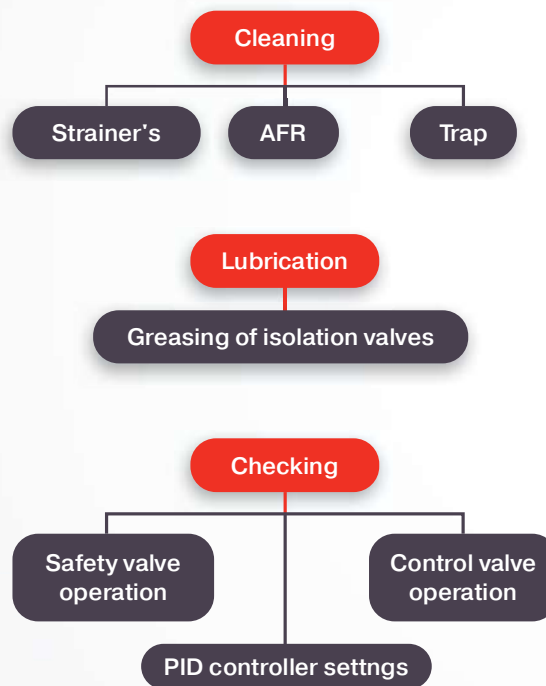
10.1 Calibration Procedure for Samson Control Valve Positioner:

- Set air supply as mentioned in valve actuator tag plate.
- Tight "Xp" (turn close clockwise) & open 1 turn in anti-clockwise direction.
- Loose Zero adjustment Screw.
- Give 4 mA from source or PLC and check valve movement.
- If the zero shifts its place, tight zero till the valve closes.
- Give 8mA, 12mA, 16mA, 20 mA and check movement of valve.
- If hunting occurs, please open Xp till hunting stops.

10 Troubleshooting

Malfunction	Possible reasons
Control valve not operating	Low / No air pressure.
	No 4 -20mA output from PID controller.
	Calibration disturbed.
Valve jerking during stroke	Packing nut over tight.
Gland leakage	Packing nut loose.
Control valve passing in close position	Calibration disturbed.
	Seat & Plug worn out
	Foreign particle accumulated
Outlet Pressure Fluctuation	Inlet pressure not as per design.
	Steam flow higher than design flow.
	High fluctuation in steam demand.

11 Maintenance



- Up to 5000 hours of operation, strainer needs to be checked for every 200 hours of operation.
- After 5000 hours of operation, the strainers need to be checked for every 5000 hours.
- If any additional or new welding work carried out at the upstream of the pipeline and if TPRS shifted to other location, then, again for up to 5000 hours of operation, strainer needs to be checked for every 200 hours of operation



12 Warranty

Only trained or instructed personnel may be assigned to operation or servicing.
All our equipment is thoroughly inspected before dispatch and therefore can be depended upon for long and trouble-free services. We undertake to make goods by replacement or repair, defects arising out of faulty design, materials or workmanship within 12 (twelve) months of the date of commissioning or 18 (eighteen) months from the date of dispatch, whichever is earlier, subject to mentioned in your purchase order warranty terms. The parts, in respect of which a claim is made, must be sent to our works at buyer's expenses. If the claim is found to be legitimate, we shall refund such expenses.

Warranty Excludes

- Normal Wear & Tear
- Damages/defects due to wrong operation at the purchaser's end, and/or arising out of forced major.
- Bought out components are guaranteed by us only to the extent of guarantees given to us by our suppliers.
- Electrical components such as heaters, motors, contactors etc. Rubber components and instruments such as pressure gauges, thermometers, Controllers, etc. are however, not covered under this warranty.

This warranty is valid subject to the following conditions: -

- Installation completed within three months from the date of dispatch of the equipment and as per our installation instructions.
- The supply/ installation formally accepted as per the handing over clause.
- Use of specified utilities in technical quotation.
- The equipment being operated and maintained as per our Operation and Maintenance Manual.
- The equipment, or part thereof, not being subject to accident, alteration, abuse or misuse.
- Any replacements/repairs required under provisions of the above warranty will be carried out at our option, either at site or at works. In the latter case, buyer will send the defective parts to our works at buyer's cost & liability.
- Warranty period for the entire equipment including replaced or repaired parts will be limited to the unexpired portion of the total warranty period.
- Accessories and fittings not manufactured by us, form an integral part of the equipment supplied, the warranty for such accessories & fitting will be in line with main equipment.
- If the purchaser delays to lift the equipment up its readiness, the warranty will be limited to 18 months from the date of readiness at our works.

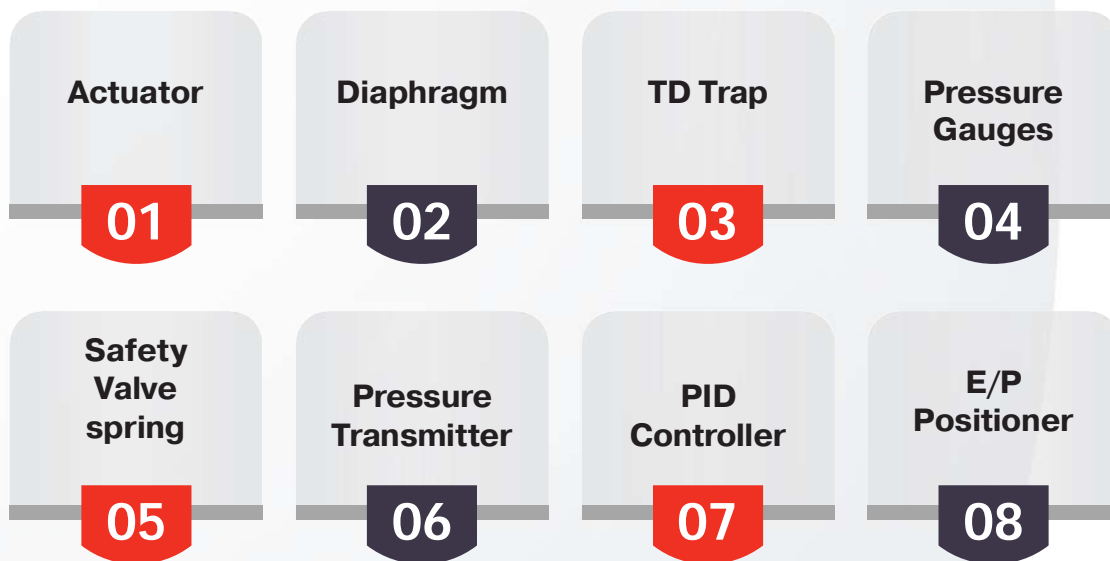
- Any repair / replacement on our equipment during the warranty period shall be carried out by authorized representatives, in writing from us.
- The warranty obligations will be honoured by us provided buyer has fulfilled obligations under the order relating to release of due payments, etc.
- After repairs/replacement, warranty period for the entire equipment including replaced or repaired parts will be limited to the unexpired portion of the total warranty period.
- Any short supply or damages to the equipment to be intimated to Thermax within 15 days of receipt of material at site. Any late report will void the warranty.

- If the transit insurance is in client scope, damages and missing items during transit to be claimed by clients directly.
- Any improper use, intervention in the design and deviation from the design data will automatically lead to termination of the warranty.



Diaphragm will get damaged if steam directly comes in contact with the diaphragm, such a failure is not cover under warranty.

13 Recommended Spares



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