Operating, Maintenance & Installation Manual for an Electric Heater

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1. Information on safety

1.1. General safety information for the electric heater

1.1.1. The electric heater is manufactured in accordance with the Pressure Equipment Directive PED 97/23/EC. The foundations for the design are the AD-2000 Rules. The electric heater was subjected to a conformity evaluation in accordance with PED 97/23/EC, Article 3, Article 9 and Article 10 (see the appropriate datasheet as well).

1.1.2. As a pressure appliance in danger of overheating the electric heater is subject to special conditions. The operator/plant builder must ensure that the requirements of PED 97/23/EC Annex I No. 5 are observed and applied.

The electric heater is equipped with at least one overheating protector in the form of a temperature cut-out, which, for example, measures the surface temperature of the heating elements. This is a pure measuring instrument. If the switchgear is provided by the customer, the operator/plant builder is obliged to install the signal in the safety chain in such a way that the electric heater is switched off permanently (e.g. electronic cut-out) if the max. approved surface temperature (see system description) is exceeded.

The cut-outs that are used may only be set and reset by personal trained in this. In addition, use only cut-outs that are secured against unintentional re-adjustment.
If the output of the electric heater is shared to more than one group, the owner must be ensure that in any case this group is the base load group in which the limiter is installed. It is to ensure that the based load will switch on as the first and switch off at the last.

1.1.3. If the electric heater is used to heat liquids or similar in a container, the operator/plant builder must ensure that the electric heater may only be switched on when the level of the liquid is not less than 50 mm above the highest point of the electric heater. If the liquid is below this level there is a danger that the electric heater will overheat and that it and adjacent components will be destroyed.

1.1.4. If equipment with a safety function is built onto the electric heater, this must be also satisfy the requirements of PED 97/23/EC. It is the duty of the operator/plant builder to check how far the rules must be applied. All equipment that is fitted to the electric heater must be suitable for the operating and design conditions (see data sheet).
See the danger analysis for the safety devices that are fitted to or in the electric heater.

1.1.5. The operator/plant builder must also check and comply with the requirements in PED 97/23/EC, Article 3 (1.3) for the pipes.

1.2. Safety information for transporting and storing the electric heater

1.2.1. The total weight of the electric heater is shown on the data sheet. To transport the electric heater use only suitable lifting and carrying gear that is designed for the weight.
To transport the electric heater use only the lugs on the container. If there is a lug on the heating flange this is exclusively for removing and transporting the heating element.

1.2.2. Storage
If the electric heater has to be stored this must be done in a dry heated room. The heating elements in particular must be protected from damp. For this purpose a drying agent must be inserted in addition in the wiring chamber; this agent must be replaced or processed at regular intervals.

1.2.3. During storage all open pipe sockets must be fitted with blind flanges.

1.2.4. If the appliance is to be used, carry out a complete check beforehand, in particular of the electrical values. The electric heater must not be switched on if the values shown in the test report are not reached. A start may only be carried out as described after the fault has been remedied successfully.

1.3. Safety information on placing the electric heater

1.3.1. The electric heater must be placed in such a way that it cannot cause any danger to the operating personnel or the surroundings during operations.
The operator is responsible for ensuring that both the electric heater and the incoming and outgoing pipes are insulated in accordance with the requirements of personnel safety or that protection against contact is guaranteed in another suitable way.

1.3.2. The electric heater is placed in accordance with the drawing on a foundation capable of bearing the weight. The foundation must be clean, straight and level. We recommend that steel or stainless steel panels be let into the foundation. Remove any transport bolts and other devices that are only for transport. Make sure that the movable base is fastened to the foundations so that it can be moved. The fixed base is screwed to the foundation with suitable screws.

1.3.3. The operator must ensure that the pipes are connected by suitably qualified personnel only.

1.3.4. The incoming and outgoing pipe must be connected in accordance with the marking in the production drawing.
ATTENTION: the medium's direction of flow must not be reversed.
If the direction of flow cannot be ensured through construction measures or measures specific to the plant, the operator must monitor the direction flow through suitable measures.

1.3.5. Unless otherwise mentioned in the drawing and/or the data sheet, connector loads (forces and torques) are not taken into account for the strength specifications. In this case the pipes must be connected to the electric heater without stress (including under operating conditions).
Unless otherwise mentioned, loads from wind, earthquakes or similar are not taken into account either.

1.4. Safety information for starting the electric heater

1.4.1. Before starting the electric heater carry out the following tests:

1.4.2. Mechanical test
The complete pressure system, including that of the electric heater, must be subjected to a leak test in accordance with PED 97/23/EC and/or AD 2000. The conditions required by the operator or the local acceptance agencies must be taken into account.
This test must be repeated at regular intervals by arrangement with the operator and a local acceptance inspector.

1.4.3. Electrical test
Before and after connection to the mains an insulation measurement must be carried out between the heater elements (groups) and the ground and between the heater elements (groups). The measured resistance must not fall below 25 kΩ at 500 V.
The resistance between the heater elements (groups) must also be measured.
We recommend that a record be kept of all values.

Because of the construction of a heater element it is possible that after a long period of storage or a longer standstill of the electric heater the heater element may have absorbed moisture from the surroundings. This can lead to a deterioration of the insulation resistance.

If the insulation resistance is less than 25 kΩ at a test voltage of 500 V, the heater elements must be dried before starting.
(see No. 5.3)

1.4.4. The operator must ensure that the electric heater can only be switched on if the medium is flowing under operating conditions.

1.5. Safety information for operating the electric heater

1.5.1. Unless otherwise stated in the drawing and/or the data sheet, the electric heater is designed mainly for steady compression loads.

1.5.2. In principle the electric heater may only be used for the operations shown in the data sheet. The electric heater may not be started up until the operating medium is flowing under operational conditions. The pressure and temperature limits are mandatory and must be complied with.

1.5.3. The installation of a temperature meter in the immediate proximity of the outlet connection to regulate the electric heater is absolutely necessary. If we do not supply the measuring instrument, the operator/plant builder is responsible for installing a suitable measuring instrument in the connecting pipes. To prevent temperature corruption, adequate insulation must be placed over the pipe through to the installation position, so that there is only an insignificant temperature drop upstream from the measuring point. If the customer supplies the switchgear, the operator/plant builder must ensure that the temperature set at the controller does not exceed the operating temperature. Once the operating temperature is reached, the electric heater must be switched off in accordance with the controls.

1.5.4. When the electric heater is being operated higher temperatures may be experienced at the surface of the pressure vessel and this may cause the surface to heat up and be a source of danger. Unless otherwise stated in the danger analysis, the electric heater is supplied without insulation. In this case, it is the responsibility of the operator/plant builder to provide a suitable insulation so that a hot surface does not lead to danger.
If we have supplied the insulation for the pressure vessel, it is also the responsibility of the operator/plant builder to insulate the built-on parts (e.g. pipes, measuring instrument), or to carry out other measures to protect them from contact.
In all cases the operating personnel and any other personnel who might come into the environment of the electric heater must be warned about the danger by means of work instruction or similar. In addition, we recommend that signs warning of possible hot surfaces be attached to the insulation.

1.5.5. The operator/plant builder must ensure that after the electric heater is switched off the operating medium is led through the electric heater under operating conditions for a further 10 minutes (see PED 93/23/EC Annex I No. 5 as well). This discharges the thermal energy that is in the heaters in a controlled manner.

1.5.6. The personnel who are responsible for operating the electric heater must be informed of possible dangers from the electric heater by means of the user's manual and internal work instructions.

1.6. Safety information for maintenance work on the electric heater

1.6.1. All maintenance work on the electric heater must be performed by skilled, adequately qualified workers (ICE 364, CENELEC HD 384, observe DIN VDE 0100, IEC-Report 664, DIN VDE 110 and national accident prevention rules). Qualified workers within the meaning of these basic safety precautions are people who are familiar with the installation, assembly, repair and operation of the product and possessing the qualifications necessary for their occupation.

1.6.2. If maintenance work is carried out on the electric heater the owner must ensure that the power supply is switched off. This includes making sure that the electricity supply cannot be switched on again unintentionally when the work is being carried out. National regulations applying to the electric heater must be complied with.

1.6.3. Before opening the flange connection or similar, make sure that the electric heater is no longer under pressure, has been emptied and has cooled down completely. The heater must be secured against an unintentional start-up in this case as well.
A leak test must be carried out after all maintenance work on all components that are under pressure.

1.6.4. We recommend that the inside walls of the pressure vessels are checked at regular intervals for signs of corrosion or other material losses, in particular if these vessels are not inspected permanently by a designated agency. This includes a water test pressure with the test overpressure shown in the data sheet. This test should be carried out at least every three years. During this maintenance work the surface of the heaters can be checked and where necessary deposits removed. We recommend using a stream cleaner and, if required, a soft brush for cleaning.

1.6.5. Check, and where necessary clean, the sealing surfaces at every maintenance. Use only original parts as spare parts.

1.6.6. Inspection
The inspection periods required for the electric heater are usually regulated in national statutes. The owner must ensure that the inspection periods are complied with.

2. Description of the electric heater

2.1. The electric heater consists basically of a pressure vessel, a heating element inserted into this and a wiring space.

2.2. The heating elements are distributed evenly around the circumference of the flow area. The heating elements are spaced either through a retaining guard or by guide plates.

2.3. At least one temperature meter is installed in the heating element to limit the temperature of the heater. The type and the number of measuring devices can be seen in the system description. See the wiring diagram for the recommended setting value of the cut-out.
Do not set a higher temperature than the one in the system description before consulting us.

2.4. The wiring space contains the internal wiring for the heaters, the temperature meters and, where applicable, an anti-condensation heater.
The power and control cables supplied by the customer are led through cable entries into the wiring space and connected to the appropriately marked positions.

2.5. If an anti-condensation heater is installed, this must be switched on when the electric heater is not operating. Switch the anti-condensation heater off for maintenance and repair work.

3. Installing the electric heater

3.1. The electric heater must be installed vertically or horizontally in accordance with the appropriate drawing. The heater may only be installed on the parts provided for this purpose (e.g. mounting base, brackets, etc.).

3.2. There must be sufficient space in front of, above and below the electric heater to enable the heating element to be pulled out completely and removed.

3.3. The installation must be planned in such a way that the electric heater can absorb the thermal expansion without tension.

3.4. The following table lists thermal expansion values in dependence on the outlet temperature and the length. An ambient temperature of 20 °C is assumed as the base temperature.
The value 15.0 E-06 is assumed as the expansion coefficient. If there is another expansion coefficient, this must be taken into consideration with the values.

Outlet temperature °C	Length mm							
	500	1000	1500	2000	2500	3000	3500	4000
50	0	0,5	1	1	1	1	2	2
100	1	1	2	2	3	4	4	5
150	1	2	3	4	5	6	7	8
200	1	3	4	5	7	8	9	11
250	2	3	5	7	9	10	12	14
300	2	4	6	8	11	13	15	17
350	2	5	7	10	12	15	17	20
400	3	6	9	11	14	17	20	23
450	3	6	10	13	16	19	23	26
500	4	7	11	14	18	22	25	29

If the electric heater is installed with a moveable and a fixed base we recommend that the work is done in the following steps:

- Place the electric heater on the prepared foundation for the fixed and the movable base
- Fix the fixed and the movable base in place with self-locking nuts
- Tighten the self-locking nuts on the fixed base
- Make sure that there is a gap of min. 2 mm between the plate of the movable base and the nut
- Secure the nut and therefore the gap with a counternut

3.5. Connect the inlet and outlet pipes at the appropriate pipe sockets free of tension. Where applicable, connect the pipes for discharging, emptying or similar to the appropriate pipe sockets free of tension.
Unless otherwise stated in the drawing, socket forces and moments through the pipe are not permitted.
ATTENTION: the direction of flow cannot be reversed.

3.6. Make the electrical connections in accordance with the information on the wiring diagram in the wiring space.

3.7. The electric heater must be earthed.
There is an earth terminal or earth terminal positions provide in the wiring space. There is also an earthing jumper installed on the pressure vessel (e.g. on the fixed base).

3.8. If the electric heater is installed in the open air, we urgently recommend that a protective roof is installed above the area of the wiring space. We also urgently recommend that you place a suitable drying agent in the wiring space and replace it at regular intervals. Alternatively, we recommend the installation of a anticondensations heating with temperature control.

4. Start-up

4.1. Carry out the following electrical measurements before start-up:

- Resistance between the phases L1/L2/L3. The resistance must conform to the performance data in the wiring diagram. The rest must be carried out for each group.
- Measurement of the insulation resistance. The insulation resistance may not less than 25 kΩ with a test voltage of 500 V. If this value is not achieved, see No. 5.3.

4.2. Set the thermal cut-out to the value shown in the wiring plan. The owner must ensure that if the temperature is exceeded the electric heater remains switched off (closing lockout).
If the thermal cut-out is triggered, the electric heater may not be switched on again until the reason has been clarified explicitly.

4.3. Set the temperature controller to the operating temperature shown in the system description.

4.4. Start the medium flow through the electric heater.

4.5. The owner must ensure that the electric heater can only be switched on if the medium is flowing under operating conditions (type of medium, flow rate, pressure, inlet temperature, etc.) (e.g. flow indicator pressure and temperature measurements).
The operating conditions for the electric heater are contained in the appropriate data sheet.
In that case that the temperature limiter will be activate periodical is possible and allowed to increase the limiter value to 35 up to 50 °C once time.

4.6. Compare the supply voltage with the information on the data sheet and on the ratings plate. The voltages must correspond.

4.7. Switch the electric heater on.
We recommend that you increase the output of the electric heater slowly in steps of 10%.

When doing this, check the power consumption and the temperature at the cut-out continuously.

Check all the flanged connections for leaks after the first warming up.

5. Maintenance

5.1. The electric heater must be maintained and inspected at regular intervals. The owner must fix these intervals in dependence on the operating characteristics and the ambient conditions. However, we recommend that you carry out an annual maintenance and inspection.

<u>The maintenance and inspection should cover the following points as a minimum:</u>

- Check the operating conditions.
- Tighten all flanged connections and check them for leaks.
- Check the pressure vessel for damage.
- Check the surface of the heaters for dirt and damage. If required clean, e.g. with a steam jet and/or a soft brush.
- Check the settings of the thermal cut-out and temperature controller.
- Check the reliability performance of the thermal cut-out and temperature controller.
- Check the power consumption of the heaters.
- Check the insulation resistance.
- Check the terminal connections of the connection cables.
- Check the terminal connections of the heaters.
- Check the wiring space for damage.

5.2. These checks should be repeated at regular intervals even when the electric heater is constantly operated.

The insulation resistance may not fall below a value of 25 kΩ at a test voltage of 500 V. If the value falls below this, the reason may be the absorption of moisture from the environment by the heater.
In this case, the heater must be dried.

Please consult with us.

6. Shutting down

6.1. To switch the electric heater off use the main switch at the switchgear.

6.2. After switching the main switch off, the medium can be switched off after a delayed flow period of approx. 10 minutes.

6.3. Reduce the pressure in the electric heater slowly to the ambient pressure. To do this, use the devices that are required in the installation. The electric heater does not have a pressure release value, unless one is referred to separately in the drawing.

6.4. If necessary, empty the electric heater.

7. Remedying faults

7.1. The electric heater does not heat, or only insufficiently:

- Check the supply voltage (compare the data sheet and the ratings plate)
- Check the power cable and the terminals in the wiring space and at the switchgear
- Check the functions of heater groups or heater by measuring the power consumption
- Check the setting and function of the temperature controller
- Check the insulation of the electric heater

If you cannot locate the fault, please contact us.

7.2. Thermal cut-out has switched the electric heater off:

- Check the flow of the medium (foreign bodies in the heating element)
- Check the operating conditions for the medium (pressure, temperature, etc.)
- Check the setting and function of the cut-out

Do not switch the electric heater on again until the fault has been remedied.

If you have any further questions regarding the product, feel free to contact us.