Technical Specifications

STEAMTHERM ST 3000

Direct method of measurement of heat content in steam

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Contents

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1. APPLICATION

The STEAMTHERM ST 3000 system is a certified meter for direct measurement of heat content in steam in steam-supply piping systems containing superheated steam. It is used as commercial (invoicing) meter at the inputs of steam supply piping systems to the customer plant (e.g. heated premises), heat exchanger stations or in technological processes utilising the steam energy.

2. TECHNICAL DESCRIPTION

2.1. Direct measurement method

The quantity of the transferred/delivered heat corresponds to the heat contained in steam at the input to the customer plant. The heat content in steam is calculated using the direct method where the heat power, the heat content in steam at the input point and the quantity of the heat delivered to the customer plant are calculated in regular intervals (every second) from the measured steam parameters. In each measurement and calculation cycle, the limit condition of steam saturation is checked. If unsaturated steam is indicated at the input point, application of the direct method of heat-content determination is discontinued and only the time of discontinued measurement is registered.

2.1.1. Direct method

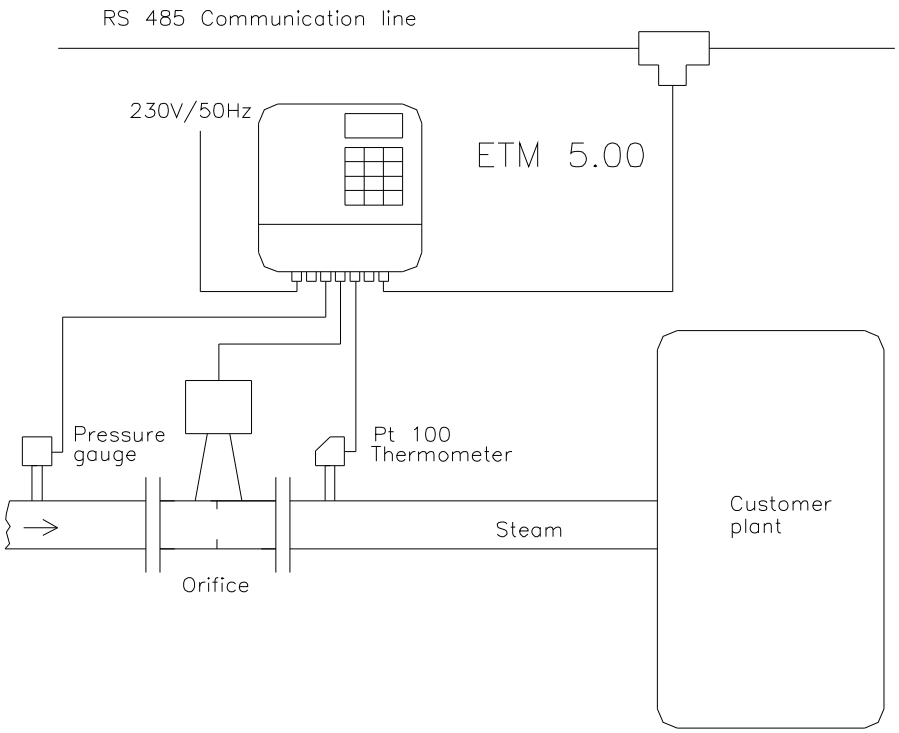
The heat power (q_p) in steam (supersaturated steam) is defined as the product of the volume flow rate of supersaturated steam (V_p), the specific density of steam (H_p) and the specific enthalpy of superheated steam (E_p):

$$q_p = V_p \cdot H_p \cdot E_p$$

The heat quantity Q delivered over the time interval of Δt is derived by time integration of the heat power function:

$$Q_p = \int_t q_p \cdot dt$$

2.2. Fitting the meter into a heat supply system



3. TECHNICAL PARAMETERS

3.1. System including flow meter in the compact version; basic technical specifications

Steam

Temperature in the feeding line	from the saturation threshold temperature up to 600 °C
Pressure in the feeding line	0.08 to 2 MPa

Metrological properties

The total error of the measurement system is the aggregate of the measurement errors of the system components, where the maximum error is:

±4 % for the steam flow-rate range 0.3 Qn ≤ Q ≤ Qn, and
±5 % for the steam flow-rate range 0.1 Qn ≤ Q ≤ 0.3 Qn.

3.2. System including steam-flow meter with orifice gauge; basic technical specifications

Steam

Temperature in the feeding pipe	from the saturation-limit temperature to 600 °C
Pressure in the feeding pipe	0.08 MPa to 9.9 MPa

Metrological properties

The total error of the measurement system is the aggregate of the measurement errors of the system components; it is

±3 % pro steam pressure between 0.2 and 9.9 MPa.

3.3. Technical specifications

Operating conditions

Ambient temperature	+5 to +55 °C
Maximum relative humidity	93 %
Supply voltage	230 V ±10 %
Power frequency	50 Hz ±2 %

Input signals

a) Temperature sensor Pt 100
b) Pressure sensor 0 ÷ 20 mA or 4 ÷ 20 mA
c) Steam flow-rate sensor 0 ÷ 20 mA or 4 ÷ 20 mA

Output signals

a) LC display – 2 lines of 16 characters each
b) RS 485 communication line
c) 2 programmable impulse outputs (relay or optron signals)
d) 2 isolated power sources +24 V/30 mA

Measured and evaluated flow parameters

See enclosure: Displayed data

Auto-diagnostic features
Error message on the meter display and error record in the error buffer
- wet (saturated) steam
- temperature error
- pressure-gauge error
- flow-meter error or change in differential pressure
- power failure

4. METER DESIGN

The measurement system comprises the following component parts:

4.1. Calorimetric counter

Calorimetric counter is an electronic device used to measure and record data on the delivered heat energy and the quantity of the heat-carrying medium passed through the meter sensor. The ST 3000 meter system includes the ETM 5.00 calorimetric counter in a plastic housing. The ETM 5.00 counter design makes possible easy dismantling or replacement of the meter module including the associated electronic unit for the purposes of regular parameter verification. This module is interconnected with the basic electronic unit by means of a flat cable and connector, provided with an assembly seal. The basic electronic unit of the meter includes two isolated DC power sources +24 V/30 mA that can be used for energising external devices such as pressure gauges, flow sensors and others.

4.2. Resistance temperature sensor

The temperature sensor is essential part of the steam-temperature measurement system. A suitable model is Pt 100. The function of the Pt 100 sensor is based on the resistance/temperature characteristic of a platinum resistor.

4.3. Pressure sensor

The pressure sensor is used to measure steam pressure. The recommended model is overpressure sensor with the operational range of 0 to 40 bar. Absolute-pressure sensors can also be used.

4.4. Steam flow meter

4.4.1. Compact-design version of flow mater

The steam flow meter is used to measure the steam volume passed through the feeding steam line. Suitable meter type is vortex flow meter of sufficient range of operating temperatures, with a current output. The recommended model is vortex flow meter with a straight-line characteristic within the pressure range of 16 to 100 bar and operating temperatures between 230 and 430°C.

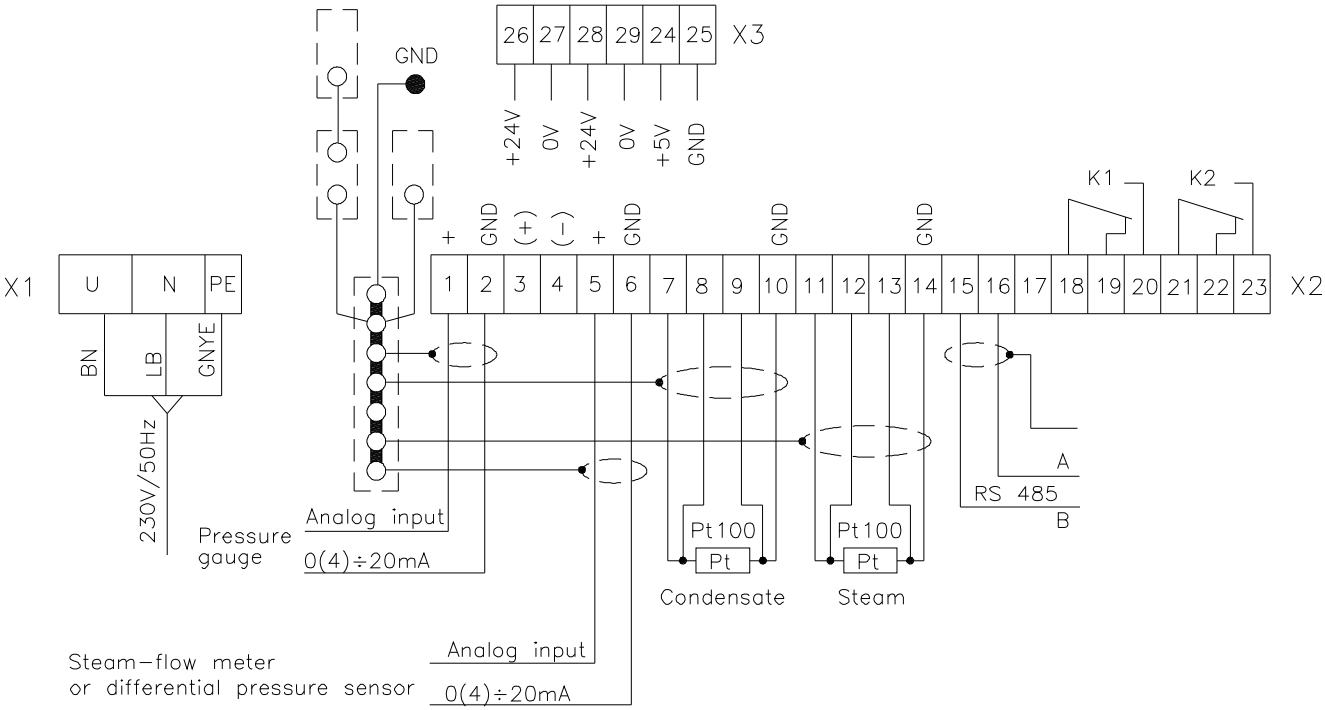
4.4.2. Orifice and differential pressure sensor

By including a mechanical obstacle in the form of orifice in the steam flow, a pressure difference at locations before and after the orifice will be created proportional to the steam flow velocity. Such difference is measured by a suitable pressure gauge and converted subsequently into an analog signal used in the calorimetric counter to determine the steam flow rate.

5. EXTERNAL ELECTRICAL AND MECHANICAL CONNECTIONS

5.1. Electrical connections

5.1.1. Calorimetric counter ETM 5.00



5.2. Mechanical connections

The ETM 5.00 calorimetric counter shall be attached to a vertical supporting plate by means of four bolts M5. The resistance thermometer shall be mounted by means of a screw fitting into the welded-on piece on the steam pipe, and the pressure sensor by means of a screw fitting at the end of the condensation loop.
Depending on the rated pipe diameter, the vortex flow meter is either provided with flanges to be attached to the corresponding flanges on the steam piping, or it is fitted between two pipe flanges clamped together by means of bolts (a “sandwich” connection).
Regarding the procedure for the orifice fitting, follow the respective standard and manufacturer’s directions.

6. PRODUCT MARKING

Each of the system components has its own rating plate. Apart from that, the system rating plate is attached to the calorimetric counter housing.

<u>External rating plate data</u>
Product type designation
Production series number
Protection class
Type verification certificate number

Internal rating plate data
Steam:
Temperature range
Temperature sensor
Pressure gauge rating
Pressure gauge output signal
Steam flow meter rating
Computational temperature
Computational pressure
Flow-meter output signal
Orifice manufacturing series number

7. METER ORDERING SPECIFICATIONS

Every product order shall include the following specifications:

- The system components required by the customer:
  - type of calorimetric counter
  - type of thermometer
  - type of pressure sensor (including the range of the current output signal)
  - type of steam flow meter (including the range of the current output signal)
- Installation site altitude
- Steam temperature range
- Absolute steam pressure range
- Communication requirements
  - station number: 1 to 255
  - group number: 1 to 255
  - parity: even / odd
  - Baud rate: 1,200 Bd / 2,400 Bd / 4,800 Bd / 9,600 Bd
- Data collection by means of a notebook computer requirement
- Data archiving requirement
- Binary outputs requirement

8. TESTING

Individual system components are tested for compliance with the requirements in the respective testing directives.

9. METER VERIFICATION

The system consists of metrologically verified components.

10. PRODUCT ACCEPTANCE PROCEDURE

The product acceptance procedure consists of visual inspection of the system components and check on their completeness with reference to the delivery note information. The delivery shall include a complete ST 3000 system, application and maintenance manuals, a product compliance statement and delivery note.

11. WARRANTY CONDITIONS

The warranty period for the STEAMTHERM ST 3000 products is 12 months, during which all system failures due to defective materials or parts will be repaired free of charge. In the case of a warranty repair, the warranty period for the product concerned will be extended by the period during which the system was inoperative due to such repair. The product warranty shall not apply to any system failures originating from incorrect installation, handling, intentional damage, pilferage or any consequences of force majeure conditions.

Annex to ST 3000: description of the push-button meter control system (for a system including the ETM 5.00 calorimetric counter). The latest version of the counter control procedures is included in the system application manual forming part of the system delivery package.

Direct method of measurement (with no condensate return)

Key	Legend – description of system status	Displayed text
Switch to 0	PAGES 1 and 2	
-	Instantaneous temperature of steam	Steam temperature [^{o}C]
1	Heat content in supersaturated steam (SS)	Heat in steam [GJ] [MWh]
1+D	Figure after decimal point = heat content in supersaturated steam	After dec. point, key 1 [GJ] [MWh]
2	Unsaturated steam (US) delivery period	US period [hr:min]
3	Meter power failure period	Power failure [hr:min]
4	Sensor failure period	Sensor failure [hr:min]
5	Instantaneous steam flow rate (SS)	Steam flow rate [t/hr] [m^3/hr]
6	Quantity of supersaturated steam	SS quantity [t] [m^3]
6 + D	Figure after decimal point = supersaturated steam quantity	After dec. point, key 6 [t] [m^3]
7	Heat flow in supersaturated steam	SS heat flow [GJ/hr] [MW]
E + 6	Time to archived data rewrite start	Data archiving time left [hr:min]
E + 7	Communication parameters	Communication pars
Switch to 0	PAGE 3	
1	Instantaneous steam temperature	Steam temp. [^{o}C]
2		EMPTY KEY
3	Absolute steam pressure, instant. value	Abs. steam pressure [MPa]
4	Specific steam enthalpy, instant. value	Steam enthalpy [kJ/kg]
5		EMPTY KEY
6	Supersaturated steam density, inst. value	SS density [kg/m^3]
7		EMPTY KEY
8		EMPTY KEY
9	Real time	Time [hr:min:sec]
A	Real calendar date	Date [day:month:year]
C	Meter operation time	Operation time [hr:min]
D	Flow meter range	Flow-rate range [m^3/hod]
F	Software number	