Measuring System „autarkon®“
Electronic Steam Meter EDZ 371 D
Electronic Steam Heat Meter EWZ 351 D
in Microprocessor Technology

METRA Energie-Messtechnik
Member of Bopp & Reuther Messtechnik Group

Application

Measurement and recording of mass and heat of saturated / superheated steam with pressure and temperature compensation.

Transmitter DT 311
with cross-section probe

Arithmetic unit ERW 521

Pt 100/1000 sensor

Special properties

- No moving parts in the flow section
- Compact, highly integrated static measuring sytem
- All parts in the flow section are made of stainless steel
- Modular design
- With pressure and temperature compensation
- With integrated zero-balancing block, thus zero-level and long-term stable
- Low pressure loss at high measuring dynamic range
- Mainly maintenance-free
- Minimum installation effort due to integration of differential and absolute pressure transducer into one device
- Standard measuring range 1 : 20 for mass flow

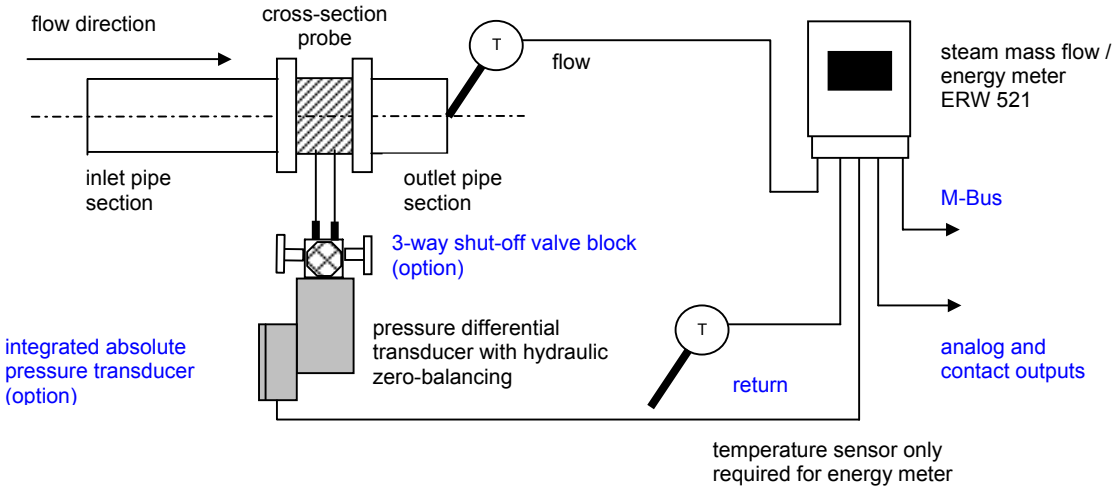
General

The EDZ 371 D and EWZ 351 D consist of:

- Cross-section probe with inlet and outlet pipe section
- Temperature decoupling module
- Hydraulic zero-balancing module
- Differential pressure transducer DT 311
- Integrated absolute pressure transducer (options)
- 3 – way shut-off valve module (option)
- Temperature sensor Pt 100 / 1000 with immersion pocket
- Steam mass flow / energy meter ERW 521
  With multi-functional LC display

Due to the suction pressure/effective pressure measuring method, there are no moving parts in the flow section. The measuring system is thus wear-resistant and insensitive to blinding. The temperature and – optionally – pressure dependent changes of media properties are compensated. All relevant are displayed via a multi-functional LCD. They can be forwarded via standardized current and contact outputs. The measuring system can be networked via an M – Bus output according to EN 1434 – 3.

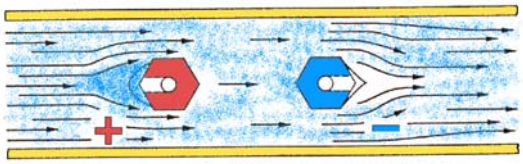
Scheme of Measuring Point

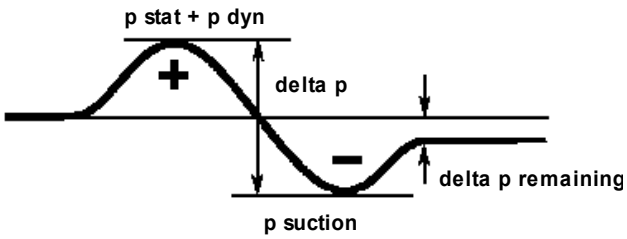


Functional principle and application

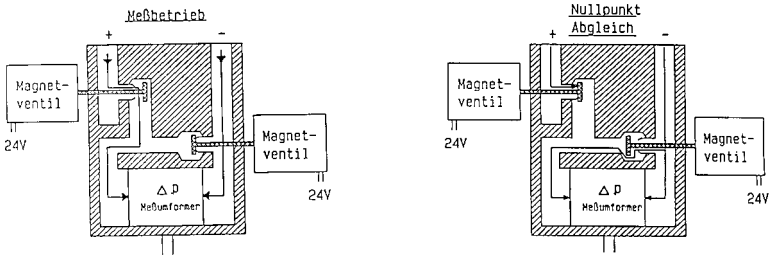
A stainless steel measuring ring contains two pressure probes measuring the total and the suction pressure in order to determine the flow velocity. The pressure probe facing the flow measures the static plus the dynamic part of the pressure, the probe averting the flow senses the difference between the static and the dynamic parts of the pressure (suction). Both pressure signals are forwarded to a ceramic pressure differential cell and converted into a proportional electric signal.
The zero point of the pressure differential measuring head is automatically balanced dependent on the existing pressure differential, thus ensuring a high level of accuracy and long-term stability.
In combination with the temperature and – as an option – the pressure, the velocity-proportional pressure differential signal is converted into a corresponding mass flow and subsequently into the amount of heating energy.

Cross-section probe





Differential pressure transducer with zero-balancing module



Modular Design

Cross-section probe

Cross-section probe
consisting of
dynamic/suction
pressure probe
low pressure loss

Transducer DT311

Oval adapter with Swagelok fittings

3-way shut-off valve module (option)

Zero-balancing module

Pressure differential transducer
Absolute pressure transducer (option)

Caculation unit ERW 521

Flow: q = f(Δp, ρ, k)

Δp = differential pressure (function of velocity,
medium density; diameter ratio)
ρ = density (function of medium pressure and temperature)
k = Tube-specific number dependent of nominal width

Technical data EDZ 371 D / EWZ 351 D

Nominal diameter DN	15	20	25	32	40	50	65	80	100	125	150	200	250*
k - factor	125	252	403	605	832	1436	2344	3276	5544	8820	on demand		
Max. mass flow (kg/h) ρ = fluid density at T and P (kg/m^3)	$qm_{max} = k \cdot \sqrt{\cdot 1{,}2 \cdot \rho}$												
Nominal pressure	PN 25 / 40										16/25/40		
Design	measuring ring, sandwich type										measuring tube		
Face-to-face length	Transducer without inlet and outlet pipe sections 65 mm										500 mm		
Max. operating temperature	Up to 250 °C for compact design, 300 °C for separate transducer, higher values on demand												
Material	Materials in contact with the medium consist of stainless steel (1.4571 / 1.4581)												
Medium	Saturated / superheated steam p >= 2 bara (p < 2bara on demand)												
Permissible environmental temperature	Transducer DT 311 4 – 55 °C												
Protection class	Transducer DT 311, IP 65, calculation unit IP 54												
Multi-functional LC display integrated in calculation unit ERW 521	alphanumeric P in kW or MW, m in kg/h or t/h, t_w in °C, t_k in °C, Δt in K, E in kWh or MWh, m in kg or t, other units see instuction manual												
Temperature sensor	1 x Pt 100 / 1000 (four-wire, passive)												
Output	fault indication, crawl flow contact												
Power supply	230 V AC, power consumption 15 VA, 24 V DC (option)												
Test certificate	3 measuring points, basis: water												
Permissible ambient temperature	4 to + 50 ° C												
Inet and outlet pipe section L (mm)	Dimension dependent on nominal diameter (see table)												

Additional Equipment

4 floating outputs 0(4) – 20 mA can be freely assigned to any of the actual values; calibration current for the adjustment of external displays, tracers etc. Voltage-free contacts for volume and energy as well as limit contacts
2 floating outputs 0(4) – 20 mA can be freely assigned to any of the actual values; calibration current for the adjustment of external displays, tracers etc. Voltage-free contacts for volume and energy as well as 2 limit contacts
1 floating outputs 0(4) – 20 mA can be freely assigned to any of the actual values; calibration current for the adjustment of external displays, tracers etc. Voltage-free contacts for volume and energy
3-way shut-off valve module mounted to the transducer
Integrated absolute pressure transmitter 0-16 / 25 / 40 bara
Pt 1000 temperature sensor including immersion pocket type 160 (type 75)
Pt 100 temperature sensor including immersion pocket type 160 (type 75)
Immersion pocket type 200
Welding-type immersion pocket type 200, solid material, stainless or creep-resistant steel
Sensor connection cable 4-wire, screened
M-BUS interface
External absolute pressure transducer 0-16 / 25 / 40 bara
8 digit remote counter, controlled by voltage-free contacts
Optoelectronically coupled outputs
Pulse input board
Fault indication counters for energy and mass (volume)
Additional counters for energy and mass (volume) only in combination with pulse input board
Power supply 24 V DC / AC
DT 311P / DT 312 P version „precision“ (only available in combination with zero-balancing module)
Inlet and outlet pipe section with centering device for measuring ring
Centering flange for pre-installation
Intermediary for pre-installation
Test certificate for 10 flow data points (basis : water)
System test, commissioning and instruction by METRA service personnel

Determination of steam density as a function of pressure and temperature

saturated steam

Steam pressure p (bar abs)	**Steam temperature** t (°C)	**Steam density** ρ (kg/m³)	**Steam pressure** p (bar abs)	**Steam temperature** t (°C)	**Steam density** ρ (kg/m³)	**Steam pressure** p (bar abs)	**Steam temperature** t (°C)	**Steam density** ρ (kg/m³)
1.0	**99.63**	**0.59**	**9.0**	**175.63**	**4.65**	**21.0**	**214.85**	**10.54**
1.5	111.37	0.86	10.0	179.88	5.15	22.0	217.24	11.03
2.0	120.23	1.13	11.0	184.07	5.64	23.0	219.55	11.52
2.5	**127.43**	**1.39**	**12.0**	**187.96**	**6.13**	**24.0**	**221.78**	**12.02**
3.0	133.54	1.65	13.0	191.61	6.62	25.0	223.94	12.51
3.5	138.87	1.91	14.0	195.04	7.11	26.0	226.04	13.01
4.0	**143.62**	**2.16**	**15.0**	**198.29**	**7.60**	**27.0**	**228.07**	**13.51**
4.5	147.92	2.42	16.0	201.37	8.09	28.0	230.05	14.76
5.0	151.84	2.67	17.0	204.31	8.57	29.0	231.97	14.51
6.0	**158.84**	**3.17**	**18.0**	**207.11**	**9.07**	**30.0**	**233.84**	**15.01**
7.0	164.96	3.67	19.0	209.80	9.55			
8.0	170.41	4.16	20.0	212.37	10.05			

Superheated Steam:

In superheated steam, the steam density is reduced. An exact determination of the density can only be achieved if the h,s - Mollier diagram is applied.

However, an approximative determination of the steam density can be achieved via the general state equation of ideal gases.

$$\rho = p / (Ri \times T)$$

ρ = steam density in kg/m³

p = steam pressure in N/m² (Pa)

Ri = specific gas constant

(for steam 462 (Nm/(kgK))

T = steam temperature in K

Calculation example:

asserted: steam pressure p = 10 bara = 10 x 10^5 N/m² (Pa)

steam temperature T = 200 °C

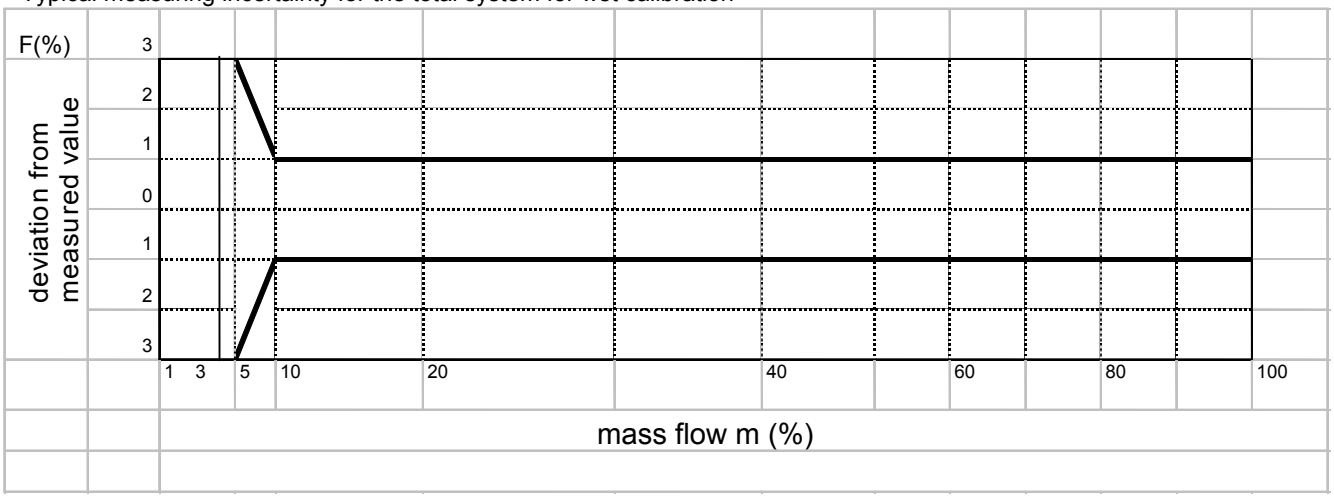
absolute steam temperature T = 200 °C + 273 K = 473 K

Ri = 462 (Nm/(kgK))

steam density ρ = 10 x 10^5 / (462 x 473) = 4,6 kg/m³

Error limits

Typical measuring incertainty for the total system for wet calibration *



* The standard turn down is 1 : 20

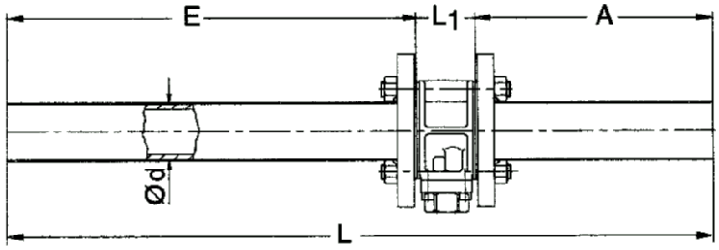
Inlet and outlet pipe sections for transducer (measuring ring) up to DN 125

Interference	DN = Nominal diameter of measuring tube	
	inlet section	outlet section
Strainer, shut-off valve fully open bend two bends in the same plane	Face-to-face dimension as METRA section	Face-to-face dimension as METRA section
two bends in different planes	18 x DN	5 x DN
Control valve partly open	18 x DN	5 x DN

If the inlet is conducted via a T-piece, a flow conditioner is required.

For exact centering of the measuring ring we recommend the use of METRA centering flanges with inlet and outlet pipe sections including bolts, nuts and gaskets. For pre-installation or pressurizing and flushing of the plant, adapting rings should be used. If the inlet and outlet pipe sections are not supplied by METRA, please ensure that the internal pipe diameter matches the measuring ring width „d“ exactly. The measuring rings comply with the nominal pressure rate PN 40. Please refer to the table below for the corresponding intermediate flanges.
In case of pipe reductions or extensions please make sure that they are concentric.

Dimensions of inlet and outlet pipe sections



Nominal diameter	Pressure rating
DN 15 to DN 50	PN16, PN25, PN40
DN 65 to DN 125	PN25, PN40

Nominal diameter DN	15	20	25	32	40	50	65	80	100	125	150*	200*	250*
L (mm)	500	550	600	700	750	1000	1200	1400	1800	2200			
E (mm)	265	300	331	404	437	621	751	891	1151	1421			
A (mm)	166	181	200	227	244	310	380	440	580	710			
Internal diameter d (mm)	17.3	22.3	28.5	37.2	43.1	54.5	70.3	82.5	107.1	131.7			
L_1 (mm)	65 + 2 x 2 mm gasket										500	500	500
Nominal pressure PN	40										16 / 25 / 40		
Weight approx. [kg]	2.5	3	4	5.5	6.5	9	14	18	27	41			

* Measuring tube designs with DN 150 and more with flanges PN 16, PN 25 or PN 40 with separate transducer only,

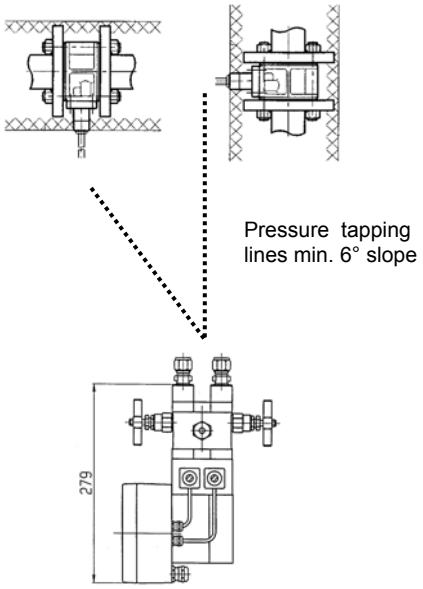
Please note:

The lengths of inlet and outlet pipe sections are always dependent of the inlet disturbance.

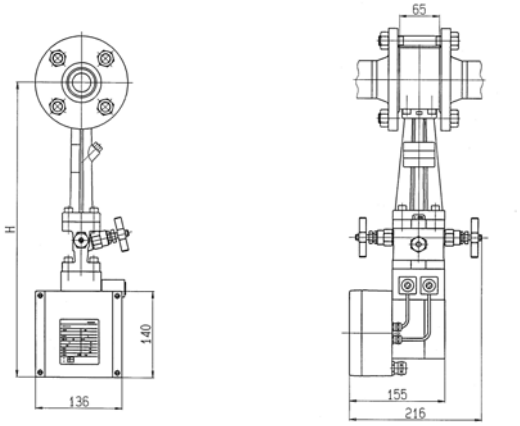
It is strongly recommended to adhere to ISO 5161-1 to ISO 5161-4.

Dimensions

Separate transducer



compact transducer

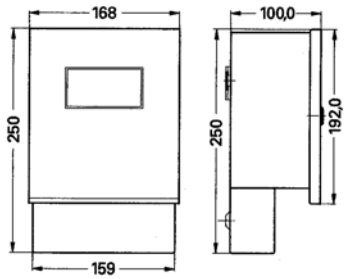


Dimensions of transducer in compact design

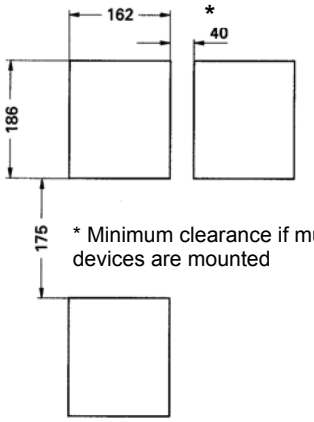
DN	15	20	25	32	40	50	65	80	100	125
H (mm)	465.3	463.6	469.5	475.3	483.8	480	491	499	511.6	525
Weight (approx. kg)	7	7	7	7.5	8	8.5	9	9.5	10.5	11

Calculation unit

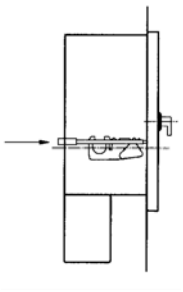
Wall mounting



panel mounting

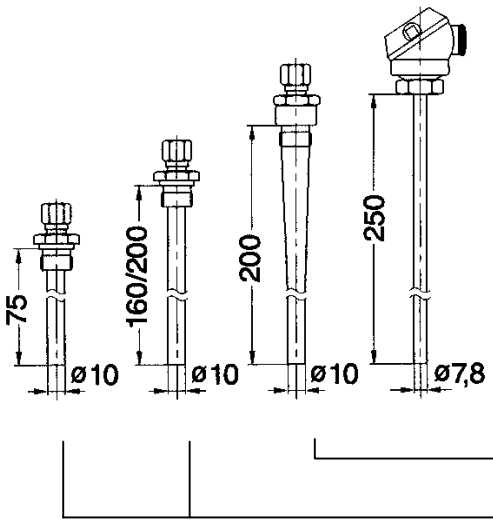


* Minimum clearance if multiple devices are mounted



Installation kit for panel mounting

Temperature sensor with immersion pocket



type 75 fitting G ½“
type 160 fitting G ½“
type 200 fitting G ½“
type 200 welding-type immersion pocket G ½“

Connection threads acc. to DIN 2999

Welding-type immersion pocket

Screw-type immersion pocket

Steam Flow / Heat Meter “autarkon®“ EDZ 371D / EWZ 351D in Microprocessor Technology

Text for quotations and orders:

Steam flow / heat meter “autarkon“
EDZ 371 D / EWZ 351 D in microprocessor technology consisting of:
transducer DN …, PN …,
nominal flow … kg/h, fluid …,
operation mode …, flow or heat meter,
operating temperature …°C, operating pressure …bara, fitting position vertical / horizontal …
measuring ring with cross-probe, all wetted parts in stainless steel
DT 311 transducer with hydraulic zero-balancing for maximum accuracy and long-term stability
ERW 521 calculation unit as flow/heat meter for saturated/superheated steam
Power supply 230 V, 50/60 Hz
multi-functional LC display for $\dot{m}$, P, t_w, t_k, Δt
electronic counter for mass (m) in kg or t, energy (E) in kWh or MWh
output voltage-free contact for fault indication and crawl flow shut-off,
1 Pt 1000/Pt 100 temperature sensor including immersion pocket type …,
test certificate with 3 points, measured on accredited test stand, based on water

Additional equipment

4 floating outputs 0(4) – 20 mA can be freely assigned to any of the actual values;
calibration current for the adjustment of external displays, tracers etc.
voltage-free contacts for volume and energy as well as 2 limit contacts

2 floating outputs 0(4) – 20 mA can be freely assigned to any of the actual values;
calibration current for the adjustment of external displays, tracers etc.
voltage-free contacts for volume and energy as well as 2 limit contacts

1 floating output 0(4) – 20 mA can be freely assigned to any of the actual values;
calibration current for the adjustment of external displays, tracers etc.
voltage-free contacts for volume and energy

3-way shut-off valve module mounted on transducer

integraterd absolute pressure transducer 0-16 / 25 / 40 bara

Pt 1000 temperature sensor including immersion pocket type 160 (type 75)

Pt 100 temperature sensor including immersion pocket type 160 (type 75)

immersion pocket type 200

welding-type immersion pocket type 200 massive material, stainless or creep-resistant steel

sensor connection cable, 4-wire, screened

M-BUS interface

external absolute pressure transducer 0-16 / 25 / 40 bara

8 digit remote counter, controlled by voltage-free contacts

optoelectronically coupled outputs

pulse-input board

fault indication counters for energy and mass (volume)

additional counters for heat and mass (volume) only in combination with
pulse-input board

power supply 24 V DC / AC

DT 311P / DT 312 P version „precision“ (only available in combination with zero-balancing module)

inlet and outlet pipe sections with centering flange for measuring ring ..

centering flange for pre-installation

intermediary for pre-installation

test certificate for 10 flow datapoints (basis: water)

System test, commissioning and instruction by METRA service personnel

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