

Measuring equipment



5/2	In situ Oxygen analyzer
5/2	Oxygen analyzer with ZrO ₂ probe
5/13	Dust concentration measuring equipment
5/13	D-R 290 dust concentration measuring device
5/17	D-R 300/-40 dust concentration and soot coefficient measuring device
5/21	D-RX 250 combined sensor probe
5/24	Gas measuring and warning systems
5/24	Sensors for explosive gases and vapors
5/26	Sensors for monitoring threshold limit values
5/28	8022 evaluation unit and accessories



Measuring equipment

In situ Oxygen analyzer

Oxygen analyzer with ZrO₂ probe



Design

Each oxygen analyzer comprises

- a probe which measures the oxygen concentration directly in the flue gas duct (in situ),
- an evaluation unit which converts the measured signal of the probe into a standardized signal and
- the electric and pneumatic connections (only electric cables with 7MB1 943-6DF... to -6DK...).

The design, material and length of the oxygen probes can be optimally adapted to the conditions of use, thus ensuring long service lives and high availability.

Because of the large maximum distance of 150 m between the probe and electronics, the components can be mounted in optimum locations.

OXITEC ECONOMY

The **OXITEC ECONOMY** oxygen analyzer (7MB1 943 -6DF... to -6DK...) is suitable for small and medium-size furnaces operated with natural gas or oil. The flue gas temperature at the point of installation should be less than 400 °C and have a low dust concentration.

The probe lengths of 300 mm, 500 mm and 800 mm permit optimum adaptation to the respective cross-section of the flue gas duct.

A high-temperature probe with a cooling/protective tube either 500 mm or 1000 mm long is available for flue gas temperatures up to 1400 °C.

Application

Measurement of the oxygen concentration in flue gases from furnaces and in all types of inert gases in the temperature range 20...1400 °C.

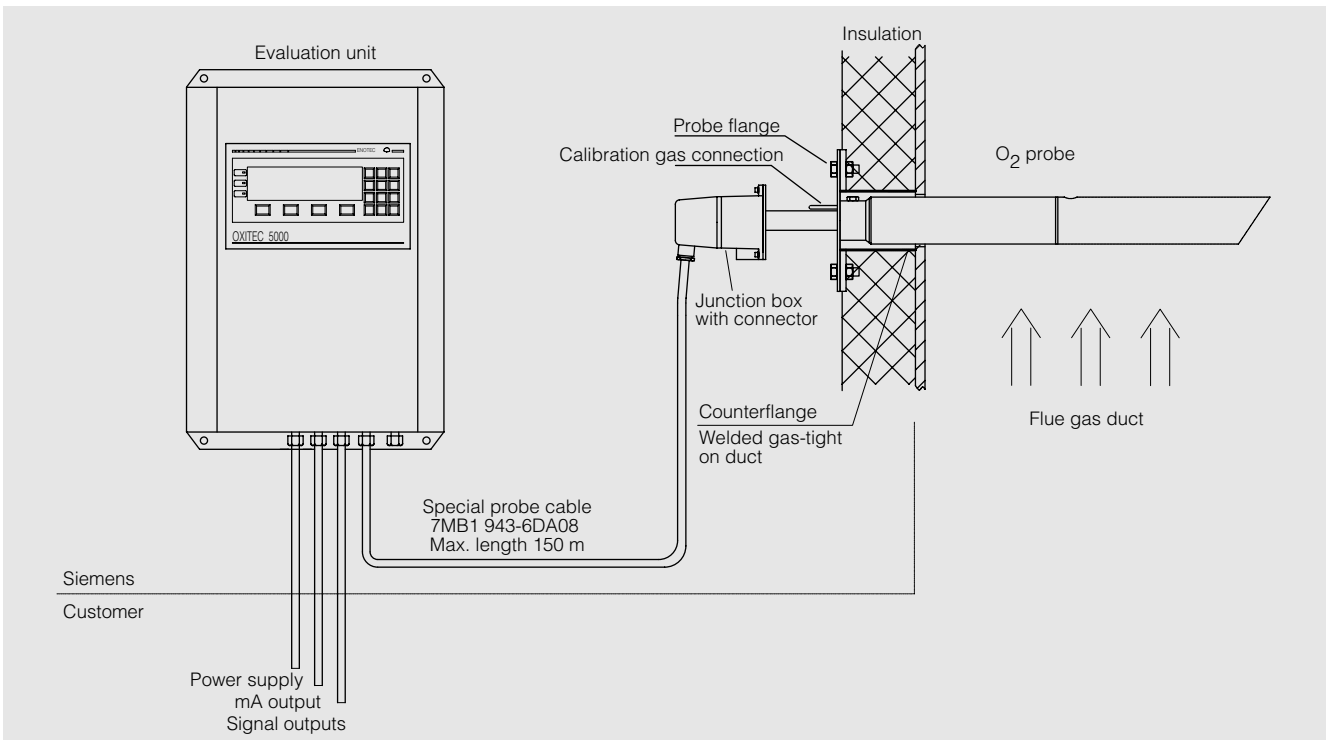


Fig. 5/1 Design of OXITEC ECONOMY oxygen analyzer for small and medium-size power plants

Measuring equipment In situ Oxygen analyzer

Oxygen analyzer with ZrO₂ probe

OXITEC 5000

The **OXITEC 5000** oxygen analyzer (7MB1 943- 6B...) is suitable for power plants, waste incineration plants, cement plants and other incineration plants with high dust concentrations and flue gas temperatures up to 600 °C.

The rugged probe with filter head and protective tube with installation lengths of 520...1865 mm (other lengths on request) enables optimum adaptation to all installation situations.

The evaluation unit is additionally equipped with a pneumatic unit (either pump or instrument air) with which manual or automatic calibration can be easily carried out.

A high-temperature probe with a cooling/protective tube either 500 mm or 1000 mm long is available for flue gas temperatures up to 1400 °C.

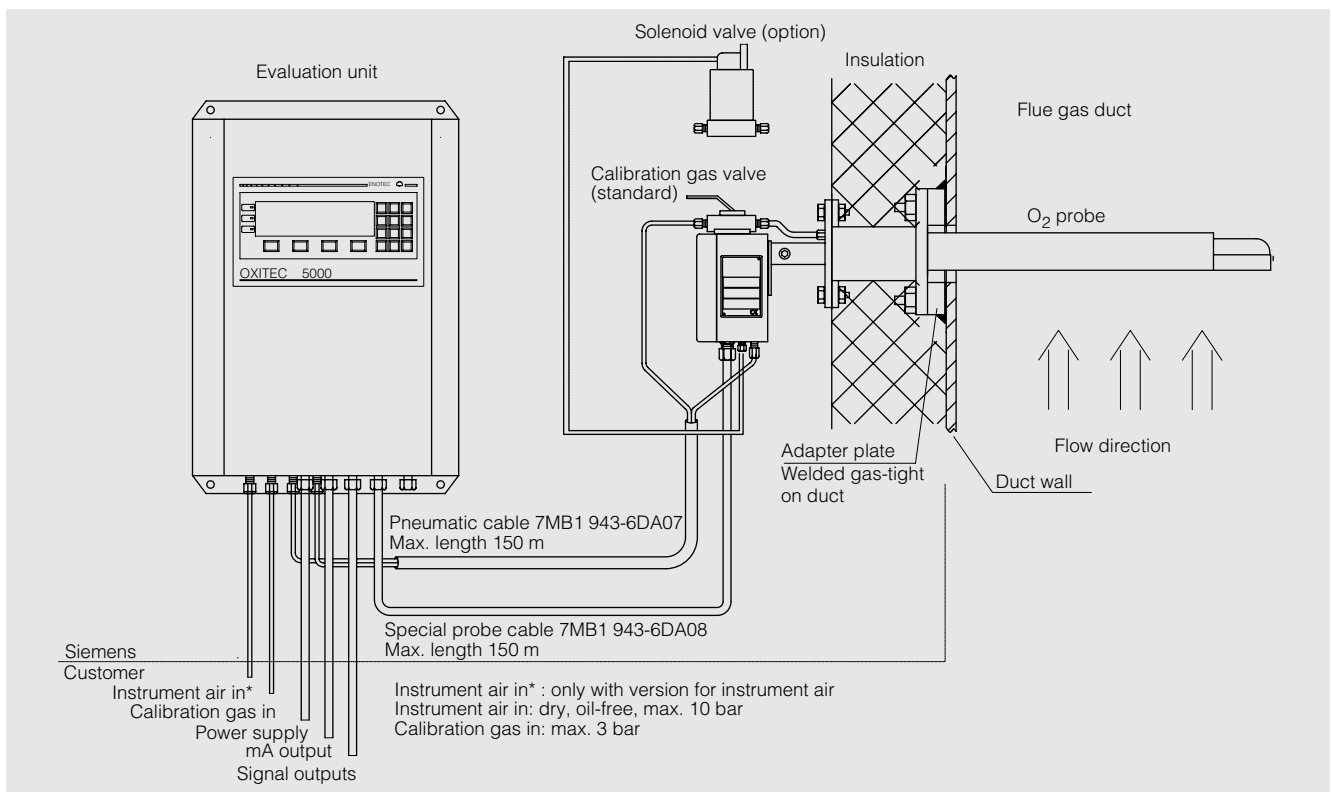


Fig. 5/2 Design of OXITEC 5000 oxygen analyzer for power plants, waste incineration plants etc.

Measuring equipment

In situ Oxygen analyzer

Oxygen analyzer with ZrO₂ probe

OXITEC 5000EX

The **OXITEC 5000EX** explosion-proof oxygen analyzer (7MB1 943-6CB... to -6CF...) is suitable for plants in Ex Zone 1. The flue gas temperature at the probe should be max. 500 °C.

The rugged, ATEX-certified probes are available with lengths of 520 mm, 950 mm and 1865 mm.

A high-temperature probe with a cooling/protective tube either 500 mm or 1000 mm long is available for flue gas temperatures up to 1400 °C.

The associated ATEX-certified evaluation unit is also suitable for use in Ex Zone 1.

The pneumatic unit for instrument air is accommodated in a rugged IP65 sheet-steel housing, and can be installed directly on site.

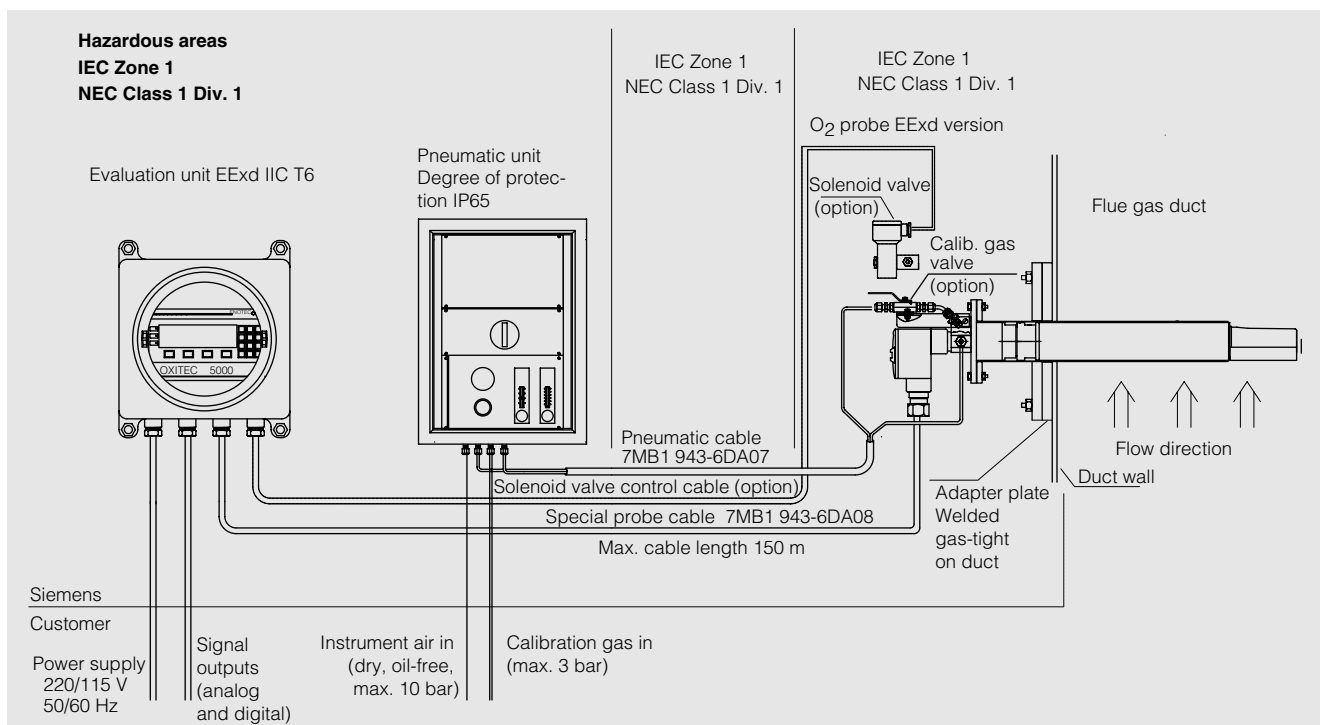


Fig. 5/3 Design of OXITEC 5000EX oxygen analyzer for Ex Zone 1

Mode of operation

The oxygen analyzer measures the actual oxygen concentration present in the exhaust gas. Measurement is carried out directly in the flue gas duct (in situ), since the measuring cell is fitted to the tip of the probe.

The presence of water in every flue gas, which has an influence on the actual O₂ concentration, is incorporated in the measurement with this wet measuring procedure. The wet procedure produces a lower measured value than the dry procedure, as it refers to the total volume.

The sample gas diffuses through the filter element and reaches the flue gas side of the measuring cell which is protected by the filter head. The reference gas (air) constantly flows past the other side of the measuring cell.

The measuring cell itself is a ZrO₂ disk which is platinum-coated on both sides and soldered gas-tight in a supporting tube. When this measuring cell is heated at a constant temperature, the O₂ molecules on the platinum layer are ionized and migrate through the electrolyte from the higher to the lower O₂ partial pressure side and are combined again into O₂ molecules with the release of electrons. The resulting electromotive force (EMF) according to the Nernst equation is a measure of the difference in partial pressure and - because one partial pressure is known (air) - is a measure of the oxygen concentration on the flue gas side. The EMF is converted to a standardized signal by the evaluation unit.

Maintenance

The OXITEC oxygen analyzer is low-maintenance. Depending on the ambient conditions and the model, you need to check the following:

- the reference air filter in the evaluation unit approx. every 8 weeks and
- the probe filter, once a year.

Calibration

The OXITEC oxygen analyzer is pre-calibrated in the factory. To achieve an optimum accuracy, the first calibration should be carried out under process conditions using air and a further calibration gas (e.g. 2.1% O₂ in N₂). Later calibrations can then be carried out using air (single-point calibration).

Technical data

Oxygen probe

Max. flue gas temperature	400...1400 °C, depending on model
Flue gas pressure	1000 ± 50 mbar
Flue gas composition	
• Steam	Max. 100% v/v
• Dust	No known limits
• SO ₂	Any concentration encountered in flue gas ducts
• HCl	The service life of the probe is influenced at > 1000 mg/m ³
• HF	The service life of the probe is influenced at > 100 mg/m ³
• CO	ZrO ₂ measuring cells are sensitive to all flammable gases. This error is generally negligible in flue gases.
Service life	4 to 5 years, possibly shorter or longer depending on the flue gas composition

Permissible ambient temperature	-10 ... +80 °C
Response time and T ₉₀ time for flue gas flow > 10 m/s	Response time T ₉₀ time
- Probe for 400 °C	2.0 s 30 s
- Probe for 600 °C	0.5 s 5 s
- Probe for 1400 °C	4.0 s 120 s
- Explosion-proof probe	2.0 s 35 s
Permissible flow velocity	0...50 m/s
Measuring cell tolerance	± 0.2% of measured value
Measuring cell resolution	< 1 ppm O ₂
Power supply	Via evaluation unit
Enclosure protection	IP65 (junction box)

Evaluation unit

Power supply	See ordering data
Power consumption	400 VA (heating-up phase), 100...200 VA (normal operation)
Output signal	0 (4) ... 20 mA, electrically isolated
Load	Max. 500 Ω
Resolution	0.021% O ₂
Measuring tolerance	< 0.05% O ₂

Weight/enclosure protection	
- Sheet-steel field housing	Approx. 15 kg / IP66
- 19-inch plug-in	Approx. 10 kg / IP20
- Explosion-proof electronics	Approx. 54 kg / IP65
- Protective housing made of glass-fiber-reinforced plastic	Approx. 25 kg / IP66

Permissible ambient temperature	-20 ... +55 °C
---------------------------------	----------------

Adapter plate

Design/dimensions	See figure
Material	St 37

Special probe cable

With single lines for measured signal, thermocouple, heater, solenoid valve	
Material (sheath)	Polyurethane (green, ~ RAL 6026)
Permissible ambient temperature	-40 ... +90 °C
Outer diameter	11.7 mm
Length	Max. 150 m

Technical data

Pneumatic line

with 2 pipes (4/6 mm HDPE) for the reference air supply (30 l/h continuous) and calibration gas supply (150...200 l/h as required)	
Material (sheath)	Polyurethane (green, ~ RAL 6026)
Permissible ambient temperature	-40 ... +90 °C
Outer diameter	16.6 mm
Length	Max. 150 m

Schematics

OXITEC ECONOMY
7MB1 943-6DF... to -6DK...

X1

1	-O-	L	Input	230/115 V AC	
2	-O-	N	Input	"	
3	-O-	PE	Input	"	
4	-O-	L	Output	230/115 V AC	
5	-O-	N	Output	"	
6	-O-	PE	Output	"	
7	-O-				
8	-O-	L	Output	Probe heater	
9	-O-	N	Output	"	
10	-O-	PE	Output	"	
11	-O-				
12	-O-	+	Input	Measuring cell	
13	-O-	-	Input	"	
14	-O-	+	Input	Thermocouple	
15	-O-	-	Input	"	
16	-O-		GND		
17	A	-O-	+	Output	0/4 - 20 mA
17	B	-O-	-	Output	"
18	A	-O-		NO contact	Maintenance *)
18	B	-O-		NO contact	"
19	A	-O-		NC contact	System fault
19	B	-O-		NC contact	"
20	A	-O-			
20	B	-O-			
21	A	-O-			
21	B	-O-			
22	A	-O-			
22	B	-O-			
23	A	-O-		NC contact	Limit 1 *)
23	B	-O-		NC contact	"
24	A	-O-		NC contact	Limit 2 *)
24	B	-O-		NC contact	"
25	A	-O-			
25	B	-O-			
26	A	-O-			
26	B	-O-			
27	A	-O-			
27	B	-O-			

Terminal connection diagram for special type "OXITEC ECONOMY"

*) Option

Measuring equipment

In situ Oxygen analyzer

Oxygen analyzer with ZrO₂ probe

Dimensional drawings

Dimensions of OXITEC ECONOMY probes and electronics

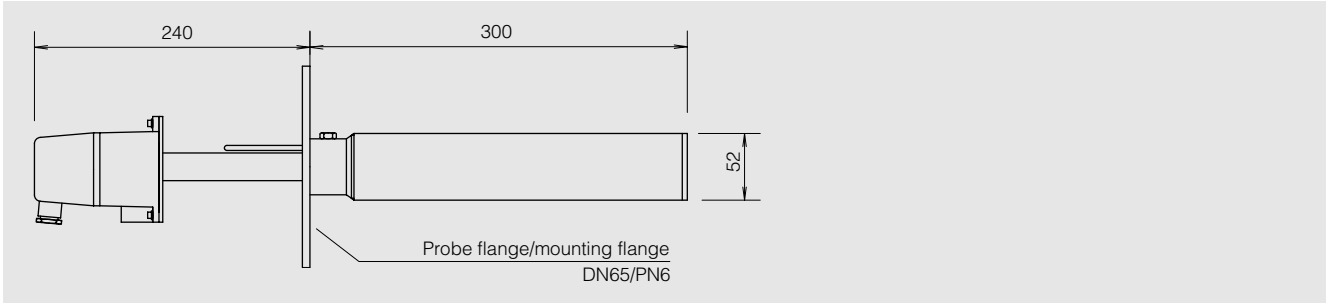


Fig. 5/4 Oxygen probe for max. 400 °C flue gas temperature, immersion length 300 mm

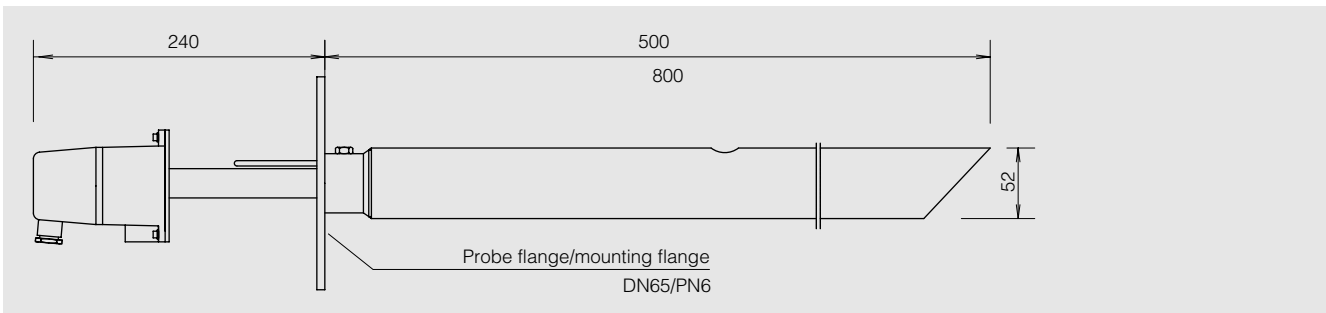


Fig. 5/5 Oxygen probe for max. 400 °C flue gas temperature, immersion length 500/800 mm

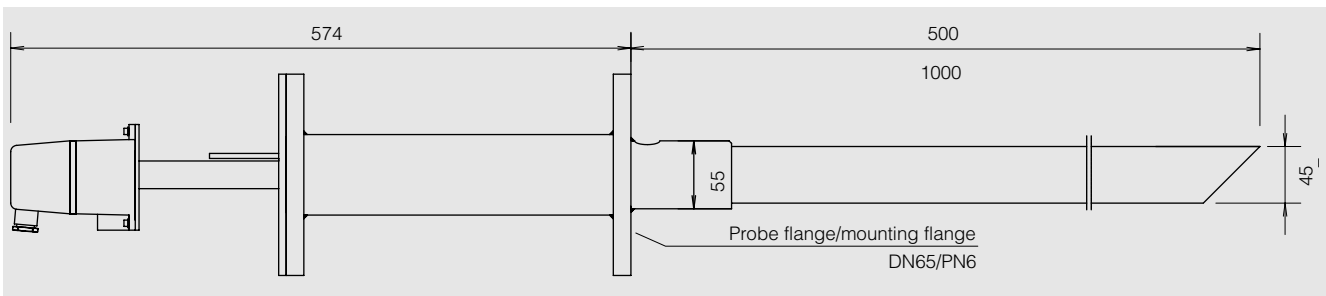


Fig. 5/6 Oxygen probe for max. 1400 °C flue gas temperature, immersion length 500/1000 mm

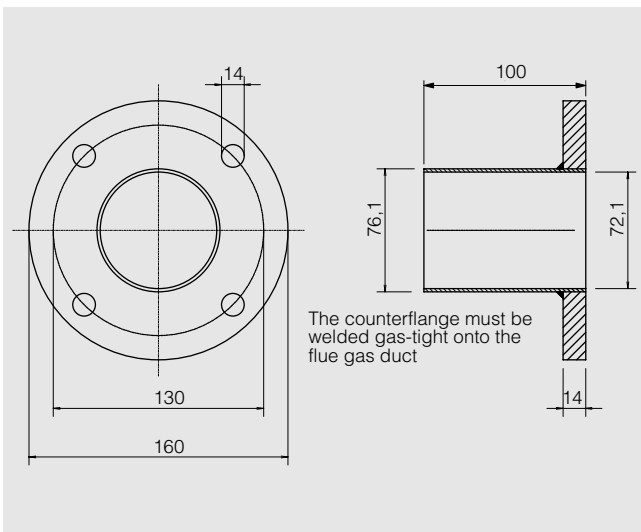


Fig. 5/7 Counterflange 7MB1 943-6D105

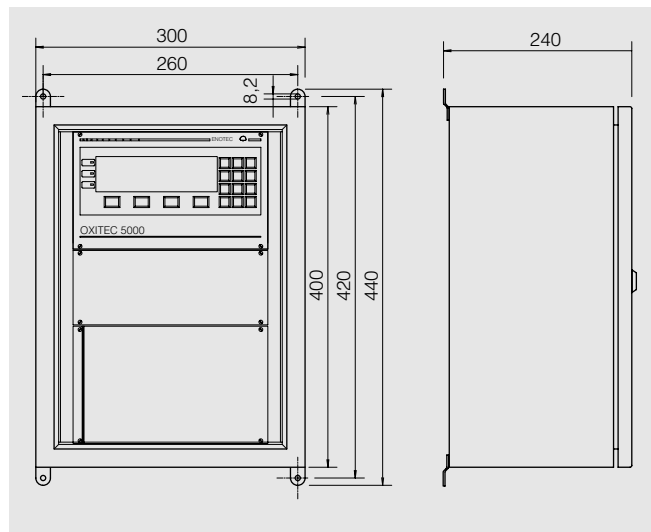


Fig. 5/8 Evaluation unit, sheet-steel field housing

5

Ordering data	Order No.	Accessories	Order No.
OXITEC ECONOMY oxygen analyzer comprising probe, electronics and cable, for small and medium-size furnaces up to 1400 °C	7MB1 943- 6 D ■ 1 0 - 0 ■ A ■	Counterflange matching the probe flange DN65/PN6	7MB1 943-6DA05
Probe Flange: similar to DN65/PN6 Material: 1.4571 / 1.4301 (SiC) Manual calibration gas connection Filter element: sintered metal 20 µm Enclosure protection: IP65 for connector		Special probe cable 2 x 0.75 mm ² for thermocouple 2 x 0.75 mm ² for cell signal 3 x 1.50 mm ² for heater Max. ambient temperature 90 °C; delivery unit 1 m, max. length 150 m	7MB1 943-6DA08
Electronics Sheet-steel field housing with door with window, dimensions (HxWxD) in mm: 400x300x240, enclosure protection IP66, 1 measuring range, start-of-scale and full-scale values freely-programmable from 0 ...99 % Output: 0/4...20 mA programmable, floating, max. load 500 Ω Ambient temperature -10 ... +55 °C Status signal: system fault		Pump for calibration air for single-point calibration with air, power supply 230 V AC, 50 Hz	7MB1 943-6DA15
Cable 6 m special probe cable with connector (other lengths on request)			
System assemblies <ul style="list-style-type: none"> Flue gas temperature 400 °C <ul style="list-style-type: none"> Immersion length 300 mm Immersion length 500 mm Immersion length 800 mm Flue gas temperature 1400 °C <ul style="list-style-type: none"> Immersion length 500 mm Immersion length 1000 mm 	F G H J K		
Electronics options <ul style="list-style-type: none"> Without supplementary electronics 2 adjustable limits, parameterizable as min./max., status signal "Maintenance" 			A B
Power supply <ul style="list-style-type: none"> 230 V AC, 50/60 Hz 120 V AC, 50/60 Hz 			0 1

Measuring equipment

In situ Oxygen analyzer

Oxygen analyzer with ZrO2 probe

Schematics

OXITEC 5000 7MB1 943-6DA00-... / 7MB1 943-6DA02-... / 7MB1 943-6DA10-...				
X1				
1		-O-	L Input	230/115 V AC
2		-O-	N Input	"
3		-O-	PE Input	"
4		-O-	L Output	230/115 V AC
5		-O-	N Output	"
6		-O-	PE Output	"
7		-O-		
8		-O-	L Output	Probe heater
9		-O-	N Output	"
10		-O-	PE Output	"
11		-O-		
12		-O-	+ Input	Measuring cell
13		-O-	- Input	"
14		-O-	+ Input	Thermocouple
15		-O-	- Input	"
16		-O-	GND	
17	A	-O-	+ Output	0/4 - 20 mA
17	B	-O-	- Output	"
18	A	-O-	NO contact	Maintenance
18	B	-O-	NO contact	"
19	A	-O-	NC contact	System fault
19	B	-O-	NC contact	"
20	A	-O-	NO contact	Measuring range
20	B	-O-	NO contact	"
21	A	-O-	L Input	Probe valve (115 V AC) ¹⁾
21	B	-O-	N Input	"
22	A	-O-	Output	Probe valve (115 V AC) ¹⁾
22	B	-O-	Output	"
23	A	-O-	NC contact	Limit 1
23	B	-O-	NC contact	"
24	A	-O-	NC contact	Limit 2
24	B	-O-	NC contact	"
25	A	-O-	+ Dig. input	Enable calibration (12-24 V)
25	B	-O-	- Dig. input	"
26	A	-O-		
26	B	-O-		
27	A	-O-	+ Dig. input	Range switchover (12-24 V)
27	B	-O-	- Dig. input	"

Terminal connection diagram for probe types 7MB1 943-6DA00-..., 7MB1 943-6DA02-... and 7MB1 943-6DA10-...

1) Standard

Schematics

OXITEC 5000EX 7MB1 943-6DA01-...				
X1				
1		-O-	L Output	Probe valve (115 V AC) ¹⁾
2		-O-	N Output	"
3		-O-	PE Output	"
4		-O-	L Output	Probe heater
5		-O-	N Output	"
6		-O-	PE Output	"
7		-O-	+ Input	Measuring cell
8		-O-	- Input	"
9		-O-	+ Input	Thermocouple
10		-O-	- Input	"
11		-O-		
12		-O-	+ Output	0/4 - 20 mA
13		-O-	- Output	"
14		-O-		
X2				
1		-O-	NO contact	Maintenance
2		-O-	NO contact	"
3		-O-	NC contact	System fault
4		-O-	NC contact	"
5		-O-	NO contact	Measuring range
6		-O-	NO contact	"
7		-O-	NC contact	Limit 1
8		-O-	NC contact	"
9		-O-	NC contact	Limit 2
10		-O-	NC contact	"
11		-O-	+ Dig. input	Enable calibration (12-24 V)
12		-O-	- Dig. input	"
13		-O-	+ Dig. input	Range switchover (12-24 V)
14		-O-	- Dig. input	"
PE		-O-		
PE		-O-		
PE		-O-		
PE		-O-		
PE		-O-		
L		-<	L Input	230/115 V AC
N		-<	N Input	"
PE		-<	PE Input	"

Terminal connection diagram for probe type 7MB1 943-6DA01-...

1) Standard

Dimensional drawings

Dimensions of OXITEC 5000 and OXITEC 5000EX probes

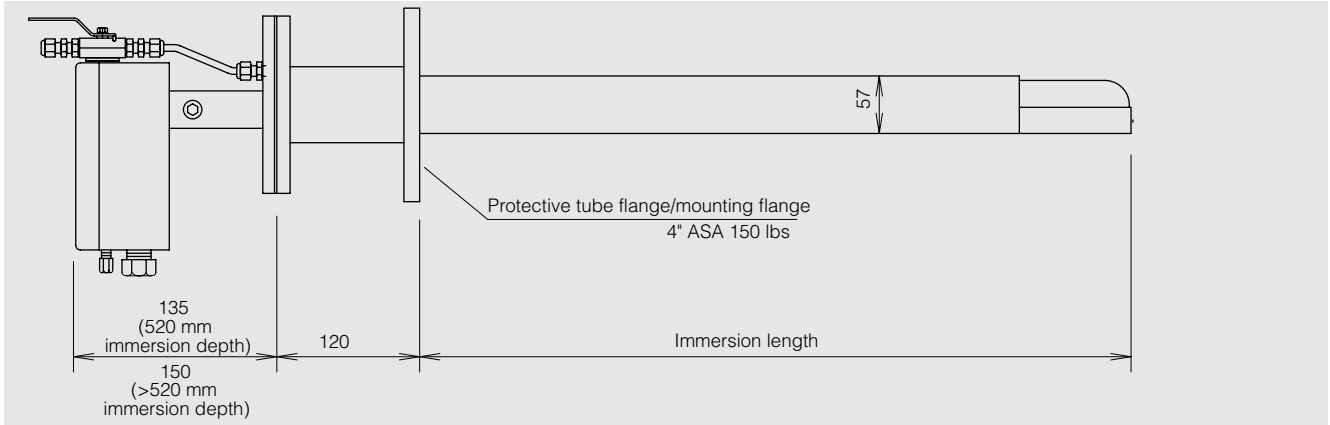


Fig. 5/9 Oxygen probe for max. 600 °C flue gas temperature

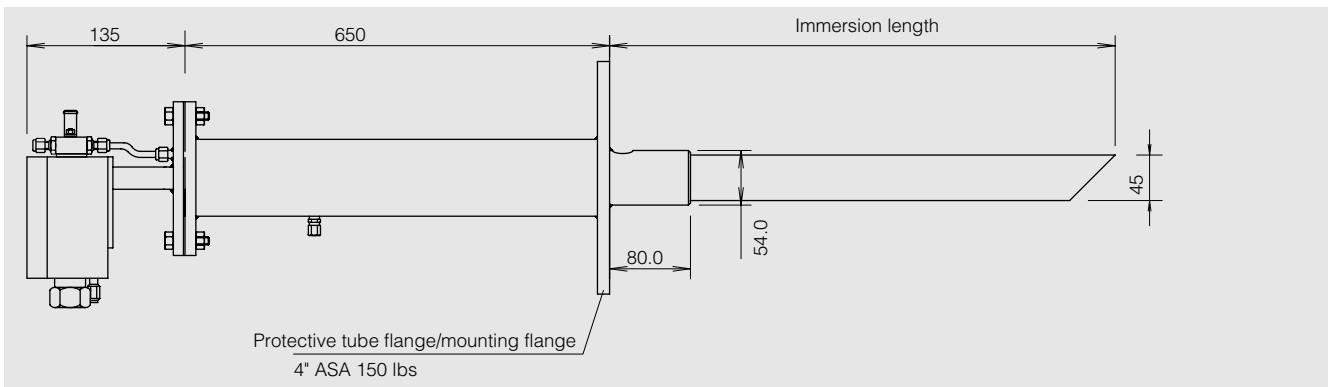


Fig. 5/10 Oxygen probe for max. 1400 °C flue gas temperature

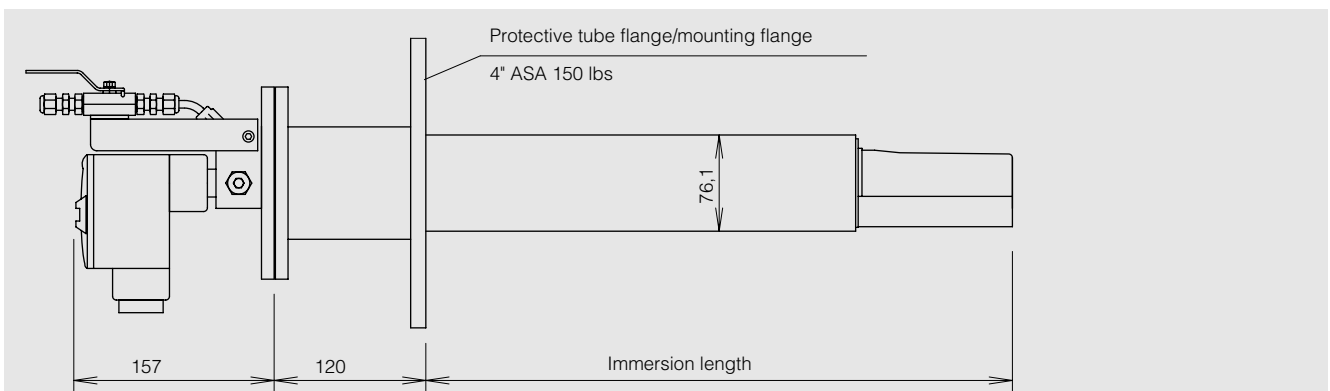


Fig. 5/11 Explosion-proof oxygen probe for max. 500 °C flue gas temperature on the probe

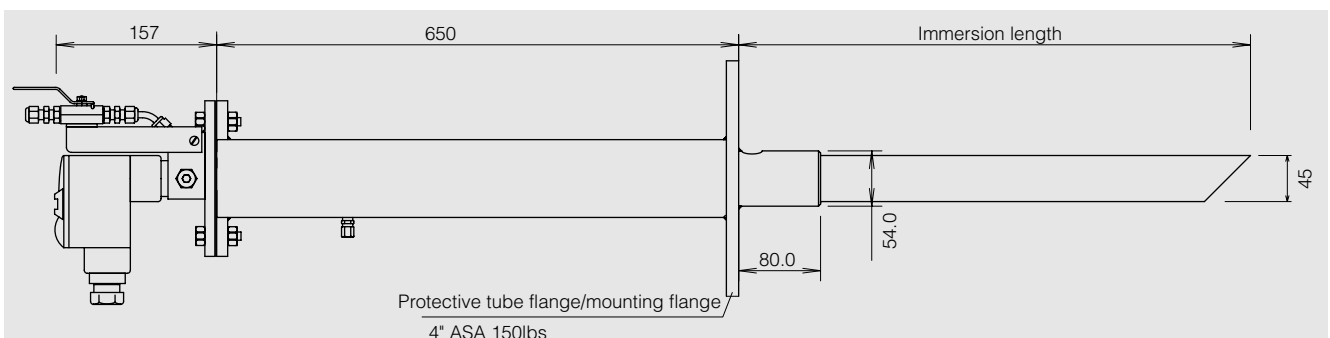


Fig. 5/12 Explosion-proof oxygen probe for max. 1400 °C flue gas temperature

Measuring equipment

In situ Oxygen analyzer

Oxygen analyzer with ZrO₂ probe

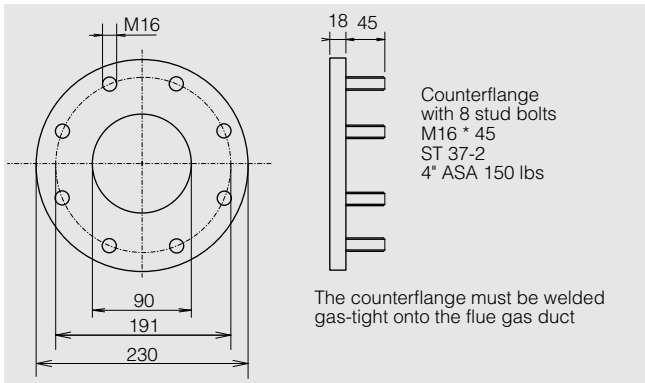


Fig. 5/13 Counterflange 7MB1 943-6DA06

Dimensions of OXITEC 5000 and OXITEC 5000EX evaluation units

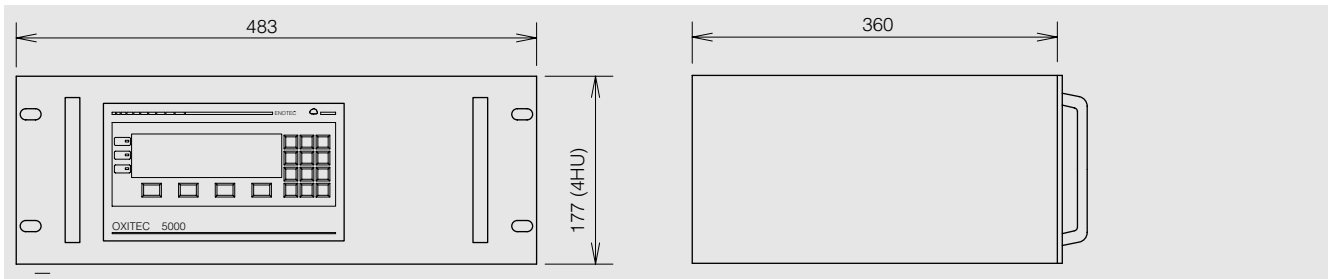


Fig. 5/14 Evaluation unit, 19-inch plug-in

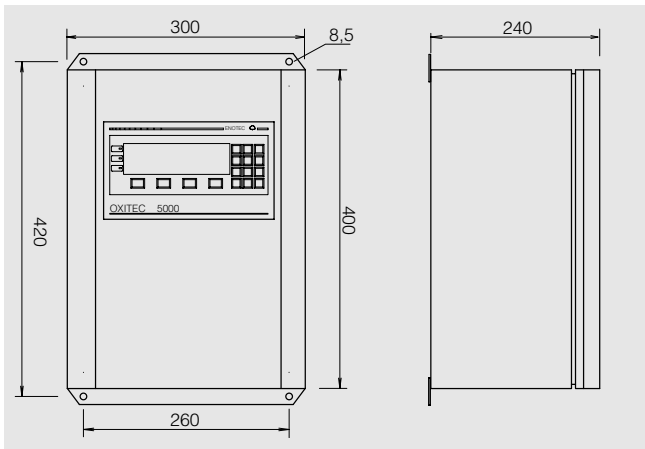


Fig. 5/15 Evaluation unit, sheet-steel housing

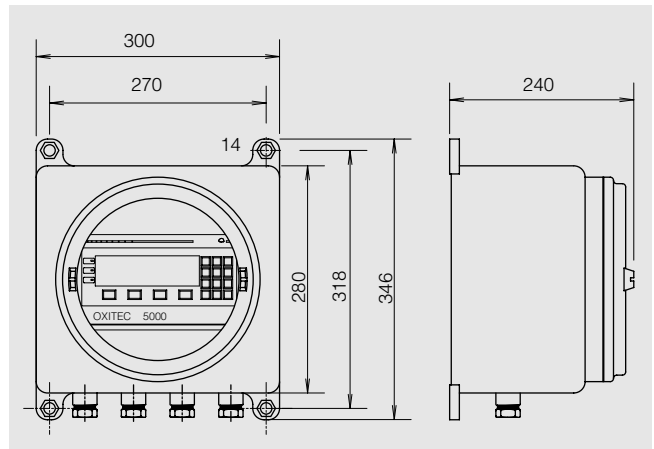


Fig. 5/16 Evaluation unit, explosion-proof housing

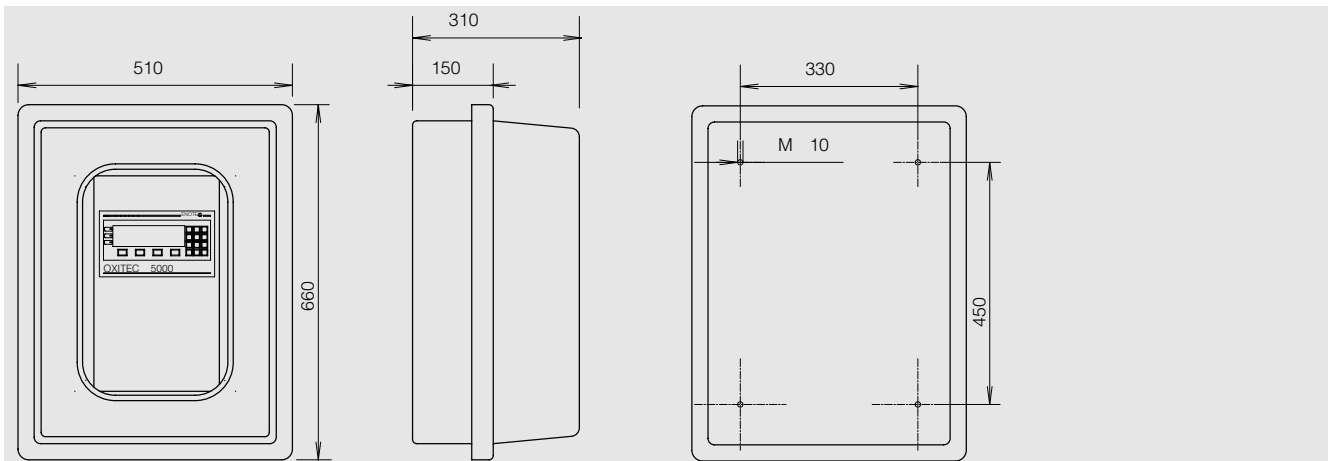


Fig. 5/17 Evaluation unit, housing made of glass-fiber-reinforced plastic

Ordering data	Order No.	Ordering data	Order No.
<p>ZrO₂ oxygen probe for medium-size and large furnaces; flue gas temperature max. 600 °C</p> <p>Model with 8-hole flange ASA 4 inch, 150 lbs*, complete, material 1.4571</p> <p>* Other models on request</p>	7MB1 943- 6 B	<p>ZrO₂ oxygen probe as explosion-proof model for medium-size and large furnaces; flue gas temperature max. 500 °C</p> <p>Model with flame arrester filter head with sintered metal filter; protective tube with 8-hole flange ASA 4 inch, 150 lbs*, complete, ATEX II 2G EEx d II C T3 for Zone 1 applications</p> <p>* Other models on request</p>	7MB1 943- 6 C 1
<p>Immersion length</p> <ul style="list-style-type: none"> • 520 mm • 950 mm • 1865 mm <p>Other lengths on request</p>	A B C	<p>Immersion length</p> <ul style="list-style-type: none"> • 464 mm • 924 mm • 1865 mm • 500 mm (1400 °C) • 1000 mm (1400 °C) 	B C D F G
<p>Filter</p> <ul style="list-style-type: none"> • With ceramics filter (standard model) • With sintered metal filter (for extreme applications) • With flame arrester and sintered metal filter (for extreme applications) 	0 1 2	<p>Calibration gas connection</p> <ul style="list-style-type: none"> • With manual shut-off valve • With shut-off solenoid valve for 115 V AC (standard) <p>Other models on request</p>	0 2
<p>ZrO₂ oxygen probe with high-temperature cooling/protective tube for flue gas temperatures from gas furnaces up to 1400 °C; dust concentration < 100 mg/m³, e.g. gas turbines, thermal exhaust combustion, industrial and refinery furnaces</p> <p>Model with 8-hole flange ASA 4 inch, 150 lbs*, complete, material 1.4571</p> <p>* Other models on request</p>	7MB1 943- 6 C A	<p>Accessories</p> <p><i>For all oxygen analyzers with ZrO₂ probe</i></p> <p>Counterflange matching the protective tube flange ASA 4 inch, 150 lbs*, with stud bolts, gasket and accessories * Others on request</p> <p>Probe pneumatic line with 2 HDPE pipes 4/6 mm for reference air and calibration gas, Max. ambient temperature 90 °C; delivery unit 1 m, max. length 150 m</p> <p>Special probe cable 2 x 0.75 mm² for thermocouple 2 x 0.75 mm² for cell signal 3 x 1.50 mm² for heater Max. ambient temperature 90 °C; delivery unit 1 m, max. length 150 m</p>	7MB1 943-6DA06 7MB1 943-6DA07 7MB1 943-6DA08
<p>Immersion length</p> <ul style="list-style-type: none"> • 500 mm • 1000 mm 	0 1		
<p>Calibration gas connection</p> <ul style="list-style-type: none"> • With manual shut-off valve • With shut-off solenoid valve for 115 V AC (standard) <p>Other models on request</p>	0 2		

Measuring equipment

In situ Oxygen analyzer

Oxygen analyzer with ZrO₂ probe

Ordering data	Order No.
Evaluation unit for ZrO₂ oxygen probes	7MB1 943- 6 D A 0 ■ - ■ ■ ■ ■ ■
Housing	0 1 2
<ul style="list-style-type: none"> Sheet-steel field housing with door with window, dimensions (HxWxD) in mm: 400x300x240, enclosure protection IP66 19-inch plug-in, 4 standard units high, 360 mm deep, enclosure protection IP20 Protective case made of glass-fiber-reinforced plastic, dimensions (HxWxD) in mm: 660x510x310, enclosure protection IP66 	
Electronics	0 1
<ul style="list-style-type: none"> 1 measuring range freely-programmable from 0...2% to 0...25%, O₂ limit module with 2 adjustable O₂ limits, programmable as min. or max. contact, system fault and maintenance contact, contact rating 230 V AC, max. 1 A Additional options: Second measuring range freely-programmable from 0...2% to 0...25%, local/remote range selection, fully-automatic calibration with air and using internal clock (solenoid valve required on probe), selectable measured value memory 	
Pneumatic unit	A C B D
<ul style="list-style-type: none"> For connection to instrument air provided by the customer (1.5...10 bar, dry and oil-free), monitoring of flows, suitable for semi-automatic and fully-automatic calibration (permanent connection of calibration gas cylinder necessary) With 2 built-in pumps for reference air and calibration gas, monitoring of flows, suitable for semi-automatic and fully-automatic calibration (permanent connection of calibration gas cylinder necessary) 	
Power supply	0 1
<ul style="list-style-type: none"> 230 V AC, 50/60 Hz 120 V AC, 50/60 Hz 	

Ordering data	Order No.
Explosion-proof evaluation unit (EEx d II C T6) for ZrO₂ oxygen probes	7MB1 943- 6 D A 1 ■ - ■ ■ ■ ■ ■
Housing	0
<ul style="list-style-type: none"> Certified field housing, dimensions (HxWxD) in mm: 346x300x240, ATEX II 2 GD EEx d II C T6, enclosure protection IP66, with window, for Zone 1 applications 	
Electronics	0 1
<ul style="list-style-type: none"> 1 measuring range freely-programmable from 0...2% to 0...25%, O₂ limit module with 2 adjustable O₂ limits, programmable as min. or max. contact, system fault and maintenance contact, contact rating 230 V AC, max. 1 A Additional options: Second measuring range freely-programmable from 0...2% to 0...25%, local/remote range selection, fully-automatic calibration with air and using internal clock (solenoid valve required on probe), selectable measured value memory 	
Pneumatic unit	A A A C
<ul style="list-style-type: none"> In separate field housing, dimensions (HxWxD) in mm: 400x300x210, enclosure protection IP65, for connection to instrument air provided by the customer (1.5...10 bar, dry and oil-free), suitable for semi-automatic calibration with ambient air and calibration gas Suitable for fully-automatic calibration with ambient air and calibration gas 	
Power supply	0 1
<ul style="list-style-type: none"> 230 V AC, 50/60 Hz 120 V AC, 50/60 Hz 	

Measuring equipment

Dust concentration measuring equipment

D-R 290 dust concentration measuring device

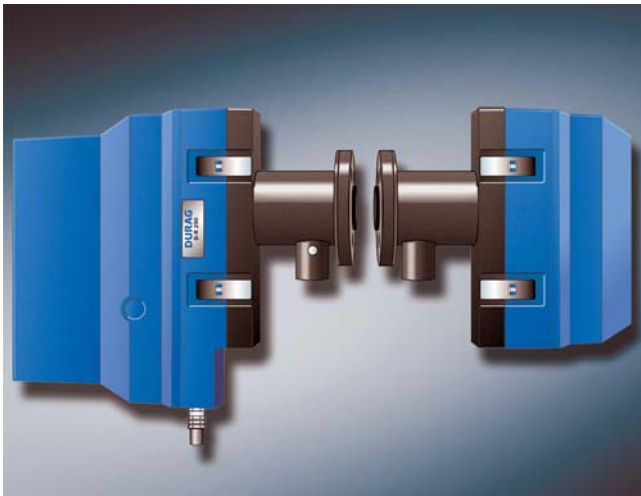


Fig. 5/18 D-R 290 dust concentration measuring device

Application

The D-R 290 dust concentration measuring device is used to continuously measure the emission of dust in flue gas ducts, dust extraction lines etc.

In addition to monitoring the efficiency of filtering plants by measuring the quantity of residual dust, it is also possible to signal impermissibly high dust or flue gas emissions without delay. In this manner it is frequently possible to intervene directly in the monitored process and to thus guarantee reliable adherence of the stipulated limits.

Without the use of dust concentration measuring devices, the operation of large boiler plants in a manner which is economical and in compliance with the regulations in power plants, district heating plants or industrial operations is just as unthinkable as the monitoring of process operations in the chemical industry or in cement factories where dust emission is an essential criterion for optimum functioning of the plant.

In refineries and other plants of the petrochemical industry, in the iron and steel industry, in waste and refuse incineration plants, in soot-emitting factories and anywhere where impermissible dust emissions could lead to environmental pollution, dust concentration measuring equipment has already been successfully used for years to monitor the sound functioning of these plants in a manner which is incorruptible, exactly reproducible, independent of the time of day or weather conditions, and is automatic without manual operations.

Approvals

- Type-tested in accordance with the directives of the German Federal Minister for the Environment, Nature Conservation and Reactor Safety specific to verifying the suitability of measuring equipment for continuous emission measurements
- Test report No. 936/801017/A of the TÜV (German Technical Inspectorate) Rhineland, Berlin-Brandenburg

Functions

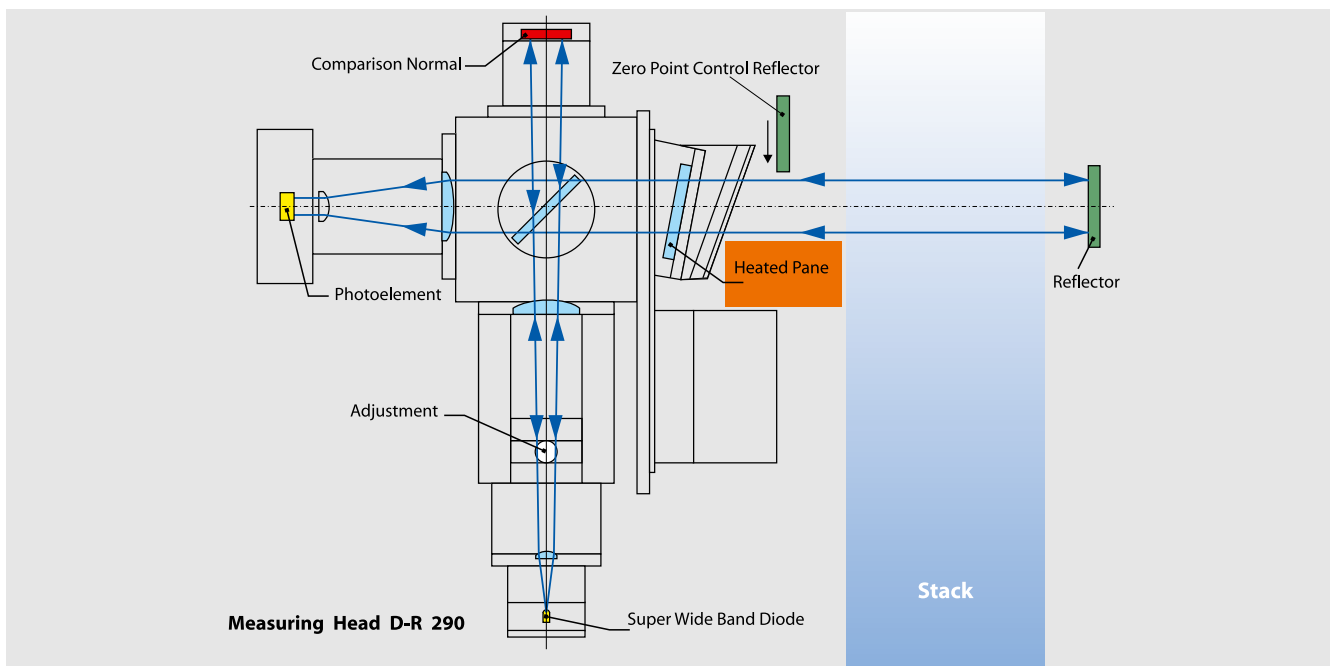


Fig. 5/19 Measuring principle

Measuring equipment

Dust concentration measuring equipment

D-R 290 dust concentration measuring device

The D-R 290 dust concentration measuring device operates in accordance with the transmission principle. The measuring head and the reflector are installed opposite one another. Use of the autocollimator principle means that the light traverses the measurement path twice. This doubles the sensitivity of the measurement. The modulated light is transmitted from the measuring head to the reflector.

It is then reflected and thus traverses the measurement path for the second time. The attenuation of the beam due to the dust particles is proportional to their density.

The homogeneous light spot imaged on the reflector side has a considerably greater diameter than the area of the reflector. This greatly facilitates adjustment, and prevents errors in measurement which would result in the case of thermal distortion of the installation areas of the measuring head and reflector.

The unavoidable intensity drifts of the optical receiver and the semiconductor light source - caused by aging and temperature factors - are automatically compensated by the device. For this purpose, the light from the source (modulated at 2 kHz) is split into a measurement beam and a reference beam. An optical receiver alternately receives the measurement and reference beams. The alternation between the two beams is carried out using a stepping motor.

Design

Evaluation unit (1)

The electrical connection as well as operation of the D-R 290 measuring device are made on the evaluation unit. This is connected to the measuring head by a cable approx. 2 m long with a special connector.

Measuring head (2)

The transmitter and receiver optics together with the electronics are integrated as a compact structural unit in a stable and rugged aluminium housing. The measuring head is mounted on the welding-type flange (4).

Reflector (3)

The reflector is integrated in a stable and rugged aluminium housing. The reflector is mounted on the welding-type flange (4) directly opposite the measuring head.

Purging air unit (5)

The measuring head and reflector are connected to the purging air unit via a hose connection. The filtered air keeps the optical border areas of the measuring head and reflector clean.

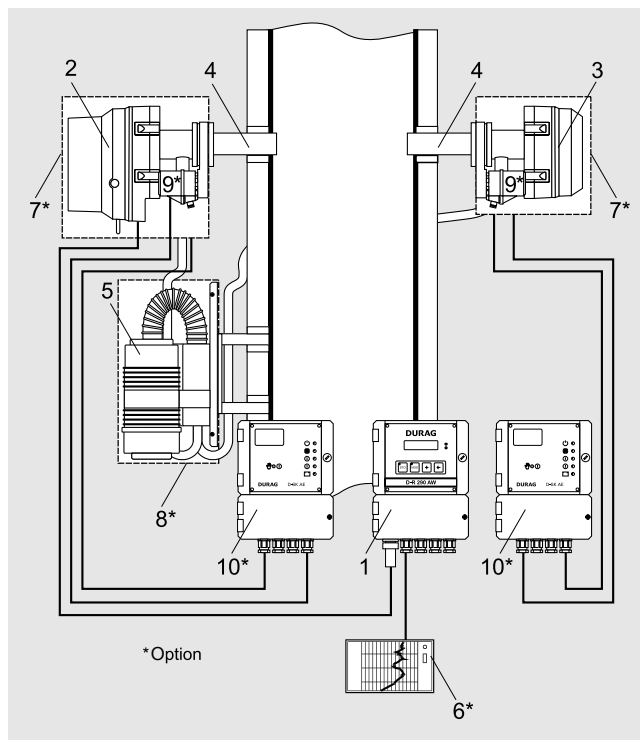


Fig. 5/20 System components of the D-R 290

Options:

Fail-safe shutters (9)

The fail-safe shutters must be mounted on the measuring head and reflector sides between the welding-type flanges (4) and the connected devices (measuring head, reflector). In the event of a malfunction (failure of power supply or purging air), they automatically shut off the path between the exhaust gas duct and the measuring equipment.

Electronics for fail-safe shutter (10)

Each fail-safe shutter requires a terminal box which controls its function.

Recording of measurements (6)

In the simplest case, a chart recorder is used to record the measured values and control values. The measured values and status signals which are output can also be fed to an emission computer system for further processing.

A recorder can be used for the measured values and control values if these values are not saved in an external PC system.

Weather protection covers (7, 8)

If the measuring equipment is installed outdoors, weather protection covers are available to protect the measuring head (2), the reflector (3), the purging air pump (5) and the junction boxes (1, 10).

Measuring equipment

Dust concentration measuring equipment

D-R 290 dust concentration measuring device

Technical data

D-R 290 measuring device

Measuring range referred to 1 m measurement path	0...200 mg/m ³ to 0...4000 mg/m ³ Calibration in accordance with VDI 2066
Light source	Super-wide band diode SWBD
Measuring range	Extinction: 0.1-1.6 ext. Opacity: 20...100% Range switchover
Length of measurement path	1...12 m
Output signal	2 x 0...20 mA, zero point 4 mA
Maximum load	500 Ω
Relay outputs	6 x status, floating (limit, fault, control cycle etc.)
Max. switching power	250 V, 100 VA
Inputs	6 x status, floating (inlet unrestricted, failure of purging air, 2 x range switchover, control cycle)
Integration time of output signal	8...1800 s, each output separately adjustable in steps of 1 s
Permissible ambient temperature	253...323 K (-20 ... +50 °C)
Exhaust gas temperature	Above dew point

Electrical data

Power supply	90...264 V, 48...62 Hz
Power consumption	Approx. 30 W

Mechanical data

Enclosure protection	IP65
Weight	
• Measuring head	Approx. 10 kg
• Reflector	Approx. 7 kg

Technical data

Purging air unit

Power supply	115/230 V, 50 Hz, 0.37 KW / 115/230 V, 60 Hz, 0.43 KW
Pump delivery rate	Approx. 80 / 90 m ³ /h
Dimensions (H x W x D) in mm	350 x 550 x 500
Weight	Approx. 12 kg The purging air unit includes a 10-m hose

Automatic fail-safe shutter

Power supply	115/230 V ±10%, 48/62 Hz
Power consumption	Approx. 10 VA
Motor drive	24 V DC
Output contacts	Floating, max. switching power 250 V/100 VA resistive load Adjustable switching hysteresis and sensitivity
Shut-off flap	Stainless steel 1.4571

Measuring equipment

Dust concentration measuring equipment

D-R 290 dust concentration measuring device

Ordering data	Order No.	Ordering data	Order No.
D-R 290 dust concentration measuring device Measuring equipment for measurement paths up to 2.25 m comprising: • 1 D-R 290 measuring head with 2-m cable • 1 reflector • 2 welding-type pipes with adjustment flange, material St37 • 1 operating unit in wall housing, 90...264 V, 48...62 Hz • 1 fan, single-phase 115/230 V 50/60 Hz, hose length 10 m	7MB1 943-7AA01	Miscellaneous D-R 290-70 adjustment unit as aid when mounting the welding-type tubes D-R 290-80 control unit for checking the linearity Welding-type tubes, stainless steel Welding-type tubes of specific length up to 500 mm Welding-type tubes of specific length up to 500 mm, stainless steel LineMaster 100 servo line recorder, recording width 100 mm, error limit $\pm 0.5\%$, chart drive 20-60-120 mm, front frame 144x144 mm, three-channel unit 3 test filters for checking the linearity in accordance with the EPA regulations	7MB1 943-7AA40 7MB1 943-7AA41 7MB1 943-7AA45 7MB1 943-7AA46 7MB1 943-7AA47 7ND3 121-1CA11-1NA1
Measuring equipment for measurement paths up to 12 m comprising: • 1 D-R 290 measuring head with 2-m cable • 1 reflector • 2 welding-type pipes with adjustment flange, material St37 • 1 operating unit in wall housing, 90...264 V, 48...62 Hz • 1 fan, single-phase 115/230 V 50/60 Hz, hose length 10 m	7MB1 943-7AA02	Consumables Filter cartridge P77-5631	7MB1 943-7AA52
Accessories/options Fail-safe shutters D-SK 290 as protective equipment with mechanics and electronics (115/230 V, 50/60 Hz)	7MB1 943-7AA10	Spare parts Fan unit, single-phase 115/230 V 50/60 Hz, hose length 10 m Purging air hose 1 m Super-wide band diode	7MB1 943-7AA55 7MB1 943-7AA60 7MB1 943-7AA61 7MB1 943-7AA62
Weather protection covers • For measuring head, horizontal or 45-degree light beam • For reflector, horizontal or 45-degree light beam • For fan unit • For operating unit • For D-SK 290 fail-safe shutter	7MB1 943-7AA14 7MB1 943-7AA15 7MB1 943-7AA16 7MB1 943-7AA17 7MB1 943-7AA18	Instruction Manual The German Instruction Manual is supplied with each measuring equipment. • D-R 290 in English • D-R 290 in German	7MB1 943-7AA70 7MB1 943-7AA71
Cable between measuring head and evaluation unit • 5 m extension • 10 m extension • Junction box for longer extensions	7MB1 943-7AA25 7MB1 943-7AA26 7MB1 943-7AA27		
Dust-free measurement path Complete dust-free measurement path • Up to 2 m • Up to 3 m • Up to 4.5 m	7MB1 943-7AA30 7MB1 943-7AA31 7MB1 943-7AA32		

Measuring equipment

Dust concentration measuring equipment

D-R 300/-40 dust concentration and soot coefficient measuring device

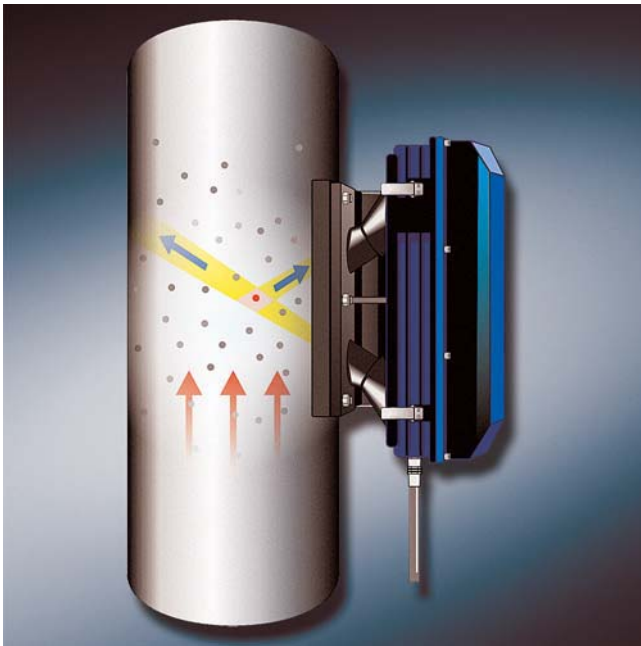


Fig. 5/21 D-R 300/-40 dust concentration and soot coefficient measuring device

The measuring device is flanged directly to the exhaust gas duct, and continuously monitors the turbidity of the flue gas. Not only the measured values are recorded, the violation of flue gas turbidity limits are also signaled without delay. In this manner it is frequently possible to intervene directly in the control of the firing system in order to optimize the combustion and to thus guarantee reliable adherence of the stipulated limits.

D-R 300-40 dust concentration measuring device

The D-R 300-40 dust concentration measuring device can be used to continuously measure dust concentrations in dust extraction lines, flue gas ducts of power plants and in the cement industry, and also in incineration plants for refuse and similar combustible materials in accordance with 17. BImSchV (German Federal Emission Directive for Waste Incinerators).

In addition to monitoring the efficiency of the filtering plant by measuring the quantity of residual dust, it is also possible to signal impermissibly high dust or flue gas emissions without delay. In this manner it is frequently possible to intervene directly in the monitored process and to thus guarantee reliable adherence of the stipulated limits.

Approvals

Type-tested in accordance with the directives of the German Federal Minister for the Environment, Nature Conservation and Reactor Safety specific to verifying the suitability of measuring equipment for continuous emission measurements

D-R 300 soot coefficient measuring device

Test report No. 936 800002 of the TÜV Rheinland, Cologne

Included in the list of suitable measuring devices for continuous recording of emissions GMBL No. 37 from 1991

D-R 300-40 dust concentration measuring device

Test report No. 936 801004, No. 936/803011 and No. 936/804020 of the TÜV Rheinland, Cologne

Included in the list of suitable measuring devices for continuous recording of emissions GMBL No. 45 from 1992 and GMBL No. 33 from 1995

Application

D-R 300 soot coefficient measuring device

According to TA-Luft (technical instructions for the maintenance of air purity), light oil firing systems having a heat output of 5 MW to 25 MW must be provided with measuring equipment which continuously determines the turbidity of the flue gas. The measuring equipment should be able to determine observation of the blackening density of soot coefficient 1 with adequate reliability.

Functions

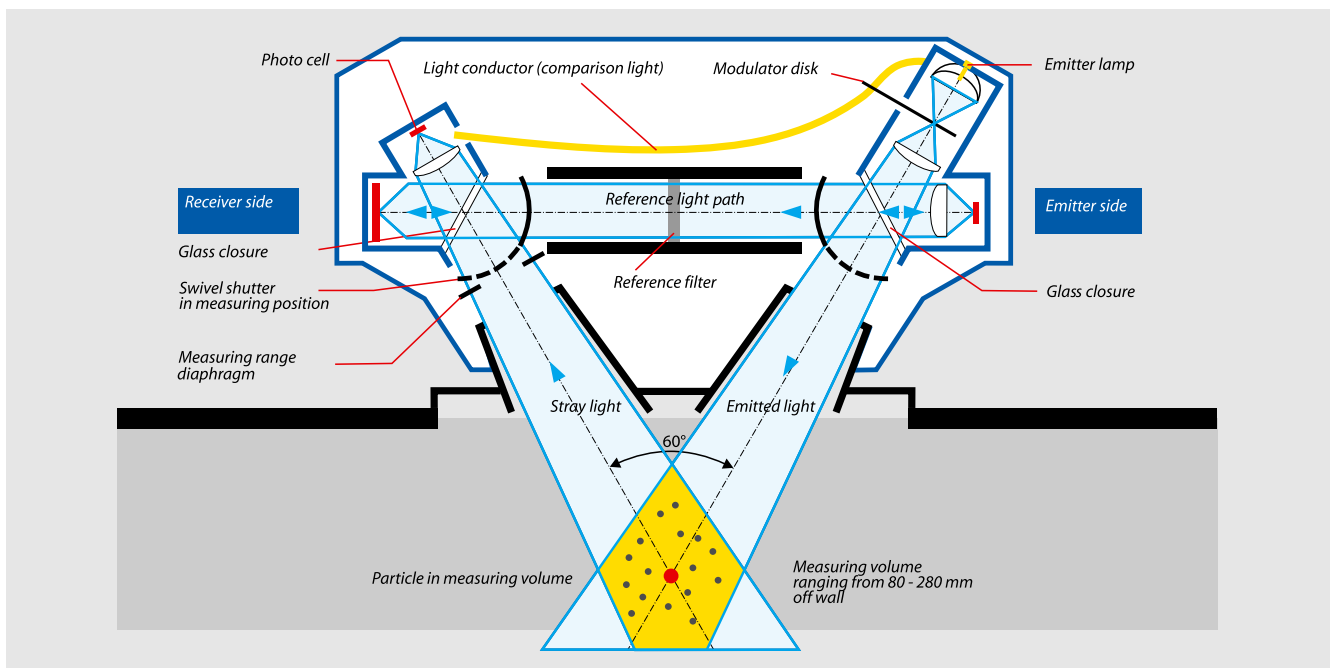


Fig. 5/22 Measuring principle

Measuring equipment

Dust concentration measuring equipment

D-R 300/40 dust concentration and soot coefficient measuring device

The D-R 300 measuring device operates according to the in-situ scattered light principle. The non-contact measurement is carried out directly and continuously in the flow of flue gas without having to remove samples. The modulated light of a halogen lamp is sent into the measuring duct at an angle of 30° and illuminates the dust particles in the measured volume. This light is reflected (scattered) by the particles present in the measured volume. The returned scattered light is received by the receiver optics at an angle of 30° and passed on to an optical sensor.

The signal current generated by the receiver is proportional to the received intensity of the scattered light. The ratio between the measured intensity of the scattered light and the emitted light intensity corresponds to the density of particles in the measured volume. The measured volume utilized for the measurement is in the region 80...280 mm from the duct wall and is at a maximum at a distance of 150 mm.

The unavoidable intensity drifts of the optical receiver and the halogen lamp - caused by aging and temperature factors - are automatically compensated by the device. For this purpose, the modulator disk is shaped such that scattered light from the measured volume reaches the optical receiver during the "Measure" phase via the receiver optics. During the "Reference" phase, the optical receiver is illuminated directly by reference light via an optical fiber.

In order to verify that the D-R 300 is functioning correctly, a control cycle is performed at intervals of 4 hours. During this control cycle, the zero point, the contamination of the optical border areas and a reference value are measured automatically and displayed. During this check, swivel covers close the light emission and reception openings on the device. At the same time, the previously closed reference beam path with the reference filter is released by the swivel covers for the control measurement.

The results of the subsequent measurements are corrected by the magnitude of the measured contamination. An error message is output in addition if a defined degree of contamination is exceeded.

The digital evaluation electronics calculates the dust concentrations or the soot coefficient in the measured volume from the received scattered light and the intensity (reference light) of the transmission lamp. The calculated value is output on the 4-digit display and also as an analog current signal. The result is capable of calibration, and can be specified as the soot coefficient (0...10) or the dust concentration (mg/m³).

Design

D-R 300-40/D-R 300 measuring devices (1)

The transmitter and receiver optics together with the electronics are integrated as a compact structural unit in a stable and rugged aluminium housing. This unit is mounted directly on the flange opening of the exhaust gas duct.

Light trap (2)

A light trap is mounted opposite the measuring unit in order to suppress undesirable reflections on the inside walls of ducts with a small diameter which could falsify the results. Particularly in the case of outdoor units, the light trap must be insulated such that the dew point cannot be fallen below within the trap. A second light trap is required for soot coefficient measurements.

Purging air unit (3)

At the point of measurement, the measuring device is purged by filtered air from the purging air unit via a hose. This air cleans the optical border areas of the transmitter and receiver optics of the D-R 300-40/D-R 300.

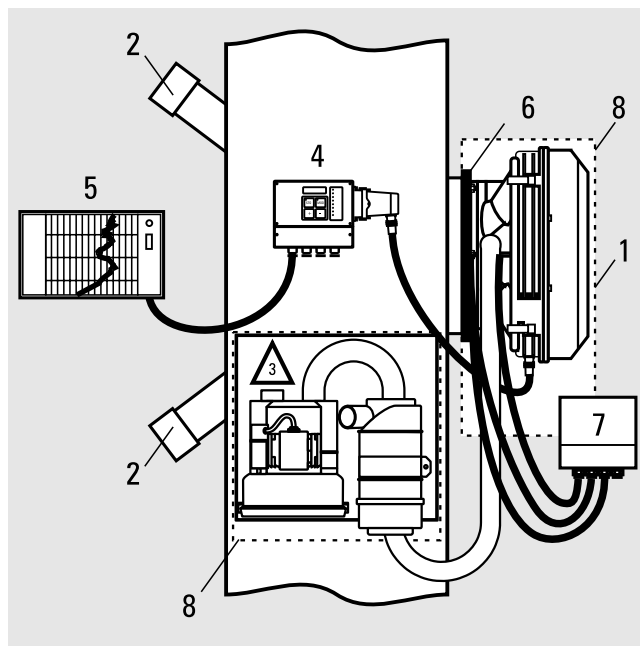


Fig. 5/23 System components

Terminal box (4)

The D-R 300-40/D-R 300 measuring equipment is connected electrically on the terminal box which is fitted with a display and with keys for operation.

Options:

Recording of measurements (5)

In the simplest case, a chart recorder is used to record the measured values and control values. The measured values and status signals which are output can also be fed to an emission computer system for further processing.

D-SK 310 fail-safe shutter (6)

The D-SK 310 fail-safe shutter can be optionally fitted between the mounting flange and the D-R 300-40/D-R 300. In the event of a malfunction (failure of purging air), it is then possible to mechanically close the path between the measuring device and the exhaust gas using the fail-safe shutter, thus protecting the measuring equipment.

D-SK AE control electronics (7)

The DSK AE control electronics is required for the fail-safe shutter. It contains the electrical connection and the power supply for the fail-safe shutter.

Weather protection covers (8)

If installed outdoors, weather protection covers are available to protect the measuring system and the purging air unit.

Measuring equipment

Dust concentration measuring equipment

D-R 300/-40 dust concentration and soot coefficient measuring device

Technical data		Technical data	
Function	Continuous in-situ scattered light measurement without sampling	Purging air unit	
Measuring range		Power supply	115/230 V, 50 Hz, 0.37 KW / 115/230 V, 60 Hz, 0.43 KW
• D-R 300	Soot coefficient 0-3, other ranges can be set by changing the measuring range diaphragm	Pump delivery rate	Approx. 80 / 90 m ³ /h
• D-R 300-40	Dust concentration measurement Measuring range dependent on medium 0...2 mg/m ³ , other ranges can be set by changing the mea- suring range diaphragm at approx. 150 mg/m ³ . 3 electronically selectable ranges (1:3:9) are available as an option.	Dimensions (H x W x D) in mm	350 x 550 x 500
Transmitter/receiver unit		Weight	Approx. 12 kg
Output signal	2 current outputs 0...20 mA, live zero 4 mA, max. load 500 Ω	Light trap	
Relay contacts	2 limit contacts and 1 status con- tact "Measurement ON/OFF". In autoranging mode, the limit contacts are used to output status signals for the range switchover. All contacts as floating changeover contacts, max. rat- ing 250 V AC, 100 VA with resis- tive load.	Diameter	Max. 195 mm
Integration time	The integration time of the mea- surement can be set from 10...900 s in steps of 10 s.	Length	360 ... 660 mm
Light source	Maintenance-free special halo- gen incandescent lamp, service life in the measuring device approx. 10,000 operating hours	Dimensions in mm	350 x 530 x 470
Design	The transmitter and receiver optics together with the elec- tronics are integrated as a rugged structural unit in a compact and stable aluminium housing with degree of protection IP65 to DIN 40050 Weight approx. 18 kg	Weight	Approx. 20 kg
Temperature ranges	Permissible ambient temperature 253...323 K (-20 ... +50 °C) Exhaust gas temperature above the dew point up to 593 K (+320 °C) Permissible pressure above atmospheric in the duct +200 mm water gauge when using the stan- dard purging air unit Additional modules are available for exhaust gas temperatures up to 600 °C	D-SK 310 automatic fail-safe shutter	
Power supply	115/230 V AC ± 10%; 60/50 Hz	Power supply	115/230 V AC ± 10%; 50/60 Hz
Fuse	2 A / 1 A, slow-blow	Fuse	0.1 A, slow-blow
Power consumption	Approx. 70 VA	Power consumption	Approx. 10 VA
Dimensions (W x H x D) in mm	565 x 310 x 200 (410)	Degree of protection	IP65 DIN 40050
		Shut-off flap	Stainless steel 1.4571 with PTFE coating (Teflon)
		Weight	11 kg

Measuring equipment

Dust concentration measuring equipment

D-R 300/-40 dust concentration and soot coefficient measuring device

Ordering data	Order No.	Ordering data	Order No.
D-R 300 soot coefficient measuring device comprising: • 1 transmitter and receiver unit, 230 V/50 Hz • 1 display/junction box • 1 mounting flange, St37 • 2 light traps, St37 • 1 fan unit, single-phase, 115/230 V/50 Hz, with 3 m hose	7MB1 943-7AB01	Miscellaneous D-R 300-70 adjustment unit as aid when mounting the welding-type tubes	7MB1 943-7AB30
D-R 300-40 dust concentration measuring device comprising: • 1 transmitter and receiver unit, 230 V/50 Hz • 1 display/junction box • 1 mounting flange, St37 • 2 light traps, St37 • 1 fan unit, single-phase, 115/230 V/50 Hz, with 3 m hose	7MB1 943-7AB04	D-R 300-80 control unit for checking the linearity	7MB1 943-7AB31
Accessories/options Fail-safe shutters D-SK 310 as protective equipment with mechanics and electronics (115/230 V, 50/60 Hz)	7MB1 943-7AB11	Flange and light traps made of stainless steel (D-R 300-40)	7MB1 943-7AB35
Weather protection covers • For vertical transmitter and receiver units	7MB1 943-7AB15	Flange and light trap made of stainless steel (D-R 300)	7MB1 943-7AB36
• For horizontal transmitter and receiver units	7MB1 943-7AB16	Autoranging and second measured-value output for 17. BlmSchV	7MB1 943-7AB40
• For fan unit	7MB1 943-7AB17	Additional Halar coating of device base	7MB1 943-7AB41
• For control unit/junction box	7MB1 943-7AB18	Self-regulating heating of device base, 230 V/50 Hz	7MB1 943-7AB42
		1.5 m heated purging hose, 230 V/50 Hz, incl. control unit, max. 60 °C	7MB1 943-7AB43
		LineMaster 100 servo line recorder, recording width 100 mm, error limit $\pm 0.5\%$, chart drive 20-60-120 mm, front frame 144x144 mm, three-channel unit	7ND3 121-1CA11-1NA1
		High-temperature version, up to 600 °C Measuring head cooling, comprising fan unit, 115/230 V AC, 50/60 Hz and cooling cover	7MB1 943-7AB05
		Additional fan unit, 115/230 V AC 50/60 Hz, for the redundant design of the purging air or cooling air fan, with electronics for switching over	7MB1 943-7AB06
		Consumables Transmission lamp in installation base	7MB1 943-7AB55
		Replacement filter cartridge for Cyclopak filter SMP-1050	7MB1 943-7AB57
		Spare parts Fan unit, single-phase 115/230 V 50/60 Hz, hose length 10 m	7MB1 943-7AB60
		Purging air hose per m (specify length in m)	7MB1 943-7AB61
		Instruction Manual The German Instruction Manual is supplied with each measuring equipment.	
		• D-R 300 in English	7MB1 943-7AB70
		• D-R 300 in German	7MB1 943-7AB71
		• D-R 300-40 in English	7MB1 943-7AB75
		• D-R 300-40 in German	7MB1 943-7AB76
		Other languages on request	

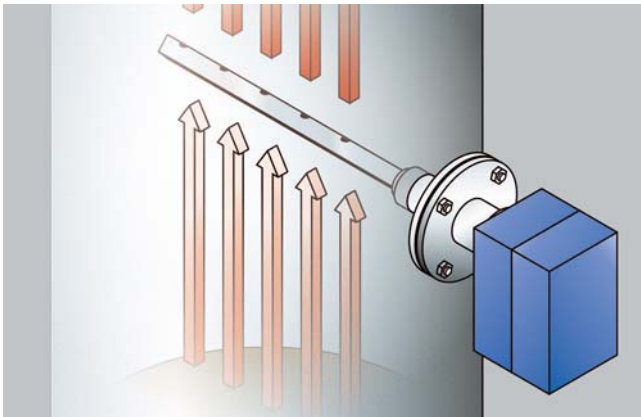


Fig. 5/24 D-RX 250 combined sensor probe

Application

The D-RX 250 combined sensor probe can be used downstream of filtering separators (not electrostatic filters) to continuously monitor dust concentration, volume flow, pressure and temperature in dust extraction lines and flue gas ducts of power plants and in the cement industry, and also in incineration plants for refuse and similar combustible materials in accordance with 17. BImSchV (German Federal Emission Directive for Waste Incinerators).

The combination of four selected measuring functions in just one device, in addition to monitoring of the polluting dust, means that it is possible to automate calculation of the pollutant mass flow for drawing up of the emission declaration.

Approvals

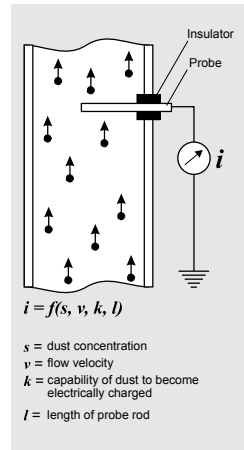
- For measurements in accordance with TA-Luft (technical instructions for the maintenance of air purity), 13., 17. and 27. BImSchV (German Federal Emission Directive for Waste Incinerators).
Type-tested in accordance with the directives of the German Federal Minister for the Environment, Nature Conservation and Reactor Safety specific to verifying the suitability of measuring equipment for continuous emission measurements
- Test report No. 936/800006/A of the TÜV (German Technical Inspectorate) Rhineland, Berlin-Brandenburg of 25.01.2001

Functions

Dust concentration

The measuring system determines the dust load by means of the tribo-electrical principle. The feature is utilized that dusts in flowing gases carry an electrical charge which is transferred at the time of collision with a probe. The insulated probe is charged in the process, and passes its charge current on to the electronics. With this measuring principle, the charge current is dependent on the flow velocity and the concentration of dust in the gas.

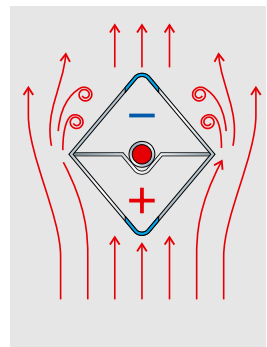
The dust concentration is calculated from the tribo-electrical signal and the flow velocity. The parameters required for this purpose are obtained during a calibration in the typical operating velocity ranges, and then constitute the basis for calculation of the concentration. The measured temperature and pressure are required to calculate the concentration in the normalized state, and are also made available by the D-RX 250.



Flow velocity

The system for recording the velocity operates according to the differential pressure principle. The probe has two separate chambers, and a differential pressure is built up between these depending on the flow dynamics.

The resulting pressure, which is prognostic to the square of the gas velocity, is recorded by a differential pressure transducer, and the corresponding signal used to correct the tribo-electrical value.



Absolute pressure

The absolute pressure of the sample gas is registered on a tube of the differential pressure transducer, and evaluated by a piezo-resistive pressure sensor in the transmitter.

Temperature

The temperature is measured in a separate chamber in the probe using a Pt 100 according to DIN 42760.

Measuring equipment

Dust concentration measuring equipment

D-RX 250 combined sensor probe

Design

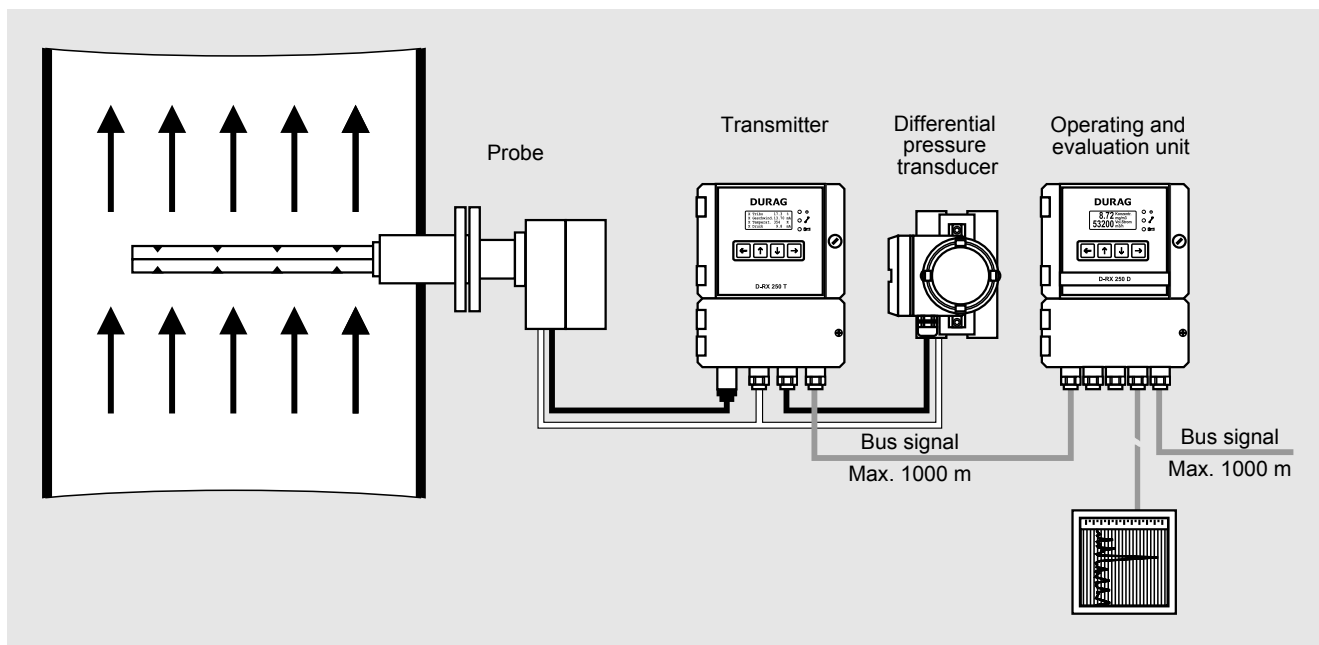


Fig. 5/25 System components

Probe

The probe consists of the measuring rod and the electronics in the head for processing the measured value. The measuring rod is a profile which protrudes into the dust duct and is flange-mounted onto it. The rod is insulated because of the tribo-electrical measurement, and contains two chambers for measuring the differential pressure.

The two chambers for measuring the pressure are connected to a differential pressure transducer. One of them is additionally connected to the absolute pressure transducer. The gas temperature is measured in a third chamber in the center of the profile using a resistor. Electronic processing of the measured value is carried out in the probe housing. The temperature of the measuring resistor and the tribo-electrical raw value are determined here. The two raw values of the temperature and tribo-electrical signal are transferred digitally to the transmitter.

Differential pressure transducer

The differential pressure transducer converts the differential pressure produced in the measuring rod by the flowing gas into a gas velocity variable.

Transmitter

The transmitter provides the supply voltages for the probe and for the transducers for absolute and differential pressure, reads in the raw measurements of these units, and transfers the measurements to the evaluation unit via the RS485 interface. The transmitter reads the probe values of the tribo-electrical signal and the temperature via the RS485 interface.

The differential pressure transducer is connected to the transmitter by a two-wire cable. The absolute pressure transducer is situated inside the transmitter housing. It receives the pressure from a chamber of the probe rod via a tube.

Operating and evaluation unit

The operating and evaluation unit reads out the raw measurements from the transmitter. It converts the measurements into normalized dust concentrations and normalized volume flows.

All analog values can be output via Modbus or 4/20 mA signals, and all status signals via floating contacts.

Recording of measurements

In the simplest case, a chart recorder is used to record the measured values and control values. The measured values and status signals which are output can also be fed to an emission computer system for further processing.

Measuring equipment

Dust concentration measuring equipment

D-RX 250 combined sensor probe

Technical data		Ordering data	Order No.
Measuring ranges		D-RX 250 combined sensor probe comprising: • 1 two-chamber flow probe (up to 200 °C) with temperature sensor, up to 1 m long • 1 mounting flange • 1 differential pressure transducer • 2 m cable • 1 transmitter with absolute pressure sensor • 1 operating and evaluation unit incl. mounting plate	7MB1 943-7AC01
Dust concentration	0 ... 10 to 0 ... 500 mg/Nm ³		
Volume flow that can be displayed	0 ... 999.999 Nm ³ /h		
Temperature that can be displayed	0 ... 300 °C		
Pressure	900 ... 1300 hPa		
Operating conditions		Accessories/options	
Sample gas temperature	0 ... 200 °C	Ceramic mount for probe (1.4571), for gas temperatures up to 350 °C	7MB1 943-7AC11
Sample gas velocity	0 ... 30 m/s	Automatic back purging unit, 230 V/50 Hz or 115 V/60 Hz, FL100UH changeover cock required	7MB1 943-7AC12
Duct diameter	0.3 ... 5 m	PN 100 changeover cock (FL100UH)	7MB1 943-7AC13
Relative humidity of sample gas	Non-condensing, recommended <80%	Common weatherproof cover for D-RX 250 T and D, material V2A	7MB1 943-7AC15
D-RX 250 S probe		Weatherproof cover for the probe, material V2A	7MB1 943-7AC16
Gas temperature, min.	0 °C	10 m hose, 15 x 3 mm	7MB1 943-7AC18
Max. sample gas temperature	200 °C	Instruction Manual The German Instruction Manual is supplied with each measuring equipment.	
Length of probe profile	250, 400, 700 and 1000 mm	• D-RX 250 in English	7MB1 943-7AC70
Ambient temperature	-20 ... +50 °C	• D-RX 250 in German	7MB1 943-7AC71
Material of probe profile	1.4571		
Material of insulator	PTFE		
Assembly	Flange, DIN 2631 NW 65		
Enclosure protection	IP65		
Weight	8.5 ... 9.5 kg		
Differential pressure transducer (root extracted)			
Measuring range	0...3 hPa, adjustable 0...1 to 0...10 hPa		
Power supply	11.5...45 V DC		
Enclosure protection	IP65		
D-RX 250 T transmitter			
Ambient temperature	-20 ... +50 °C		
Measured-value output	RS485, Modbus		
Power supply	85...265 V, 47...63 Hz, 10 VA		
Enclosure protection	IP65		
Weight	4.5 kg		
Cable/hose length to probe	2 m		
D-RX 250 D operating and evaluation unit			
Ambient temperature	-20 ... +50 °C		
Integration time	10 s		
Measured-value signal	4 x 4...20 mA / 500 Ω per component RS485, Modbus		
Limit contact	2 programmable relay outputs / switching thresholds		
Status contacts	4 relay outputs, 250 V AC/ 100 VA with resistive load, floating		
Power supply	90...264 V, 47...63 Hz, 10 VA		
Enclosure protection	IP65		
Max. cable length to transmitter	1000 m		
Weight	5 kg		

Measuring equipment

Gas measuring and warning systems

Sensors for explosive gases and vapors



Fig. 5/26 ExDetector HC 100-M sensor and 8022 evaluation electronics

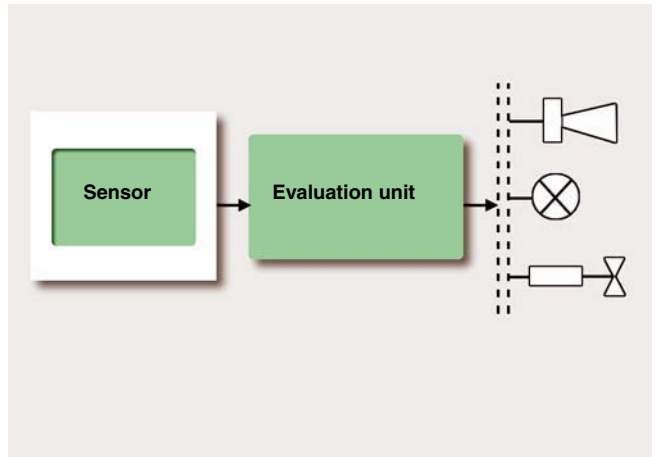


Fig. 5/27 Gas measuring and warning system, basic design

Application

Safety equipment and protective measures for dangerous gases and vapors are becoming increasingly important. Increasing awareness of this problem together with more exact research and knowledge of the dangers which may occur when using these materials are some of the reasons for this development. Two features are especially important for objective estimation of the danger:

- Flammability of the gas or vapor when mixed with air
- Danger to health (toxicity) of the gases and vapors.

Sensor for monitoring the "Lower explosive limit" (LEL)

Flammable gases and vapors are explosive when mixed with air within a specific concentration range. This range is different for each gas, and is defined by the characteristic values of the lower explosive limit (LEL) and the upper explosive limit (UEL). These values are specified in % v/v according to the percentage of the respective gas in the air.

There are two types of sensor for monitoring the lower explosive limit (LEL) for explosive gases and vapors, the HC 66 sensor and the ExDetector HC 100-M sensor. These have the following features:

HC 66 sensor

- Measurable gases: explosive gases and vapors
- Measuring range 0 to 100% LEL
- Measuring principle: catalytic combustion (heat of reaction)
- Output signal 4 to 20 mA
- One-man calibration
- 3-wire system

ExDetector HC 100-M sensor

- Technical data as for HC 66 sensor, but for use in Ex zones
- Explosion-proof EEx de IIC T6
- Simple calibration and operation using the Calibrationbox-i hand-held unit

Design

A gas warning system comprises:

- Sensor (gas monitor)
- Evaluation unit
- Corresponding peripheral equipment such as
 - valves,
 - fans and
 - warning lamps.

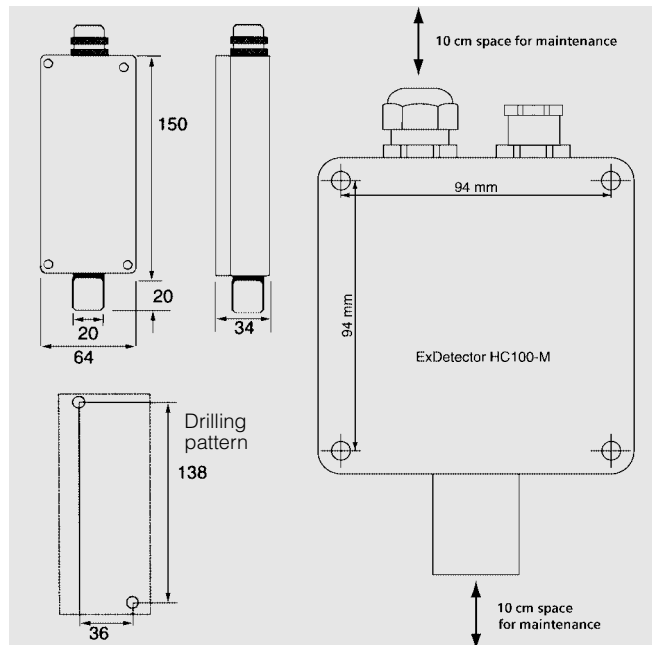


Fig. 5/28 Dimensions of HC 66 sensor (left) and ExDetector HC 100-M sensor (right)

5

Measuring equipment Gas measuring and warning systems

Sensors for explosive gases and vapors

Technical data

Sensor	HC 66 sensor (gas monitor)	ExDetector HC 100-M sensor
Field of application	Non-hazardous areas	Hazardous areas, Zones 1 and 2
Measurable gases	Flammable gases and vapors (natural gas, propane, hydrogen, acetone, toluene etc.)	
Measuring range	0 to 100% LEL	
Measuring principle	Catalytic combustion (heat of reaction)	
Output signal	4 ... 20 mA	
Response time (T90 time)	10 s (for methane)	
Max. distance from evaluation unit	1000 m	
Cable	3-core, shielded, e.g. J-Y (ST) Y 2 x 2 x 0.8 mm ² z	3 active cores, shielded, preferably H05VVC4V5-K
Permissible ambient temperature	-20 ... +60 °C	-20 ... +55 °C
Influence of temperature		
- On zero point	< 1% of signal in range -20 ... +60 °C	< 0.05% LEL/°C
- On sensitivity	< 10% of signal in range -20 ... +60 °C	< 0.0008% LEL/°C
Permissible atmospheric pressure	900 ... 1100 mbar	800 ... 1100 mbar
Permissible humidity	30 to 90% rel. humidity	20 to 90% rel. humidity
Materials	Plastic (protective cover) and aluminium (housing)	
Power supply	24 V DC, from the evaluation unit	
Current consumption	Max. 80 mA	Max. 100 mA
Enclosure protection to EN 60 529	IP 54	–
Explosion protection	–	EEx de IIC T6, PTB 00 ATEX 1075
Flame arrester	–	Sintered metal
Suitable evaluation unit	Type 8022	Type 8022
Weight	Approx. 0.26 kg	Approx. 1.3 kg

Ordering data

Order No.

Sensor for monitoring the lower explosive limit (LEL)

- Type HC 66 for non-hazardous areas
- Type ExDetector HC 100-M for hazardous areas

7MB1 943-6EA10

7MB1 943-6EA16

Factory-set to required gas concentration

(only for LEL sensors)
Specify type of sensor in plain text.

7MB1 943-6EA20

Calibrationbox-i

(only for ExDetector HC 100-M)
Hand-held unit for calibration,
approved for hazardous areas
Zone 1 and Zone 2

7MB1 943-6EA17

Calibration gas set and calibration gas cylinders

See page 5/27

Measuring equipment

Gas measuring and warning systems

Sensors for monitoring threshold limit values

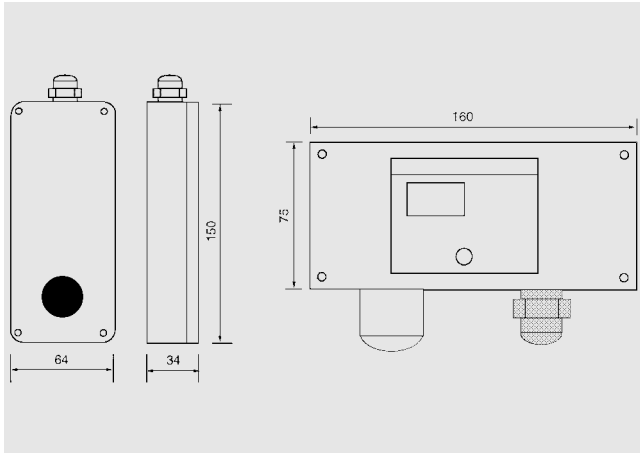


Fig. 5/29 Gas monitor TOX (left) and Ex-monitor TOX (right), dimensions

Design

There are 2 types of sensor available for monitoring the threshold limit values for toxic gases and vapors, as well as oxygen: the gas monitor TOX and the Ex-monitor TOX. These have the following features:

Gas monitor TOX

- Measurable gases: O₂, CO, H₂S, Cl₂, H₂, HCN, SO₂, NO, NO₂; further sensors for toxic gases on request
- Measuring range: depends on type of gas (see Ordering data)
- Measuring principle: electrochemical measuring cell
- Output signal 4 to 20 mA
- One-man calibration
- 2-wire system

Ex-monitor TOX

- Technical data as for gas monitor TOX, but for use in Ex zones
- Explosion-proof EEx ia IIC T4
- Concentration display

Application

A recommended value for the alarm thresholds of gas warning systems is the TLV (threshold limit value). The TLV is the maximum permissible concentration of gas, vapor or suspended material in the workplace that, according to current knowledge, will not influence the health of employees or cause unreasonable irritation even in the event of repeated and long-term exposure, usually 8 hours per day, but under observation of an average 40-hour working week (with single-shift working).

Technical data

Sensors	Gas monitor TOX	Ex-monitor TOX
Field of application	Non-hazardous areas	Hazardous areas
Measurable gases	Toxic gases and vapors (see Ordering data)	
Measuring range	See Ordering data	
Measuring principle	Electrochemical measuring cell	
Output signal	4 ... 20 mA	
Max. distance from evaluation unit	1000 m	
Cable	2-core, shielded, max. line resistance 100 Ω/core	
Recommended barriers	–	Electrical isolating amplifier
Permissible ambient temperature	-10 ... +50 °C	
Permissible atmospheric pressure	900 ... 1100 mbar	
Influence of atmospheric pressure	< 0.02% of signal/mbar	
Permissible humidity	15 ... 90% rel. humidity	
Housing material	Aluminium	Glass-fiber-reinforced polyester
Enclosure protection to EN 60 529	IP 54	–
Power supply	24 V DC, from the evaluation unit or from emergency power supply (option)	
Current consumption	Max. 100 mA	
Explosion protection	–	EEx ia II C T4
Suitable evaluation unit	Type 8022	Type 8022
Weight	Approx. 0.4 kg	Approx. 1.2 kg

Measuring equipment Gas measuring and warning systems

Sensors for monitoring threshold limit values

Ordering data

Sensor	Measuring range	Type of gas	Order No.
Gas monitor TOX O₂-25	0 ... 25% v/v	Oxygen	7MB1 943-6EA00
Gas monitor TOX CO-500	0 ... 300 ppm	Carbon monoxide	7MB1 943-6EA01
Gas monitor TOX H₂S-50	0 ... 50 ppm	Hydrogen sulfide	7MB1 943-6EA02
Gas monitor TOX H₂S-100	0 ... 100 ppm	Hydrogen sulfide	7MB1 943-6EA03
Gas monitor TOX Cl₂-20	0 ... 20 ppm	Chlorine	7MB1 943-6EA04
Gas monitor TOX H₂-1000	0 ... 1000 ppm	Hydrogen	7MB1 943-6EA05
Gas monitor TOX HCN-100	0 ... 100 ppm	Hydrogen cyanide	7MB1 943-6EA06
Gas monitor TOX SO₂-20	0 ... 20 ppm	Sulfur dioxide	7MB1 943-6EA07
Gas monitor TOX SO₂-100	0 ... 100 ppm	Sulfur dioxide	7MB1 943-6EA08
Gas monitor TOX NO-100	0 ... 100 ppm	Nitrogen monoxide	7MB1 943-6EA13
Gas monitor TOX NO-20	0 ... 20 ppm	Nitrogen monoxide	7MB1 943-6EA11
Gas monitor TOX NH₃-50	0 ... 200 ppm	Ammonia	7MB1 943-6EA12
Ex-monitor TOX O₂-25	0 ... 25% v/v	Oxygen	7MB1 943-6EB00
Ex-monitor TOX CO-1000	0 ... 300 ppm	Carbon monoxide	7MB1 943-6EB01
Ex-monitor TOX H₂S-50	0 ... 50 ppm	Hydrogen sulfide	7MB1 943-6EB02
Ex-monitor TOX H₂S-100	0 ... 100 ppm	Hydrogen sulfide	7MB1 943-6EB03
Ex-monitor TOX Cl₂-20	0 ... 20 ppm	Chlorine	7MB1 943-6EB04
Ex-monitor TOX H₂-1000	0 ... 1000 ppm	Hydrogen	7MB1 943-6EB05
Ex-monitor TOX HCN-100	0 ... 100 ppm	Hydrogen cyanide	7MB1 943-6EB06
Ex-monitor TOX SO₂-20	0 ... 20 ppm	Sulfur dioxide	7MB1 943-6EB07
Ex-monitor TOX SO₂-100	0 ... 100 ppm	Sulfur dioxide	7MB1 943-6EB08
Ex-monitor TOX NO-100	0 ... 100 ppm	Nitrogen monoxide	7MB1 943-6EB10
Ex-monitor TOX NO-20	0 ... 20 ppm	Nitrogen monoxide	7MB1 943-6EB11
Ex-monitor TOX NH₃-50	0 ... 200 ppm	Ammonia	7MB1 943-6EB12

Note:

All sensors for toxic gases are factory-set.

Calibration gases

Ordering data

Calibration gas set in plastic case
comprising:

- 1 blue plastic case
- 1 governor (check valve, flowmeter)
- 1 hose
- 1 pneumatic coupling
- 1 cable for front panel socket
- 4 PK calibration gas caps
- Unit for 2 MINICAN calibration gas cylinders (order separately)

Calibration gas cylinders made of aluminium

MINICAN calibration gas cylinder O₂

Non-returnable bottle with a geometric capacity of 1 liter; filling: gas mixture comprising 20% v/v O₂ as the measured component and 80% synthetic air

MINICAN calibration gas cylinder CO

Non-returnable bottle with a geometric capacity of 1 liter; filling: gas mixture comprising 300 ppm CO as the measured component in nitrogen

MINICAN calibration gas cylinder H₂

Non-returnable bottle with a geometric capacity of 1 liter; filling: gas mixture comprising 1.6% v/v H₂ as the measured component, corresponding to 40% LEL, in nitrogen

Order No.

7MB1 943-6EC01

7MB1 943-6EC02

7MB1 943-6EC03

7MB1 943-6EC04

Ordering data

MINICAN calibration gas cylinder CH₄

Non-returnable bottle with a geometric capacity of 1 liter; filling: gas mixture comprising 1.76% v/v CH₄ as the measured component, corresponding to 40% LEL in nitrogen

MINICAN calibration gas cylinder C₃H₈

Non-returnable bottle with a geometric capacity of 1 liter; filling: gas mixture comprising 0.68% v/v C₃H₈ as the measured component, corresponding to 48% LEL in nitrogen

MINICAN calibration gas cylinder C₄H₁₀

Non-returnable bottle with a geometric capacity of 1 liter; filling: gas mixture comprising 0.56% v/v C₄H₁₀ as the measured component, corresponding to 40% LEL in nitrogen

MINICAN calibration gas cylinder NH₃

Non-returnable bottle with a geometric capacity of 1 liter; filling: gas mixture comprising 500 ppm NH₃ as the measured component in nitrogen

Other calibration gases, e.g. SO₂, H₂S, NO, NO₂, HCN

Order No.

7MB1 943-6EC05

7MB1 943-6EC06

7MB1 943-6EC07

7MB1 943-6EC08

On request

Measuring equipment

Gas measuring and warning systems

8022 evaluation unit and accessories

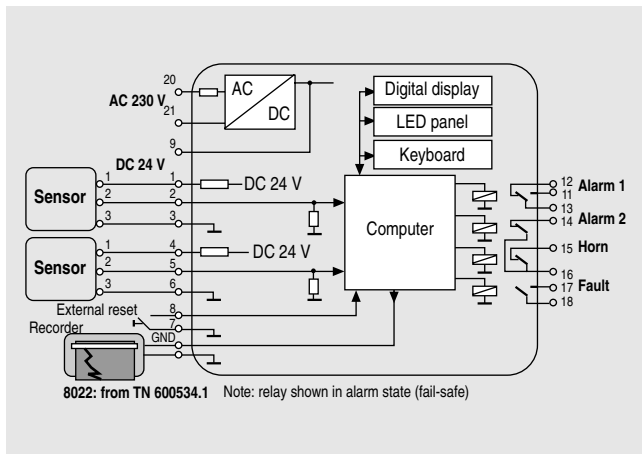


Fig. 5/30 8022 evaluation unit, function diagram

Application

The evaluation unit, when used together with sensors with a 4 to 20 mA signal output, has the following functions:

- Measurement and display of gas concentration
- Monitoring and warning of presence of gases
- Initiation of protective measures to counteract an increase in the concentration.

The evaluation unit provides the operating voltage for the sensors and compares the sensor signal with the individual alarm thresholds. If the concentration rises above the set alarm threshold, this is visually indicated by lighting-up of the corresponding LED, and the associated relay contact is activated.

Technical data

Evaluation unit

Number of connectable sensors	2
Type of sensor	All sensors with output signal 4 ... 20 mA
Number of alarm thresholds	2 alarm stages adjustable for each sensor
Outputs (relay)	- Alarm 1, non-latching (NC contact) - Alarm 2, optionally latching (changeover contact) - Horn (NC contact) - Fault (NO contact)
Output for recorder	0 ... 5 V, on front panel
Relay rating	230 V AC/ 24 V DC; 2 A
Displays	<ul style="list-style-type: none"> • LEDs
	For operational readiness, alarm 1 and 2, horn and fault for each sensor
	For concentration, guidance through the menus and display of programming data
Control elements	<ul style="list-style-type: none"> 3 buttons for • Horn and alarm reset • Guidance through menus • Programming
Warming-up time	30 min
Operating temperature	0 ... 55 °C
EC-Type Examination according to directive 94/9/EC	BVS 03 ATEX G 007 X
Housing	
• Material	Plastic
• Enclosure protection to EN 60 529	IP30 or IP54 if installed in miniature field distributor (see Ordering data)
• Assembly	Wall mounting or rail mounting (35 mm) with transparent pane and terminal cover
Electrical connection	21-pin screw terminal
Power supply	210 ... 250 V AC, 50/60 Hz, 20 VA 21.7 ... 28 V DC, 14 W or 110 V AC, 60 Hz, 20 VA 21.7 ... 28 V DC, 14 W
Weight	Approx. 0.75 kg

Emergency power supply with charger

Charger	
• Design	For mounting on a 35-mm rail (DIN), e.g. in miniature field distributors
• Enclosure protection to EN 60 529	IP20
• Dimensions (<i>H x W x D</i>) in mm	96 x 105 x 56
• Weight	Approx. 0.4 kg
Rechargeable battery	
• Rated voltage	12 V
• Capacity	2.2 Ah
• Dimensions (<i>H x W x D</i>) in mm	66 x 177 x 34
• Weight	Approx. 0.8 kg

Miniature field distributor

Enclosure protection to EN 60 529	IP54
Dimensions (<i>H x W x D</i>) in mm	
• Type KFV1	180 x 254 x 110
• Type KFV2	360 x 254 x 110

Dimensional drawings

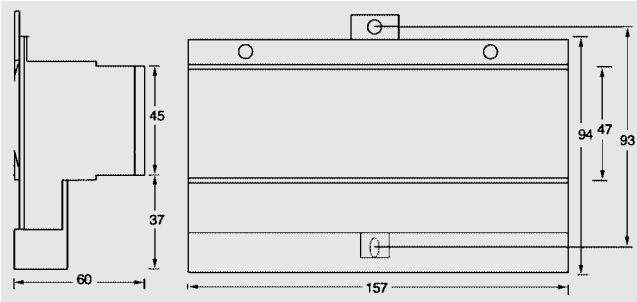


Fig. 5/31 8022 evaluation unit, dimensions

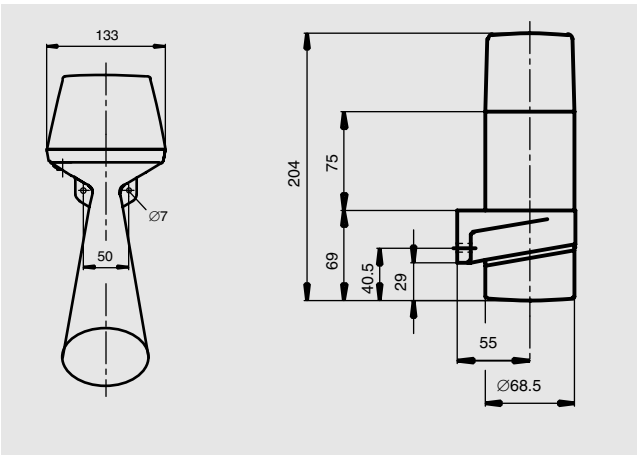


Fig. 5/32 Signal horn IP55 (left) and flasher lamp IP54 (right), dimensions

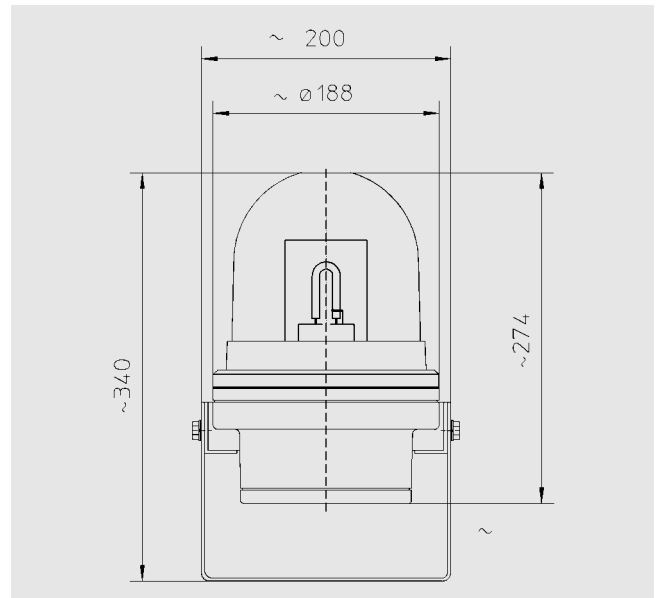


Fig. 5/34 EEx flasher lamp IP66, dimensions

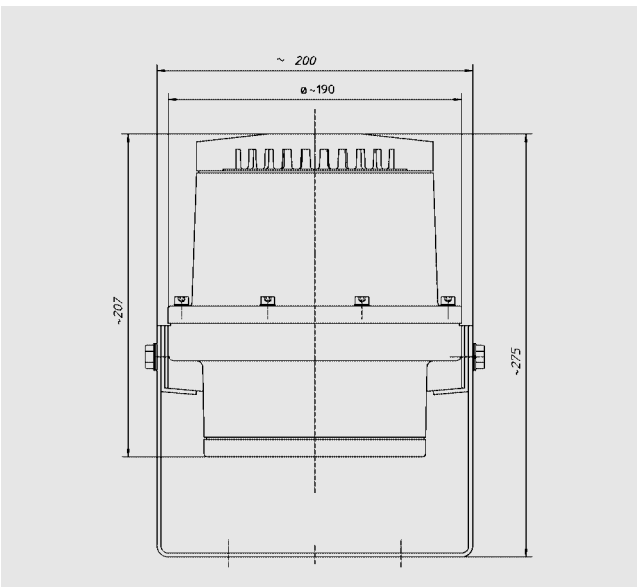


Fig. 5/33 EEx signal horn IP66, dimensions

Measuring equipment

Gas measuring and warning systems

8022 evaluation unit and accessories

Ordering data	Order No.	Ordering data	Order No.
8022 evaluation unit With housing for wall mounting or for 35-mm rail mounting <ul style="list-style-type: none"> • Power supply 230 V AC /24 V DC • Power supply 110 V AC /24 V DC 	7MB1 943-6EA30 7MB1 943-6EA35	EEx signal horn IP66 For indoor or outdoor installation, enclosure protection IP66 to IEC 529, without acoustic horn, approx. 105 dB (A), 1 m, type of explosion protection II 2G EEx de IIC T6, PTB approval PTB 01 ATEX 1063, housing: bottom part made of glass-fiber-reinforced polyester, top part made of Macrolon, temperature range -20 ... +40 °C, weight 3.5 kg <ul style="list-style-type: none"> • Power supply 230 V AC, 50 Hz, 0.07 A • Power supply 24 V DC, 0.3 A 	7MB1 943-6EA74 7MB1 943-6EA75
Accessories Emergency power supply with charger type NV 24 Device for supply of 8022 evaluation unit with 24 V DC emergency power, with low-voltage check, comprising charger and 2 batteries 12 V/2.2 Ah <ul style="list-style-type: none"> • Power supply 230 V AC • Power supply 110 V AC 	7MB1 943-6EA40 7MB1 943-6EA45 7MB1 943-6EA46	EEx flasher lamp IP66 Visual warning and signal equipment for use in hazardous areas (Zones 1 and 2), enclosure protection IP66 to IEC 529, flash energy 15 joules, type of explosion protection II 2G EEx de IIC T6, PTB approval PTB 02 ATEX 1008, housing: bottom part made of glass-fiber-reinforced polyester, top part made of Macrolon, temperature range -20 ... +40 °C, weight 3.5 kg <ul style="list-style-type: none"> • Power supply 230 V AC, 50 Hz, 0.2 A • Power supply 24 V DC, 1 A 	7MB1 943-6EA76 7MB1 943-6EA77
Spare battery ¹⁾ Rated voltage 12 V, capacity 2.2 Ah, dimensions (H x L x W) in mm: 66 x 177 x 34	7MB1 943-6EA50		
Miniature field distributor KJV1 To accommodate an 8022 evaluation unit, incl. installation and wiring	7MB1 943-6EA55		
Miniature field distributor KJV2 To accommodate two 8022 evaluation units, incl. installation and wiring	7MB1 943-6EA65 7MB1 943-6EA66		
Signal horn IP55 For indoor and outdoor installation, with acoustic horn, approx. 108 dB (A), with impact-proof, thermoplastic (ABS) housing, gray <ul style="list-style-type: none"> • Power supply 230 V AC, 50 Hz, 0.1 A • Power supply 24 V DC, 0.45 A 	7MB1 943-6EA67 7MB1 943-6EA68		
Flasher lamp IP54 Optical signal transmitter for indoor or protected outdoor installation, with impact-proof, thermoplastic (ABS) housing, gray, with red perspex calotte, flash energy 5 joules <ul style="list-style-type: none"> • Power supply 230 V AC, 50 Hz, 0.09 A • Power supply 24 V DC, 0.35 A 			

1) Two batteries are required for the emergency power supply. Max. 2.2 Ah permissible when installed in miniature field distributor. Batteries with capacity up to max. 38 Ah on request.

