



Oxygen Flue Gas Analyzer BA 2000

Some combustion processes, e.g. process heaters, steam boilers or heating furnaces the air required to achieve optimal system efficiency can easily fluctuate. And the economic optimum of the process fluctuates within a relatively narrow range. Both elevated NO_x or SO_x emission due to an excess supply of air (excess O₂) as well as energy loss within the system due to incomplete combustion (lack of O₂) require measuring the oxygen level in the flue gas of the combustion process. Sampling near the combustion chamber is therefore just as vital as using a rapid response sensor to allow for responding to changes in the combustion gas temperature and/or other variables in the combustion process promptly. The BA 2000 was developed specifically for this application.

Quick response time

Tool-less filter change

Easy handling

Flue gas temperatures up to 1600 °C

Durable ZrO₂ measuring cell

Display includes O₂

4-20 mA output signal

Ambient temperature -20 to +70 °C

No reference glass needed

No test gas needed

No gas conditioning needed

Calibration with instrument air



Description

The injector built into the filter housing constantly supplies the ZrO₂ sensor with fresh process gas. The self-regulating probe part is heated to 180 °C to prevent condensation. The ZrO₂ sensor in the BA 2000 provides accurate, extremely fast measurements.

No reference gas needed for operation. The sensor's 1-point calibration uses instrument air also needed to operate the injector. If necessary, 2-point calibration may also be performed. The test gas additionally needed for calibration in this case should ideally correspond with the O₂ concentration of the sample gas.

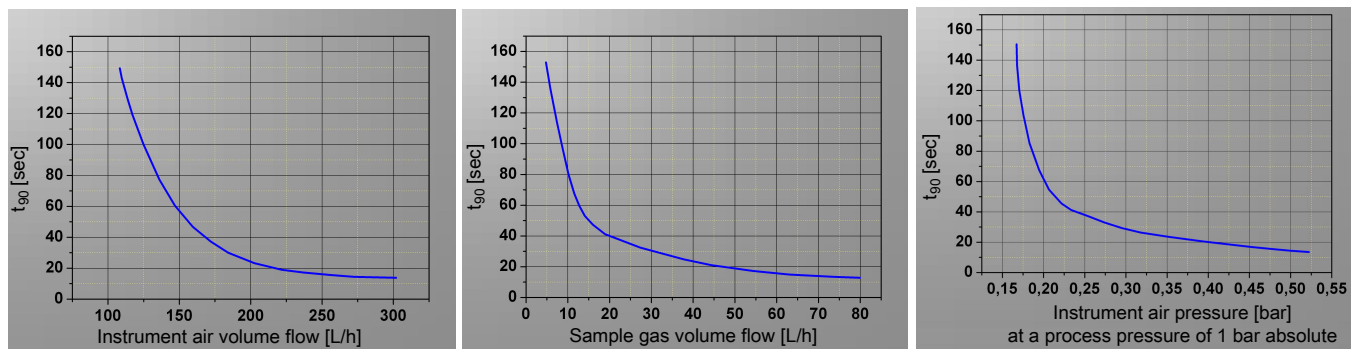
A filter built into the probe protects the measuring cell from dust exposure. The filter can be changed in seconds without tools by simply turning the handle 90°.

The filter elements are available in ceramic, sintered or star-pleated stainless steel.

Together with the filters listed, the BA 2000 can be used for gases with a dust load of up to approx. 2 g/m³.

The BA 2000 will provide all the information required for safe operation. The controller features a display with key pad for entering commands, alarm output, calibration function and 4 - 20 mA output signal.

t₉₀ times depending on volume flow and pressure



Oxygen measurement principle with ZrO₂ cells

The NERNST equation serves as the basis for determining the oxygen concentration in gases by zirconium dioxide measuring cell.

$$(I) U = \frac{RT}{4F} \ln \frac{p_{O_2, air}}{p_{O_2, sample gas}}$$

<i>U</i>	Cell voltage in V
<i>R</i>	Universal gas constant, R = 8.31447 J/(mol·K)
<i>T</i>	Measuring temperature in K
<i>F</i>	Faraday-constant, F = 96485.34 C/mol
<i>p_{O₂}, air</i>	Partial pressure of oxygen at the reference electrode in dry air in Pa
<i>p_{O₂}, Sample gas</i>	Partial pressure of oxygen at the reference electrode in dry air in Pa

The conductivity of the oxide ions of zirconium oxide increases exponentially with the temperature and reaches adequate values above 600 °C.

Provided the total pressures of the gases are about equal on both electrodes (in this case volume concentrations can be used in place of partial pressures), after adding the numeric values for the constants in equation (I) results in the following equation for the oxygen concentration.

$$(II) \Phi_{O_2} = 20,9 \cdot e^{(-46,42 \cdot \frac{U}{T})}$$

Φ_{O_2}	Oxygen concentration in sample gas in Vol.-%
<i>U</i>	Potential difference in mV
<i>T</i>	Measuring temperature in K
20,9	Oxygen concentration in dry air in Vol.-%

The BA 2000 uses a potentiometric cell. The reference and the sample gas electrode are located in two different gas chambers with different oxygen partial pressure. The two chambers are separated by the gas-tight ZrO₂ tube. The electrodes generate e.m.f. (electromotive force) proportional to the partial pressure difference of the oxygen. The NERNST equation applies.

Technical Data

BA 2000 Technical Data

Sampling tube length:	0.5 ... 2 m
Voltage:	115 or 230 V, 50/60 Hz
Probe heat output:	400 W
Measuring range:	0.1 to 21 Vol.-% O ₂
Output signal:	4-20 mA = 0-21 Vol.-% O ₂ (scalable 0-2.5/0-5/0-10/0-15)
Accuracy:	relative error < 5 %
Sensor T ₉₀ time:	< 15 sec
Alarm Sensor:	Upper and lower limit of nominal value for heating (fixed) Upper and lower limit of O ₂ concentration (adjustable)
Probe alarm:	Insufficient temperature
Ambient temperature:	-20 ... +70 °C
Process temperature:	up to 1600 °C, depending on sampling tube
Probe operating temperature:	max. 200 °C
Probe material:	1.4571
Test gas 1-point calibration:	Instrument air 20.9 Vol.-% O ₂
Test gases 2-point calibration:	Instrument air 20.9 Vol.-% O ₂ and test gas 0.1 to 15 Vol.-% O ₂

Ordering instructions

Item no.	Description
55200099	BA 2000, 230 V 50/60Hz
55201099	BA 2000-MF, 230 V 50/60Hz
55202099	BA 2000-SE, 230 V 50/60Hz
55200098	BA 2000, 115 V 50/60Hz
55201098	BA 2000-MF, 115 V 50/60Hz
55202098	BA 2000-SE, 115 V 50/60Hz
55200098I	BA 2000I, 115 V 50/60Hz, US sized
55201098I	BA 2000I-MF, 115 V 50/60Hz, US sized
55202098I	BA 2000I-SE, 115 V 50/60Hz, US sized
55200099I	BA 2000I, 230 V 50/60Hz, US sized
55201099I	BA 2000I-MF, 230 V 50/60Hz, US sized
55202099I	BA 2000I-SE, 230 V 50/60Hz, US sized

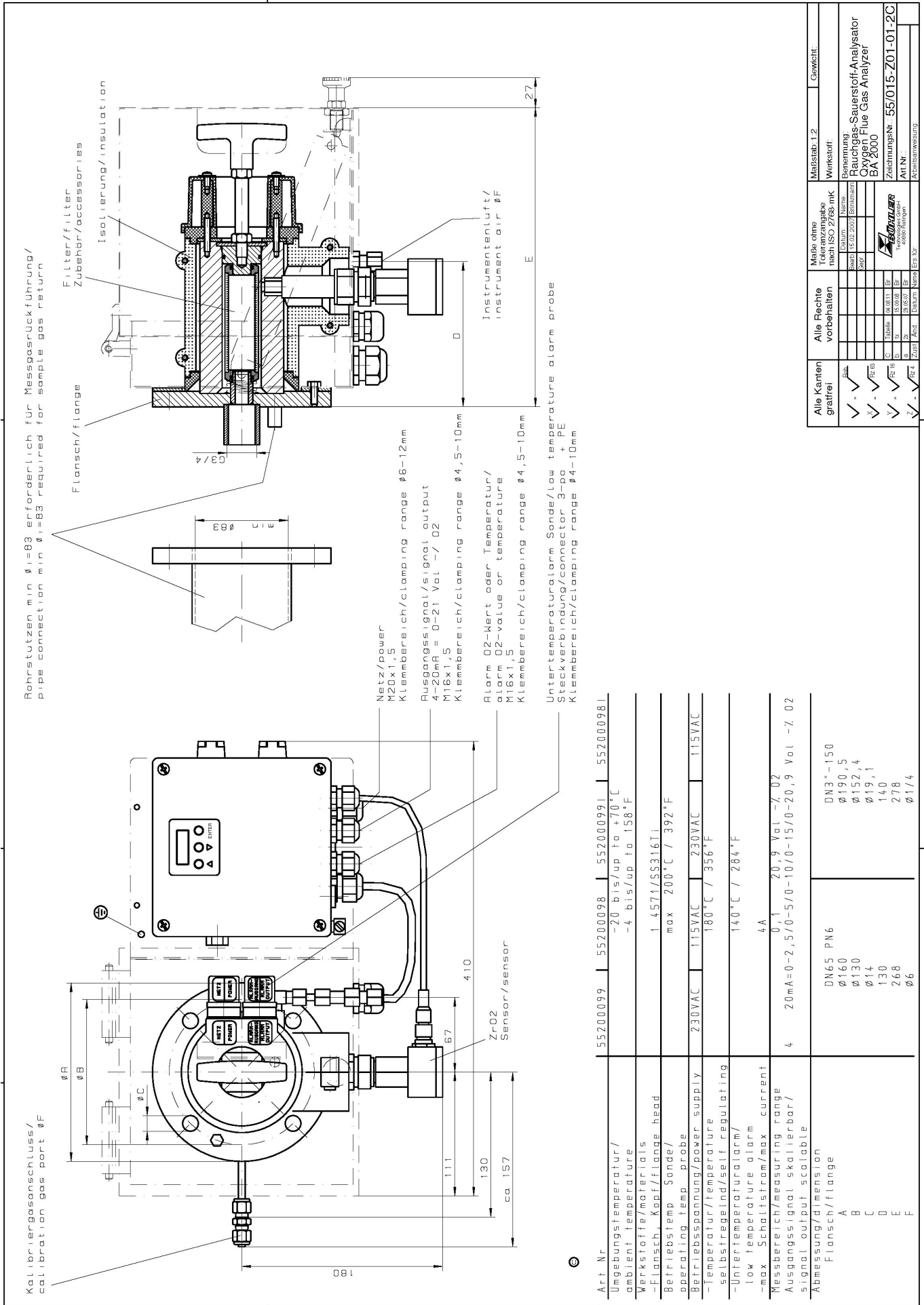
MF = separate sample gas recovery

SE = separated electronics up to approx. 15 m

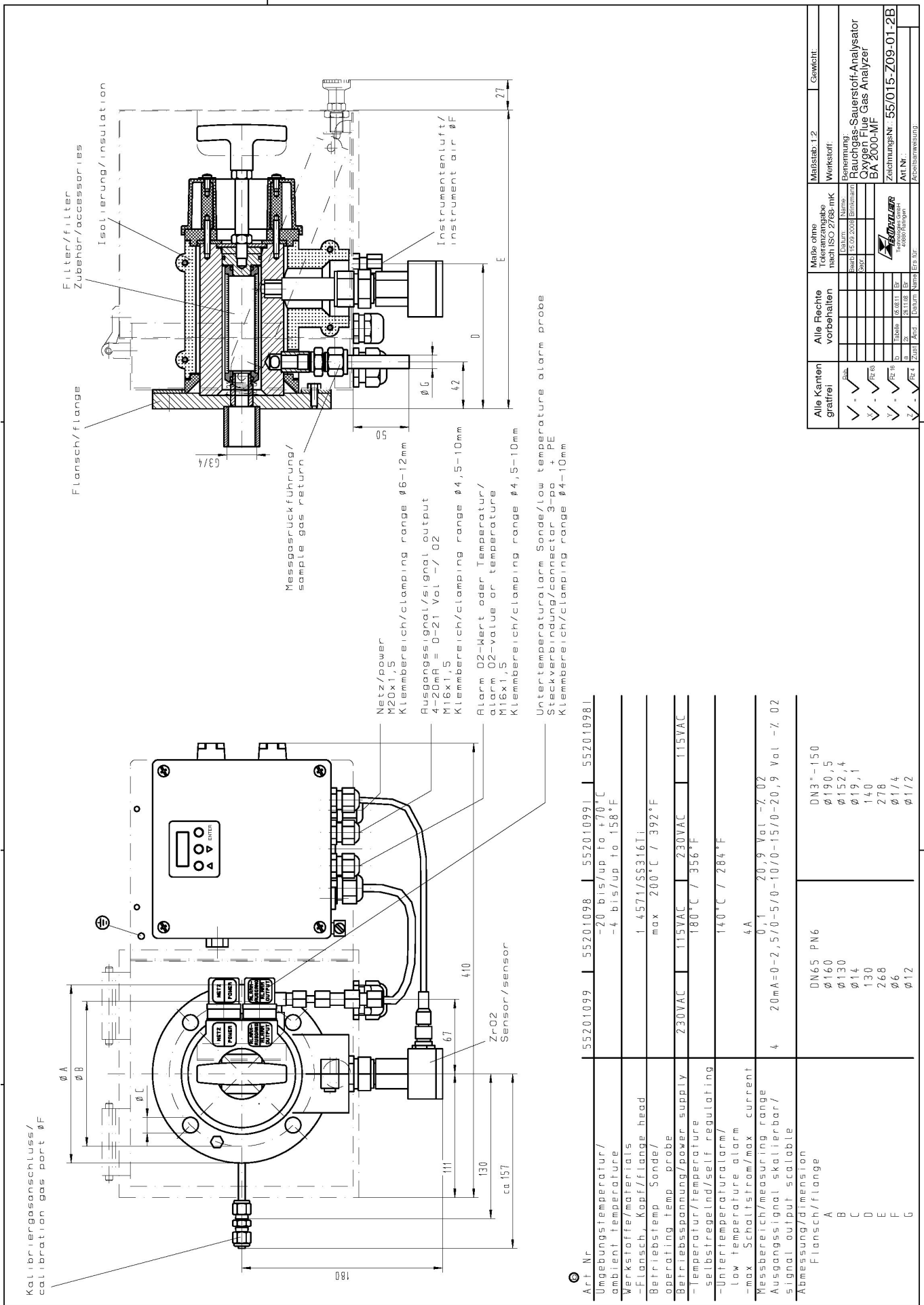
Adapter flanges

Item no.	Description
55200001	Adapter flange DN65 PN6 to Servomex
55200002	Adapter flange DN65 PN6 to Thermox
55200001I	Adapter flange DN3-150 to Servomex
55200002I	Adapter flange DN3-150 to Thermox

Drawings



Alle Kanten gratfrei	Alle Rechte vorbereiten	Maße ohne Toleranzangabe nach ISO 2768-mK	Maßstab: 1:2	Gewicht:
<input checked="" type="checkbox"/> Boh	<input type="checkbox"/>	Datum: _____	Werkstoff:	
<input checked="" type="checkbox"/> Rg/65	<input type="checkbox"/>	Stand: 15.02.2002	Benennung:	Rauchgas-Sauerstoff-Analysator
<input checked="" type="checkbox"/> Rg/15	<input type="checkbox"/>	SPZ	Zachnung:	Oxygen Flue Gas Analyzer
<input checked="" type="checkbox"/> Rg/10	<input type="checkbox"/>	04.08.11	BA 2000	
<input checked="" type="checkbox"/> Rg/5	<input type="checkbox"/>	15.09.08	Zeichnungs-Nr.:	55/015-Z01-01-2C
<input checked="" type="checkbox"/> Rg/4	<input type="checkbox"/>	28.02.07	Art. Nr.:	
<input checked="" type="checkbox"/> Rg/3	<input type="checkbox"/>	20.01.06	Abmessungen:	



Alle Kanten gratfrei	Alle Rechte vorbereiten	Melde ohne Toleranzangabe nach ISO 2768-mK	Maßstab: 1:2	Gewicht:
✓ <input checked="" type="checkbox"/> Raub		Datum: _____	Werkstoff:	
✓ <input checked="" type="checkbox"/> Rz0,6		Name: _____	Benennung:	
✓ <input checked="" type="checkbox"/> Rz0,8		Seit: 15.09.2009	Zeichnungs-Nr.:	55/015-Z09-01-2B
✓ <input checked="" type="checkbox"/> Rz1,6		Erstellt: _____	ART-Nr.:	
✓ <input checked="" type="checkbox"/> Rz2,5		Geprüft: _____	Revisionsbezeichnung:	
✓ <input checked="" type="checkbox"/> Rz5,0		Freigegeben:		

Benennung:	Rauchgas-Sauerstoff-Analysator Oxygen Flue Gas Analyzer BA 2000-MF
Zeichnungs-Nr.:	55/015-Z09-01-2B
ART-Nr.:	
Revisionsbezeichnung:	

Kalibriergasanschluss/
calibration gas port \varnothing F

Elektronik zur separaten Montage,
Befestigungsbohrungen für Schrauben M6/
controller for separat mounting,
fixing holes for screws M6

Flansch/flange

Filter/filter
Zubehör/accessories

Isolierung/insulation

Instrumentenluft/
instrument air \varnothing E

Netz/power
M20x1,5
Klemmbereich/clamping range \varnothing 6-12mm

Ausgangssignal/signal output
4-20mA = 0-21 Vol -/ 02
M16x1,5
Klemmbereich/clamping range \varnothing 4,5-10mm

Alarm 02=Wert oder Temperatur/
alarm 02=value or temperature
M16x1,5
Klemmbereich/clamping range \varnothing 4,5-10mm

Untertemperaturalarm/Sonde/low temperature alarm probe
Steckverbindung/connector 3-pa + PE
Klemmbereich/clamping range \varnothing 4-10mm

180

160

140

111

130

ca 157

67

ZrO2
Sensor/sensor

Kabellänge/
cable length
ca 15m

00
91

160

140

111

130

ca 157

67

ZrO2
Sensor/sensor

Art. Nr. 55202099 | 55202098 | 55202099 | 55202098

Umgebungstemperatur/
ambient temperature
-20 bis/up to +70°C
-4 bis/up to 158°F

Werkstoffe/materials
1.4571/55316Ti
max 200°C / 392°F

Betriebstemp. Sonde/
operating temp. probe
230VAC | 115VAC | 230VAC | 115VAC
180°C / 356°F

-Temperatur/temperature
selbstregelnd/self regulating
140°C / 284°F

-Untertemperaturalarm/
low temperature alarm
4A

-max Schlichtstrom/max current
0,1 20,9 Vol -/ 02

Messbereich/measuring range
Ausgangssignal skalierbar/
signal output scalable
20mA=0-2,5/0-5/0-10/0-15/0-20,9 Vol -/ 02

Abmessung/dimension
Flansch/flange

A	DN65 PN6	DN3"-150
B	\varnothing 160	\varnothing 190,5
C	\varnothing 130	\varnothing 152,4
D	\varnothing 14	\varnothing 19,1
E	130	140
F	268	278
	\varnothing 6	\varnothing 1/4

Alle Kanten gratfrei	Alle Rechte vorarbeiten	Mäße ohne Toleranzangabe nach ISO 2768-mK	Mäßestab 1:2	Gewicht:
<input checked="" type="checkbox"/> Flank <input checked="" type="checkbox"/> R <input checked="" type="checkbox"/> R0,5 <input checked="" type="checkbox"/> R1 <input checked="" type="checkbox"/> R2 <input checked="" type="checkbox"/> R3 <input checked="" type="checkbox"/> R4 <input checked="" type="checkbox"/> R5 <input checked="" type="checkbox"/> R6 <input checked="" type="checkbox"/> R8 <input checked="" type="checkbox"/> R10 <input checked="" type="checkbox"/> R12 <input checked="" type="checkbox"/> R15 <input checked="" type="checkbox"/> R20 <input checked="" type="checkbox"/> R25 <input checked="" type="checkbox"/> R30 <input checked="" type="checkbox"/> R40 <input checked="" type="checkbox"/> R50 <input checked="" type="checkbox"/> R63 <input checked="" type="checkbox"/> R80 <input checked="" type="checkbox"/> R100 <input checked="" type="checkbox"/> R125 <input checked="" type="checkbox"/> R160 <input checked="" type="checkbox"/> R200 <input checked="" type="checkbox"/> R250 <input checked="" type="checkbox"/> R315 <input checked="" type="checkbox"/> R400 <input checked="" type="checkbox"/> R500 <input checked="" type="checkbox"/> R630 <input checked="" type="checkbox"/> R800 <input checked="" type="checkbox"/> R1000	<input type="checkbox"/> 0 <input type="checkbox"/> 0,1 <input type="checkbox"/> 0,2 <input type="checkbox"/> 0,3 <input type="checkbox"/> 0,5 <input type="checkbox"/> 0,8 <input type="checkbox"/> 1 <input type="checkbox"/> 1,5 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 8 <input type="checkbox"/> 10 <input type="checkbox"/> 12 <input type="checkbox"/> 15 <input type="checkbox"/> 20 <input type="checkbox"/> 25 <input type="checkbox"/> 30 <input type="checkbox"/> 40 <input type="checkbox"/> 50 <input type="checkbox"/> 60 <input type="checkbox"/> 80 <input type="checkbox"/> 100	Datum: _____ Name: _____ Stand (ab 05.2009) (Einmann) Spez: _____ Zeichnungs-Nr.: 55/015-Z11-01-2B AT-Nr.: _____ ABS-Steuerung	Werkstoff: Benennung: Rauchgas-Sauerstoff-Analysator Oxygen Flue Gas Analyzer BA 2000-SE	