



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 ZrO_2 sensor with fresh process gas. The self-regulating probe part is heated to 180 °C to prevent condensation. The ZrO_2 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 O_2 concentration of the sample gas.

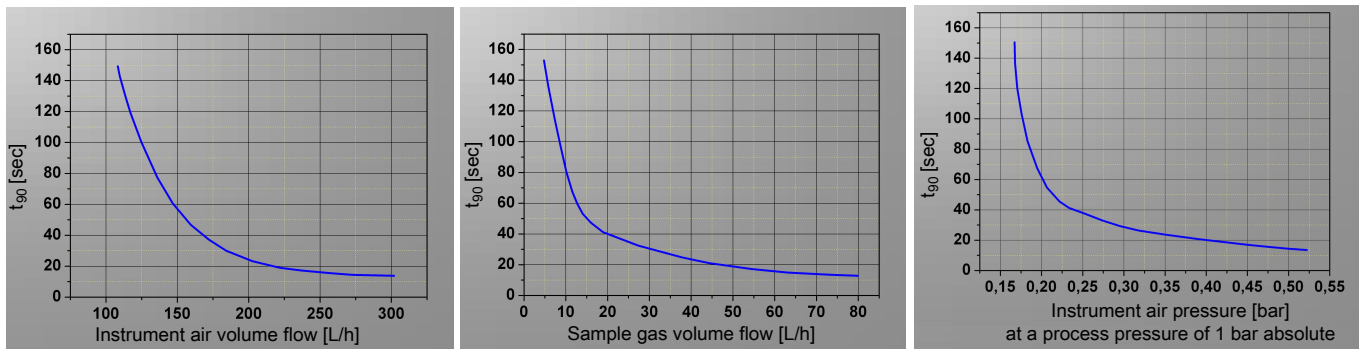
A filter built into the probe protects the measuring cell from dust exposure. The filter can be changed in seconds without tools by simply turning the handle 90°.

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.

t_{90} times depending on volume flow and pressure



Oxygen measurement principle with ZrO_2 cells

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

$$(L) U = \frac{RT}{4F} \ln \frac{p(O_2), \text{air}}{p(O_2), \text{sample gas}}$$

U	Cell voltage in V
R	Universal gas constant, $R = 8.31447 \text{ J/(mol} \cdot \text{K)}$
T	Measuring temperature in K
F	Faraday-constant, $F = 96485.34 \text{ C/mol}$
$p(O_2), \text{sample gas}$	Partial pressure of oxygen at the reference electrode in dry air in Pa
$p(O_2), \text{air}$	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.

$$(II) \quad \Phi(O_2) = 20.9 \cdot \left(-46.42 \frac{U}{T} \right)$$

$\Phi(O_2)$	Oxygen concentration in sample gas in Vol.-%
U	Potential difference in mV
T	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 ZrO_2 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

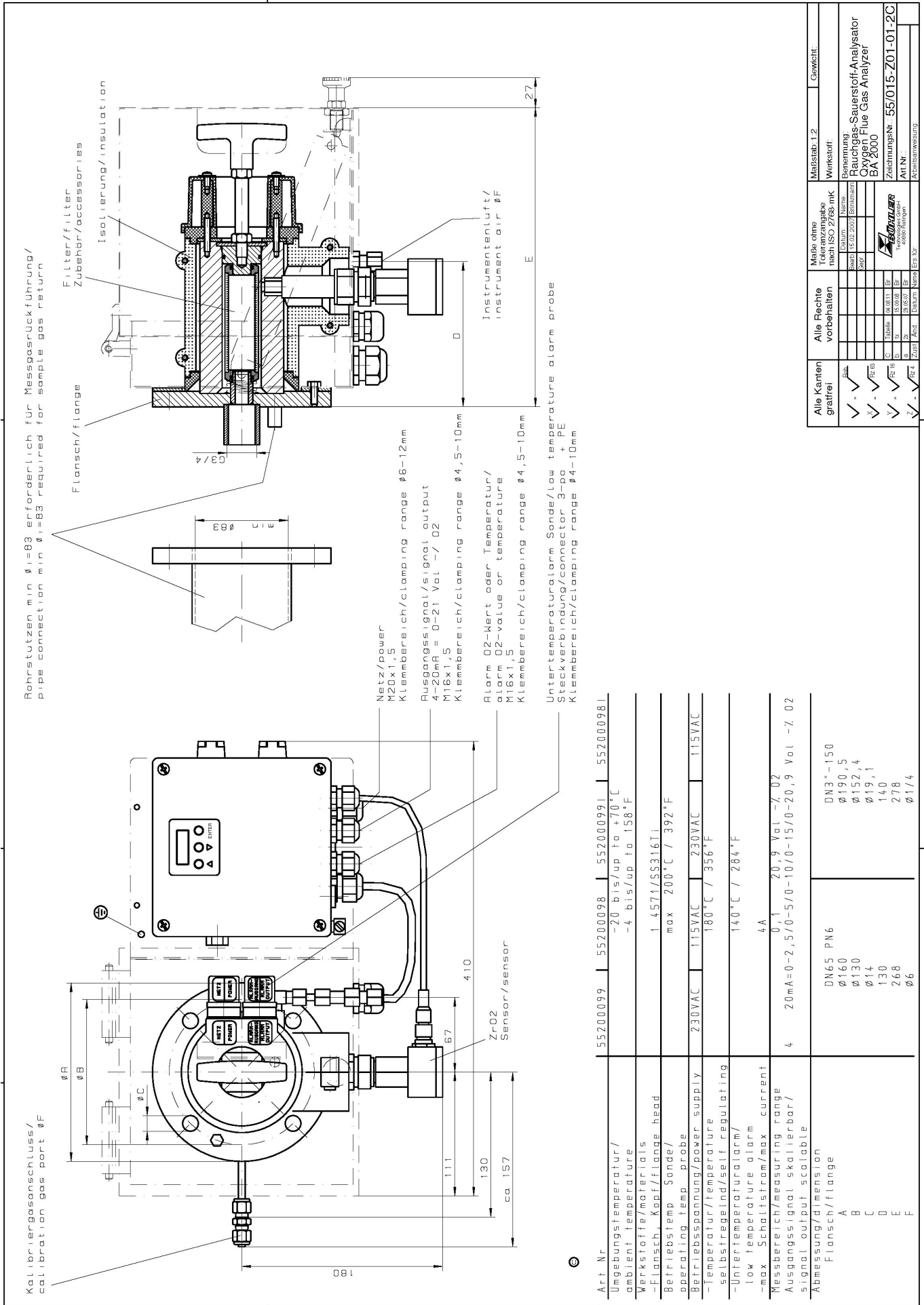
MF = separate sample gas recovery

SE = separated electronics up to approx. 15 m

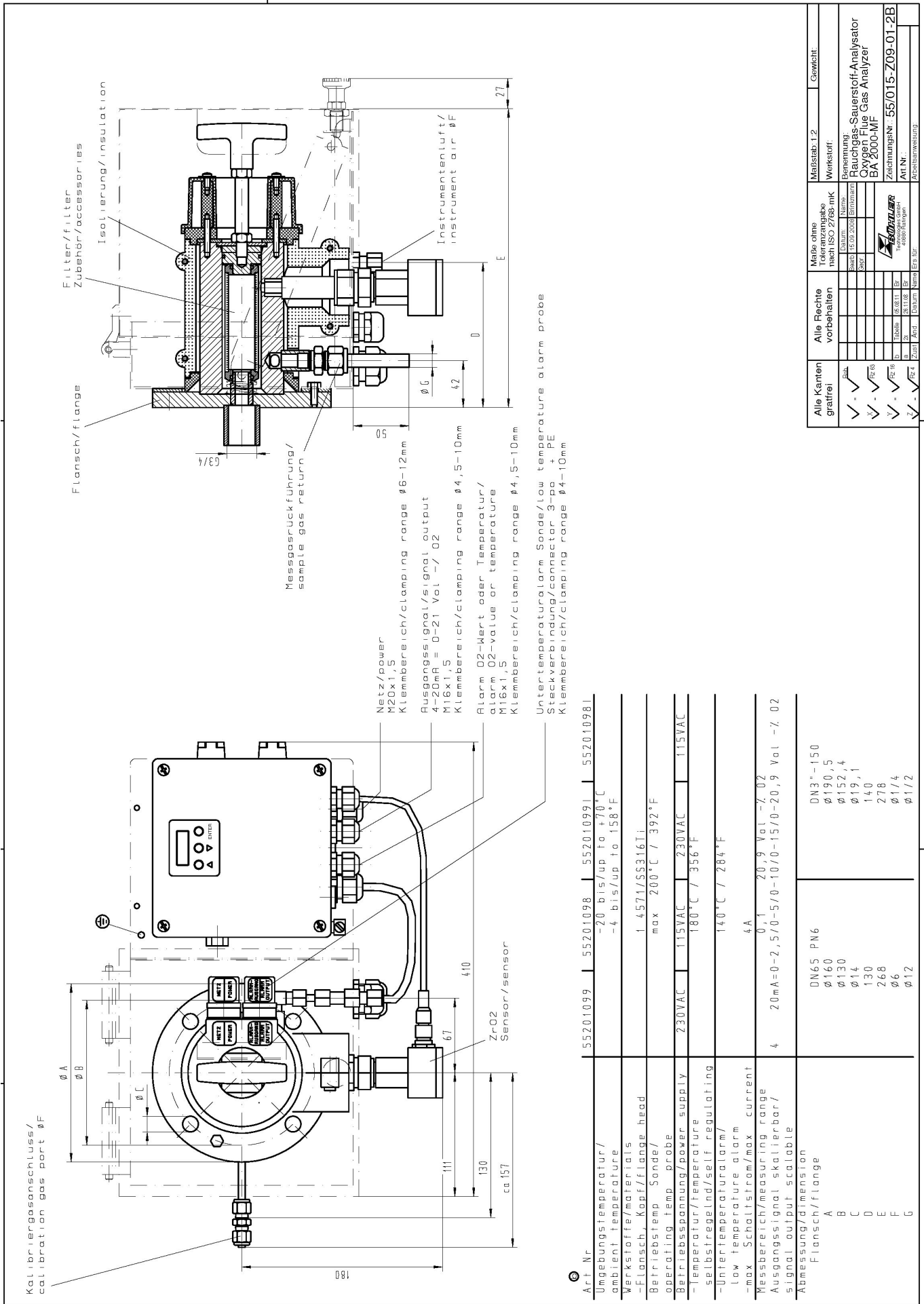
Adapter flanges

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

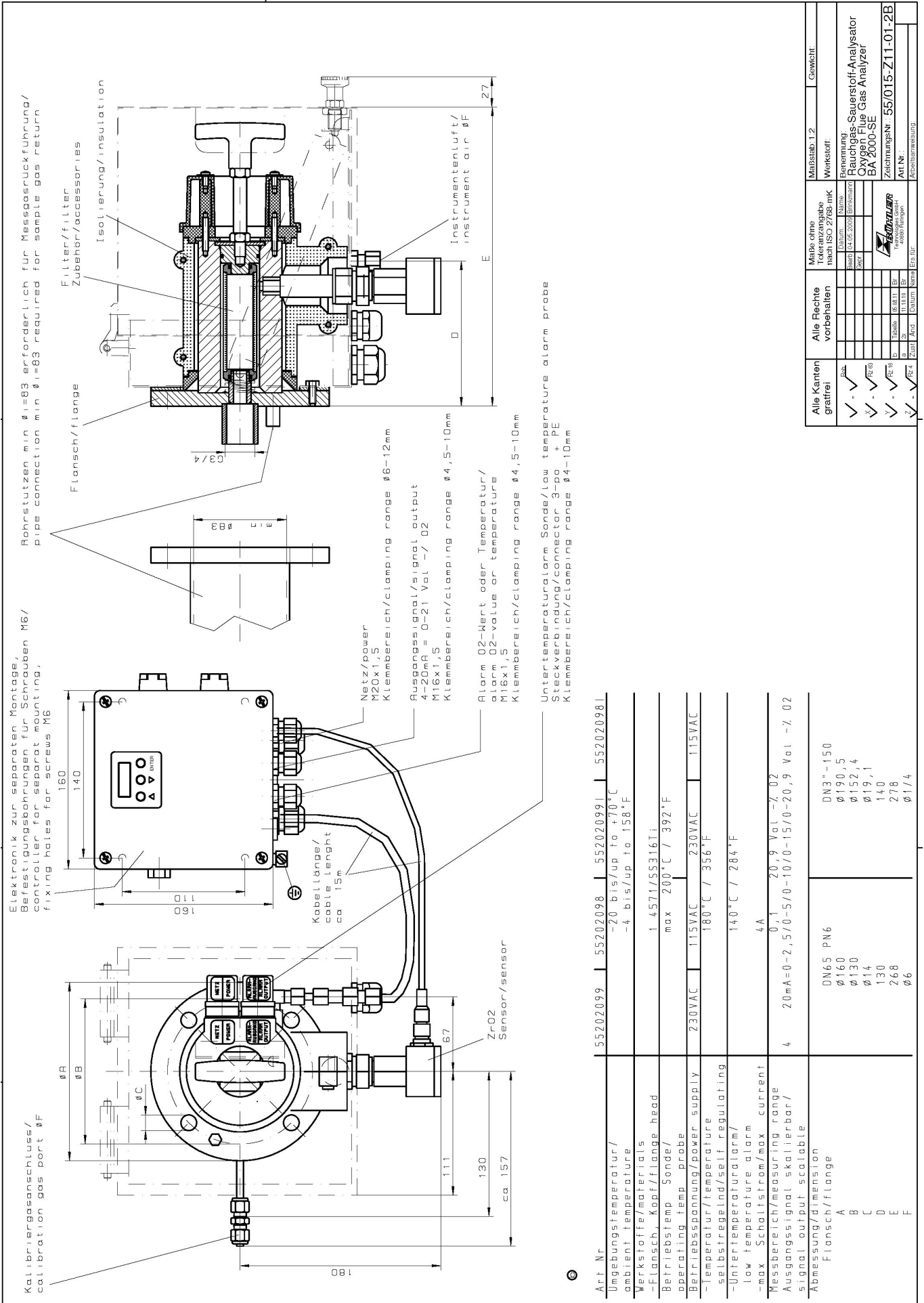
Drawings



Alle Kanten gratfrei		Alle Rechte vorbereiten		Maße ohne Toleranzangabe nach ISO 2768-mK		Maßstab: 1:2		Gewicht:	
Art	Größe	Art	Größe	Datum:	Name:	Werkstoff:			
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✓	✓	Name: Bauteil: 15.09.2009 Datum: 30.08.11	Werkstoff:	
✓	✓	Benennung: Rauchgas-Sauerstoff-Analysator Oxygen Flue Gas Analyzer BA 2000-MF	Zeichnungs-Nr.: 55/015-Z09-01-2B	
✓	✓	ART-Nr.:		
✓	✓	Technische Zeichnung		
✓	✓	Revisionszeichnung:		



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Art. Nr.	55202099	55202098	55202099I	55202098I
Umgebungstemperatur/ ambient temperature	-20 bis/up to +70°C	-4 bis/up to 158°F		
Werkstoffe/materials				
-Flansch, Kopf/flange head				
Betriebstemp. Sonde/ operating temp. probe				
Betriebsspannung/power supply	230VAC	115VAC	230VAC	115VAC
-Temperatur/temperature				
selbstregelnd/self regulating				
-Untertemperaturalarm/ low temperature alarm				
-max. Schaltstrom/max. current				
Messbereich/measuring range	0,1 - 20,9 Vol -/ 02			
Ausgangssignal skalierbar/ signal output scalable				
Abmessung/dimension				
Flansch/flange				
A	DN65 PN6			DN3" -150
B	Ø160			Ø190,5
C	Ø130			Ø152,4
D	Ø14			Ø19,1
E	130			140
F	268			278
	Ø6			Ø11,4