Superior technology and quality from the world leader in oxygen measurement

Integral reference-air supply option
— avoids necessity for additional equipment

Dual fuel data input with manual or automatic selection from up to 17 different fuels
— extends the operating range of the system

User programmable
— enables maximum flexibility of control

Two levels of program security
— reduces possibility of accidental changes

High levels of accuracy, resolution and RFI immunity
— provides customer confidence in operation
ZMT Transmitter

The ZMT Zirconia Indicating Transmitter/Alarm Unit is a versatile oxygen analyzer designed primarily to meet the requirements for energy management in the boiler market.

The ZMT is suitable for use with ZFG2 zirconia oxygen probes and can be provided in standard and advanced efficiency form.

The standard analyzer has high/low alarms and isolated retransmission. Display features include:

- Probe mV
- Probe temperature
- Cell constant
- Retransmission range
- Cell ‘warming up’ indication
- High/low cell temperature fault indication
- Thermocouple failure fault indication
- Provision to measure cell impedance
- Ability to display a calculated inferred CO2 value

The standard unit also accepts inputs of probe mV and thermocouples.

The standard analyzer provides oxygen readout with computation based on the probe output voltage. The voltage output is Nernstian in form and follows the equation:

\[ E(mV) = 0.0496T \left( \log_{10} \frac{P_0}{P_1} \right) \pm C(mv) \]

Where:
- \( T \) = Absolute temperature (°K)
- \( P_0 \) = \( O_2 \) Partial pressure reference gas (air)
- \( P_1 \) = \( O_2 \) Partial pressure sample gas
- \( C \) = Cell constant (zero offset)
- 0.0496 = Faraday’s Gas Constant

The advanced analyzer, in addition to the facilities offered by the standard analyzer, provides an efficiency calculation readout by application of the Siegert formula:

\[ \text{Efficiency} = 100 - \frac{K(T_1 - T_2)}{20.8 - \%O_2} \]

Where:
- \( T_1 \) = Flue temperature (at economizer or boiler outlet)
- \( T_2 \) = Inlet-air temperature
- \( \%O_2 \) = Measured \( \%O_2 \) in flue gas
- \( K \) = Fuel constant dependent on fuel type

For example:
- Natural gas, \( K = 0.66 \)
- Fuel Oil, \( K = 0.70 \)
- Bituminous coal, \( K = 0.73 \)

The efficiency is displayed as a percentage, with the facility to display inlet-air temperature and flue-gas temperature as required.

Further options are available for serial communications (RS485 ABB protocol) and Auto-calibration.

Auto-calibration requires the addition of the gas panel and test gas cylinders. The test gases are selected by solenoid valves on the gas panel, the valves being switched by relays within the ZMT.

The ZMT can accept a carbon monoxide signal transmitted from another analyzer unit. This signal can be displayed as ‘ppm CO’.

The temperature of the zirconia cell is automatically controlled by the ZMT when used with the ZFG2 zirconia probes.

Probe reference-air supply is available, either through pump units or by use of an air regulator operated from the customer’s instrument-air line.
Construction and Operation

The ZMT zirconia analyzer is housed in a sheet-steel enclosure, environmentally protected to IP55. It has a hinged front door fitted with a 15-button tactile-membrane switch panel and display window.

There are two blue-filtered, vacuum fluorescent displays visible through the door window. The upper, five-digit display is used for monitoring process values. The lower 20-character, dot-matrix display is used during setting, operating and programming.

Membrane switches on the ZMT unit include:

- % O₂
- Temperature
- Alarm
- Efficiency
- CO₂/CO
- Calibration

The % O₂, efficiency and CO₂/CO switches are dedicated push buttons, that is, when depressed only the required monitored value is displayed. The units of measurement are indicated on the dot-matrix display.

Temperature, alarms and calibration switches, in conjunction with the switch, permit programming and setting up of the various parameters for system operation. Additional pages are available through operation of the switch, such as the Analog Retransmission page, the Relay Allocation page, Diagnostic page and Commissioning page.

Two levels of security are provided to protect various stages of the programming. The first involves operation of the front panel switches, the second, more secure level, is an internal switch.

Single-fuel and dual-fuel boiler operation is monitored by programmable selections from seventeen different fuel types. On dual-fuel applications changeover is implemented either manually or automatically.

The instrument uses a CMOS 6303 microprocessor, a switch-mode power supply, with pulse-width modulation circuitry for analog retransmission, and offers up to three analog outputs (isolated) plus up to four relay outputs in combinations of up to six outputs total.
ZMT Transmitter – Specification

Displays

**Measured value**
- Five-digit, seven-segment blue-filtered, vacuum fluorescent

**Information**
- 20-character, single line, dot-matrix, blue-filtered, vacuum fluorescent

**Ranges**
- **Oxygen**
  - Programmable within the limits of 0 to 25% O₂ to a minimum span of 5% O₂ linear
- **Probe temperature**
  - 0 to 1400 °C (32 to 2552 °F)
  - 200 °C (392 °F) span min. for retransmission

**Accuracies**

**Oxygen concentration**
- ≤ 0.1 % O₂, whichever is the greater

**Display and Retransmission**
- **Measurement resolution**
  - Thermocouple, mV, V and mA < 0.1 % span
  - ACJC error 0.05 °C/°C (0.09 °F/°F) change in ambient temperature
  - Thermocouple linearizer ±0.2 °C (±0.36 °F)

**Display resolution**
- ±1 digit

**O₂ System accuracy**
- ZMT + ZFG2 probe when calibrated with certified test gas

**Display**
- ≤ 2 % of reading or ± 0.1 % O₂ whichever is the greater

**Retransmission error**
- ≤ 2 % of reading

**Error due to ambient temperature variation**
- ± 0.02 % span/°C (± 0.36 % span/°F) typical

**Error due to power supply voltage regulation**
- None for ±15 % variation

Outputs and Set Points

**Analog outputs (isolated)**
- 0 to 10 mA, 0 to 20 mA or 4 to 20 mA – up to three max. into 1 kΩ max. load

**Output Modules 1 and 2 programmable**
- %O₂: any range (5 % min. span within the range of 0 to 25 % O₂ i.e. dual ranging possible)
- Temperature: any range (200 °C [392 °F] min. span) within the ranges:
  - Cell temp. 0 to 1400 °C (32 to 2552 °F)
  - Flue temp. 0 to 700 °C (32 to 1292 °F)
  - Air temp. –40 to 400 °C (–40 to 752 °F)
  - 0 to 100 % combustion efficiency

*Available only when Combustion Efficiency option selected.

**Output Module 3 programmable**
- As for Modules 1 and 2 or 2 relays (auto-cal or alarm) or serial communications

**Relay outputs**
- Maximum of four available

**Set point adjustment**
- Programmable

**Relay contacts**
- Single pole changeover

**Rating**
- 250 V AC
- 250 V DC
- 3 A AC
- 3 A DC max.

**Loading (non-inductive)**
- 750 V
- 30 W max.

**Insulation**
- Contacts to earth 2 kV RMS

Power Supply

**Voltage requirements**
- 110 V or 230 V (±15 %) 50/60 Hz

**Power consumption**
- 150 VA

**Insulation, mains to earth (line to ground)**
- 2 kV RMS
Display Function

- %O₂
- Temperature
- Cell temperature
- Flue temperature
- Air temperature
- Efficiency version
- % Combustion efficiency
- Inferred CO₂
- PPM CO

Environmental Data

Operating temperature limits
0 to 55 °C (32 to 131 °F)

Operating humidity limits
0 to 80 % RH

Protection
IP55

Weight
16.5 kg (36 lb)

Programming

Unless specified otherwise at the time of ordering all instruments are set up as follows:

Standard programming – basic version
- Output Module 1: O₂ range 0 to 25 %
- Output Module 2: O₂ range 0 to 25 % (optional)
- Alarms set at: 5 % O₂ EB (Module 1)
- 15 % O₂ EA (Module 2)

Module 3 (optional) alarms allocated to cell temperature or auto/cal
- Alarm 3: low temperature
- Alarm 4: high temperature

Standard programming – advanced efficiency version

As basic version plus
- Output Module 3: ranged 0 to 100 % Efficiency
- Output: 4 to 20 mA

For either version

Fuel 1: Gas (selected in manual mode)
Fuel 2: No. 6 oil
CO Display: 0 to 4000 ppm (max. range)
CO input: 4 to 20 mA

ZMT Transmitter – Overall Dimensions

Dimensions in mm (in.)

Net Weight
16 kg (35 1/4 lb).

4 Holes 9.0(0.35) Dia.

2 x 1/4 inch OD Compression Fittings. See Note 2 on Page 6

Eight Cable Entry Holes, 20(0.79) Dia. in Gland Plate
### ZMT Transmitter – Ordering Information

<table>
<thead>
<tr>
<th>ZMT Zirconia Indicating Transmitter/Alarm Unit</th>
<th>ZMT / X / X / X XX X X / X X X X</th>
</tr>
</thead>
<tbody>
<tr>
<td>for use with Probe Type</td>
<td>ZFG/ZFG2 2</td>
</tr>
</tbody>
</table>

**Reference Air Supply (see Note 2)**

<table>
<thead>
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<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulator</td>
<td>2</td>
</tr>
<tr>
<td>Pump and flow indicator (ZFG2 only)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Probe Temperature Control**

| Temperature control (ZFG2 only) | 1 |

**1st Fuel Option (see Note 1)**

<table>
<thead>
<tr>
<th>00</th>
<th>01</th>
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<tbody>
<tr>
<td>17</td>
<td></td>
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**2nd Fuel Option (see Note 1)**

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<tr>
<td>17</td>
<td></td>
</tr>
</tbody>
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**Program**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Combustion Efficiency</td>
<td>1</td>
</tr>
<tr>
<td>Humidity in air</td>
<td>2</td>
</tr>
<tr>
<td>Auto-cal basic</td>
<td>3</td>
</tr>
<tr>
<td>Auto-cal efficiency</td>
<td>4</td>
</tr>
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</table>

**Program**

<table>
<thead>
<tr>
<th>None</th>
<th>0</th>
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</thead>
<tbody>
<tr>
<td>RS485 ABB protocol</td>
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**Output Module 1**

<table>
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<tr>
<th>None</th>
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</thead>
<tbody>
<tr>
<td>Analog + relay</td>
<td>4</td>
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</tbody>
</table>

**Output Module 2**

<table>
<thead>
<tr>
<th>None</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>One relay</td>
<td>1</td>
</tr>
<tr>
<td>Analog + relay</td>
<td>4</td>
</tr>
</tbody>
</table>

**Output Module 3**

<table>
<thead>
<tr>
<th>None</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>One relay</td>
<td>1</td>
</tr>
<tr>
<td>Two relays (auto-cal or alarms)</td>
<td>2</td>
</tr>
<tr>
<td>Analog + relay</td>
<td>4</td>
</tr>
<tr>
<td>Serial communications</td>
<td>5</td>
</tr>
</tbody>
</table>

**Mains Voltage**

| 110 V 50/60 Hz             | 1 |
| 230 V 50/60 Hz             | 2 |

**Note 1**

Fuel options available:

- 00 No fuel specification
- 01 Natural gas
- 02 Propane
- 03 Butane
- 04 Medium oil
- 05 Heavy oil
- 06 General fuel oil
- 07 Naphtha
- 08 Kerosene
- 09 Distillate oil
- 10 No. 4 fuel oil
- 11 No. 5 fuel oil
- 12 No. 6 fuel oil
- 13 Coal (general)
- 14 Bituminous coal
- 15 Steam coal
- 16 Anthracite
- 17 Coke

**Note 2**

Reference-air options 2 and 3 have the air outlet inside the enclosure to suit ZFG2 probe type. Flow rate 500 to 1000 ml/min. (0.02 to 0.04 cu.ft./min approx.)
Zirconi Oxygen Probes

Introduction to the Probes
The ZFG2 Flue Gas Oxygen Probe is the most advanced in the world. A simplified design makes all the component parts easily accessible and field-serviceable. The new universal probe construction gives the ultimate system flexibility while retaining all the features, benefits and reliability of the previous generation.

ZFG2 Probe
Fully interchangeable with previous ABB models and the ability to upgrade from other manufacturer's products, the ZFG2 probe, in common with earlier models is of the in situ type, inserted directly into the boiler smoke box, or flue duct, eliminating the need for costly sampling installations.

Operating in the process temperature range of 20 to 600 °C (68 to 1112 °F) the system gives true wet-analysis of net excess oxygen in combustion gases. The ZFG2 probes can be fitted with an optional flame-trap, thereby extending their use to measurement on gas-fired boilers.

Installation and commissioning are particularly easy and the level of in-service maintenance is extremely low.

Principle of Operation
The detector cell is constructed from stabilized zirconia employing integral platinum electrodes and is specific to oxygen. Air is supplied to the internal (reference) electrode to provide a constant partial pressure of oxygen while the measured gases are in contact with the outer electrode producing a potential proportional to O₂ concentration.

The zirconia probes, constructed from 316 stainless steel, house a ceramic dust filter and flame-arrester, the detector cell, cell-heater and thermocouple. Wiring between the electronics unit and the probe can be carried in a single 6m (20ft) flexible conduit, which is PVC coated for IP65 (NEMA4) rated probes. The conduit also contains the tubing for the reference-air supply.

The standard probe insertion lengths available are 0.4, 1.0, 1.5 and 2.0 m (16, 39, 58 and 78 in.) and fixing to the duct or smoke box is by means of a drilled flange. Stand-off fixings can be used to reduce the insertion length for smaller ducts. A screwed bush is available for fixing the 0.4 m probe to the duct or smoke box.

Where a fast response ZFG2 probe is required the optional Fast-response Cell Adaptor can be fitted. However, this adaptor eliminates the use of flame-arrester and dust filter.

Unique Electrode Technology
The ABB innovative and unique electrode technology employed in these probes ensures continuous operation under severe reducing and sulphurous conditions with extended cell life. This technology gives fast recovery from reducing to oxidizing conditions without shift in calibration.

Independent test reports show an accuracy of ± 0.2 % for process temperature change from 20 to 600 °C (68 to 1112 °F).
ZMT & ZFG2
Zirconia Oxygen Analyzer Systems

ZFG2 Probe – Specification

Calibration (in situ)
- One point using clean air
- Two point using certified test gas

Flue temperature
20 to 600 °C (68 to 1112°F)

Pressure
Suitable for all normal positive or negative flue pressures

Probe fixing
- Flange (or 2½ in. NPT screwed fitting for ZFG2 0.4 m)

Probe insertion
0.4, 1.0, 1.5 or 2.0 m (16, 39, 58 or 78 in.) standard

Flange options (mm)

<table>
<thead>
<tr>
<th>Flange options</th>
<th>Diameter</th>
<th>Thickness</th>
<th>Holes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0.4m ZFG2 Standard</strong></td>
<td>6.0 ±0.4</td>
<td>101.0 ±1</td>
<td>6 x 7.3 dia.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±0.2 P.C.D.</td>
<td></td>
</tr>
<tr>
<td><strong>1.0, 1.5 and 2.0m ZFG2 Standard</strong></td>
<td>12.0 ±1</td>
<td>165.0 ±1</td>
<td>6 x 12.5 ±0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±0.2 P.C.D.</td>
<td></td>
</tr>
<tr>
<td><strong>Westinghouse Model 132 equivalent</strong></td>
<td>6.0 ±0.4</td>
<td>127.0 ±1</td>
<td>4 x 9.5 (0.375 in.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±0.2 P.C.D.</td>
<td></td>
</tr>
<tr>
<td><strong>Westinghouse DIN equivalent</strong></td>
<td>12.0 ±1</td>
<td>185.0 ±0.5</td>
<td>4 x 18 dia.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±0.2 P.C.D.</td>
<td></td>
</tr>
<tr>
<td><strong>Westinghouse ANSI equivalent</strong></td>
<td>12.0 ±1</td>
<td>153.0 ±0.5</td>
<td>4 x 20.0 ±0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±0.2 P.C.D.</td>
<td></td>
</tr>
<tr>
<td><strong>Westinghouse JIS equivalent</strong></td>
<td>12.0 ±1</td>
<td>155.0 ±0.5</td>
<td>4 x 15 equispaced</td>
</tr>
</tbody>
</table>

Cable length
10 m or 6 m (32 or 20 ft) as fitted. Max. distance probe to electronics unit 100 m (325 ft) using cables EXFG/0194 (Signal) and EXFG/0195 (Heater)

Probe weight
- 0.4 m (16 in.) 6 kg (13.2 lb) (including 6 m [20 ft] cable)
- 1.0 m (39 in.) 10.8 kg (23.7 lb) (including 6 m [20 ft] cable)
- 1.5 m (58 in.) 11.6 kg (25.5 lb) (including 6 m [20 ft] cable)
- 2.0 m (78 in.) 12.5 kg (27.5 lb) (including 6 m [20 ft] cable)

ERA Citation of suitability for gas fired installations where Group IIB equipment is applicable

Measuring Range

<table>
<thead>
<tr>
<th>Response rate (typical)</th>
<th>Standard Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤40 s to 63 % of final value</td>
<td>≤1 minute to 90 % of step change</td>
</tr>
<tr>
<td>Initial response ≤ 5 s</td>
<td>Initial response ≤ 2 s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fast-response cell*</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 7 s to 63 % of step change</td>
</tr>
<tr>
<td>≤ 12 s to 90 % of step change.</td>
</tr>
<tr>
<td>Initial response ≤ 2 s</td>
</tr>
</tbody>
</table>

Reference gas
Clean, oil-free air
Any stable flow in the range 100 to 1000 ml/min

Thermocouple
NiCr/NiAl Pt. 4 BS4937 Type K

Insertion length
0.4 m, 1.0 m, 1.5 m or 2.0 m (16, 39, 58 or 78 in.)

Protection class
Meets requirements of NEMA 4x

Note. * Fast-response Cell cannot be used with Filter and/or Flame-arrester.
ZFG2 Probe – Ordering Information

<table>
<thead>
<tr>
<th>Insertion Length</th>
<th>ZFG2</th>
<th>/</th>
<th>X</th>
<th>X</th>
<th>/</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>X</th>
<th>/</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4 m (16 in.)</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1.0 m (39 in.)</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 m (58 in.)</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0 m (78 in.)</td>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Flange Type</th>
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</thead>
<tbody>
<tr>
<td>ABB Std.</td>
<td></td>
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</tr>
<tr>
<td>DIN equivalent/Westinghouse</td>
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<td>2</td>
</tr>
<tr>
<td>ANSI equivalent/Westinghouse</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Westinghouse/YEW JIS equivalent</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Westinghouse Model 132 equivalent (only 0.4 m [16 in. option)]</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Special</td>
<td></td>
<td>9</td>
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<table>
<thead>
<tr>
<th>Conduit Entry</th>
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<tbody>
<tr>
<td>20 mm (0.78 in.)</td>
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<tr>
<td>½in. NPT</td>
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<td>2</td>
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<table>
<thead>
<tr>
<th>Conduit Length (see Note 1)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td>00</td>
</tr>
<tr>
<td>1 x standard 6 m (20 ft)</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>1 x standard 10 m (32 ft)</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>1 x standard special length</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>2 x standard 6 m (20 ft)</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>2 x standard 10 m (32 ft)</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>2 x standard special length</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>1 x IP65, 6 m (20 ft)</td>
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<td>31</td>
</tr>
<tr>
<td>1 x IP65, 10 m (32 ft)</td>
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<td>32</td>
</tr>
<tr>
<td>1 x IP65, special length</td>
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<td>39</td>
</tr>
<tr>
<td>2 x IP65, 6 m (20 ft)</td>
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<td>41</td>
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<tr>
<td>2 x IP65, 10 m (32 ft)</td>
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<tr>
<td>2 x IP65, special length</td>
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<table>
<thead>
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<tr>
<td>Standard flow-through cell</td>
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<tr>
<td>Fast-response cell</td>
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<table>
<thead>
<tr>
<th>Flame Arrester (see Note 2)</th>
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<td>Flame Arrester</td>
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<table>
<thead>
<tr>
<th>Reference Air Supply</th>
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<tr>
<td>External</td>
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<table>
<thead>
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<th>Mounting Plate Assembly</th>
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<td>0</td>
</tr>
<tr>
<td>Standard (see Note 3)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Standard (see Note 4)</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2½ x NPT adaptor (see Note 5)</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

Note 1. Only with 20 mm conduit entry. Special conduit lengths of less than 10 m (32.5 ft) only, when 20 mm conduit entry fitted.

Note 2. Flame arrester and/or filter not available when Fast-response Cell fitted.

Note 3. Only available with 0.4 m (16 in.) probe fitted with ABB standard flange.

Note 4. Only available with 1 m, 1.5 m and 2 (39, 58, 78 in.) probes fitted with ABB standard flange.

Note 5. Only available with 0.4 m (16 in.) probe fitted with ABB standard flange.
ZMT & ZFG2
Zirconia Oxygen Analyzer Systems

ZFG2 Probe – Overall Dimensions

Dimensions in mm (in.)

0.4 m (16 in.) Model

1.0 m (39 in.), 1.5 m (58 in.), and 2.0 m (78 in.) Models


1000, 1500 or 2000 (39.73, 59.05 or 78.74)

152 (5.98)

150 (5.9)

62 (2.44) Dia.

62 (2.44)

190 (7.48) nom.

400 (15.74)

62 (2.44) Dia.