The COSA 9610 Provides a Fast and Accurate Measurement of Wobbe Index, Heating Value and Combustion Air Requirement Index (CARI)
MEASUREMENT PRINCIPLE (RESIDUAL OXYGEN MEASUREMENT)
The COSA 9610 BTU Analyzer's measuring principle is based on the analysis of the oxygen content in the flue gas after combustion of the sample. A continuous gas sample is mixed with dry air at a precisely maintained constant ratio, which depends on the BTU range of the gas to be measured. The fuel air mixture is oxidized in a combustion furnace in the presence of a catalyst at 800°C, and the oxygen concentration of the combusted sample is measured by a zirconia oxide cell. The residual oxygen provides an accurate measurement for the Combustion Air Requirement of the sample gas, which can be correlated accurately to the Wobbe Index of the gas.

ADVANTAGES
Key advantages of this method are its insensitivity to changes in ambient temperature, a very fast response with the ability to measure gases with BTU values down to zero and the measurement of the Combustion Air Requirement Index besides Wobbe Index and Heating Value.

WOBBE INDEX VS. COMBUSTION AIR REQUIREMENT INDEX
The COSA 9610 provides a direct measurement of the Combustion Air Requirement Index (CARI) of a fuel, which is ideally suited for the precise control of the fuel-air ratio of a combustion process.

In applications where the amount of energy introduced to the burner is to be controlled, the Wobbe Index can be closely correlated to the CARI index and differences between the two measurements can be cancelled out by the use of suitable

Correlation Between Wobbe Index and Combustion Air Requirement

<table>
<thead>
<tr>
<th>Gas</th>
<th>Combustion Air Requirement (mol/mol)</th>
<th>Wobbe Index (BTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARBON MONOXIDE (CO)</td>
<td>2.427</td>
<td>326.9</td>
</tr>
<tr>
<td>HYDROGEN (H₂)</td>
<td>9.048</td>
<td>1041</td>
</tr>
<tr>
<td>ACETYLENE (C₂H₂)</td>
<td>12.52</td>
<td>1509.1</td>
</tr>
<tr>
<td>METHANE (CH₄)</td>
<td>12.787</td>
<td>1226.1</td>
</tr>
<tr>
<td>ETHYLENE (C₂H₄)</td>
<td>14.475</td>
<td>1532</td>
</tr>
<tr>
<td>ETHANE (C₂H₆)</td>
<td>16.292</td>
<td>1599.1</td>
</tr>
<tr>
<td>PROPYLENE (C₃H₆)</td>
<td>17.638</td>
<td>1830.7</td>
</tr>
<tr>
<td>BUTYLENE (C₄H₈)</td>
<td>18.541</td>
<td>2098.8</td>
</tr>
<tr>
<td>PROPAINE (C₃H₈)</td>
<td>19.126</td>
<td>1899.5</td>
</tr>
<tr>
<td>BENZENE (C₆H₆)</td>
<td>20.966</td>
<td>2275.2</td>
</tr>
<tr>
<td>N-BUTANE (n-C₄H₁₀)</td>
<td>21.487</td>
<td>2167.7</td>
</tr>
<tr>
<td>ISO-BUTANE (i-C₄H₁₀)</td>
<td>21.527</td>
<td>2156.9</td>
</tr>
<tr>
<td>PENTENE (C₅H₁₀)</td>
<td>22.34</td>
<td>2360</td>
</tr>
<tr>
<td>TOLUENE (C₆H₅)</td>
<td>22.839</td>
<td>2528.6</td>
</tr>
<tr>
<td>N-PENTANE (n-C₅H₁₂)</td>
<td>23.45</td>
<td>2425.2</td>
</tr>
<tr>
<td>ISO-PENTANE (i-C₅H₁₀)</td>
<td>23.509</td>
<td>2413.2</td>
</tr>
<tr>
<td>HEXANE (C₆H₁₄)</td>
<td>25.161</td>
<td>2663.6</td>
</tr>
</tbody>
</table>

The table and graph above shows the relationship of Wobbe Index and the Stoichiometric Dry Air Requirement for some typical gas constituents. The correlation is close to linear ($R^2=0.9767$) with an intercept close to zero. The residual oxygen method takes advantage of this correlation by linear extrapolation between measurements of known calibration gases. $R^2$ for typical natural gas constituents plus hydrogen and CO is 0.9888.
calibration gases. In natural gas applications the instrument accuracy of the COSA 9610 in terms of Wobbe Index is better than ±0.4% of reading.

The stability, accuracy speed of response and reliability of the residual oxygen measurement represent significant advantages over traditional flame calorimeters and more than compensate for the small theoretical error in calculating Wobbe. It should be noted, that other calorimeters including flame type are not primary standards either, and they also depend on the use of suitable calibration gases.

**HEATING VALUE**

For applications requiring the measurement of the Heating Value, a precision specific gravity cell with an accuracy of ±0.1% of reading is integrated into the COSA 9610, and the processor computes the heating value. In applications, where the fuel-air ratio is to be optimized based on the CARI, the measurement of specific gravity is not required.

**ANALYZER CONSTRUCTION**

The COSA 9610 is housed in a painted stainless steel NEMA4x (IP65) cabinet with the dimensions 41” x 41” x 16” suitable for outdoor installations without additional temperature controlled shelter. For extreme climate conditions, the standard operating temperature range of the COSA 9610 can be extended with the addition of a cabinet heater and/or vortex cooler. The cabinet is suitable for wall mounting or rack mounting. A rack is optionally available.

The analyzer cabinet has three compartments: the gas mixing compartment, the combustion furnace compartment and the electronics compartments.

- **Gas mixing compartment**: contains sample conditioning and the gas mixing system. Components in this compartment are intrinsically safe. The gas mixing compartment can optionally be heated to avoid condensation of heavier gas constituents.

- **Electronics compartment**: contains the industrial PC based controller, which performs all instrument control functions and calculations. Results are available through isolated analog outputs and an LCD, which is visible through a cabinet window and displays residual O2 in %, Cell voltage in mV, Wobbe-Index and Calorific Heating Value (optionally) in BTU/SCF or MJ/Nm$^3$, relative density (optional), and CARI (Combustion Air Requirement Index).

- **Combustion furnace compartment**: contains the combustion furnace with the zirconia oxide sensor. The exhaust gas is vented and drained.

- **Purge panel**: mounted at the underside of the enclosure.

**MAINTENANCE**

The COSA 9610 has no moving parts and consequently, maintenance requirements are low. With the use of proper sample conditioning, the COSA 9610 can operate unattended for several months. All compartments are easily accessible through separate doors on the front side of the enclosure.

**CERTIFICATIONS**

- FM + CSA & ATEX Certifications Available
SPECIFICATIONS
Analyzer Performance
Model:............................................ COSA 9610
Sample gas:.................................... Natural gas, fuel gas, refinery gases, biogas etc.
Ranges:............................................ Wobbe Index: 0-2730 BTU/SCF, span 1150 BTU/SCF (selectable)
CAR Index: 0-20, span 0-10
Accuracy (Wobbe):.......................... ±0.4% of reading for natural gas
±2.0% of reading for refinery gases with large variations of constituents and BTU values
Repeatability............................... ±0.7 BTU/SCF......
Drift.............................................. 0.4 BTU/SCF/24 hours
Response time............................ T90 < 5 sec Wobbe only
T90 ≥ 10sec with *Density cell
*Streaming option for <5 seconds
Ambient temperature.............. Standard: -40°C to +60°C
Outputs.......................... 2 x isolated 4-20mA, with programmable span
Backlit LCD screen
Malfunction relay
Specific Gravity (optional)............. Range: .......... 0.2-2.2 rD

Utilities:
Power supply ....................... 110 VAC, 50/60 Hz or 220 VAC/50 Hz
Power consumption .......... 350 VA maximum
Instrument air ................. 20 SCFH (analyzer) at 42 PSIG
40 SCFH (z-purge) at 80 PSIG
Sample ...................... 2 SCFH at 28 PSIG

Installation:
Mounting................................. Wall mounting
Dimensions............................ 40.82" x 40.82" x 16.33"
(1000 x 1000 x 400 mm)
Weight................................. 110 lbs (50 kg)
Certifications......................... COSA 9610 A
Ex ib px II T3 Gb Ta=+5°C to 45°C, IP66
II 2G
FM11ATEX0006X

DIMENSIONS

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