Specification WIM Wobbe Index Analyser

Analyser Performance

- *Make* : Hobré Instruments B.V.
- *Service* : Natural gas, fuel gas, biogas, steel plant gas, etc.
- *Ranges* : - Wobbe Index 0-95 MJ/Nm^3 selectable span
  : - CARI 0-20
- *Optional* : Specific Gravity, Calorific Value, Air Demand
- *Accuracy* : ± 0,4% of MV (natural gas)
- *Repeatability* : ± 30 kJ/Nm^3
- *Drift* : < 15 kJ/Nm^3/day non-directional
- *Response time*: T90 < 5 seconds
- *Autocalibration*: standard (low and high Wobbe)
- *Output* : - 2/4 x 0/4-20 mA isolated
  : - TFT color screen
  : - status relay outputs
- *Protection* : General purpose
  ATEX Cat. II 3G Eexp IICT3
  ATEX Cat. II 2G Eexp IICT3

Utilities

- *Power supply* : 110/220 VAC - 50/60 Hz 350 VA
- *Instrument air*: 10 nL/min at 4 barG

ATEX version
- *Instrument air*: 40 nL/min at 4 barG
- *Start-up* : 170 nL/min (6 minutes)
- *Sample flow* : 1 nL/min at 1.5 barG

Installation

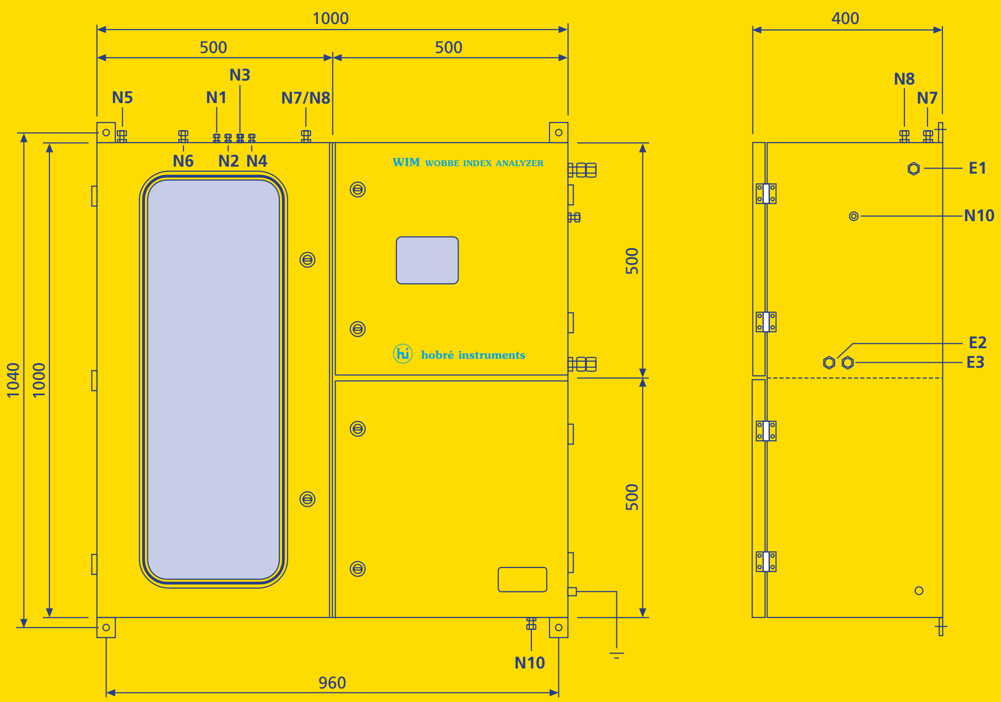
- *Mounting* : Wall mounting
- *Dimensions* : 1000 x 1000 x 400 mm
- *Weight* : ± 50 kg
- *Ambient temperature* : 10-40 °C

ATEX version
- *Mounting* : floor mounting
- *Dimensions* : 1800 x 1250 x 400 mm
- *Weight* : ± 120 kg

Please consult factory for options including: low pressure version, low and high ambient temperature version, integrated micro GC etc.

Connections

E1	Power supply analyser
E2	Analog signal (4-20mA)
E3	Digital signal
N1	Process gas supply
N2	Supply calibration gas low
N3	Supply calibration gas medium (optional)
N4	Supply calibration gas high
N5	Instrument air (pilot/instrument air)
N6	Atmospheric vent
N7	Atmospheric vent
N8	Atmospheric vent
N9	Purge air (optional)
N10	Condensate drain



Your dealer:

Hobré Instruments B.V.
Netwerk 4
P.O. Box 328
1440 AH Purmerend
The Netherlands
Tel. (31) 0299 - 420871
Fax (31) 0299 - 423302

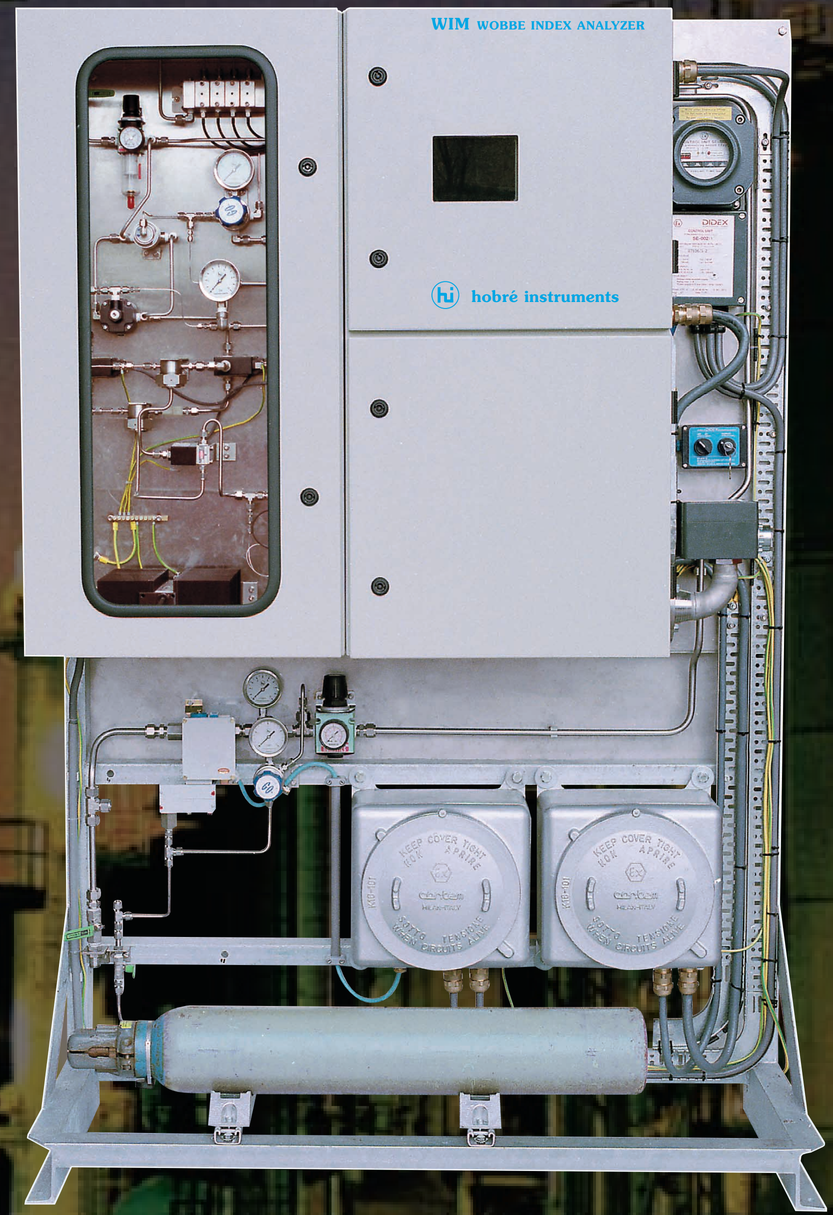
Hobré Instruments (UK) Ltd
Unit 2, Prince Rupert House
Bumpers Way, Chippenham
Wiltshire, SN14 6NQ
United Kingdom
Tel. (44) 01249 - 444133
Fax (44) 01249 - 444107

hobré instruments   www.hobre.com

Design and Realization: Creative Studio's - February 2006 - Specifications subject to change without notice

WIM

WOBBE INDEX ANALYSER



For fast analysis of Wobbe Index and Air Demand

WIM WOBBE INDEX ANALYSER

The WIM (Wobbe Index Meter) measures the Wobbe Index and the Air Demand of natural gas, refinery fuel gases and biogas. The measuring principle is based on the analysis of the oxygen content in the flue gas after combustion of the sample.

The analyser offers unique benefits:

- Designed for process control applications
- Fast response time - T90 response less than 5 seconds
- Insensitive to ambient temperature variations - no need for air conditioned environment
- No moving parts - minimal maintenance
- Newly developed computer based controller - user friendly yet very complete software
- Auto calibration - remote calibration and validation
- Flameless analyser - gases with low Wobbe Index may be measured
- Combustion Air Requirement Index is calculated for furnace control

Typical applications include feed forward and feedback control of blending of gases to a certain Wobbe Index, the control of furnaces, the analysis of biogas and gas turbine control. The WIM is available as a Cenelec certified version and can be built as a weather proof system. User specific systems, for example for very wet gases or for measuring very wide ranges can be designed and built in our factory in Purmerend, the Netherlands.

The following models are available:

WIM 9901	Standard model for general purpose area
WIM 9901 Ex	ATEX version for hazardous areas
WIM 9902	Dual range analyser for extended measuring range, safe area
WIM 9902 Ex	ATEX version of dual range analyser

Use of WIM in furnace control, using gaseous fuels

a Description of control problem

In many refineries and petrochemical plants, furnaces and boilers can be exposed to frequent and sudden changes in the fuel gas composition.

Several of these gases may contain large concentrations of CO and H_2.

Users are looking for a method to control the air/fuel ratio in such a way that disturbances in the temperature are minimised and the air fuel ratio is controlled in such a way that combustion process occurs with maximum efficiency.

b Meaning of the Wobbe Index Value (Hs) in Burner Control

The calorific value of a gas in MJ/Nm^3 is the amount of energy generated with the combustion of 1 Nm^3 of fuel gas. When we look at the gas flow over a restriction (orifice or valve) the flow (Q) varies according the formula:

$$Q_v = \alpha \cdot A_0 \sqrt{\frac{2\Delta p}{\rho}}$$

Q_v = flow
α = factor depending on size and shape of restriction
Δp = differential pressure
ρ = density
A_0 = diameter orifice

From the above formula it can be concluded that when the density of the fuel gas on a burner changes, the flow will also change and the energy produced will also change.

Therefore the Wobbe Index value, which is the Hs/√d, is introduced. This value indicates the amount of energy fed to a burner. Two gases with the same Wobbe value will produce the same amount of energy in a burner, at a fixed differential pressure.

c Meaning of the Combustion Air Requirement Index (CARI)

The Stochiometric Air Requirement Index of gas is the amount of dry air to burn 1 Nm^3 of fuel gas. The CARI value is this air requirement divided by the square root of the relative density of the fuel gas. This CARI value indicates again how much air is needed for Stochiometric combustion of a fuel gas, independent of the density of the fuel gas.

d Why are both the CARI and Wobbe Index important parameters for fuel gas

The CARI value is an important parameter for the optimum combustion of the fuel gas. The Wobbe Index analyser is the parameter which determines the amount of energy introduced into the burners.

For mixtures of inert gases and $C_n H_{2n+2}$ the Wobbe Index and CARI have a known relationship. The ratio between these values is 4,16.

Example: CH_4 : ratio is 4,163
C_3H_8 : ratio is 4,152

For mixtures of inert gas, ($C_n H_{2n+2}$), CO and H_2 the ratio is not constant; CO and H_2 have a ratio between Wobbe and CARI of 5,3.

When the fuel gases are containing CO and H_2, the CARI value is therefore needed for control of the air/fuel ratio.

The WIM has an overall response time of less than 10 seconds. By selecting the proper sample take-off point, this fast response guarantees stable furnace control, even with fast and frequent changes of the fuel gas.

e What is it that the WIM analyser measures

The Hobré Instruments WIM analyser measures the excess oxygen after complete combustion of the fuel gas and air. The mixing of fuel and air takes place over restriction orifices. There is a linear relationship between the excess oxygen measured and the CARI of the gas.

The accuracy of the instrument for CARI measurement is better than 0,4%, even with large fluctuations in the CO and H_2 content.

The excess oxygen content measured in the WIM can be correlated also to the Wobbe Index of the gas. When CO and H_2 are present there is a non-linear relationship. The typical accuracy for Wobbe Index measurement with large variation in CO and H_2 content is 2%.

f Control of furnace on CARI and Wobbe value

When the WIM analyser is calibrated in CARI value, the output can be used for the control of the air-fuel ratio. In this control loop there is no need to take the fuel gas density into account. A differential pressure measurement over an orifice or pitot tube will be sufficient for the flow signal.
Control based on CARI value will result in small errors in the energy to the burners. This error can be compensated by the temperature control loop of the furnaces.

g Conclusion

a. The temperature control should be made by increasing the air flow to the furnace. The amount of air is a better parameter for the amount of heat produced than the fuel flow.

b. The fuel/air ratio is to be controlled by the WIM analyser. If air flow is increased, due to a need to increase the temperature or a higher product flow, the fuel will have to be increased by the fuel/air ratio control loop also.

The WIM has an overall response time of less than 10 seconds. By selecting the proper sample take-off point, this fast response guarantees stable furnace control, even with fast and frequent changes of the fuel gas.