Explosion-proof Calorimeter

Model: OHC-800

The importance role of Calorimeter

RIKEN KEIKI

"Saving Energy" is getting more attentions from all over the world and the concern enables us to make progress of efficient energy usages.

Calorimeter will contribute to the world enabling to use fuel gas efficiently by accurate calorific value measurement.

The customer Benefits of accurate calorific value measurement

Accurate calorific value measurement

Efficient Air-Fuel ratio control of combustion furnace, gas engine, boiler and gas turbine

- Energy-saving
- Misfire trouble prevention
- Stable operation of the production process
- Environmental friendly

Application

OHC-800 can be used in various fields where gas measurement is required.

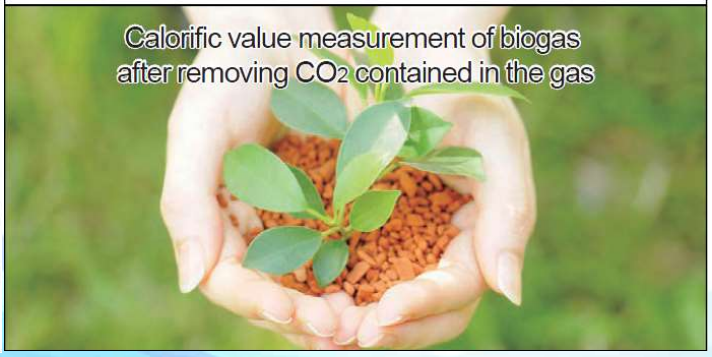
Electric power energy
(Power generation plant, cogeneration power plant)

Gas energy
(LNG terminal etc.)

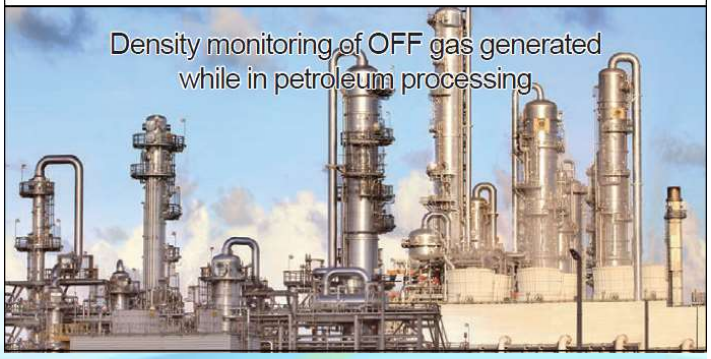
Gas engine for ship
(LNG ship etc.)

Iron steel
(Coke-oven etc.)

Biogas
(Biogas plant, general factory)

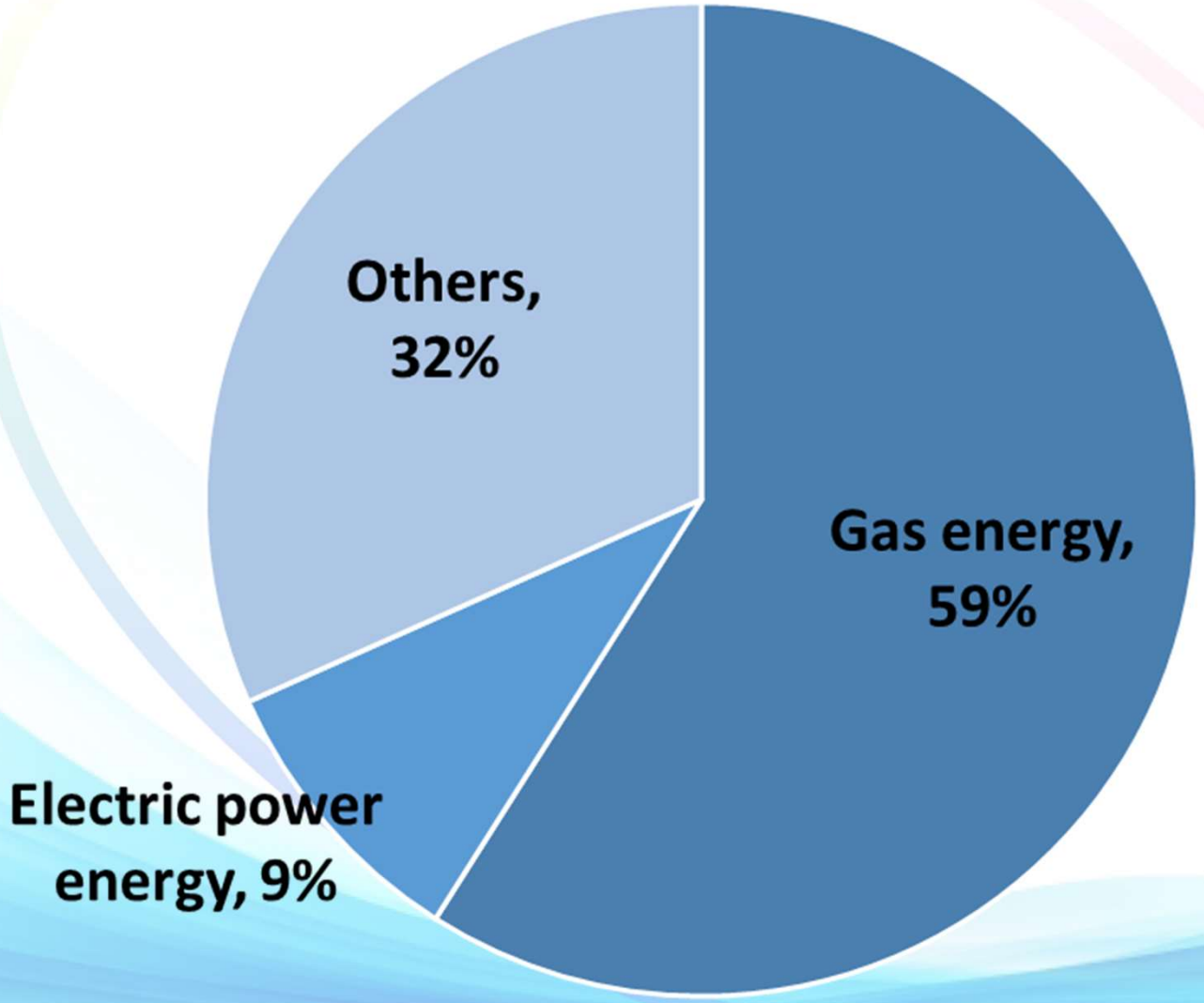


Refinery
(Refinery plant, petro chemical plant)



The applications above are just examples.
Contact RIKEN KEIKI for the other measuring targets and measuring ranges.

Number of shipments from 2013 to 2018



Total 161 units

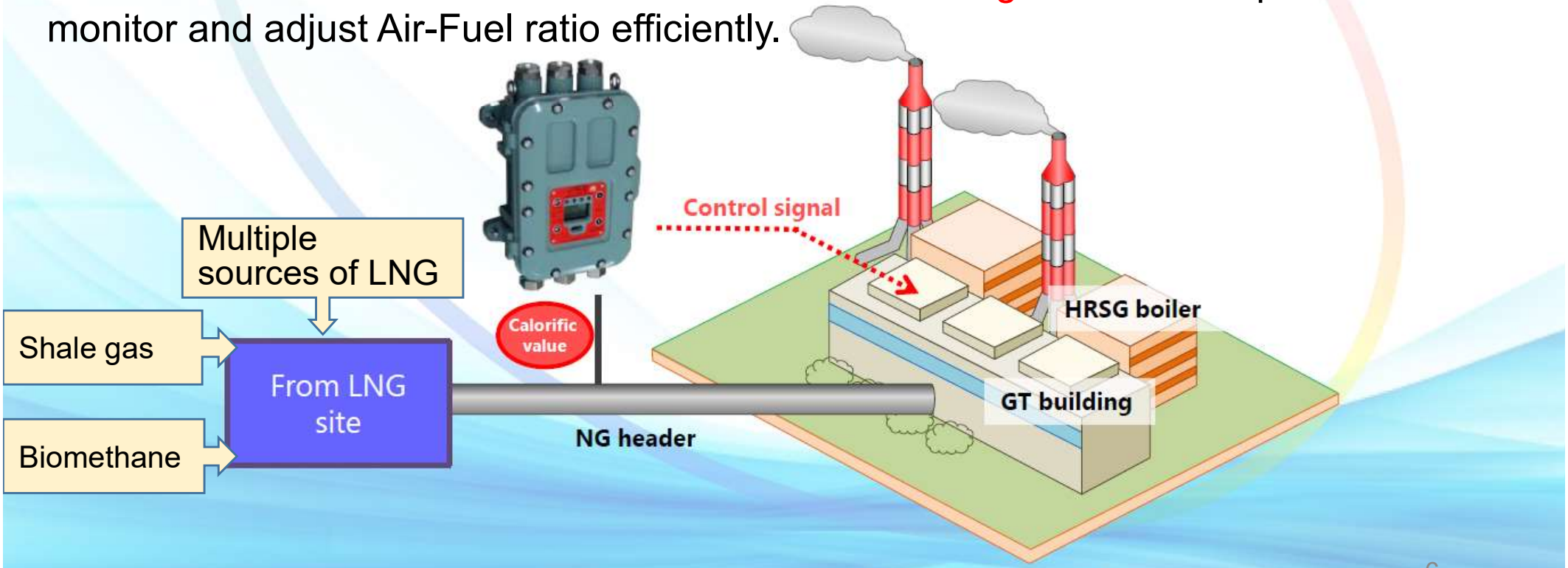
The most popular application

(Power generation by gas turbine)

- LNG is vaporized in the vaporizer to become natural gas (NG).
NG is then supplied to the turbine via the NG header.

Gas turbine operations may be affected by variations in the calorific value of the gas caused by diversification of LNG sources, an increase in BOG* processing …etc.

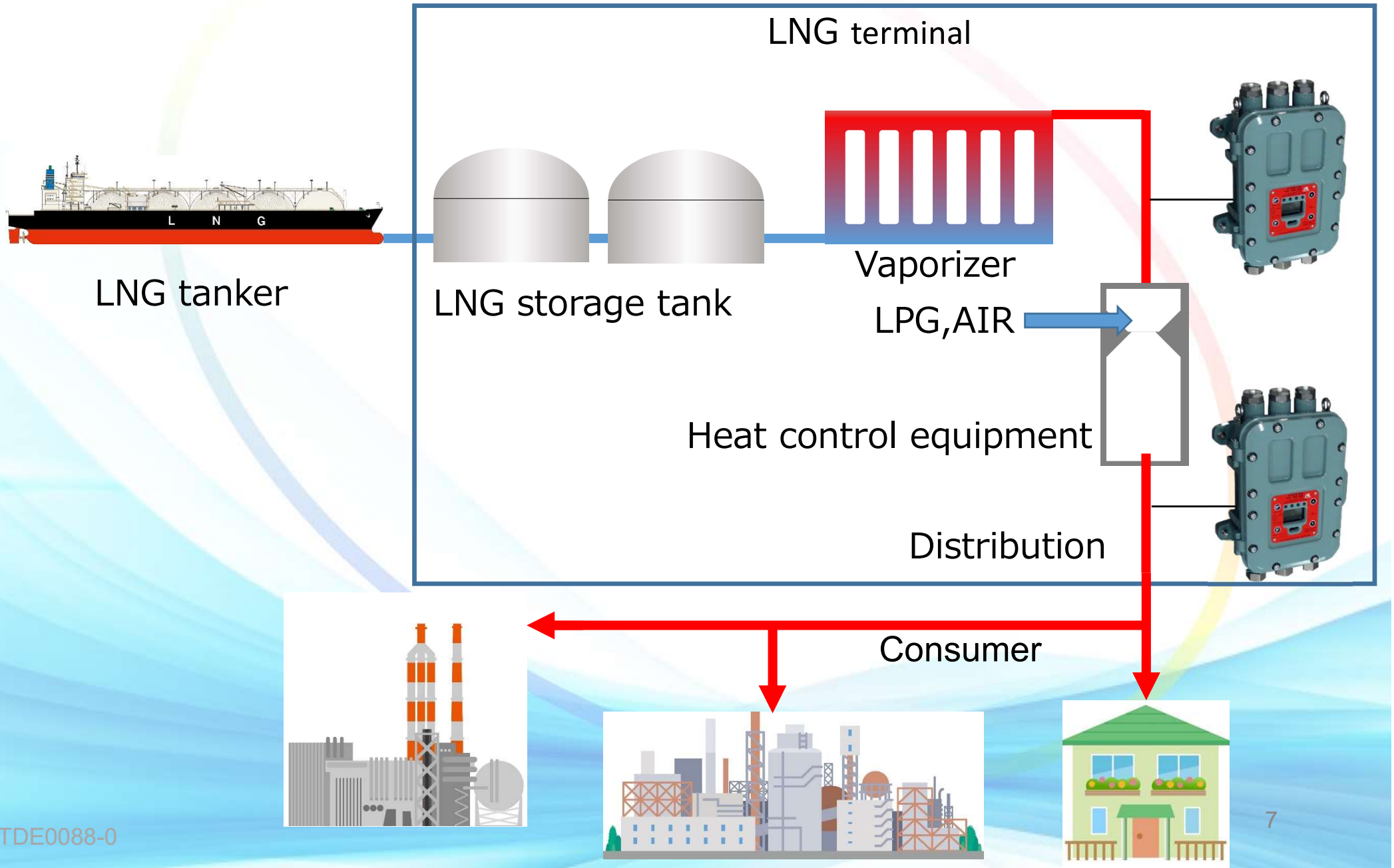
⇒ Fast & Accurate measurement of calorific value using OHC-800 helps users to monitor and adjust Air-Fuel ratio efficiently.



* BOG (boil off gas): Gas formed by vaporization of part of LNG stored in a tank

The most popular application

(LNG terminal)



The most popular application
(Steel-By-Product Gas)

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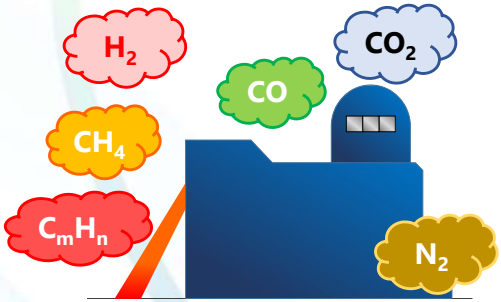
① COG（Coke oven gas）

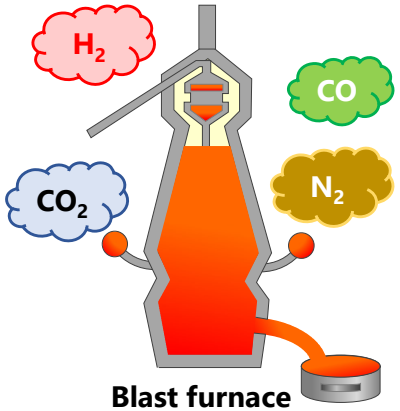
H_2 : 56vol%
CH_4 : 30vol%
C_mH_n : 3vol%
CO : 6vol%
CO_2 : 2.5vol%
N_2 : 2.5vol%



Coke plant

② BFG（Blast furnace gas）

H_2 : 4vol%
CO : 22.5vol%
CO_2 : 22.5vol%
N_2 : 51vol%

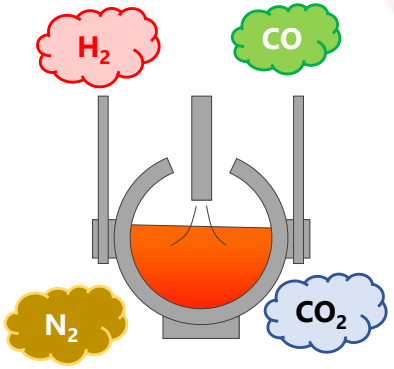


Blast furnace

Pig iron

③ LDG（Linz-Donuwitz converter gas）

H_2 : 1vol%
CO : 68vol%
CO_2 : 16vol%
N_2 : 15vol%



Converter

Energy conversion

Boiler, Power generation facility

Error due to fluctuations in CO concentration, type OHC-800 was unable to accurately measure the steel by-product gas. By combining the CO gas detector, it is now possible to perform calculation correction and measure accurate calorimetry.

Why OHC-800

- High accuracy
- High response speed
- Minimum effects of N_2,O_2,CO etc. and H2
- Maintenance-free
- Easy parts replacement

Why OHC-800

- **High accuracy**
- **High response speed**
- **Minimum effects of N_2,O_2,CO etc. and H2**
- **Maintenance-free**
- **Easy parts replacement**

Why OHC-800

- **High accuracy**

Accuracy ≦ ±0.02MJ/m^3

※ In the case of general specifications for LNG

Why OHC-800

- High accuracy
- **High response speed**
- Minimum effects of N_2,O_2,CO etc. and H2
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Why OHC-800

- **High response speed**

T90 ≦ 5sec

Why OHC-800

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- High response speed
- **Minimum effects of N_2,O_2,CO etc. and H2**
- Maintenance-free
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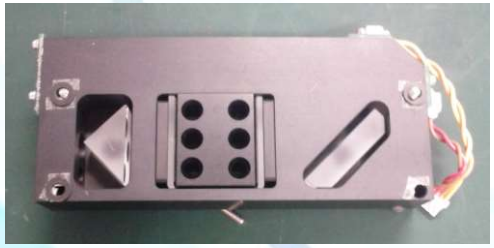
Why OHC-800

- **Minimum effects of N_2,O_2,CO etc.**

OHC-800 is equipped with two sensors, a “optical sensor” and a “sonic sensor”.



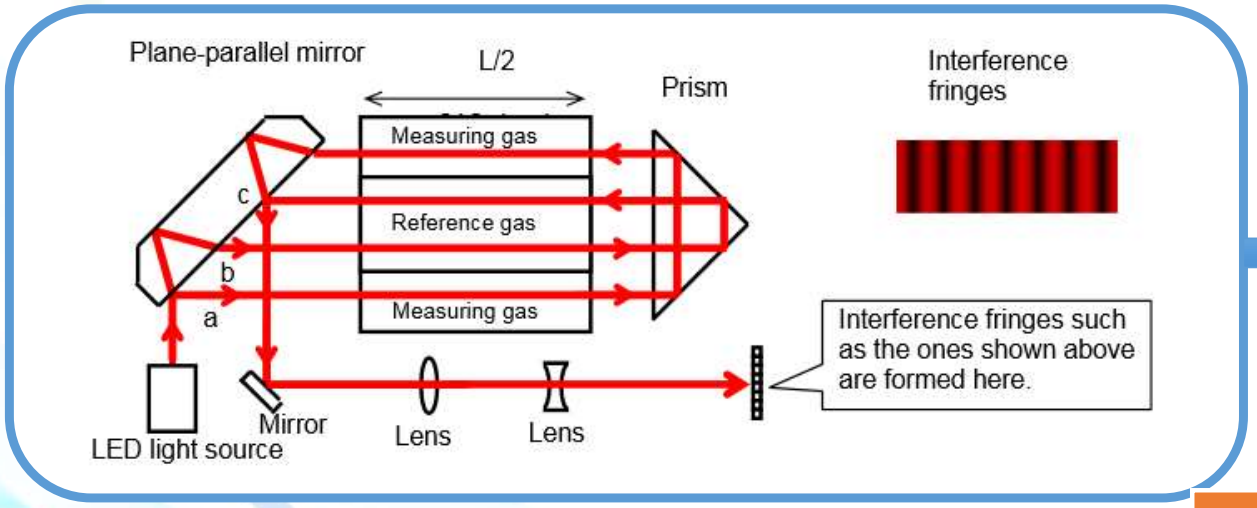
← Optical sensor

←Sonic sensor

Why OHC-800

- **Minimum effects of N_2,O_2,CO etc.**

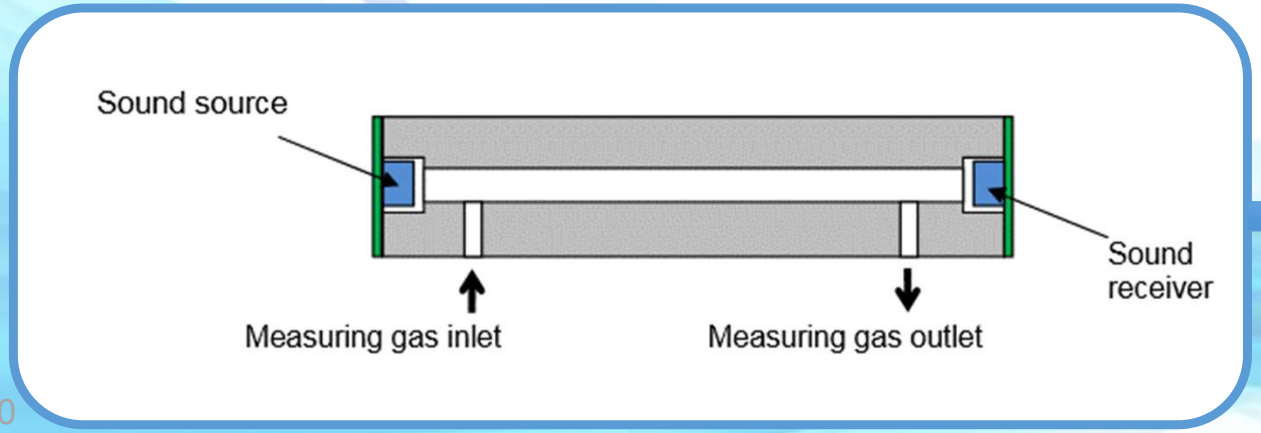
Optical sensor



Refractive index of the gas

"Opt-Sonic" calculation

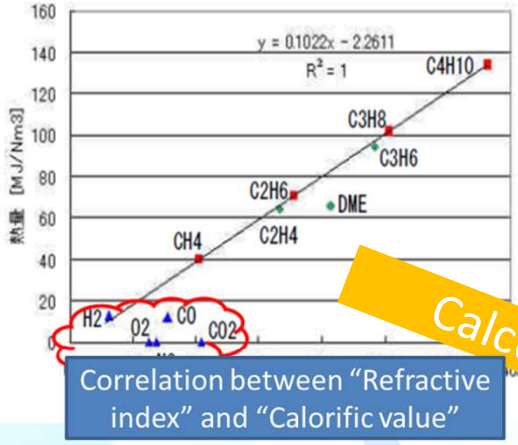
Sonic sensor



Sound velocity of the gas

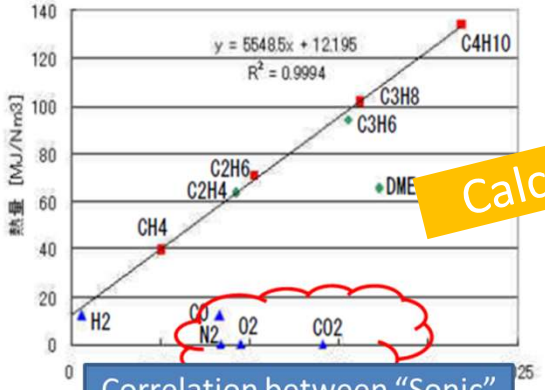
Why OHC-800

- **Minimum effects of N_2,O_2,CO etc.**



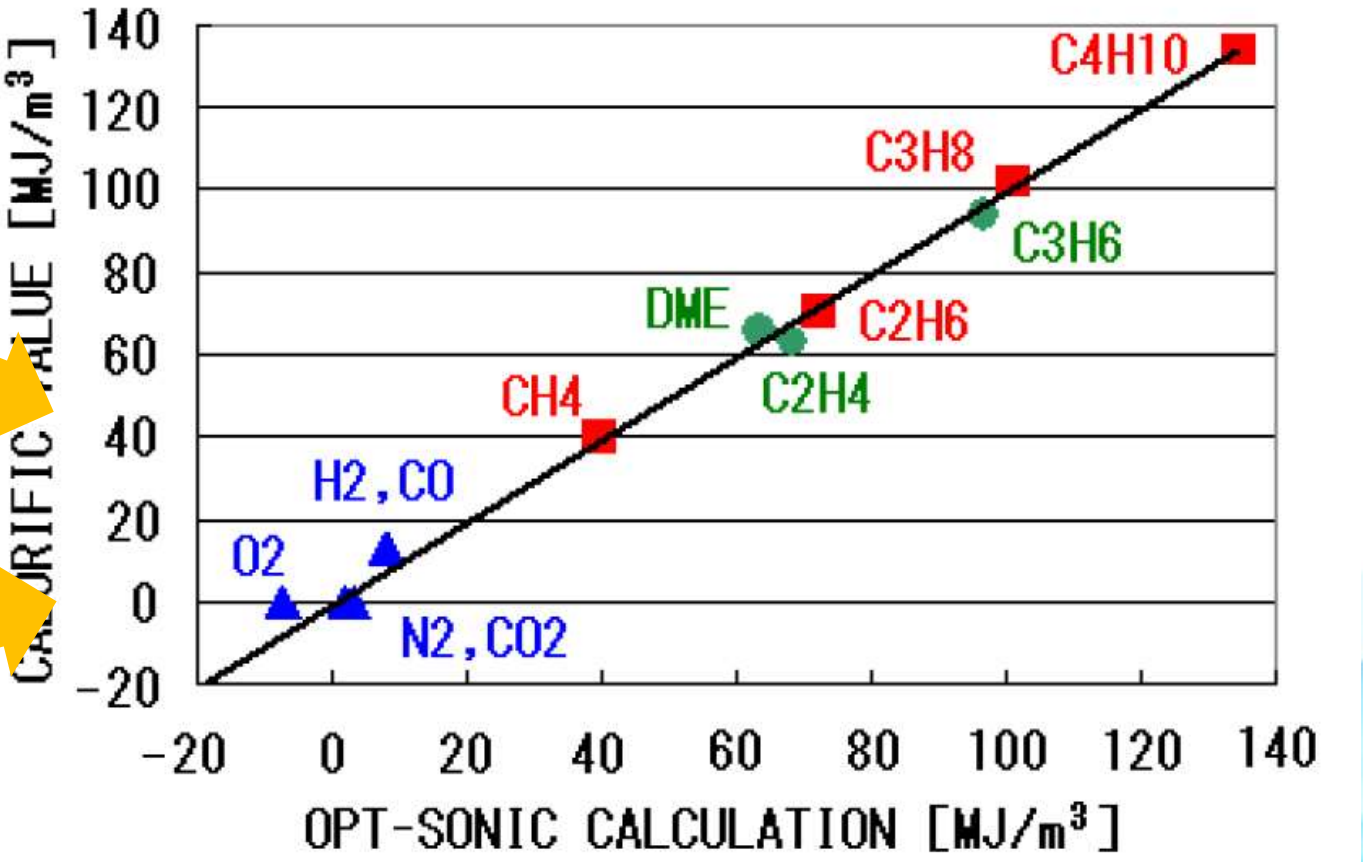
Correlation between "Refractive index" and "Calorific value"

Calculation



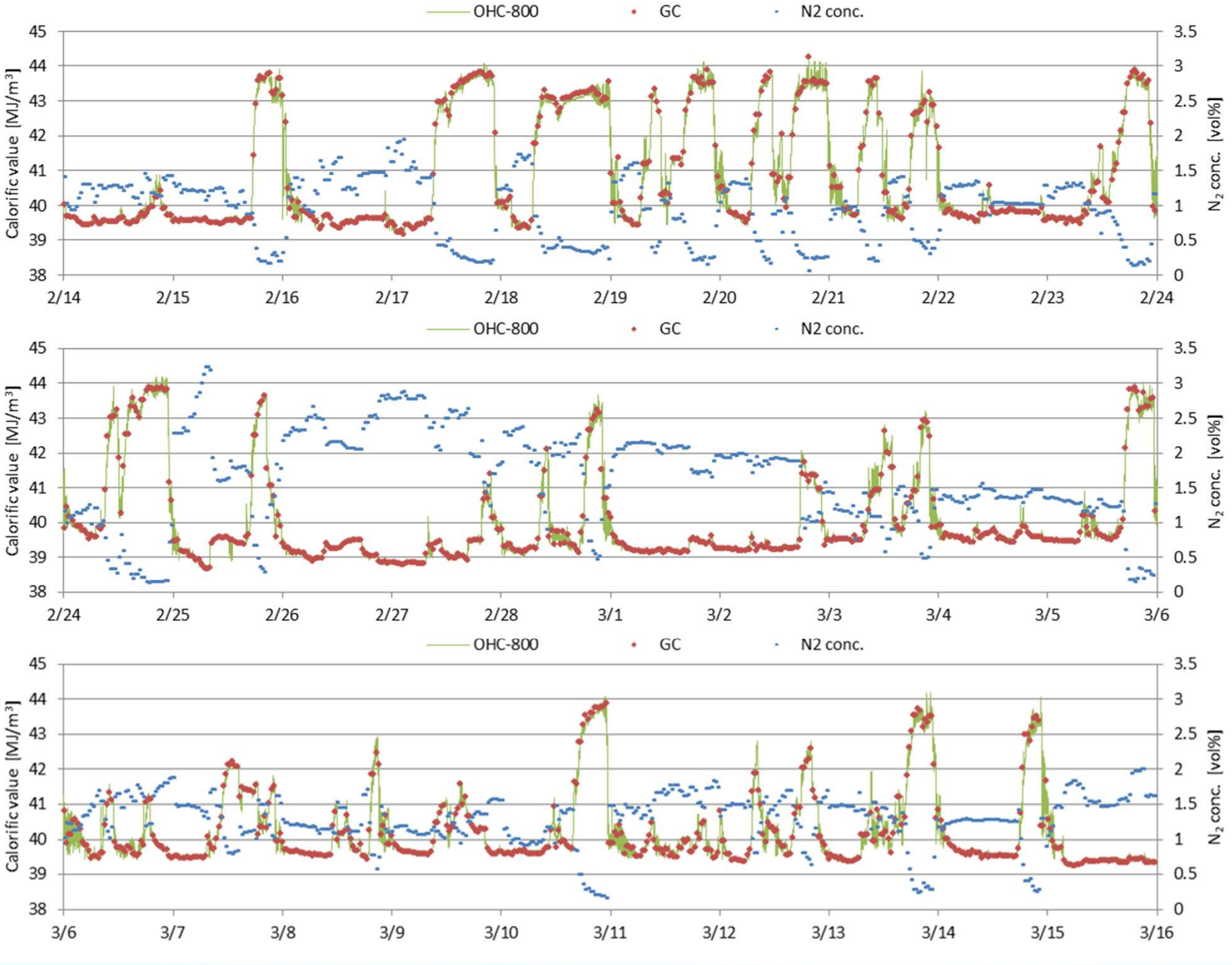
Correlation between "Sonic" and "Calorific value"

Calculation



Relationship between Opt-Sonic calculation and calorific value

（Comparison with GC）



Why OHC-800

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- **Minimum effects of high H2**

	Composition, vol%						ISO 6976			OHC-800			Error, %		
							calorific value		specific gravity	calorific value		specific gravity	calorific value		specific gravity
	CH_4	N_2	CO_2	O_2	H_2	C_2H_6	MJ/Nm^3, Gross	BTU/ft^3, Gross	AIR=1	MJ/Nm^3, Gross	BTU/ft^3, Gross	AIR=1	MJ/Nm^3, Gross	BTU/ft^3, Gross	AIR=1
A	30		70				11.98	304.2	1.238	11.86	301.2	1.235	0.98	0.98	0.17
B	30	10	60				11.98	304.1	1.181	12.07	306.6	1.178	-0.83	-0.83	0.29
C	30	8	60	2			11.98	304.1	1.184	11.85	300.8	1.181	1.08	1.08	0.26
D	40		60				15.97	405.5	1.140	15.95	405.1	1.137	0.11	0.11	0.22
E	40	10	50				15.97	405.5	1.084	16.12	409.3	1.081	-0.94	-0.94	0.27
F	40	8	50	2			15.97	405.5	1.086	15.88	403.2	1.084	0.57	0.57	0.21
G	50		50				19.96	506.9	1.043	20.06	509.3	1.038	-0.47	-0.46	0.41
H	50	10	40				19.96	506.8	0.986	20.16	512.0	0.983	-1.03	-1.03	0.35
I	50	8	40	2			19.96	506.8	0.989	19.92	505.9	0.986	0.20	0.20	0.27
J	80	20					31.95	811.2	0.638	32.30	820.1	0.630	-1.10	-1.10	1.31
K	80		20				31.94	811.1	0.750	32.03	813.4	0.744	-0.28	-0.28	0.82
L	80	10	10				31.94	811.1	0.694	32.20	817.7	0.686	-0.81	-0.81	1.16
M	100						39.94	1014.1	0.555	39.95	1014.4	0.551	-0.04	-0.04	0.77
N	60				40		29.05	737.8	0.361	29.07	738.1	0.365	-0.05	-0.05	-1.11
O	80				20		34.49	875.8	0.458	34.47	875.3	0.457	0.06	0.06	0.20
P	40		30		30		19.79	502.4	0.701	19.94	506.3	0.710	-0.76	-0.76	-1.27
Q	65				30	5	33.29	845.4	0.434	33.16	842.0	0.436	0.40	0.40	-0.49

Test results in enagas

Reference gas mixture:	1		2		3		4		5		6
Bottle Nº:	BOC-194546		BOC-132862		BOC-194506		BOC-194558		Linde - D213407		Natural gas
Components:	Amount	Uncertainty	Amount	Uncertainty	Amount	Uncertainty	Amount	Uncertainty	Amount	Uncertainty	Amount
	% mol/mol		% mol/mol		% mol/mol		% mol/mol		% mol/mol		% mol/mol
Methane	90,87	0,1	79,15	0,06	49,76	0,25	70,85	0,05	85,53	0,86	91,6219
Ethane	5,019	0,018	10,01	0,04	29,94	0,15	14,9	0,08	7,686	0,08	4,9387
Propane	0,994	0,005	1,268	0,009	0,1	0,001	4,856	0,017	1,906	0,02	0,7054
iso-Butane	0,151	0,001	1,274	0,007	2,464	0,013	-	-	0,3083	0,006	0,2264
n-Butane	0,202	0,002	0,0095	0,00019	-	-	2,491	0,013	0,491	0,010	0,1194
iso-Pentane	0,0501	0,0008	0,1895	0,001	-	-	0,1	0,0006	0,0504	0,003	0,04
n-Pentane	0,0501	0,0008	0,402	0,0041	-	-	0,01059	0,00024	0,0516	0,003	0,0217
n-Hexane	0,0497	0,0016	0,15	0,0009	-	-	0,01008	0,00024	0,0502	0,003	0,0659
Nitrogen	1,002	0,006	2,619	0,014	7,535	0,038	3,818	0,02	2,737	0,03	1,1459
Carbon dioxide	0,498	0,003	1,009	0,008	3,028	0,016	1,505	0,006	1,191	0,01	1,1148
Carbon monoxide	0,0508	0,0011	-	-	2,01	0,011	-	-	-	-	-
Oxygen	0,0102	0,0006	0,0853	0,00171	0,0607	0,0013	0,1253	0,0013	-	-	-
Hydrogen	0,998	0,01	3,763	0,019	5	0,025	1,324	0,007	-	-	-
Helium	0,05	0,0011	-	-	0,103	0,002	-	-	-	-	-
Net Calorific Value (MJ/m³)	37,51	0,04	39,06	0,04	40,87	0,13	42,75	0,06	38,58	0,31	37,36
Relative density	0,6010	0,0006	0,6524	0,0006	0,7826	0,0022	0,7387	0,0010	0,6488	0,0049	0,7628
Net Wobbe Index (MJ/m³)	48,39	0,03	48,35	0,03	46,20	0,09	49,74	0,04	47,89	0,21	42,78
Methane Number	79		63		56		57		71		79

Reference conditions: 0°C, 0°C 101,3025 kPa
Net calorific value, relative density, Wobbe index and their associated uncertainties, calculated according to ISO 6976:2016
Methane number calculated according to EN 16726-2015. NOTE: This method is valid for L & H natural gasses. It could not reproduce MN for mixtures with H_2 up to 5 %
Uncertainty (k=2)

CV RESULTS (MJ/m3)	RGM 1	RGM 2	RGM 3	RGM 4	RGM 5	NG
Experimental Average:	37,49	39,05	40,69	42,92	38,60	37,34
Repeatability (%):	0,13%	0,04%	0,04%	0,05%	0,08%	0,17%
Theoretical value:	37,51	39,06	40,87	42,75	38,58	37,33
Accuracy (%):	-0,07%	-0,02%	-0,45%	0,38%	0,07%	0,03%

Test results in enagas

Overall results

5 Reference gas mixtures + Natural gas		
Components:	**Range**	
	% mol/mol	
Methane	50	92
Ethane	5	30
Propane	0,1	5
iso-Butane	0,1	2,5
n-Butane	0,01	2,5
iso-Pentane	0,05	0,2
n-Pentane	0,01	0,4
n-Hexane	0,01	0,05
Nitrogen	1	7,5
Carbon dioxide	0,5	3
Carbon monoxide	0	2
Oxygen	0	0,1
Hydrogen	0	5
Helium	0	0,1
Net Calorific Value (MJ/m^3)	**37**	**43**
Relative density	**0,6**	**0,8**
Net Wobbe Index (MJ/m3)	**43**	**50**
Methane Number	**56**	**79**

The system complies with accuracy limits for CVDD class A (OIML 140)

Response time < 30 s

Results better than the following limits

Property	Repeatability	Accuracy
Net Calorific Value:	0,2%	0,5%
Relative Density:	0,2%	1%
Wobbe Index:	0,2%	1%

NOTE 1: Repeatability expressed as 2 times the standard deviation

Off-set adjustment every 15 days

Reference conditions: 0ºC, 0ºC 101,3025 kPa

Net calorific value, relative density, Wobbe index and their associated uncertainties, calculated according to ISO 6976:2016

Methane number calculated according to EN 16726-2015. NOTE: This method is valid for L & H natural gasses. It could not reproduce MN for mixtures with H_2 up to 5 %

Uncertainty (k=2)

It was confirmed that OHC-800 has performance complying with the international legal metrology

Why OHC-800

- High accuracy
- High response speed
- Minimum effects of N_2,O_2,CO etc. and H2
- **Maintenance-free**
- Easy parts replacement

Why OHC-800

- **Maintenance-free**

Both sensor is Physical based sensor.
(No chemical reaction, No burning …etc.)

↓

- **No calibration is required**
  (Sensitivity is stable for very long time)
- **No consumables is required**

↓

Periodic maintenance work
after installation is not required!!

Why OHC-800

- High accuracy
- High response speed
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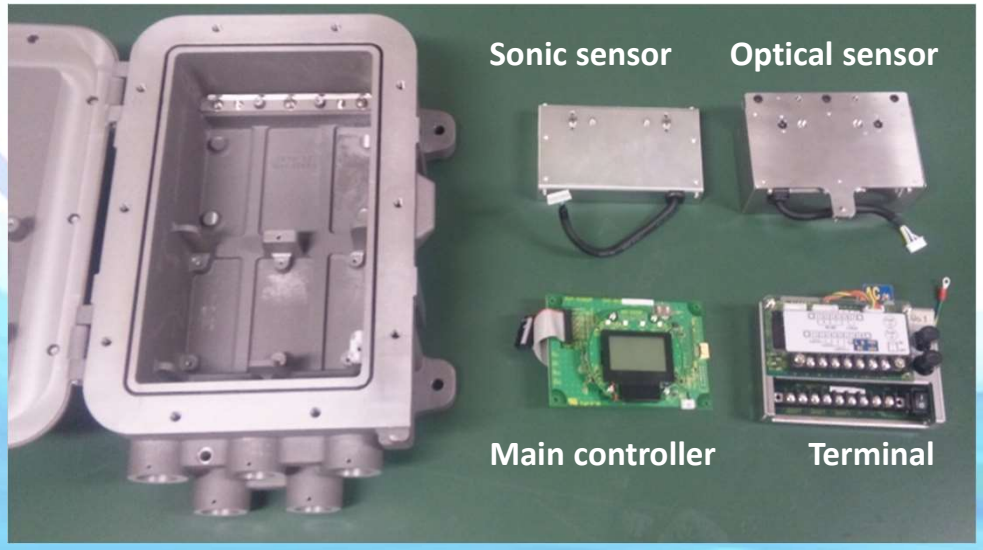
Why OHC-800

- **Easy parts replacement**

Easy unit replaceable design

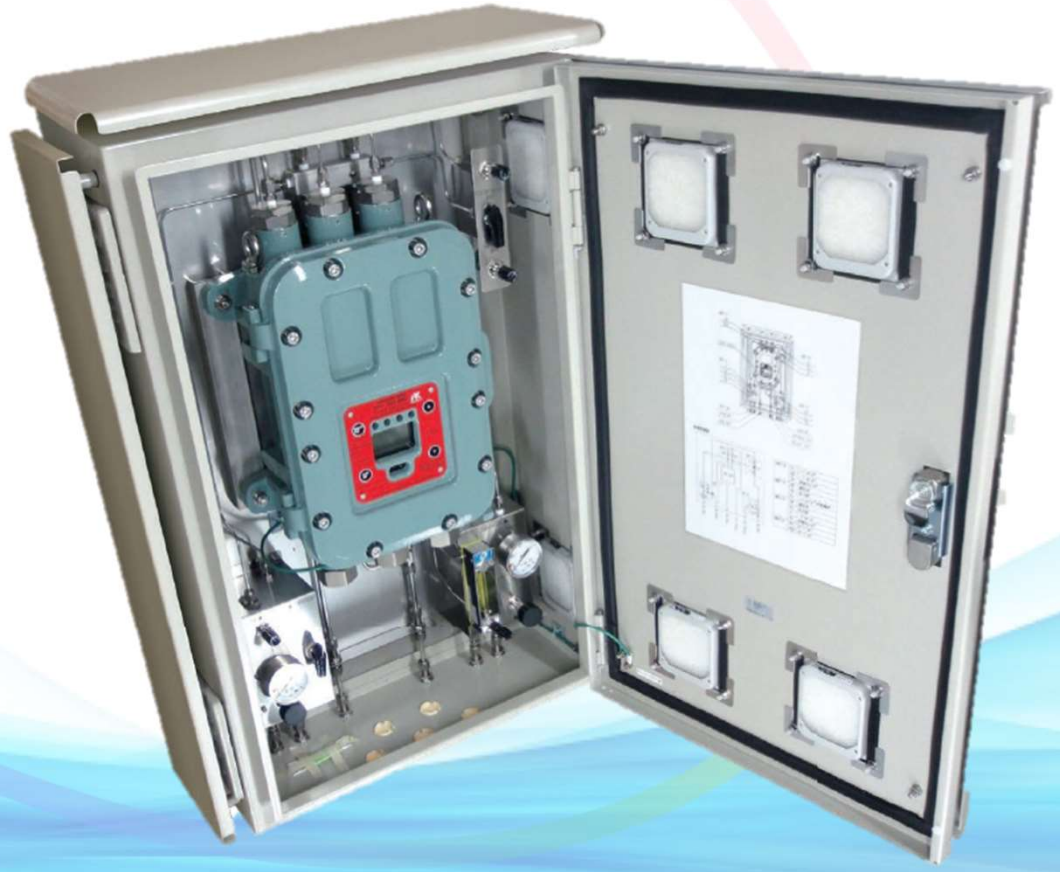
OHC-800 is composed of 4 parts. If abnormal condition is monitored by the self-diagnosis function, and replacement part is needed, it is only required to replace the deteriorated unit to the new unit. No further adjustment required after the unit replacement.



Install available to various places

- **Explosion proof : IECEx / ATEX Ex d IIB + H2 T4 Gb**
  Installable to hazardous area

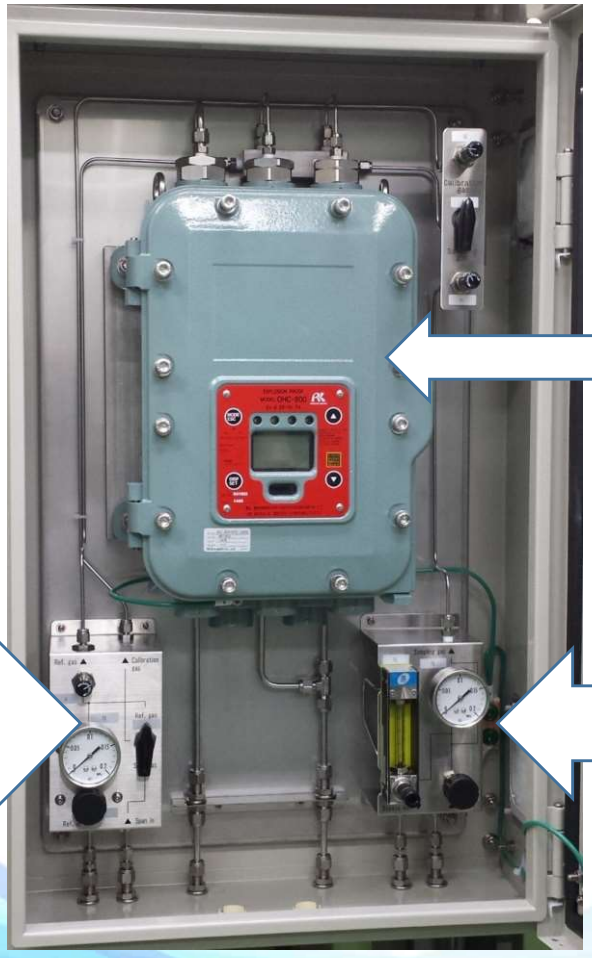
- **Operating temperature : -20 to +60°C**
  Installable to the variety of temperature condition



Standard sampling device

No carrier gas needed

- **Instrument Air only is needed as Reference gas.**



Measuring unit
OHC-800

Pressure reduction unit for
Reference gas-in
Instrument Air (or N2)
0.02 to 0.9MPa, 15mL/min

Pressure reduction &
by-pass unit for
sampling gas
0.02 to 0.9MPa,
300mL/min

Reference
GAS IN

Measuring
GAS IN

Data logger and data analysis service

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- **Data logger**

  < DAILY LOG >

  Collect data every 3 hours. Max. 3519 data can be stored (for 439 days)

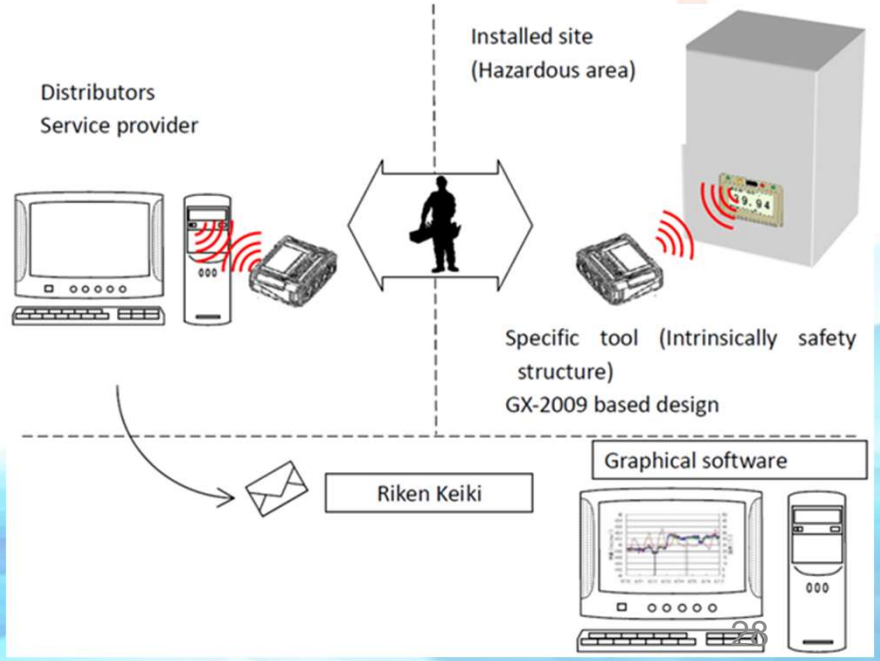
  - Recorded Date & Time
  - Measured value, Temp./Pressure…etc
  - Data of sonic sensor unit for 20 minutes before data collection (1 minute interval×20 times)
  - Data of optical sensor unit for 20 minutes before data collection (1 minute nterval×20 times
  - Trouble flag/Self-diagnosis flag…etc.

  < EVENT LOG >

  Data for 1 minute just after particular kind of event is caused (6 seconds interval×10times)
  Max.64 data can be stored.

- **Data analysis service**

  Logged data can be downloaded by using a specific tool (GX-2009DL).
  If some abnormal operation is found on the OHC-800, send the data to RIKEN KEIKI, so that RIKEN KEIKI will do data analysis and provide some feedback to customers.



Comparison between sensor principles

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Principle	GC	Residual oxygen content	Combustion	Opt-Sonic	IR	TCD	TCD + IR + Density	Raman
Continuous measurement	NG	★★★	★★★	★★★	★★★	★★★	★★	★★★
Response time	★	★★	★★	★★★	★★★	★★★	★★	★★★
Explosion proof	★★★ Zone 1	★★ Zone2	NG	★★★ Zone 1	★★ Zone2	★★★ Zone 1	★★★ Zone 1	★★★ Zone 1
Accuracy	★★★	★	★	★★★	★★★	★	★★★	★★★
Gas composition analysis	★★★	NG	NG	NG	★★	NG	★	★★★
Carrier gas	★ Needed	★★★	★★★	★★★ (Ref. Air only)	★★★	★★★	★★★	
Maintenance (Calibration etc.)	★	★	★	★★★	★	★	★	★
Natural gas (NG)	★★★	★	★	★★★	★★★	★	★★★	★★★
NG + H2	NG	★	★	★★★	NG	Unknown	★	Unknown
Iron steel gas	★★	★	★	★ (+IR ★★★)	Unknown	Unknown	Unknown	Unknown
Biogas	★★★	★★★	★★★	★★	★★★	Unknown	★★★	★★★
Refinery gas	★★★	★	★	★★★	Unknown	Unknown	Unknown	Unknown
LPG	★★★	★	★	★★★	★★★	Unknown	Unknown	★★★
OIML R140	Some have Class A			Class A (Applying)		Some have Class B	Some have Class A	

OHC-800

Certification Standards

RIKEN KEIKI

Field test and demo measurement

Once you use the OHC-800, you would be satisfied with the quality.

We would like to provide you with the demo unit for a field test.Why don’t you try it?

RIKEN KEIKI

We are a pioneer in creating safe working environments for workers.