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Technical Information and User Manual

NCP-170S -6 Catalytic Flammable Gas Sensor

For Industrial Application

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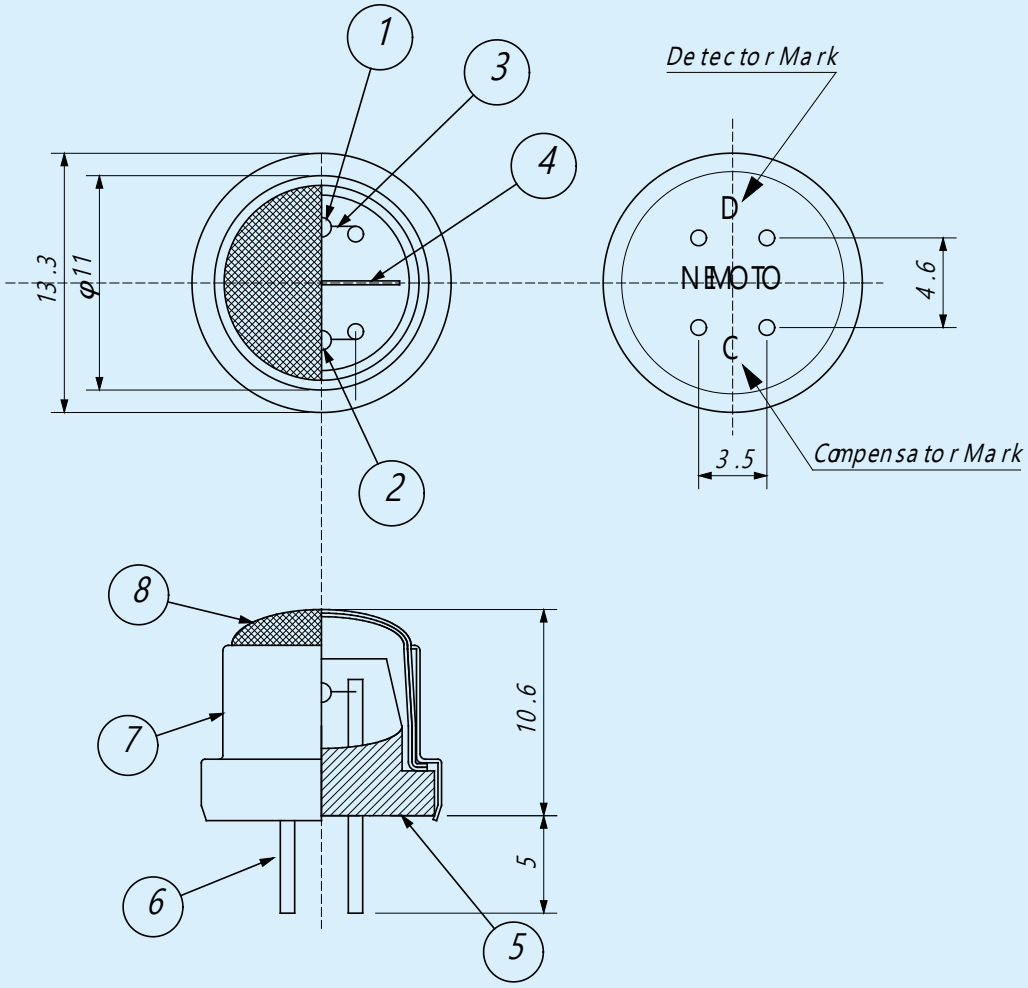
1. General Description

Catalytic type gas sensor NCP series were developed for industrial applications, and NCP-170S-6 is a single header type gas sensor for general combustible gases. Supply voltage and current are compatible with other sensors, however the shape is different from others. On the other hand, reliability, repeatability, stability and responsibility are quite superior to others, additionally the durability in strict circumstance are quite excellent. Features and typical application are as follows.

2. Ratings and Specifications

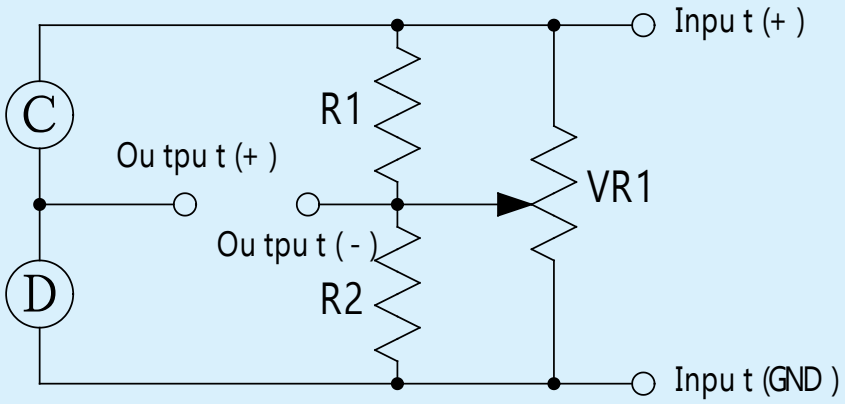
Supply voltage to sensor	AC 2.0 +/- 0.1V(50 - 60Hz) DC 2.0 +/- 0.1V
Current (when 2.0V is supplied)	AC 175 +/- 15mA(50 - 60Hz) DC 175 +/- 15mA
Ambient temperature and humidity in operation	Temperature -20 ~ +60 degree C Humidity Less than 95%RH (non-condensing)
Ambient temperature and humidity in storage	Temperature -30 ~ +70 degree C Humidity Less than 99%RH non-condensing)
Detection range	0 – around 60%LEL Lower accuracy over 60%LEL (Except acetylene)
Zero offset value in air	0 +/- 30mV (without trimming resistor)
Minimum sensitivity	45mV/1% of methane
Response time	Less than 8 sec. at T90 Less than 3 sec. at T50
Linearity	Effectively linear to 60%LEL
Detection accuracy	+/- 1%LEL
Span drift	< +/- 1% signal/month
Zero offset drift	< +/- 1mV/month
Warranty period	24 months

3. Dimensions and Materials of Construction



No	Parts	Materials	Remarks
8	Mesh	SUS316#100	Duoble
7	Strainer	Brass with Ni coating	t=0.2
6	Pin	Ni	φ0.8
5	Base mount	Phenol	—
4	Separator	SUS304	t=0.2
3	Coil	Pt	φ0.03
2	Compensator	—	—
1	Detector	—	—

4. Basic Measuring Circuit



(R1, 2 : 200ohm, VR1 : 3Kohm)

5. Gas Sensitivity Characteristics

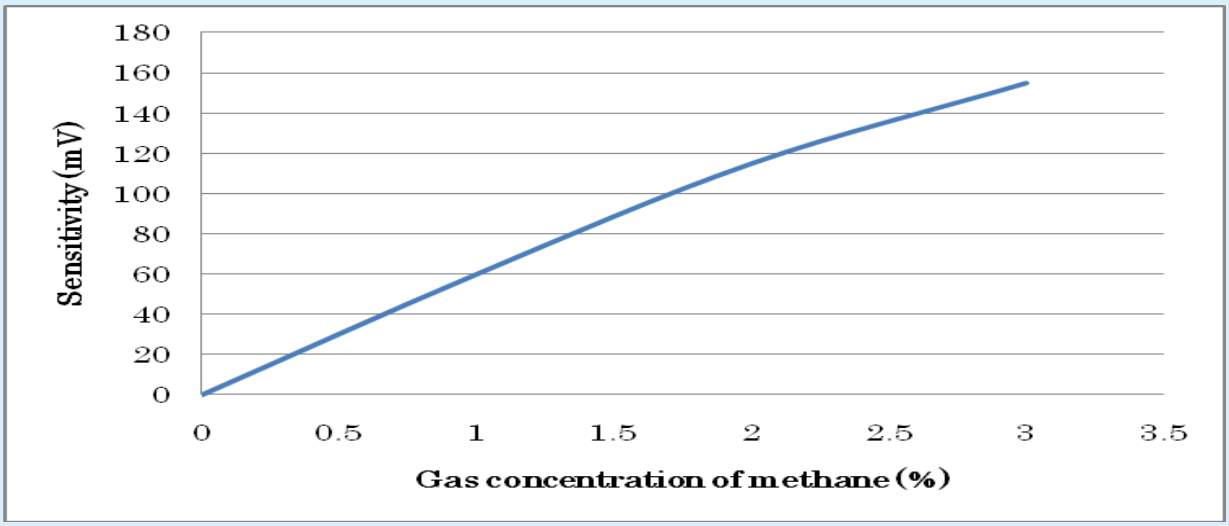
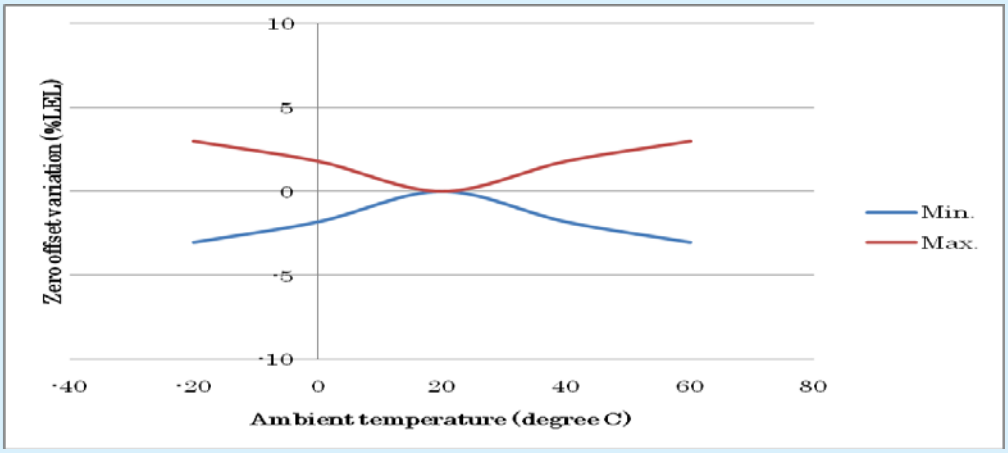
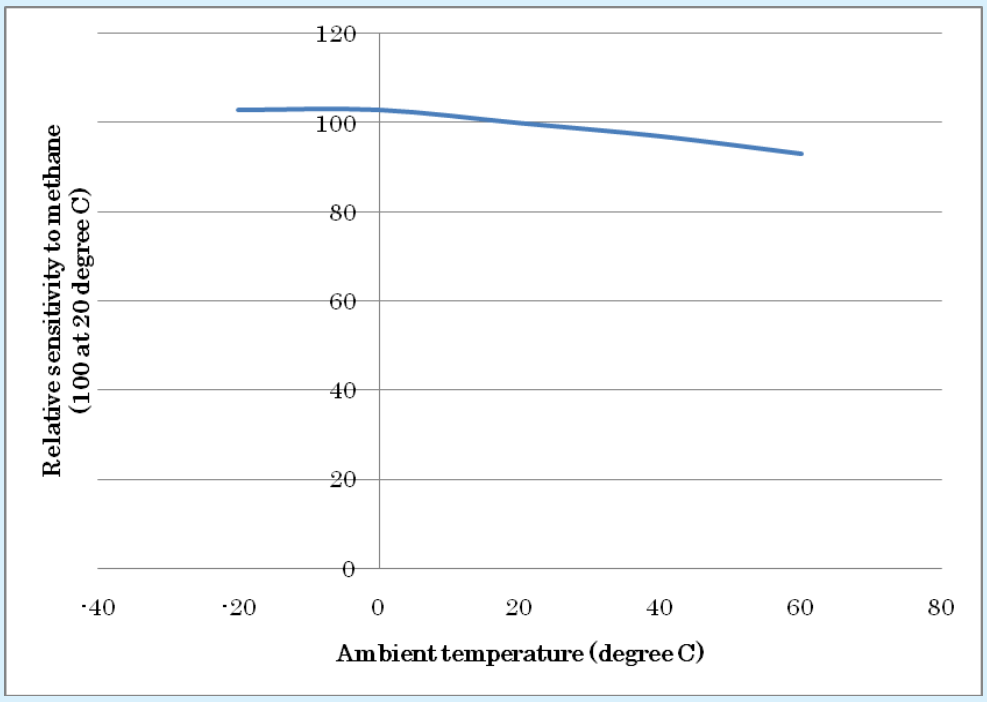


Fig. 3 : Gas sensitivity characteristics

6. Temperature Dependence (Measured at 60%RH)

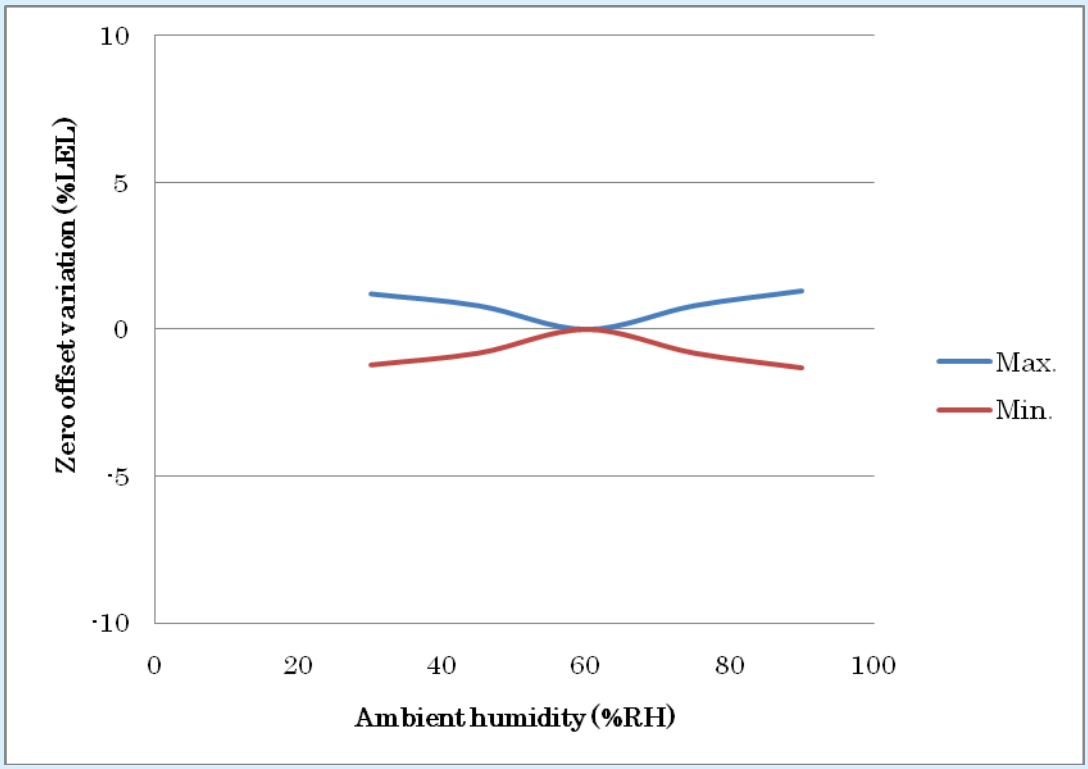


Temperature dependence of zero offset

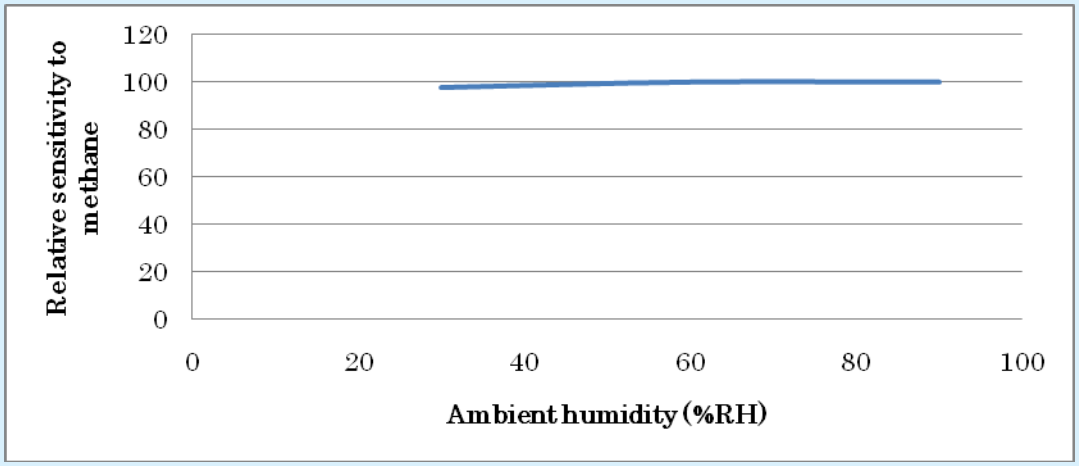


Temperature dependence of relative sensitivity to methane

7. Humidity Dependence

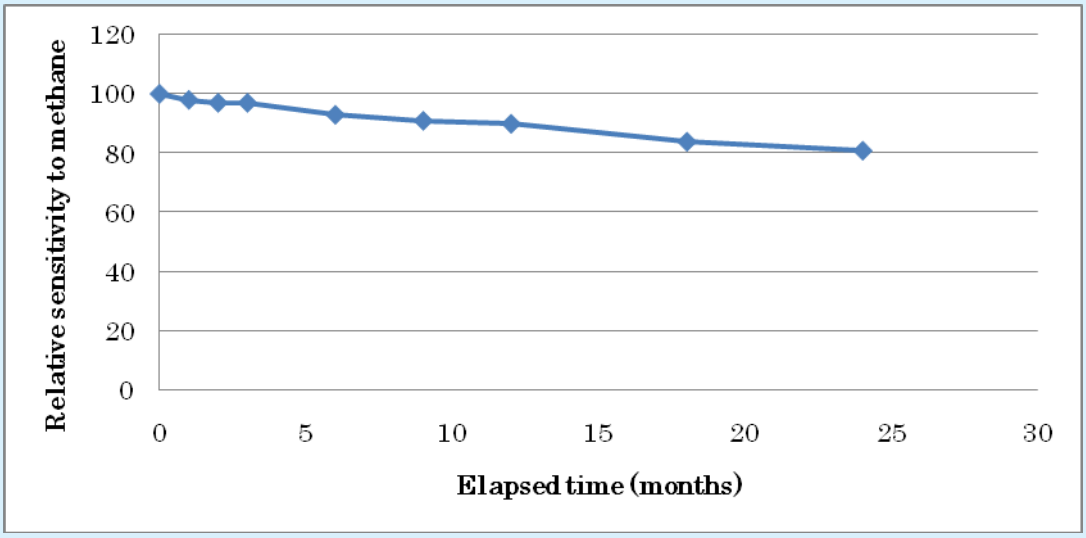


Humidity dependence of zero offset
(at 25 degree C)



Humidity dependence of relative sensitivity to methane

8. Long term stability



Long term stability of relative sensitivity to methane

9. Sensitivity distribution

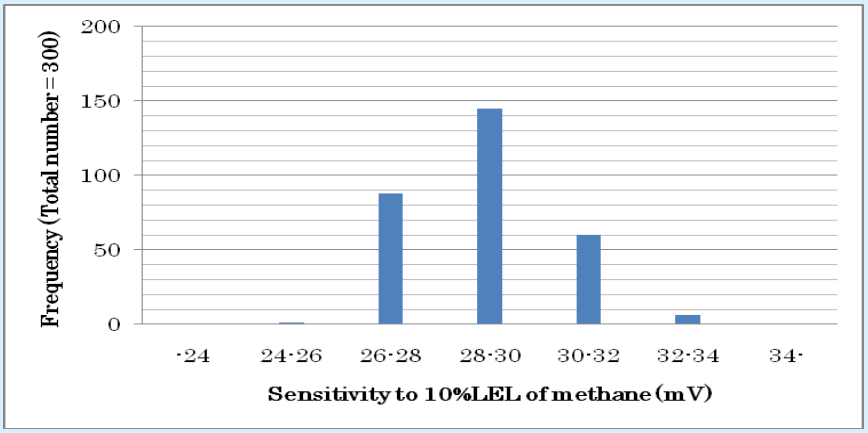


Fig. 9 : Sensitivity distribution

10. Relative Responses to Various Gases

Sensitivity to methane is set at 100)

Gas/Vapor		Chemical formula	LEL (%)	Relative sensitivity
Std.	**Methane**	**CH4**	**5.0**	**100**
1	Acetone	(CH3)2CO	2.6	75
2	Ethanol	C2H5OH	3.3	85
3	Ethyl acetate	C2H5COOH	2.2	75
4	Ethylene	C2H4	2.7	95
5	Hydrogen	H2	4.0	130
6	Iso-propanol	CH3-C2H4COOH	2.2	75
7	Methanol	CH3OH	6.7	125
8	Methyl ethyl ketone	CH3-CO-C2H5	1.9	55
9	N-butane	C4H10	1.8	80
10	N-heptane	C7H16	1.05	65
11	N-hexane	C6H14	1.2	80
12	N-pentane	C5H12	1.4	80
13	Propane	C3H8	2.1	90
14	N-octane	C8H18	0.95	60
15	Toluene	C6H5CH3	1.2	60
16	Ammonia	NH3	15.0	140
17	Carbon monoxide	CO	12.5	100
18	Unleaded petrol		1.2	80

Note: If data on other flammable gases not given here is required, please contact Nemoto.

11. Tolerance to Environmental Extremes

a) Exposure to Hydrogen Sulfide:

Test conditions:
Sensors were exposed in 50%LEL of methane and 25ppm of hydrogen sulfide for 1hr. at normal temperature and humidity.

No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity toCH4
1	27.6	100	28.8	96
2	8.3	100	8.9	94
3	23.3	100	24.8	97
4	10.4	100	11.7	101
5	17.8	100	19.4	93

b) Exposure to Silicones

Test conditions:

Sensors were exposed in 50%LEL of methane and 10ppm of HMDS (HexaMethylDiSiloxane) for 1hr. at normal temperature and humidity.

No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity to CH4
1	22.1	100	22.7	88
2	-9.2	100	-8.8	83
3	12.8	100	14.1	90
4	18.1	100	18.7	71
5	-4.7	100	-4.1	76

c) Exposure to overrange levels of Methane

Test conditions:

Sensors were exposed in 8% (160%LEL) of methane at normal temperature and humidity for 1hr.

No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity to CH4
1	25.8	100	26.7	94
2	-4.7	100	-3.2	93
3	11.4	100	13.3	91
4	11.8	100	13.3	98
5	-7.5	100	-6.6	94

d) Drop test

Test conditions:

Sensors were dropped from the height of 30cm onto a hard wooden board of 3cm thickness with free fall by 3 times.

No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity to CH4
1	21.2	100	21.1	100
2	-18.4	100	-18.7	100
3	15.8	100	16.8	100
4	14.8	100	16.2	97
5	12.2	100	14.1	100

e) Vibration test

Test conditions

Vibration which is 10Hz with the 4mm of amplitude for 20min. to 3 directions of X, Y and Z was applied to sensors at normal temperature and humidity.

No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity to CH4
1	0.7	100	0.4	100
2	8.1	100	8.8	100
3	21.1	100	21.3	101
4	-8.9	100	-9.0	100
5	10.5	100	10.9	102

f) Storage in high temperature and humidity

Test conditions:

Sensors were stored in 60 degree C, 90%RH for 1000hrs. without being energized.

No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity to CH4
1	-4.4	100	-4.9	97
2	12.2	100	11.8	96
3	-1.8	100	-2.7	94
4	24.9	100	25.6	98
5	21.7	100	22.1	98

g) Operation in high temperature and humidity

Test conditions:

Sensors were energized in 60 degree C, 90%RH for 1000hrs.

No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity to CH4
1	-27.2	100	-26.4	95
2	14.5	100	15.0	94
3	29.0	100	28.9	94
4	22.7	100	23.5	91
5	10.3	100	10.8	92

h) Storage in low temperature

Test conditions:

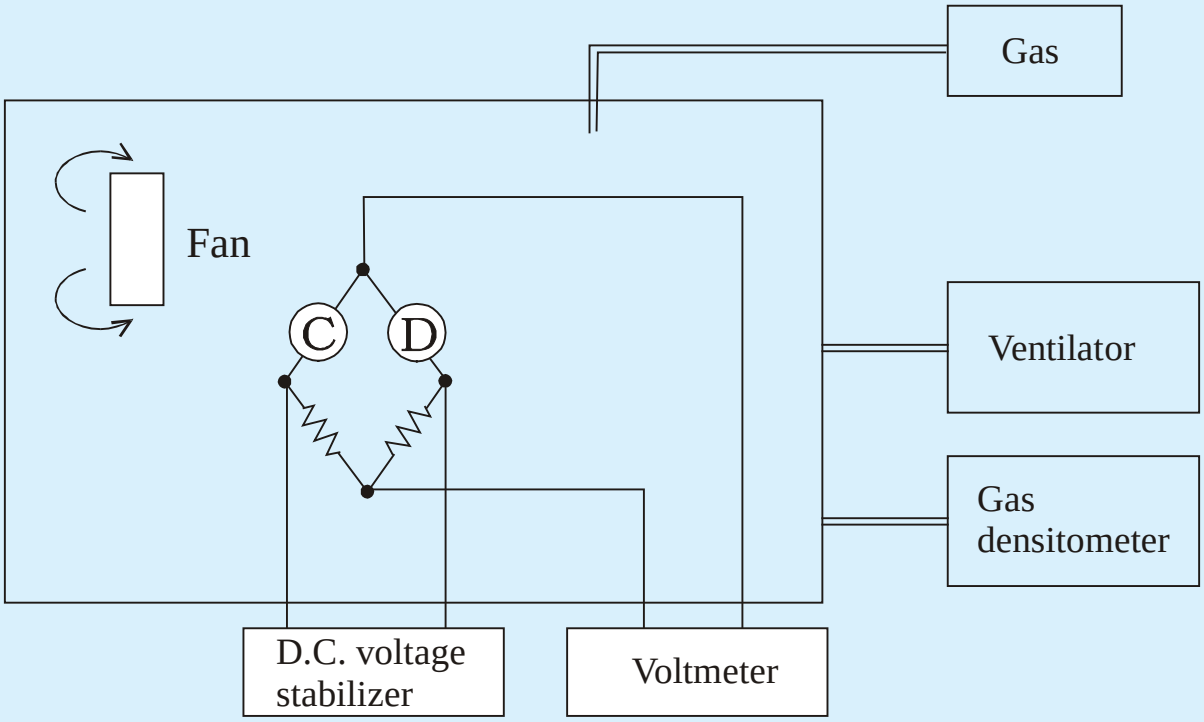
Sensors were stored in -20 degree C for 1000hrs.

No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity to CH4
1	-17.5	100	-16.8	98
2	19.7	100	19.8	95
3	10.4	100	11.1	93
4	26.4	100	25.6	97
5	12.3	100	13.8	97

12. Evaluation method

Test equipment:

Outline of test equipment is as follows.



A) Test chamber

- Material of test chamber is to be inactive like metal, glass or acrylic resin which does not exhale and adsorb gases.
- Volume of test chamber is to be more than 1 litter per 1pc. of sensor.

B) Test Conditions

・ Clean circumstance is recommended as evaluation area. Dirty circumstance which contains combustible gases like organic solvent vapor is to be avoided.

C) Gas densitometer

・ Laser gas densitometer is recommended, but volume method is available simply.

D) Agitation in test chamber

・ Air agitation in test chamber is to be conducted carefully in order not to flow air to sensor directly. Air velocity to sensor is to be less than 0.5m/sec.

E) Power supply

・ Both of AC power and DC power are available for sensor, however DC power supply is recommended for accurate evaluation.

F) Digital volt meter

・ Since the impedance of sensor is fairly low, general digital volt meter having over 100kohm as input impedance is sufficiently available.

G) Ventilation

・ Ventilator with ventilation capacity of over 10 times/min. of the volume of test chamber is recommended for the convenient evaluation.

H) Installation position of sensor in test chamber

・ When the sensor is installed in test chamber, it should be careful that each sensor is to be in constant position because output signal changes in case that position of sensor changes. If the rough evaluation is carried out, such careful treatment is not necessary.

I) Adjustment of gas concentration

Adjustment of gas concentration is to be conducted by volume method or by using laser gas densitometer. In case of volume method, gas volume to be injected into a chamber is obtained from the calculation formula below described.

$$V(m\ell) = Vi \times C \times 10^{-6} \frac{273 + Tr}{273 + Tc}$$

V : Gas volume to be injected

Vi : Volume of test chamber ($m\ell$)

Tc : Temperature in test chamber (℃)

Tr : Room temperature (℃)

C : Target gas concentration (ppm)

J) Evaluation method

K) Preliminary aging

・ Before evaluation of sensor, preliminary aging at rated voltage for over 1 hr. is recommended for accurate evaluation.

L) Measurement

・ At first, output voltage in clean air is measured. It should be confirmed that output voltage has to be stable without fluctuation.

・ Output voltage is measured around 1min. later after the designated volume of gas is injected into a test chamber.

・ Inside of test chamber should be substituted of clean air by ventilator.

M) Notes on handling

・ Sensor is to be gently handled without adding shock or dropping.

・ Handling in a location which corrosive gases or poisonous gases exist is to be avoided.

・ Sensor does not have to be dipped in water.

・ Sensor does not have to be disassembled.

・ Do not cut pins in any case.

・ It has explosion proof structure, however it is recommended to be assembled in an approved body.

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