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## Technical Information

( Catalytic Type Gas Sensor )

Model NCP - 170S-H

(Single Header Type)

For Industrial Application





## 1. General

The Nemoto NCP-170S-H is a catalytic (pellistor) type flammable gas sensor supplied as a matched pair of pellistor elements mounted on a single header and protected by a metal mesh enclosure and can.

The sensor detects and measures the presence of flammable gases and vapours in air, in the range 0-60% of the Lower Explosive Limit (LEL) of the gas or vapour being measured. Very similar to the popular NCP-170S sensor, the NCP-170S-H employs a slightly different header material which allows the sensor to be used within a very wide temperature range (-40°C to +150°C).

The NCP-170S-H exhibits excellent long term zero and sensitivity stability and a high level of resistance to catalytic poisons. The highly automated manufacturing procedure employed by Nemoto results in a repeatable reliable sensor which, unlike similar devices, requires no trimming resistor to enable the detector to be matched with a compensator.

## 2. Features and Applications

### Features:

- Good stability
- Excellent repeatability and detection accuracy
- Good linearity against gas concentration
- Fast response

### Applications:

- Fixed type gas alarm or detector for general combustible gases
- Gas densitometer

## 3. Ratings

- 1) Supply voltage to sensor  
AC 2.0 +/- 0.1V(50 - 60Hz)  
DC 2.0 +/- 0.1V



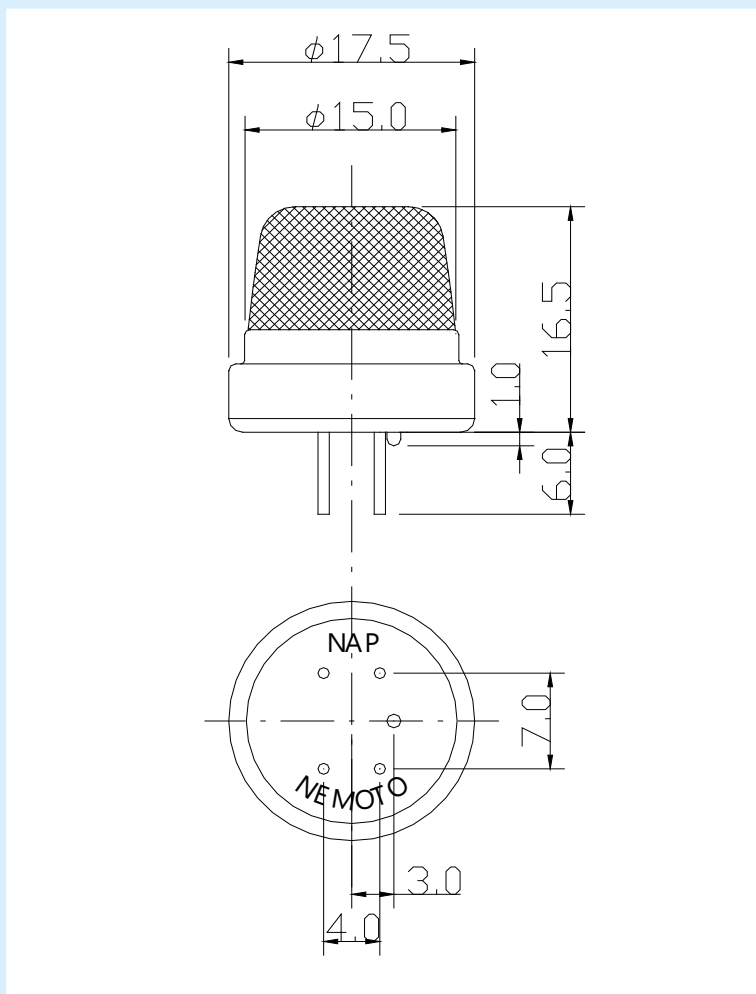
- 2) Current (when 2.0V is supplied)      AC 175 +/- 15mA(50 - 60Hz)  
DC 175 +/- 15mA
- 3) Ambient temperature and humidity in operation  
Temperature    -40 - +150 degree C  
Humidity        Less than 95%RH  
(non-condensing)
- 4) Ambient temperature and humidity in storage  
Temperature    -30 - +70 degree C  
Humidity        0-99%RH  
(non-condensing)
- 5) Linear Range                              0 – 60%LEL

#### 4. Detection Performance

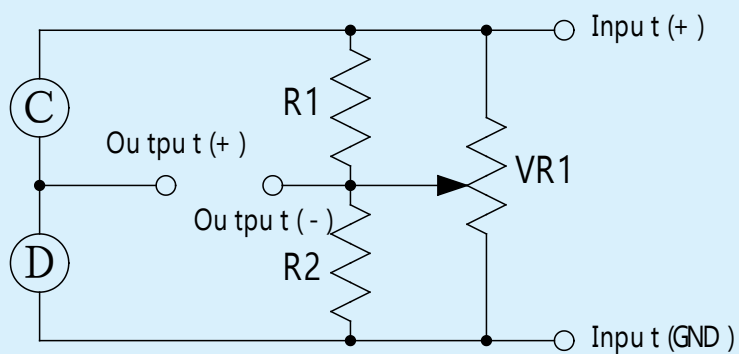
- 1) Zero offset value in air                      0 +/- 30mV  
(without trimming resistor)
- 2) Minimum sensitivity                        50mV/1% of methane
- 3) Response time                                < 8 sec. at T90  
< 3 sec. at T50
- 4) Linearity                                      Effectively linear to 60%LEL
- 5) Detection accuracy                        +/- 1%LEL
- 6) Span drift                                     < +/- 5% signal / 3 month
- 7) Zero offset drift                             < +/- 0.5 mV/month
- 8) Warranty period                              24 months



## 5. Appearance and dimensions



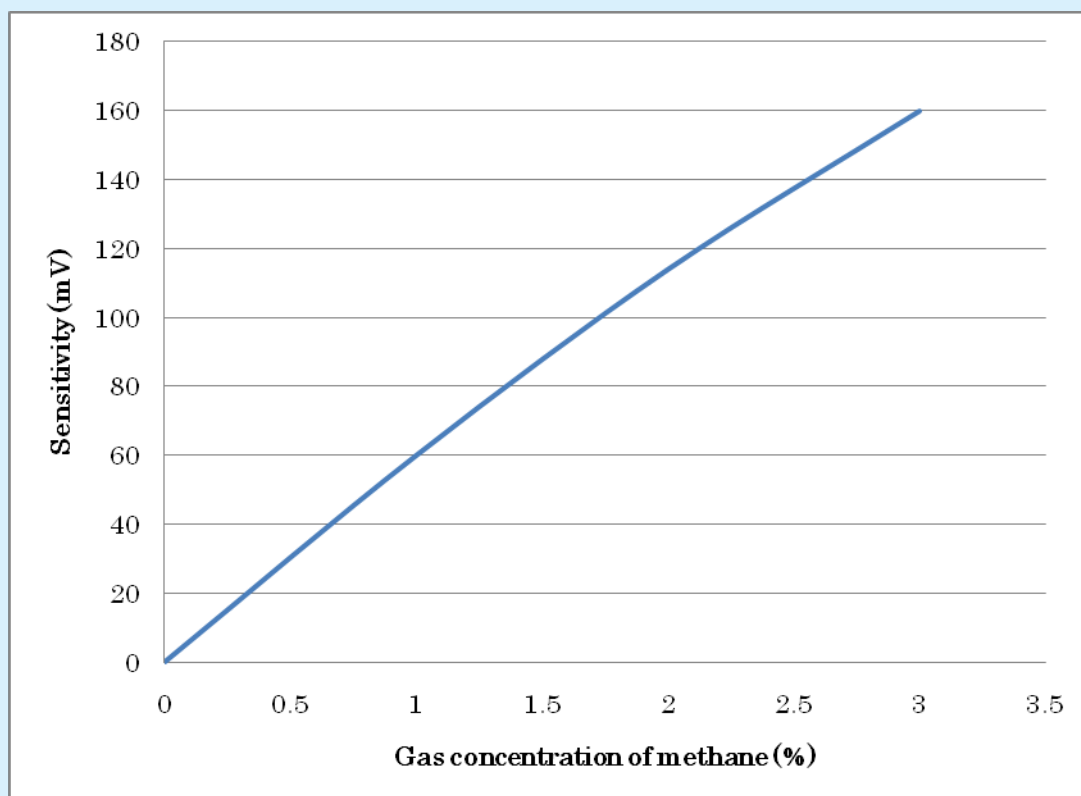
## 6. Measuring circuit diagram



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

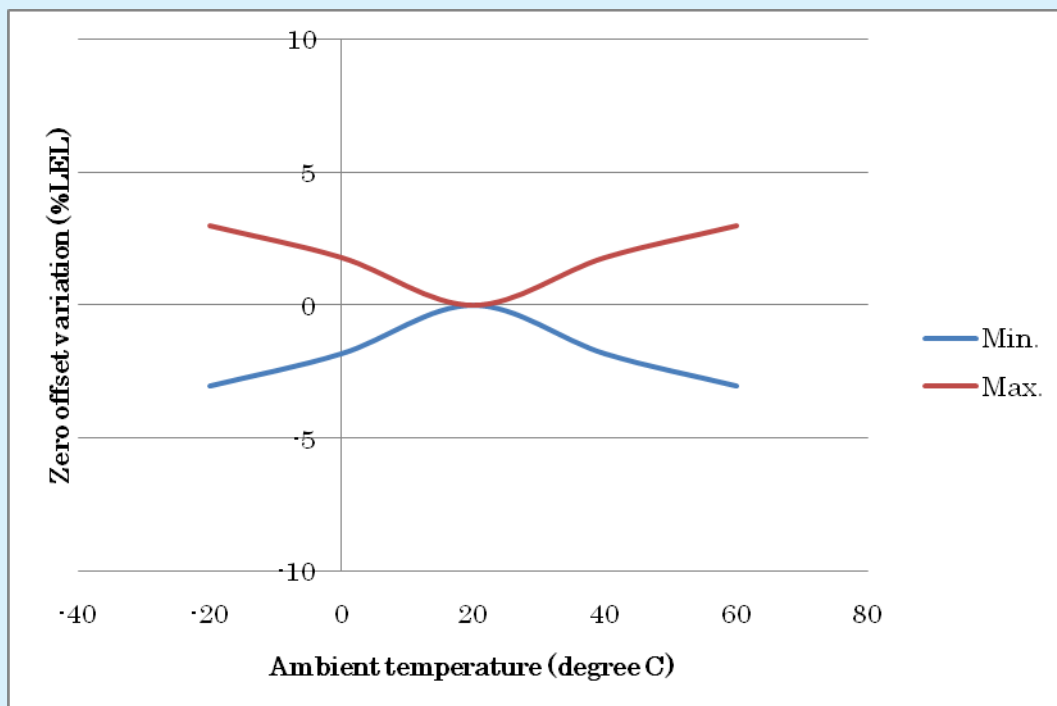


## 7. Gas sensitivity characteristics

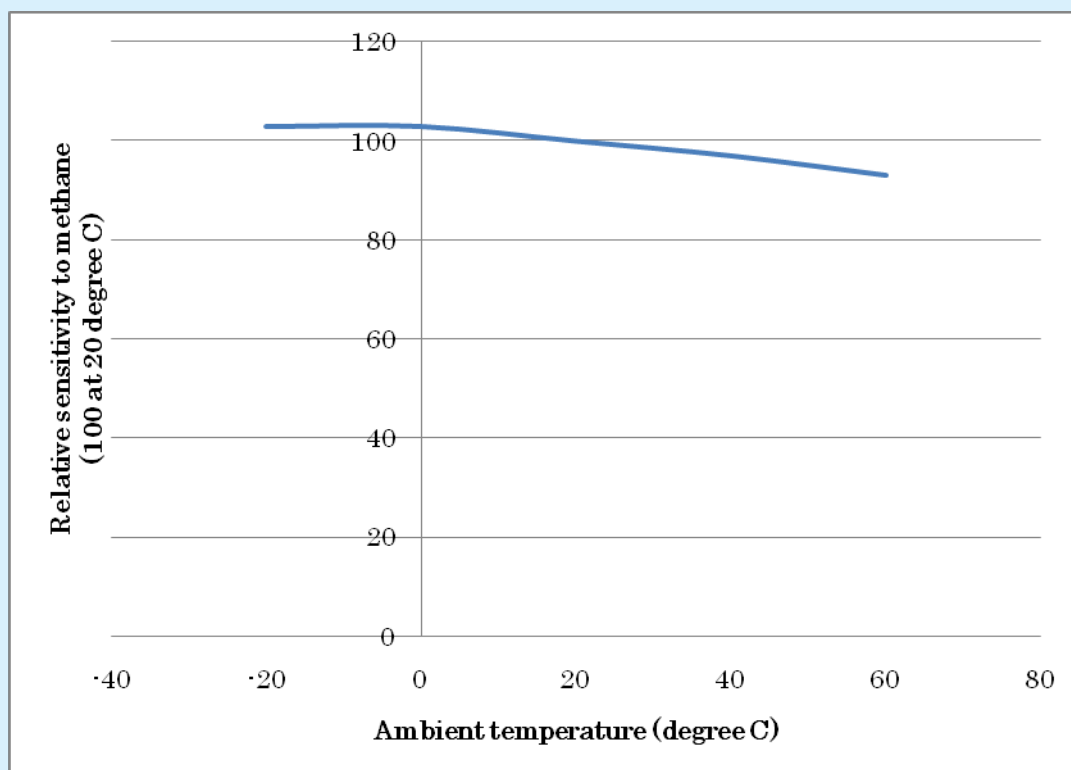




## 8. Temperature dependence at 60%RH



Temperature dependence of zero offset

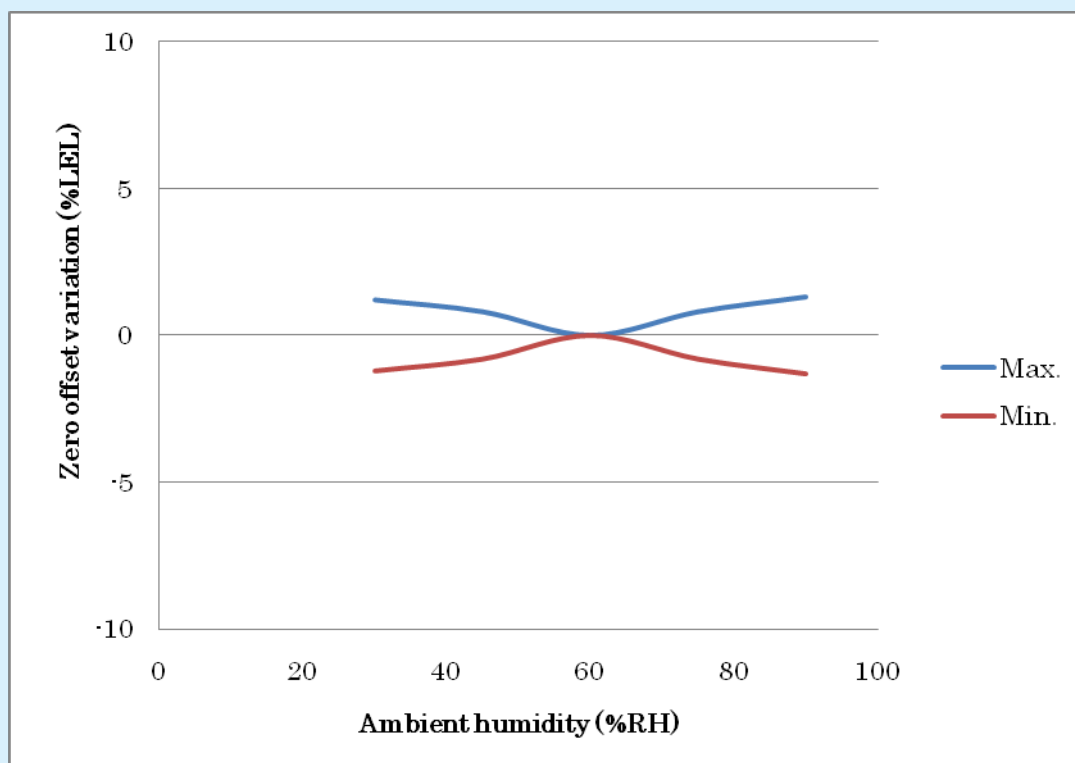


Temperature dependence of Sensitivity (Methane)

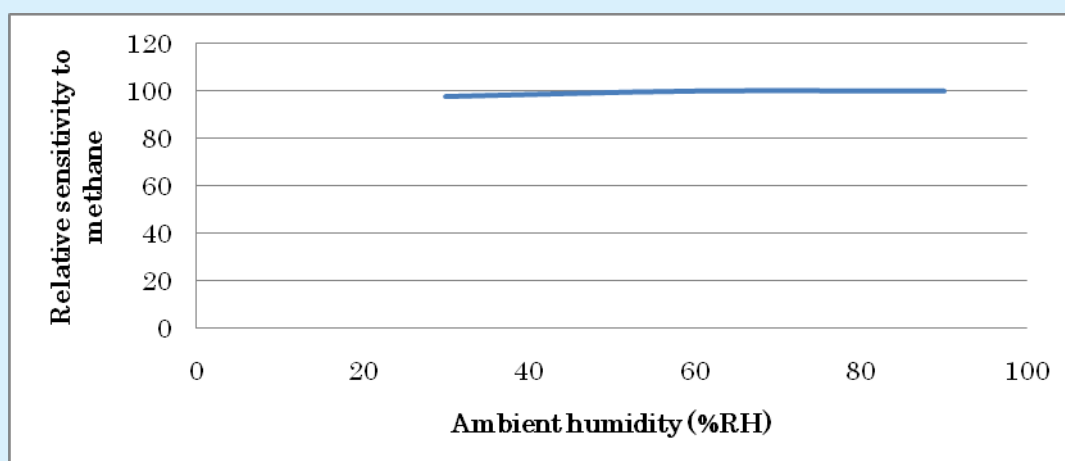


## 9. Humidity dependence

Zero Offset:

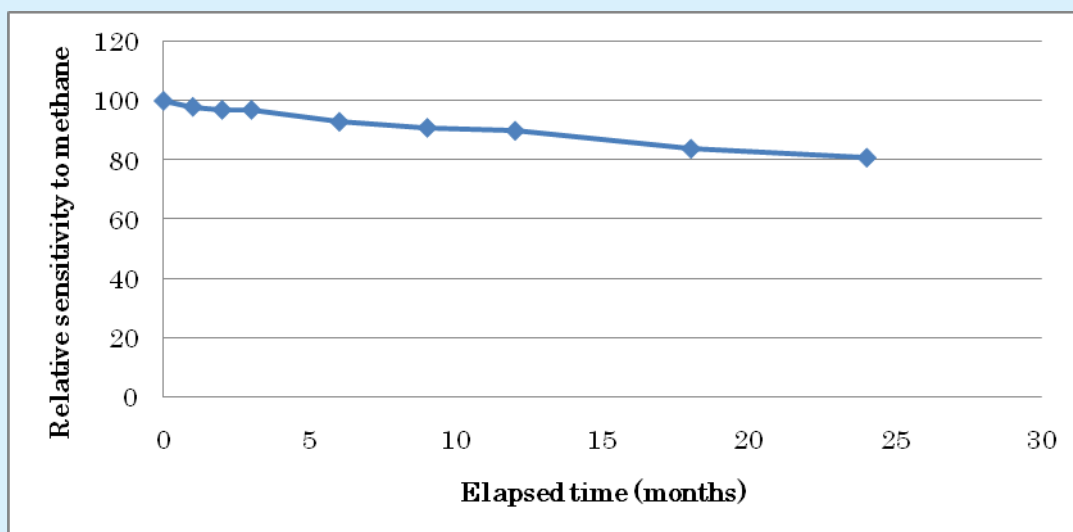


Span Sensitivity:

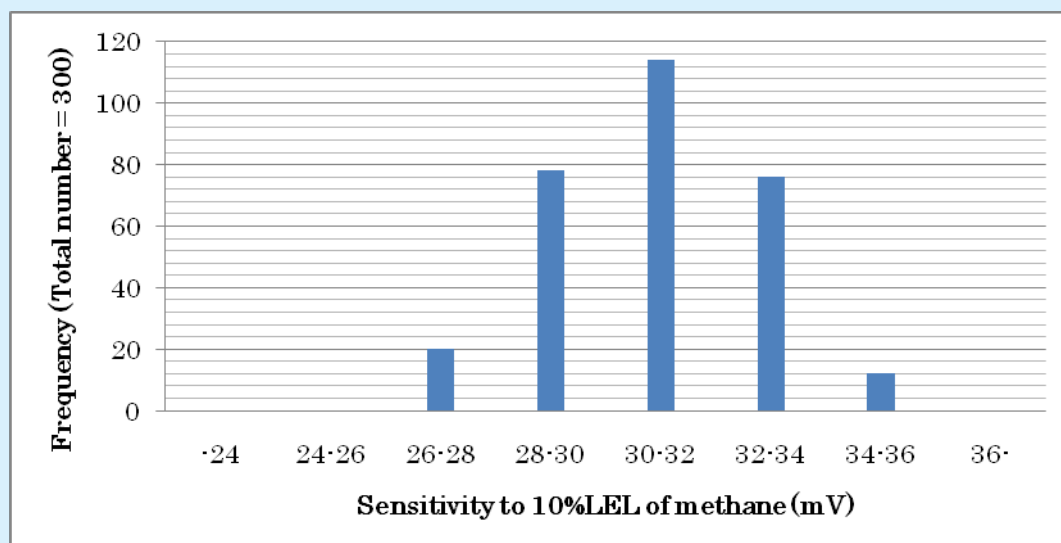




## 10. Long term stability



## 11. Sensitivity distribution







## 12. Relative Responses

(LEL Scale, Relative to Methane.)

Gas/Vapor	Chemical formula	LEL (%)	Relative sensitivity
<b>Std. Methane</b>	<b>CH<sub>4</sub></b>	<b>5.0</b>	<b>100</b>
1 Acetone	(CH <sub>3</sub> ) <sub>2</sub> CO	2.6	75
2 Ethanol	C <sub>2</sub> H <sub>5</sub> OH	3.3	85
3 Ethyl acetate	C <sub>2</sub> H <sub>5</sub> COOH	2.2	75
4 Ethylene	C <sub>2</sub> H <sub>4</sub>	2.7	95
5 Hydrogen	H <sub>2</sub>	4.0	130
6 Iso-propanol	CH <sub>3</sub> -C <sub>2</sub> H <sub>4</sub> COOH	2.2	75
7 Methanol	CH <sub>3</sub> OH	6.7	125
8 Methyl ethyl ketone	CH <sub>3</sub> -CO-C <sub>2</sub> H <sub>5</sub>	1.9	55
9 N-butane	C <sub>4</sub> H <sub>10</sub>	1.8	80
10 N-heptane	C <sub>7</sub> H <sub>16</sub>	1.05	65
11 N-hexane	C <sub>6</sub> H <sub>14</sub>	1.2	80
12 N-pentane	C <sub>5</sub> H <sub>12</sub>	1.4	80
13 Propane	C <sub>3</sub> H <sub>8</sub>	2.1	90
14 N-octane	C <sub>8</sub> H <sub>18</sub>	0.95	60
15 Toluene	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub>	1.2	60
16 Ammonia	NH <sub>3</sub>	15.0	140
17 Carbon monoxide	CO	12.5	100
18 Unleaded petrol		1.2	80

Remarks)

If other data are required, please contact us since sensitivity of many combustible gases except bad smell, dangerous, poisonous and high boiling temperature materials over 120 degree C are available for investigations.

## 13. Durability

1) Exposure in 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 CH <sub>4</sub>	Zero offset	Relative sensitivity to CH <sub>4</sub>
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



### 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	68
2	-9.2	100	-8.8	63
3	12.8	100	14.1	70
4	18.1	100	18.7	61
5	-4.7	100	-4.1	66

### Exposure in high concentration 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

### Drop test

Test conditions

Sensors were dropped from the height of 30cm onto the wood 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



### Vibration test

#### Test conditions

Vibration which is 10Hz with the 4mm of amplitude for 20min. to 3 directions of X, Y and Z was added 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

### 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

### 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

### Storage in low temperature

#### Test conditions

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

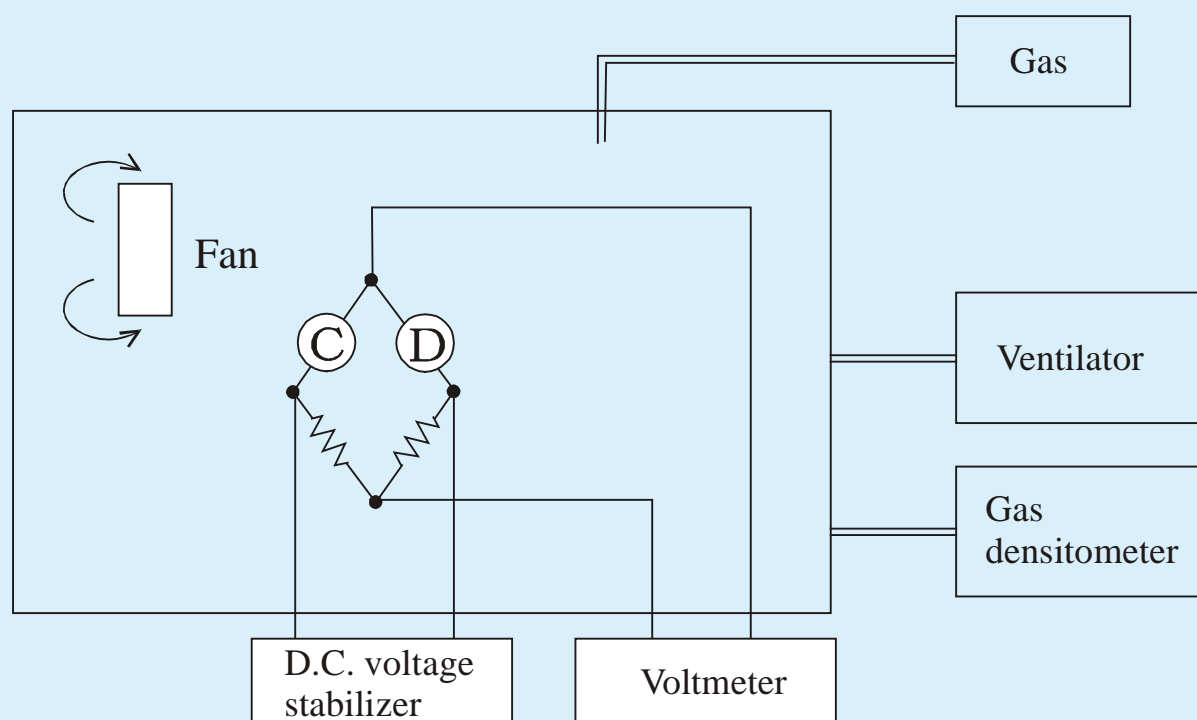
No.	Before test (mV)		After test (mV)	
	Zero offset	Relative sensitivity to CH4	Zero offset	Relative sensitivity to CH4
1	-17.5	100	-16.8	98
2	19.7	100	19.8	95
3	10.4	100	11.1	93
4	26.4	100	25.6	97
5	12.3	100	13.8	97



#### 14. Evaluation method.

The following information related to the testing equipment which Nemoto uses to test NCP-170S sensors. Other methods may be used by the customer, but it should be noted that the results might not exactly correlate with Nemoto's own published characteristics because of resulting experimental errors.

##### Test equipment:



##### Notes:

- Material of test chamber is to be inactive, such as metal, glass or acrylic resin which does not outgas or adsorb gases.
- Volume of test chamber is to be more than 1 litre per 1pc. of sensor.
- All test equipment should be clean and free of all materials which could poison Catalytic Gas Sensors.
- Air agitation in test chamber is to be conducted carefully in order not to flow air to sensor directly. The air velocity in the chamber should not exceed 0.5m/sec.
- Both of AC power and DC power may be used with the sensor for sensor, but DC power supply is recommended for accurate evaluation.



- Since the impedance of sensor is fairly low, a general purpose digital volt meter having over 100kohm as input impedance is suitable.
- 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.

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

$V$  : Gas volume to be injected

$V_i$  : Volume of test chamber (  $ml$  )

$T_c$  : Temperature in test chamber (  $^{\circ}C$  )

$T_r$  : Room temperature (  $^{\circ}C$  )

$C$  : Target gas concentration (  $ppm$  )

- Before commissioning calibration of sensor, it is recommended to run the sensor for 1 hour for complete stabilization
- 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.

#### **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 must not be immersed in water.
- Sensor must not be disassembled.
- Do not cut or bend the connection pins.

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