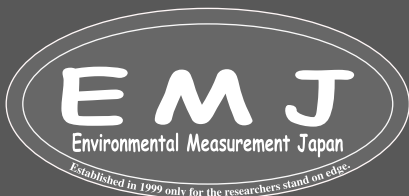


Environmental Measurement Japan, CO., LTD.  
Soil Oxygen Sensor MIJ-03 User Manual

***SOIL O<sub>2</sub> Sensor  
MIJ-03***



**Environmental Measurement Japan, CO., LTD.**

2-52-42 Takamidai, Fukuoka-city Higashiku, Fukuoka 811-0215, Japan

TEL 092-608-6412

FAX 092-985-7844

# 1.Preparation before installation

The output of MIJ-03 is usually about 40~60mV, and the output is different for all MIJ-03. First, connect the MIJ-03 to a tester or logger and leave it in the atmosphere for about 10 minutes to check the individual outputs.

Be sure to make a note of the output span value after when left unattended. Measurement data is calculated based on this span value. The output of this sensor is linear and the output value is zero when there is no oxygen in the surroundings. In other words, a conversion formula can be created by performing only span calibration.

For example, if an output of 52.3mV is obtained when left in the atmosphere, the atmospheric concentration is constant at 20.9% O<sub>2</sub>, so the conversion formula is as follows.

(Calibration should be performed when the atmospheric pressure does not deviate greatly from 1013 hpa.)

$$O_2(\%) = 20.9(\%) \times \frac{V(\text{mV})}{52.3(\text{mV})} \quad V: \text{Sensor output}$$

## Output span value

You need to prepare below items to obtain span value



**Tester**

(resolution of at least 0.1mV)



**clip for tester**



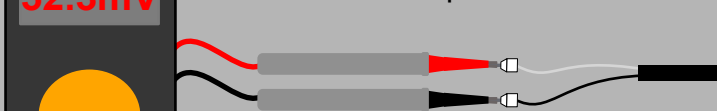
**MIJ-03**

As shown in the figure on the right, hang the MIJ-03 (connected to the tester) on a tree branch or pole for 10 to 15 minutes (please do this at the outside field).

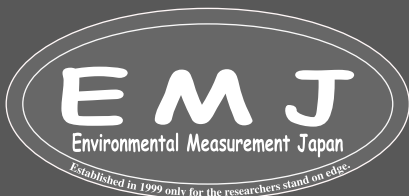


\* This manual uses an output value of 52.3mV as an example, but the output value differs for each sensor.

Leave it for 10-15 minutes and make a note of the output value.



**Connect the red wire of the tester to the white wire of MIJ-03**  
**Connect the black wire of the tester to the black wire of MIJ-03**



**Environmental Measurement Japan, CO., LTD.**

2-52-42 Takamidai, Fukuoka-city Higashiku, Fukuoka 811-0215, Japan

TEL 092-608-6412

FAX 092-985-7844

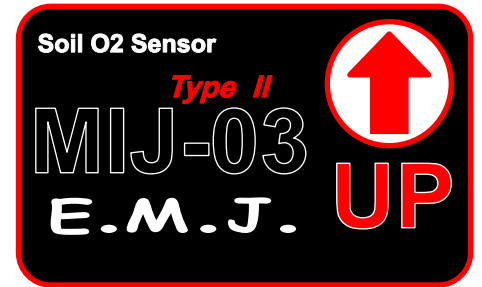
## 2. Precautions for installation

### 2.1

When burying the sensor, be sure that the cable mounting surface faces vertically upward.



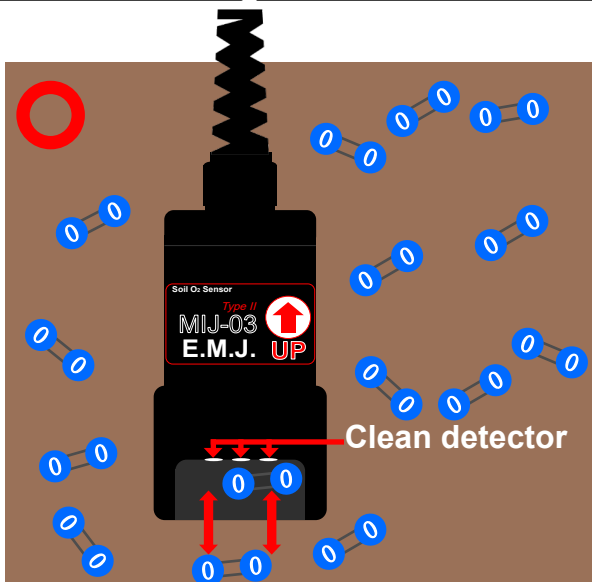
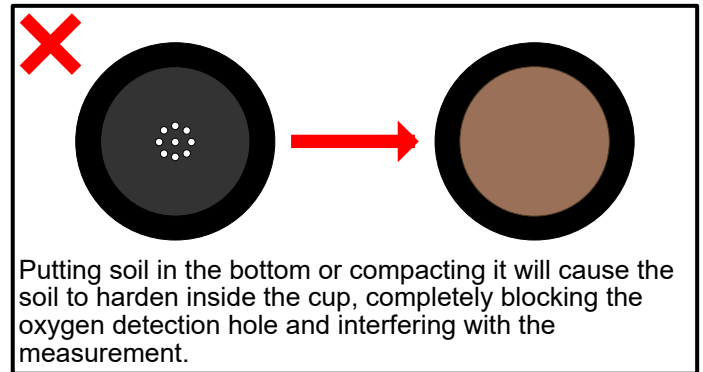
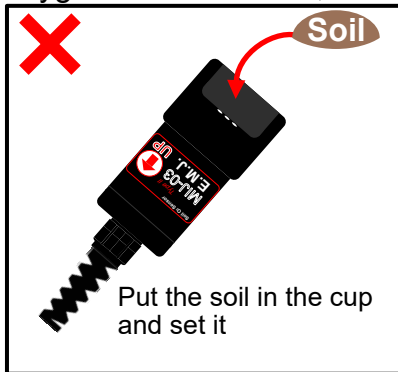
### MIJ-03 Label



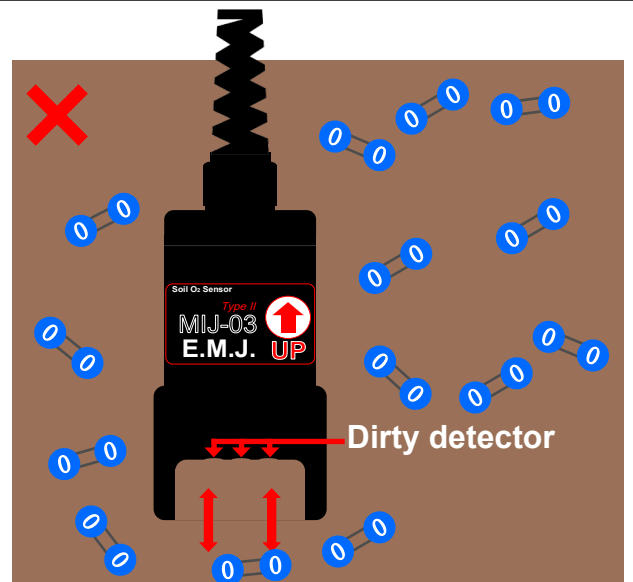
Be sure to insert the cable side up as indicated by the arrow.

### 2.2

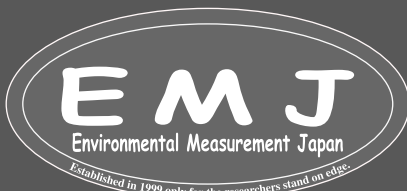
Some people intentionally put soil in the bottom of the sensor and press it down, but this is not a good practice. If you put soil in the bottom and press it down, the soil will harden and completely block the oxygen detection hole, which will interfere with the measurement.



The cup protects the O2 sensor from dirt and rainwater.



The soil inside the cup absorbs rainwater, contaminating the O2 sensor and causing clogging.



**Environmental Measurement Japan, CO., LTD.**

2-52-42 Takamidai, Fukuoka-city Higashiku, Fukuoka 811-0215, Japan

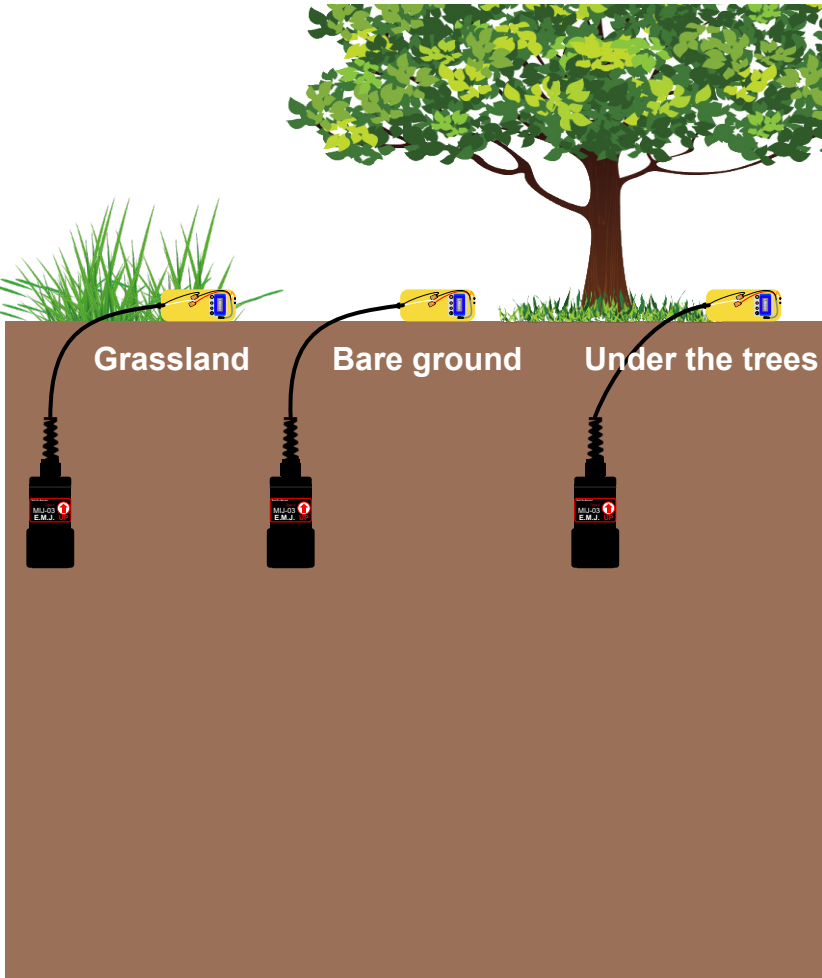
TEL 092-608-6412

FAX 092-985-7844

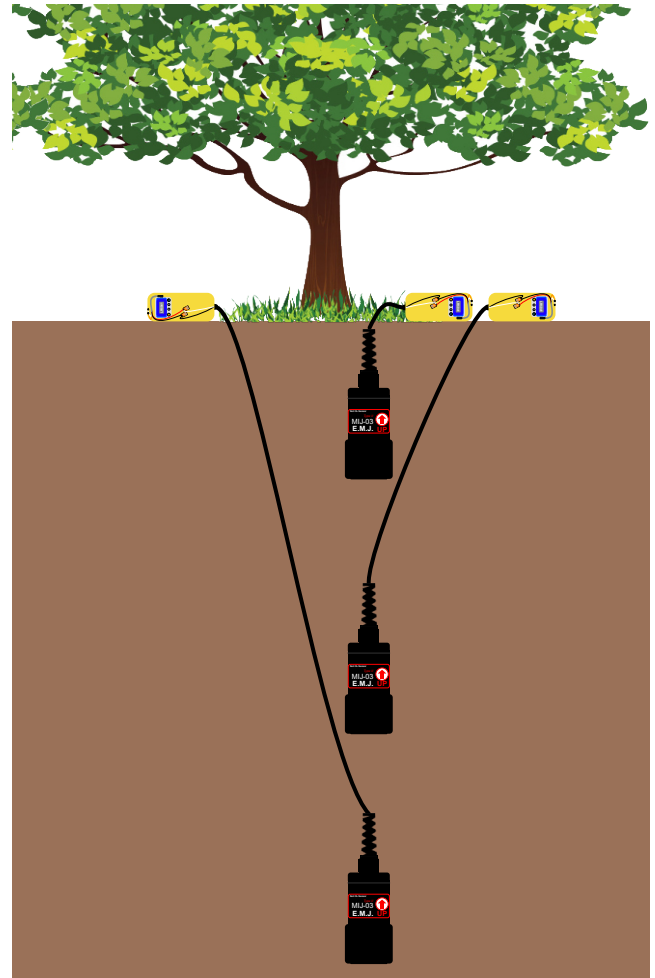
### 3. Setting image

There are various ways to use it, such as burying the MIJ-03 in combination with a data logger at the desired depth, measuring the depth direction profile, and measuring the horizontal distribution.

#### Profile in horizontal direction

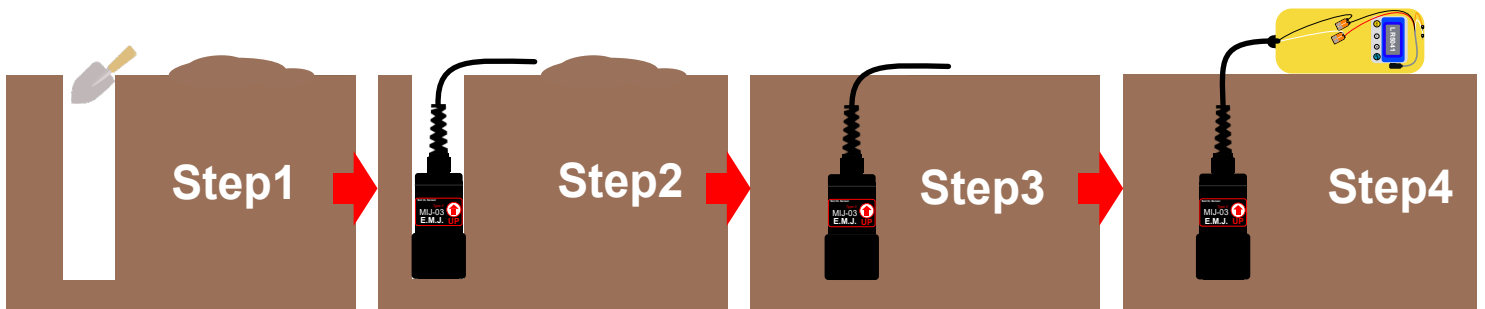


#### Depth direction profile

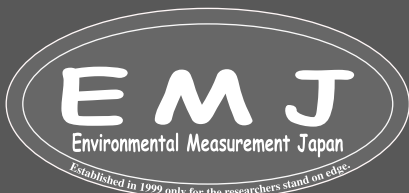


### 4. Installation procedure

The explanation assumes that you have written down the span value. Installation is easy with just 4 steps.



1. Dig a hole to the depth you want to bury the sensor with a shovel.
2. Place the MIJ-03 in the dug hole.
3. After installing the sensor, backfill the soil that was dug earlier.
4. Complete by connecting MIJ-03 to the data logger and starting measurement.



### Environmental Measurement Japan, CO., LTD.

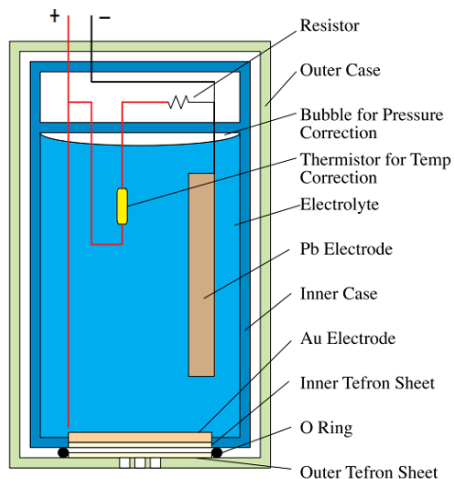
2-52-42 Takamidai, Fukuoka-city Higashiku, Fukuoka 811-0215, Japan  
TEL 092-608-6412  
FAX 092-985-7844

## 5.Principle of soil oxygen sensor

The MIJ-03 soil oxygen sensor consists of an oxygen/lead battery with a positive gold electrode and a negative Pb electrode as shown in the figure. The outside and inside are separated by the Outer Teflon Sheet, and the inner Teflon Sheet holds the internal solution. An electrolytic reduction reaction occurs in the Au Electrode according to the concentration of oxygen molecules passing through both Teflon sheets by diffusion. At that time, the weak current generated in the circuit is converted into a voltage by the resistor, which becomes the sensor output.

The factors that affect the reaction are 1. temperature fluctuations and 2. pressure fluctuations.

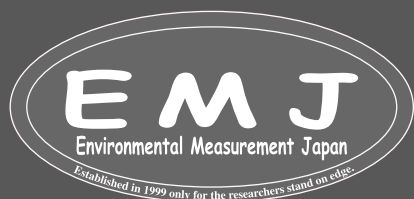
A thermistor for temperature compensation is built in as a countermeasure. For 2, measures are taken by installing bubbles for pressure compensation inside the solution.



## 6.Soil oxygen sensor accuracy

The full scale of oxygen concentration in soil is 0 to 20.9%. In other words, the oxygen concentration in the outside air cannot be exceeded. Therefore, the full scale of this sensor can also be treated as 0 to 20.9%. The measurement accuracy on this scale is  $\pm 0.5\%$ . A typical range of properties is given in the table below.

Characteristic	Typical properties
Full scale	0 ~ 20.9 %
Response speed(90%)	240 $\pm$ 30 sec
Output at 20.9% in air	45 ~ 68 mV
Operating temperature limit	0 ~ 40°C
Storage temperature	-20 ~ 60°C
lifespan	1,500,000 %h
Measurement accuracy	$\pm 0.5\%$



**Environmental Measurement Japan, CO., LTD.**

2-52-42 Takamidai, Fukuoka-city Higashiku, Fukuoka 811-0215, Japan

TEL 092-608-6412

FAX 092-985-7844

## 7. Temperature correction

Although the standard operating temperature is listed as 0 to 40°C, it can actually be used in the range of -10 to 60°C. Please consider the standard operating temperature range of 0 to 40 as a range that does not require temperature compensation.

If the temperature is lower or higher than the standard operating temperature, the following correction formula is required.

$$\text{Compensated Oxygen value (\%)} = \text{Measured Oxygen (\%)} * (1.00479 - 0.001914 * \text{Temp})$$

For example, if 20% oxygen concentration value is obtained in soil at 60°C, it will be as follows.

$$20 * (1.00479 - 0.001914 * 60) = 20 * 0.88995 = 17.799(\%)$$

## 8. Soil oxygen sensor characteristics

### About output in air:

Since the contact area between the electrode and the solution, or the state of the solution, etc., may have slight errors during manufacturing, there will be "variation" in the output when looking through multiple sensors. However, this variation is not the kind of thing that is disturbed according to the time or installation environment when looking at a single sensor, so if you perform span calibration for each sensor before installation, it will be sufficient for data handling.

### Installation and storage:

Bubbles are installed inside the solution for the purpose of pressure compensation.

If these bubbles are in contact with the Au electrode, that is, if the detection part is facing up, the reaction will be hindered and measurement will be impossible.

If this phenomenon is observed, turn the sensor downward and leave it in the air for several hours to recover. The same precautions should be taken during storage.

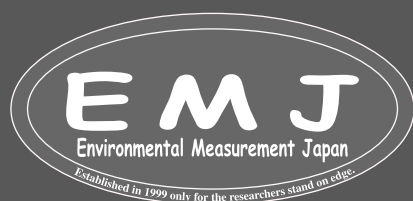
Store with the detection part facing downward or horizontally.

### Disposal:

Since the internal solution is weakly acidic, there is no danger of ignition even if a leak occurs and is left unattended. In the unlikely event that the internal solution leaks, put it in a plastic bag or the like. If that is not the case, entrust it to a disposal specialist for lead-acid batteries.

## 9. Interference gas

Interfering Gas	Interfering Gas Concentration	Effect to Out put of MIJ-03 O <sub>2</sub> %
CO	0 to 100%	No Effect
CO <sub>2</sub>	0 to 100%	No Effect
NO	0 to 1%	No Effect
NO <sub>2</sub>	0 to 1%	No Effect
SO <sub>2</sub>	0 to 3%	+3%
H <sub>2</sub> S	0 to 3%	No Effect
NH <sub>3</sub>	0 to 3%	+1%
H <sub>2</sub>	0 to 100%	No Effect
HCL	0 to 3%	+1%
C <sub>6</sub> H <sub>6</sub>	0 to 100 <sub>ppm</sub>	+1%
CH <sub>4</sub>	0 to 100%	No Effect
C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub>	Atmospheric saturated vapor pressure	Material deterioration
H <sub>2</sub> O	0 to 100%	No Effect



**Environmental Measurement Japan**

**日本環境計測株式会社**

〒811-0215

福岡県福岡市東区高美台二丁目52番42号

TEL:092-608-6412

FAX:092-985-7844