BWL-ET WATER LEVEL TRANSDUCER
INSTRUCTION MANUAL

Thank you for purchasing the KYOWA product. Before using it, be sure to read this instruction manual carefully.

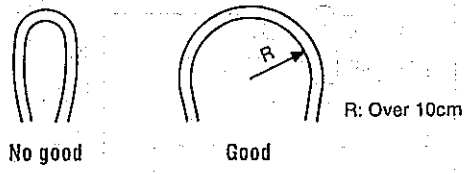
1. Handling precautions

1.1 For safe carrying

1) Be sure to place the transducer in the accessory cardboard box whenever it is carried about.
2) Be sure to keep the accessory cap on the cable end.
3) Avoid dropping or hitting or giving any other shock to the transducer. If not, the transducer may be damaged.

1.2 For safe installation

1) Do NOT disassemble the transducer. Do NOT put or drop it into the water, thereby avoiding shocks.
2) During installation, be sure to keep the accessory cap on the cable end to protect the conductor wires and capillary from water.
3) Do NOT bend the cable excessively (see the figure below), or the internal capillary may be damaged, thus causing faulty operation.

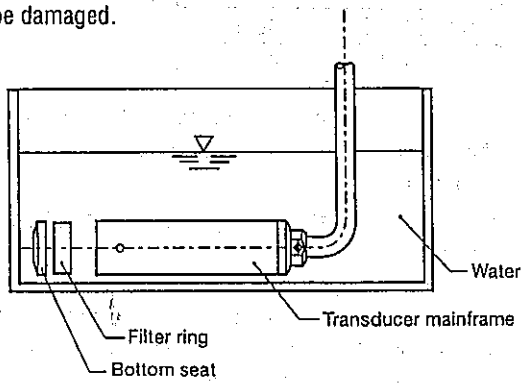


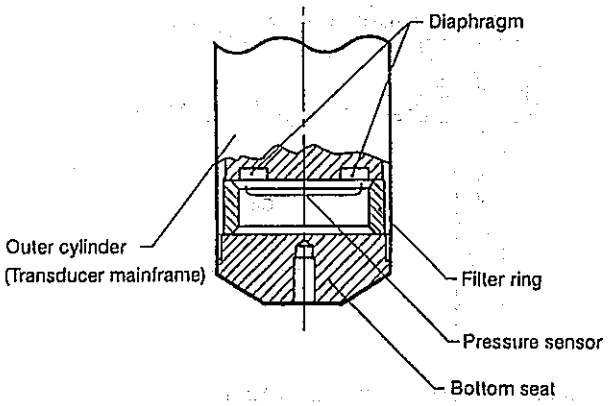
4) Carefully keep the top of the capillary from being deformed or stopped up by water, etc.
5) The filter ring having been removed, take care to avoid damage to the pressure sensor which is exposed.
6) As standard, the transducer should be made to stand straight for operation. If it is used at a slant, the initial value will vary largely.
7) There may be a difference between water and ambient temperatures on occasion. Prior to setting the initial value or measurement, therefore keep the transducer in the water for a certain period of time (more than 10 minutes or thereabouts) so that the transducer will attain the same temperature as the water.
8) Do NOT use the transducer whose filter ring has been removed.

2. Installation

2.1 Procedures

1) Turn the bottom seat of the transducer and remove it from the mainframe. Take the filter ring out, then in a vessel filled with water (see the figure below) attach it back to the transducer mainframe.
When the filter ring is out, take care to avoid pushing the pressure sensor (diaphragm) with a finger or hitting it, or the transducer may be damaged.





2) Immediately after attaching the filter ring, tentatively place the transducer in its place, then leave it as it is for about 10 minutes.
3) After that, connect the strain amplifier to the end of the transducer cable. While reading the strain amplifier, take the transducer out from the water. When the reading becomes fixed (i.e. when the transducer has gone above the water), record the reading as the initial value, $\varepsilon 0(\times 10^{-6})$.
4) After this recording, again place the transducer in its place, then measure the water level, $\varepsilon 1(\times 10^{-6})$.
The water level at the time of installation is obtained by the equation below.

$$\text{Water level} = (\varepsilon 1 - \varepsilon 0) \times f$$

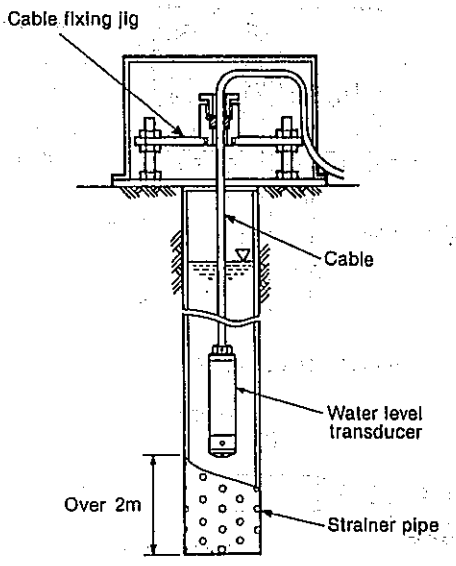
where f: Calibration coefficient $(m/1\times 10^{-6})$

2.2 Methods of installation

1) The figure below illustrates how to install the transducer in a borehole. The diameter of a borehole should be larger than ø40mm.

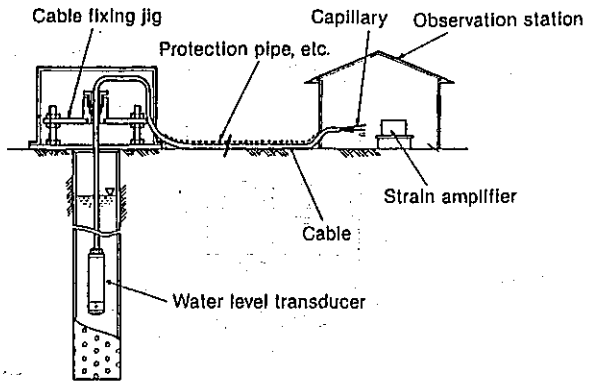
Caution In order to avoid the instrument's failure and keep its proper operation, be sure to observe the instructions given in the manual.

To measure the water level of solt water or muddy water, ask KYOWA for information.



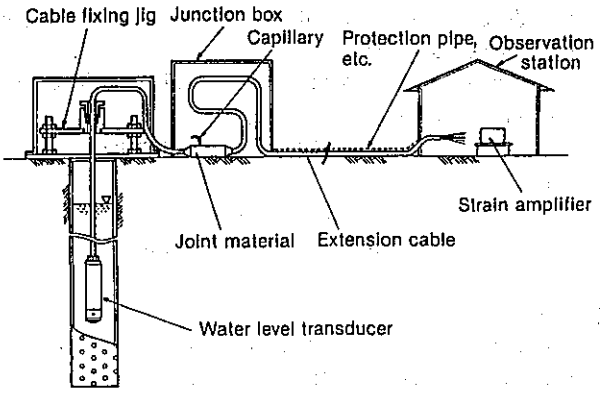
2) Cable extension and distribution

○ The figure below illustrates distribution of the standard cable direct to the observation station.



* Open the capillary to the atmosphere in the observation station. Take care so that the capillary is not stopped up by water, etc.

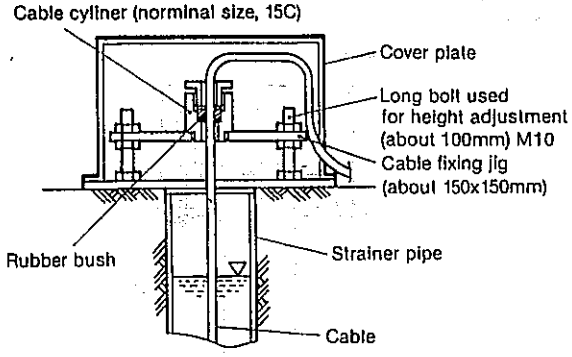
○ When using an extension cable, its distribution will be made as illustrated below. In this case, correction of readings is necessary.



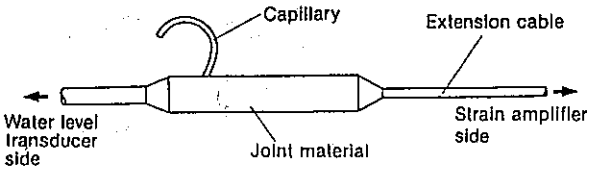
* Open the capillary to the atmosphere in the junction box. Take care so that the capillary is not stopped up by water, etc.

3) Details of the parts

○ Cable fixing jig



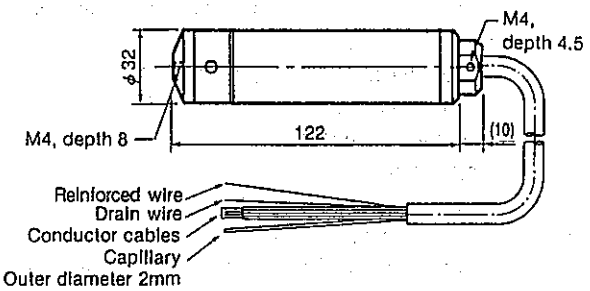
○ Joint of the extension cable



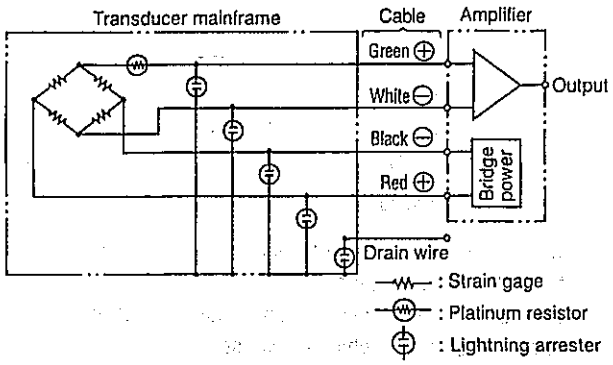
CAUTION: Be sure to check that the capillary is through. (To check, blow into the capillary. If the reading is then shifted to the negative (−) direction, it is the indication of the proper capillary. In this case, take care to avoid wetting the capillary.)

3. Connection

3.1 Sketched below are the external appearance of the transducer and that of the wires at the cable end.



3.2 Colors of the conductor wires to connect with the strain amplifier are as follows.



4. Conversion of readings

4.1 For conversion, use the calibration coefficient f ($m/1x10^{-6}$) stated in the calibration sheet.

4.2 When using a strain amplifier, the water level (m) is obtained with the equation below where the initial value is $\varepsilon 0$ ($x10^{-6}$), and the measurement value is $\varepsilon 1$ ($x10^{-6}$).

$$\text{Water level (m)} = (\varepsilon 1 - \varepsilon 0) \times f$$

5. Correction of the calibration coefficients

The numerical values stated in the calibration sheet are based on the conditions as follows.

① A constant-voltage-excitation amplifier is used.

② Cable lengths at the time of calibration

Model	Cable length
BWL-10MET	30m
BWL-20MET	40m
BWL-30MET	50m

In case the kind of stain amplifier and/or the cable length are changed, it is necessary to correct the calibration coefficient, accordingly.

5.1 When using a constant-voltage-excitation amplifier (e.g. UCAM-10B, etc.)

If an extension cable is used or the standard cable is shortened, the output is influenced by the resultant change in cable resistance. So, the calibration coefficient f', which was corrected using the equation below, should be used.

(Calibration coefficient f' after correction) = $\frac{R \pm 2r}{R} \times f$

where R: Input resistance (Ω) stated in the calibration sheet
r: Resistance per conductor wire of a shortened or extended length (Ω)
(Reference: r = 0.04Ω/m [with a nominal cross section of 0.5mm²]) .
f: Calibration coefficient (m/1x10⁻⁶) stated in the calibration sheet

5.2 When using a constant-current-excitation amplifier (e.g. UCAM-20PC, RMH, etc.)
No matter whether there is a change or not in the cable length, the output is influenced. So, use the calibration coefficient f' , which was corrected using the equation below.

(Corrected calibration coefficient f' after correction) = $\frac{350}{R} \times f$

where R: Input resistance (Ω) stated in the calibration sheet
f: Calibration coefficient (m/1x10⁻⁶) in the cal. sheet
350: Constant-current-excitation amplifier's bridge resistance (Ω)

6. Correction of temperature effect by water

The density of water varies due to temperature. This transducer is of the pressure transducer type and its output is accordingly affected by temperature to require correction.

6.1 When water temperature is even at different depths
When strain output is ε(x10⁻⁶) after correction of the initial value, the water level h(m) is obtained with the equation below.

(Water level h) = $\varepsilon \times f \times \frac{1}{\delta t}$

where f: Calibration coefficient (m/1x10⁻⁶)
δt: Water density (g/cm³) at t°C

Water density (g/cm³)

Temp.(°C)	0	4	10	15	20	25
δt	0.9998	1.0000	0.9997	0.9991	0.9982	0.9970

Temp.(°C)	30	35	40	45	50
δt	0.9957	0.9940	0.9922	0.9902	0.9880

6.2 When water temperature varies due to different depths of water
The correction method differs from item 6.1.
For instance, the measurement result of water temperature distribution from the water surface to the transducer' level may be used. For details, contact KYOWA.

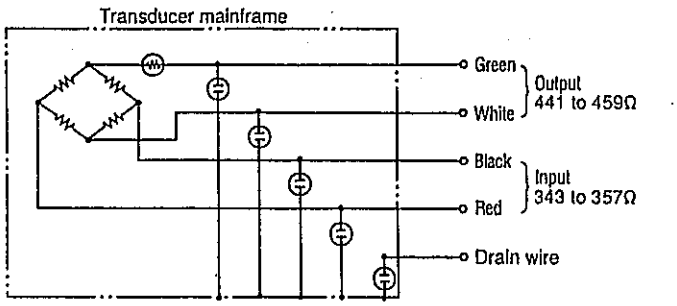
7. About temperature function

Temperature can be obtained using the equation below.
Temperature t = (S – S0) x β
where S: Amplifier's temperature reading (x0.01Ω)
S0: Reading at 0°C (x0.01Ω)
β: Temperature coefficient (°C/0.01Ω)

8. Inspection

If unstable or suspicious readings appear, first make sure that the transducer is properly connected to the amplifier, and that [1. Handling precautions] have been observed. Next, make the following checks on the transducer.

8.1 Using a tester, etc., check the input and output resistance.



8.2 Check to be sure that the insulation resistance is over 100MΩ/50Vdc between the transducer's conductors and the mainframe (the ground if the transducer is installed).
Note here that a super insulation tester should be used for measurement and an applicable voltage should be below 50Vdc.
CAUTION: If a voltage in excess of 50Vdc is used, the built-in lightning arrestor may deteriorate.

8.3 Check to be sure that the strain output is below 1000x10⁻⁶ when the transducer is taken out from the water into the air.

8.4 Apply a pressure (100kPa, max.(about 1kgf/cm²)) using the capillary and make sure that the output changes to a minus (–) value.
If the above measurement values should appear faulty, contact KYOWA.

9. Specifications

Model	Rated capacity	Temperature meas. range
BWL-10MET	10m	–20 to 60°C (No freezing of mainframe)
BWL-20MET	20m	
BWL-30MET	30m	

Safe overload rating: 150%
Rated output: 2mV/V (4000 x10⁻⁶ strain)
Non-linearity: ±0.15%RO
Hysteresis: ±0.1%RO
Recommended bridge voltage: 2 to 6V, AC or DC
Safe bridge voltage: 10V, AC or DC
Input resistance: 350Ω±2%
Output resistance: 450Ω±2% (at 0°C)
Repeatability: 0.05%RO or better
Compensated temp. range: 0 to 50°C (No freezing of measuring object)
Safe temperature range: –20 to 60°C (No freezing of mainframe)
Temp. effect on zero balance: ±0.01%RO/°C
Temp. effect on output: ±0.01%/°C
Temp. measuring error: ±0.5°C
Weight: Approx.400g (excl. cable)
Cable: 0.5mm², 4-conductor chloroprene with capillary tube built in, ø11.3mm, exposed end
Cable length: 30m (10MET)
40m (20MET)
50m (30MET)
Others: Built-in lightening arrester; atmospheric pressure compensation

■ **Accessories:**

Calibration sheet	1
Warranty	1
Instruction manual	1

KYOWA
KYOWA ELECTRONIC INSTRUMENTS CO., LTD.
Overseas Department:
Address: 1-22-14, Toranomon, Minato-ku, Tokyo 105-0001 Phone:03-3502-3553 Fax:03-3502-3678