# PHS-A Absolute Pressure Transducer
# INSTRUCTION MANUAL

Thank you for purchasing this KYOWA product. Before using it, read this instruction manual carefully. Also, keep the manual within easy reach so that you can refer to it whenever necessary.

## 1. Calling the operator's attention

The following cautionary symbols and headlines are used to invite the operator's attention. Be sure to observe the accompanying precautions in order to safeguard the operator and preserve the performance of the instrument.

**Warning!** Improper handling may cause serious injury to the operator. To avoid harm, be sure to observe the accompanying instructions.

**Caution!** Improper handling may cause deleterious effects to the operator's body. To avoid harm, be sure to observe the accompanying instructions.

**Notes** In order to avoid instrument failure or malfunction, be sure to observe the accompanying instructions.

## 2. Safety precautions

### Warning!

- Avoid pressure in excess of the allowable overload rating, or the transducer may explode.
- Avoid contact of a projecting object with the sensor, or the latter may crack to result in the transducer's explosion.
- Use the specified tightening torque. Improper tightening torque may cause the transducer's explosion.
- If excessive pressure could possibly occur, provide protective casing around the transducer installation, in order to safeguard the operator.

### Caution!

- Dismount the transducer only after the applied pressure has been completely removed.
- SUS630 (JIS G4303) is used at the point where the transducer contacts a liquid. Avoid using the transducer with corrosive liquids or gases.

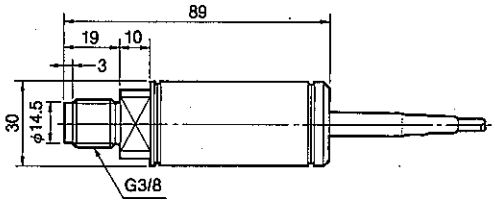
## 3. Handling precautions

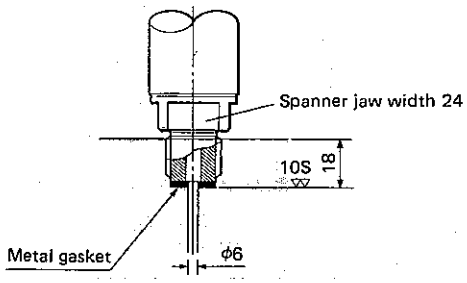
### Notes

- Do NOT disassemble the transducer.
- Avoid damage to the mount screw.
- Note that the bridge excitation voltage should be below 10V.
- Take care to avoid a large impact on the transducer.
- When installing, take care so that the cable will not be twisted.
- Do NOT pull the cable.
- The transduer cannot be used underwater because of its drip-proof costruction (conforming to JIS C0920).
- In order to retain the transducer's high accuracy, be sure to use a DC bridge excitation dynamic strain amplifier (a KYOWA CDV amplifier) in combination. If it is intended to use an AC bridge excitation (carrier wave type) amplifier (a KYOWA DPM amplifier), contact KYOWA for information.

## 4. Mounting

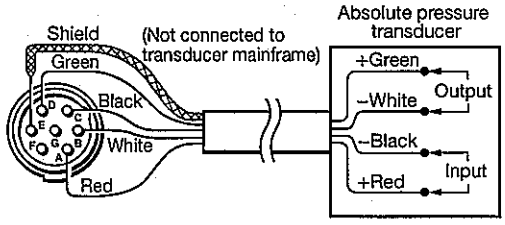
4.1 Referring to the figure below, mount the transducer.
4.2 The tightening torque should be in a range from 40 to 100N•m (Reference value: Approximately 4 to 10kgf•m ).



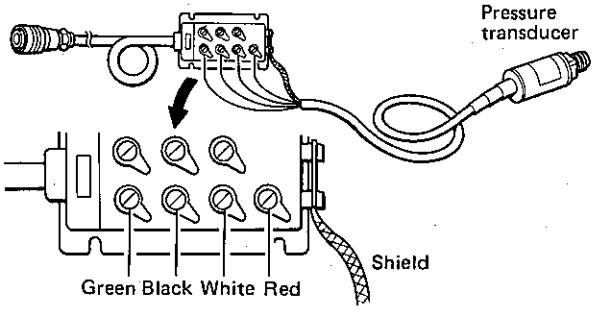




## 5. Connection

5.1 Connect the transducer to a strain amplifier.
5.2 When using an NDIS connector, perform wiring as illustrated below.




5.3 Perform connection as illustrated below when using a bridge box (a KYOWA product).



## 6. Measurement

To measure an absolute pressure, the transducer is exposed to either an atmospheric pressure or a vacuum pressure. How to measure is explained below about these two cases, respectively using three representative measuring instruments. For caution's sake, also read and observe the instruction manual of a measuring instrument you will use.

6.1 Measurement with the transducer exposed to an atmospheric pressure.
Perform necessary preparation where the transducer is exposed to an atmospheric pressure.

6.1.1 When using a static strain amplifier

(1) Perform initial balancing on the amplifier.

(2) Perform measurement. In this case, a strain value will be given as a measurement value. Obtain a pressure value through calculation according to item 7.1.

NOTES: When using an instrument having no initial balancing function, use a switch box (SS-R) which comes with the said function.
Note that without achieving initial balancing, it is possible to obtain a pressure value by finding the difference between a measurement value on the loaded transducer and another value on the unloaded transducer.

6.1.2 When using a signal conditioner or a dynamic strain amplifier

(1) Connect a voltmeter or a recorder, etc. to the measuring instrument in use.

(2) Perform initial balancing on the instrument.

(3) Adjust the sensitivity on the instrument by using the built-in CAL so that the instrument will put out a desired voltage against the rated output from the transducer. The transducer's rated output value is stated in the calibration sheet.

(4) Perform measurement. In this case, a measurement value is given in voltage.
Obtain a pressure value by the calibration method stated in item 7.2

6.1.3 When using an instrument augmented by the calculating function.

(1) Enter the calibration factor, which is stated in the calibration sheet, into the instrument.

(2) Perform initial balancing on the instrument.

(3) Perform measurement. In this case, a pressure value is given as a measurement value.

6.2 Measurement with the transducer exposed to a vacuum pressure

6.2.1 Where a vacuum pressure is obtainable
By using a vacuum pump, etc., reduce a pressure load on the transducer to a vacuum pressure (0Pa abs), then perform same adjustments as items 6.1.1 to 6. 1. 3. After this, perform measurement.

6.2.2 Where a vacuum pressure is unobtainable
In this case, the measuring instrument needs to be adjusted in advance so that its output corresponds to the present atmospheric pressure on the basis that an output of 0 corresponds to a vacuum pressure.
Perform this adjustment by shifting the instrument's output. In this case, it is necessary to know what the present atmospheric pressure is. To find it, read a barometer or contact the meteorological agency.

6.2.2.1 When using a static strain indicator

(1) Find the present atmospheric pressure.
(Reference) 1013[hPa] = 101.3[kPa]

(2) Using the equation below and calibration factor stated in the calibration sheet, obtain a strain value corresponding to the present atmospheric pressure [kPa] on the basis that a strain value under vacuum pressure is 0.

$$\text{Strain value } [1 \times 10^{-6}] = \frac{\text{Atmospheric pressure [kPa]}}{\text{Calibration factor [kPa abs/1x10}^{-6}\text{]}}$$

Note: As you see, KYOWA attaches "abs" to [Pa] unit just for convenience to denote that it is an absolute pressure.

Example: Strain value ε that corresponds to an atmospheric pressure is obtained with the equation below.

$$\varepsilon = \frac{101.3}{0.04651} = 2178 \times 10^{-6}$$

where Atmospheric pressure: 1013 [hPa]
Calibration factor: 0.04651 [kPa abs/1X10$^{-6}$]

(3) Using the balance adjustor or by using the initial value setting function, obtain the strain value calculated in item (2). By this, the instrument comes to indicate a strain value corresponding to the present atmospheric pressure on the basis that an output of 0 corresponds to a vacuum pressure.

(4) Perform measuring. In this case, a strain value is given as a measurement value. To obtain a pressure value, use item 7.1 conversion method.

6.2.2.2 By using a signal conditioner or a dynamic strain amplifier

(1) First, perform the same adjustments as item 6.1.2 (1) to (3).

(2) By using the equation below, obtain the voltage output corresponding to an atmospheric pressure on the basis that an output of 0[V] corresponds to a vacuum pressure.

$$\text{Output voltage [V] corresponding to atmospheric pressure} = \frac{\text{Atmospheric pressure [kPa]} \times \text{Measuring instrument's rated output based on rated capacity [V]}}{\text{Transducer's rated capacity [kPa abs]}}$$

Example: Where the atmospheric pressure is 1013[hPa]; the measuring instrument's rated output is 2[V] (that is, the output adjusted in item 6.1.2 (3); and the transducer's rated capacity is 500[kPa abs], the output voltage corresponding to the atmospheric pressure is expressed by:

$$\frac{101.3 \times 2}{5X10^{2}} = 0.405 \text{ [V]}$$

(3) Using the manual balancing adjustor, shift the output to obtain the output voltage calculated in item (2).
When using an instrument augmented by the automatic balancing function, shift the output as follows.
Set the built-in CAL to ON and thus offset the output. In this condition, switch the automatic balancing function ON.
Then perform adjustments as follows.

a. From the calibration factor, obtain the strain value equivalent to the atmospheric pressure on the basis that a strain value of 0 corresponds to a vacuum pressure.

b. Do this by using the same method as item 6.2.2.1 (2).
Set this strain value to CAL.

c. Set (–) CAL to ON or and switch the automatic balancing function ON.

d. Make sure if or not the voltage produced at this time equals the output voltage (0.405 [V]) in the above example), which corresponds to a vacuum pressure.
If not, adjust it by using the fine balancing adjustor.

NOTES: The above adjustment, a. through d. are possible only on an instrument which permits optional CAL value setting. An instrument having a fixed CAL value only cannot be used.

(4) Perform measurement. In this case, a measurement value is given in voltage.
Obtain a pressure value using the conversion method stated in item7.2.

6.2.2.3 Using an instrument augmented by the calculation function

(1) Enter the calibration factor, which is stated in the calibration sheet, into the instrument.
(2) Perform initial balancing on the instrument.
(3) Use the digital tare-weight reduction function so that the instrument indicates the present atmospheric pressure.
Example: When the atmospheric pressure is 1013 [hPa], enter −101.3, i.e. a tare weight value to be deducted. The instrument then indicates an atmospheric pressure of 101.3 [kPa].
(4) Perform measurement. In this case, a measurement value itself is a pressure value.

NOTES: Items 6.2.2.1 to 6.2.2.3 relate to an instrument which permits optional output shifting. If the instrument in use does not permit it, obtain an absolute pressure value as follows.
• Measure a pressure with the transducer exposed to an atmospheric pressure. (Use the same measuring method as item 6.1.).
• The pressure value thus obtained is a value which takes an atmospheric pressure as 0 (i.e. a gauge value). So add the current atmospheric values to it, and an absolute pressure value will be obtained.

## 7. Conversion

According to a measuring instrument in use, use a different method as follows for conversion of a measurement value into a pressure value.

7.1 When a static strain indicator was used
The measurement value represents a strain value. To convert it into a pressure value, multiply the calibration factor K (a pressure value corresponding to $1 \times 10^{-6}$ strain), stated in the calibration sheet, by a measurement value of $\varepsilon \times 10^{-6}$.

$$\text{Pressure value} = K \times \varepsilon \times 10^{-6}$$

[ A pressure value obtained from a measurement value in item 6.1 represents a pressure exclusive of an atmospheric pressure. A pressure value obtained from a measurement value in item 6.2 represents a pressure inclusive of an atmospheric pressure. ]

7.2 When a signal conditioner or a dynamic strain amplifier was used
In the case the sensitivity is adjusted on the instrument to produce an output voltage of E[V] against a transducer's rated output, use the equation below to obtain a pressure value.

$$\frac{P \times Em}{E}$$

where Em [V]: Measurement value
P [kPa abs]: Transducer's rated capacity

[ A pressure value obtained from a measurement value in item 6.1 represents a pressure exclusive of an atmospheric pressure. A pressure value obtained from a measurement value in item 6.2 represents a pressure inclusive of an atmospheric pressure. ]

7.3 When an instrument augmented by the calculation function was used
Provided that the calibration factor was entered, a measurement value itself is a pressure value.

[ A pressure value obtained from a measurement value in item 6.1 represents a pressure exclusive of an atmospheric pressure. A pressure value obtained from a measurement value in item 6.2 represents a pressure inclusive of an atmospheric pressure. ]

## 8. Maintenance precautions and inspection

8.1 Take care to avoid water, oil and dust on the transducer.
8.2 If the initial values and readings are found abnormal, measure the input/output resistance as well as the insulation resistance (which should be over 100MΩ). If they do not agree with the descriptions of the calibration sheet, the cause may be failure of the transducer element.
In this case, contact the KYOWA representative for necessary inspection and repair by the manufacturer.
CAUTION: For measuring the insulation resistance, the voltage applied to an insulation resistance tester should be below 50V.

## 9. Specifications

| Model | Rated capacity | Natural frequency (approx.) |
|---|---|---|
| PHS-2KA | 200kPa abs (2.039kgf/cm² abs) | 5kHz |
| PHS-5KA | 500kPa abs (5.099kgf/cm² abs) | 7kHz |
| PHS-10KA | 1MPa abs (10.20kgf/cm² abs) | 20kHz |
| PHS-20KA | 2MPa abs (20.39kgf/cm² abs) | 30kHz |
| PHS-50KA | 5MPa abs (50.99kgf/cm² abs) | 50kHz |
| PHS-100KA | 10MPa abs (102.0kgf/cm² abs) | 70kHz |
| PHS-200KA | 20Mpa abs (203.9kgf/cm² abs) | 100kHz |

NOTES:
• The units and numerical values in brackets in the [CAP.] column on the nameplate as well as in the above rated capacity column depend on the conventional unit expression just for reference.
• KYOWA attached "abs" to the above rated capacty for convenience to denote that it is an absolute pressure.

| | |
|---|---|
| Rated capacity | 1.5mV/V or higher |
| Non-linearity | ±0.2%RO |
| Hysteresis | ±0.2%RO |
| Recommended excitation voltage | 1 to 10V, AC or DC |
| Safe excitation voltage | 15V, AC or DC |
| Input resistance | $900\Omega\ ^{+100}_{-150}$ |
| Output resistance | $900\Omega\ ^{+100}_{-150}$ |
| Compensated temperature range | −30 to 200°C |
| Safe temperature range | −196 to 230°C |
| Temperature effect on zero balance | ±0.020%RO/°C |
| Temperature effect on output | ±0.015%/°C |
| Mount screw | G3/8 male screw |
| Safe overload rating | 150% |
| Weight | Approx. 500g (incl. cable) |
| Material | Mainframe: SUS, uncoated<br>Liquid contacting section: SUS630 |
| Cable | 0.3mm², 4-conductor shielded Teflon<br>5m, exposed end |

■ Accessories

| | |
|---|---|
| Calibration sheet | 1 |
| Warranty | 1 |
| Instruction manual | 1 |
| Gasket (annealed copper) | 1 |

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