azbil

OM2-5220-0000

PREX3000 Series, Liquid Level Meter Series Pneumatic Transmitter Model : KDP,KKP,KQP

User's Manual

Azbil Corporation

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DESCRIPTION

1. GENERAL

The Penumatic Transmitter (Model K□P), in conjunction with respective type of detector (meter body), is used to detect and transmit a process pressure, differential pressure, liquid level, or specific-gravity.

This manual covers the structure and maintenance of the transmitter itself and adjustment of the transmitter coupled with the meter body.

For installation and operation method of the transmitter coupled with the meter body, refer to the operator's manual of the corresponding meter body.

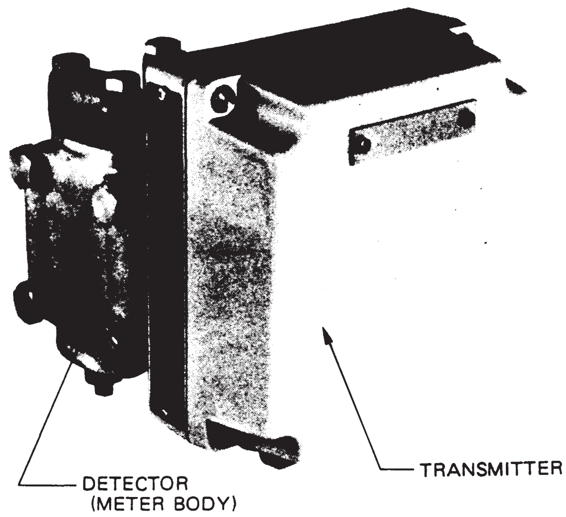


Figure 1

2. SPECIFICATIONS

Air piping connections:	Rc 1/4 or 1/4 NPT
Air supply:	1.4 ±0.14 kgf/cm^2
Output:	0.2 to 1.0 kgf/cm^2
External load:	ϕ4(ID) x 3 m + 20 cc or more
Maximum air supply capacity:	50 Nℓ/minute or more
Air consumption:	5 Nℓ/minute or less
Ambient temperature:	-30 to +80°C
Ambient humidity:	10 to 90% RH
Structure:	Dustproof splashproof structure: JIS F8001 Type 3 Splashproof, JIS C0920 Rainproof, NEMA Type 3 equivalent, IEC IP54 equivalent
Material (case and cover):	Aluminium alloy
Finish (case and cover):	Baked acryl paint, light beige (Munsell 4Y7.2/1.3)

3. COMBINATIONS WITH DETECTOR (METER BODY)

Measured Object	Range or Type	Model No.	Operator's Manual
Differential pressures	High/medium differential pressures	KDP11/22	OM2-5220-1100
	Low-differential pressures	KDP33	
	Very low differential pressure	KDP44	
	Flange type	KDP61/62	
	Remote-sealed type	KDP71/72	
	High working pressure type	KDP81/82	
Process pressures	High pressures	KKP11/12/13/14	OM2-5240-1100
	Low pressures	KKP15/16/17/18	
	Absolute pressures	KKP25/26/27/28	
	Remote-sealed type	KKP71/72/73/74/ 75/76	
Liquid levels and densities	Torque tube type	KQP410/420	OM2-5260-2100
	High damping type	KQP310/320	

4. STRUCTURE

The housing and base plate of the transmitter themselves make up pneumatic circuit boards. As the componential blocks of the transmitter are installed in respective positions on the base plate, air connections for them are automatically accomplished. No connections at all of pipes or tubes are needed.

4.1 Nozzle and Flapper

The nozzle is mounted on the base plate side and the flapper is mounted at the end of the beam.

4.2 Pilot Relay

The pilot relay boosts the back pressure of the nozzle. The pilot relay is mounted on the manifold which is structured in a unit-structure with the case.

4.3 Feedback Mechanism

The feedback mechanism is comprised of a feedback bellows which receives the output pressure of the pilot relay, a floating pivot for balancing three forces, and a span arm fixing element. The beam on which the flapper is mounted is also included in the feed mechanism.

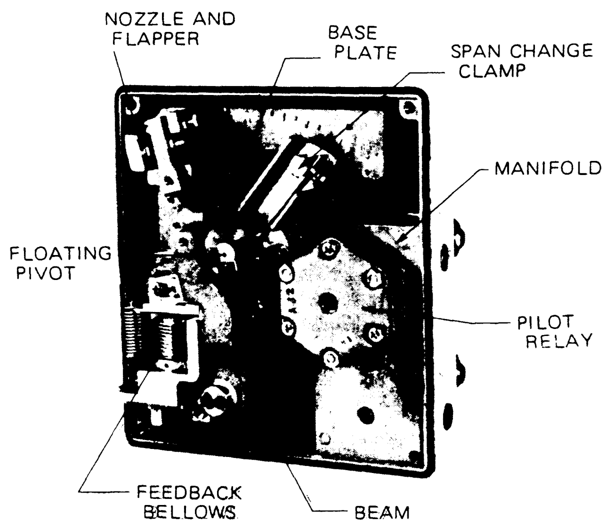


Figure 2

OPERATING PRINCIPLE

The input for the transmitter is applied as a torque through the torque tube. The torque causes the gap between the nozzle and flapper to change. The gap change causes the back pressure of the nozzle to change. The back pressure is boosted in both pressure and capacity by the pilot relay in order to be used as an output air pressure.

The output air pressure of the pilot relay is converted into a mechanical force by the feedback bellows. The mechanical force is fed as vector F1 to the beam through the strap as shown in Figure 3, thereby making up a negative feedback loop to balance the output air pressure at a valve proportional to the input.

For elevation (or suppression), a force is applied to the beam by the elevation (or suppression) spring.

Span change can be accomplished by changing the direction of vector F3. As the direction of vector F3 is changed, the effective force exercised by vector F1 changes and consequently the feedback gain changes, thereby realizing span change.

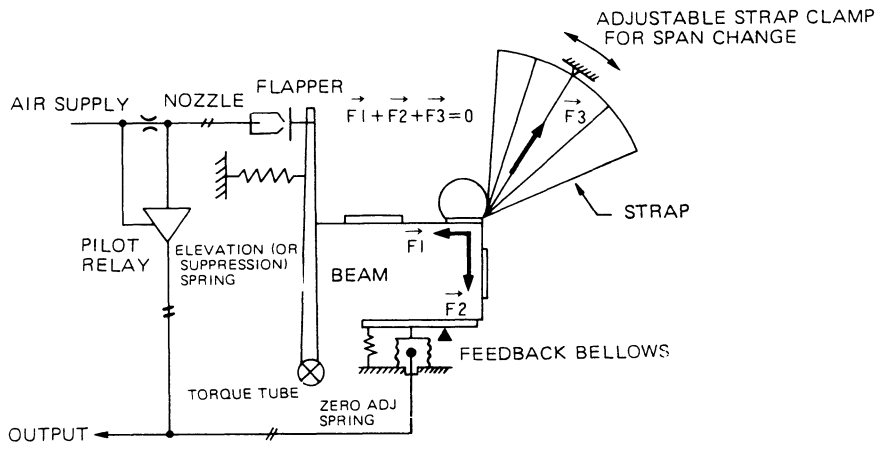


Figure 3

INSTALLATION AND OPERATION

1. INSTALLATION

The transmitter (Model K□P) is installed in the state that it is coupled to a detector (meter body). Installation and connection to the process is done by means of the meter body. For installation, refer to the operator's manual of the meter body used in conjunction.

2. PRESSURE CONNECTION TO PROCESS

Refer to the operator's manual of the meter body used in conjunction.

3. AIR SUPPLY CONNECTION

When no Airset (a combination of regulator and filter) is used, connect the air supply to the air supply connection port (internal thread) which is marked "SUP". The port marked "OUT" is the output air connection port.

When an Airset is used, connect the output port of the Airset to the air supply connection port of the transmitter.

The transmitter is shipped with its "SUP" and "OUT" ports protected by red vinyl plugs. Remove these plugs when connecting the pipes.

4. OPERATION

For the operation method, refer to the operator's manual of the meter body used in conjunction. The transmitter itself starts operating at the instant its air supply is fed.

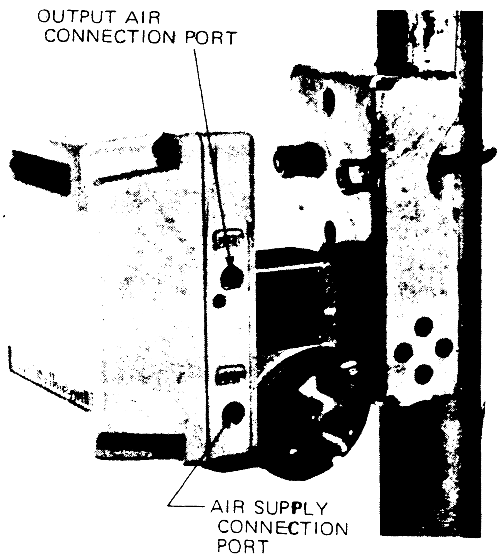


Figure 4. Air Connections

SERVICE AND UNIT REPLACEMENT

The only component which calls for service is the pilot relay. When malfunctioning of the pilot relay is suspected, service it as mentioned below. When the pilot relay is found to be defective, replace it with a new one.

When the meter body is required to be modified due to specification change or application change or due to failure, order your Yamatake agent. If it is required to be modified for yourself, order the service tools and Service Manual SM2-5220-0000 "Replacement Procedure of Meter Bodies."

1. TO REPLACE THE PILOT RELAY

Remove the pilot relay by removing the three screws shown in Figure 5.

If the gasket has been deteriorated or damaged, replace it also when replacing the pilot relay.

To install the pilot relay, place the gasket in the correct position, set the pilot relay on the manifold by setting the guide pin at the bottom of the pilot relay to the guide hole, and tighten the screws evenly.

2. TO SERVICE THE PILOT RELAY

Remove the pilot relay as described in 1 above, service it as described below, and then install it in the original position.

(a) Remove the three assembly screws (1) and nuts (19). (See Figure 5.)

(b) Parts (3) to (17) will separate in order. It is not necessary to separate parts (2) to (6) unless they are to be replaced.

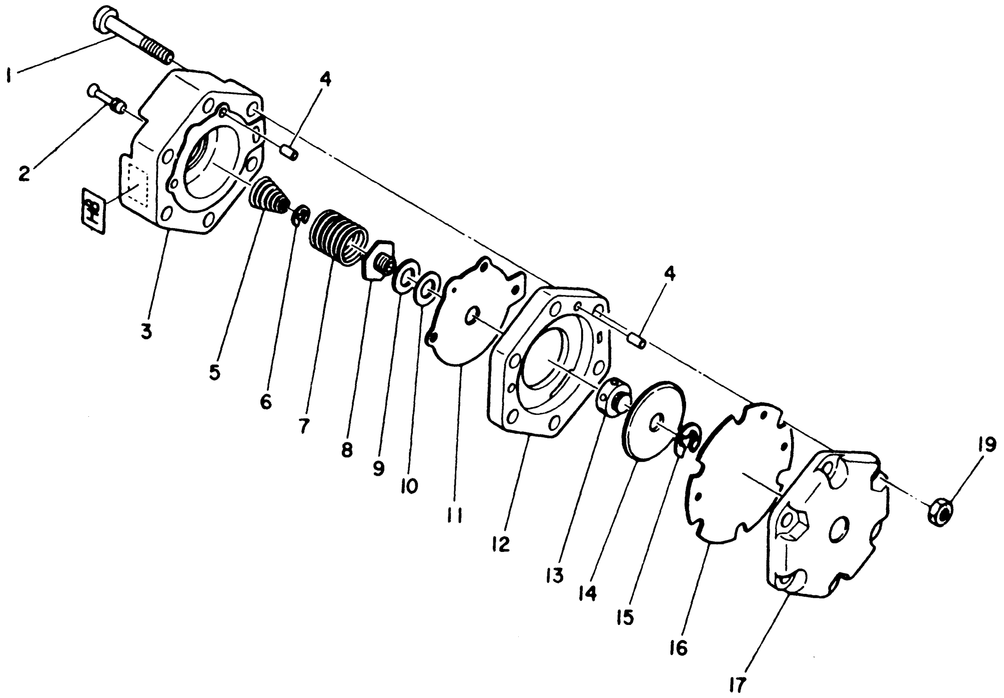
(c) Clean metal parts with approved solvent such as petroleum naphtha or Clorothene. Depress the valve stem (2) against the conical spring (5) to allow the solvent to penetrate through the seat which is hit by the port section of the valve stem.

(d) Examine the inner exhaust ring (13) and value stem (2). If dirty, clean them wit a cloth. Do not use any solvent to clean them.

(e) Dry all parts thoroughly with clean compressed air.

(f) Replace diaphragms (16) and (11) if worn or damaged.

(g) Reassemble the pilot relay by rejoining all parts in order with assembly screws (1), and nuts (19). Tighten the screws evenly.



No.	Name	Quantity
1	SCREW	3
2	VALVE STEM	1
3	HOUSING	1
4	GUIDE PIN	6
5	CONICAL SPRING	1
6	WASHER	1
7	SPRING	1
8	NOZZLE	1
9	WASHER	1
10	SEAL	1
11	DIAPHRAGM (LOWER)	1
12	EXHAUST RING (OUTER)	1
13	EXHAUST RING (INNER)	1
14	AREA PLATE	1
15	WASHER	1
16	DIAPHRAGM (UPPER)	1
17	COVER	1
19	NUT	1

Figure 5. Pilot Relay Assembly

CALIBRATION AND ADJUSTMENT

1. GENERAL

The detector (meter body) feeds a torque, which is proportional to the measured process variable, via the torque tube to the transmitting mechanism of the transmitter. Therefore, regardless of the type of the meter body, the transmitter should be adjusted so that it transmits an output signal of 0.2 to 1.0kgf/cm^2 linearly proportional to the 0% to 100% measuring range.

If the transmitter is incorporated with an elevation/suppression spring assembly, remove the assembly in order to calibrate the measuring range of the transmitter without zero-point shift.

Connect a precision pressure gauge of a range of approximately 0 to 1.5 kgf/cm^2 to the output port for calibration when checking the transmitter operation or for adjustment when replacing meter bodies or changing ranges.

2. CALIBRATION OF DIFFERENTIAL PRESSURE TRANSMITTER

(1) Release the low pressure connection port (marked L) to atmosphere.

(2) Connect to the high pressure connection port (marked H) a variable pressure source (such as the air supply via a regulator) corresponding to the measuring range and a precision pressure gauge covering the measuring range. (For a flange type meter body, prepare a piping adaptor.)

(3) Apply to the high pressure connection port a pressure corresponding to 100% of the measuring range by adjusting the variable pressure source.

(4) If the output pressure is largely shifted from 100% (1.0 kgf/cm^2), adjust the SPAN CHANGE boss using a plain screwdriver so that the output pressure becomes approximately 100%. As you turn the boss clockwise, the output pressure rises and the span becomes narrower. As you turn the boss counterclockwise, the output pressure falls and the span becomes wider.

(5) Release the high pressure connection port to atmosphere.

(6) If the output pressure is shifted from 0% (0.2 kgf/cm^2), adjust the ZERO ADJ screw so that the output pressure becomes 0%. As you turn the screw clockwise, the output pressure rises, and vice versa.

(7) Apply to the high pressure connection port a pressure corresponding to 100% of the measuring range.

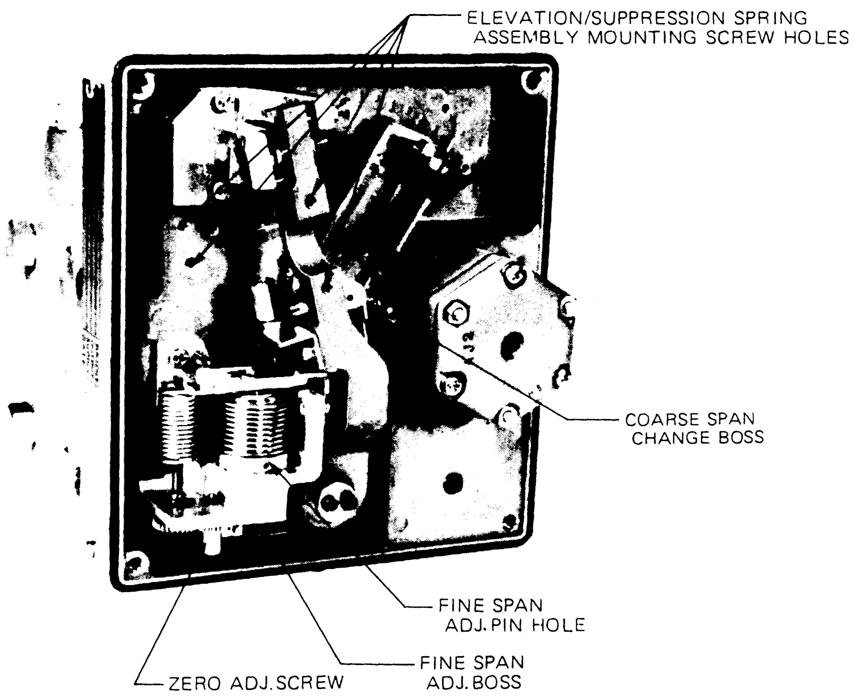


Figure 6

(8) If the output pressure is shifted from 100%, adjust the SPAN ADJ boss at the bottom of the feedback bellows as follows:

If the output is higher than 100%, turn the boss so that the output becomes lower than 100% by an amount of 1/4 of the shift. (For example, if the output is 104%, turn the boss so that the output becomes 100 - 1/4 x 4 = 99(%)).

If the output is lower than 100%, turn the boss so that the output becomes higher than 100% by an amount of 1/4 of the shift. For example, if the output is 98%, turn the boss so that the output becomes 100 + 1/4 x 2 = 100.5(%).

The span can be adjusted also by turning the feedback bellows by inserting a pin in the SPAN ADJ PIN HOLE instead of adjusting the SPAN ADJ boss. As you turn the feedback bellows, the span changes as follows:

Clockwise turn of bellows: Output increases. (Span becomes wider.)

Counterclockwise turn of bellows: Output decreases. (Span becomes narrower.)

(9) Repeat the procedures of (5) - (8) until the required accuracy is attained.

3. CALIBRATION OF GAUGE PRESSURE TRANSMITTER

(1) Connect to the process pressure connection port of the meter body a variable pressure source (such as the air supply via a regulator) corresponding to the measuring range and a precision pressure gauge covering the measuring range. (For a flange type meter body, prepare a piping adaptor.)

(2) Apply to the process pressure connection port a pressure corresponding to 100% of the measuring range by adjusting the variable pressure source.

(3) If the output pressure is largely shifted from 100% (1.0 kgf/cm^2), adjust the SPAN CHANGE boss so that the output pressure becomes approximately 100%. As you turn the boss clockwise, the output pressure rises and the span becomes narrower. As you turn the boss counterclockwise, the output pressure falls and the span becomes wider.

(4) Release the process pressure connection port to atmosphere.

(5) If the output pressure is shifted from 0% (0.2 kgf/cm^2), adjust the ZERO ADJ screw so that the output pressure becomes 0%. As you turn the screw clockwise, the output pressure rises, and vice versa.

(6) Apply to the process pressure connection port a pressure corresponding to 100% of the measuring range.

(7) If the output pressure is shifted from 100%, adjust the SPAN ADJ. boss at the bottom of the feedback bellows as follows:

If the output is higher than 100%, turn the boss so that the output becomes lower than 100% by an amount of 1/4 of the shift. For example, if the output is 104%, turn the boss so that the output becomes 100 - 1/4 x 4 = 99(%).

If the output is lower than 100%, turn the boss so that the output becomes higher than 100% by an amount of 1/4 of the shift. For example, if the output is 98%, turn the boss so that the output becomes 100 + 1/4 x 2 = 100.5(%).

The span can be adjusted also by turning the feedback bellows by inserting a pin in the SPAN ADJ PIN HOLE instead of adjusting the SPAN ADJ boss. As you turn the feedback bellows, the span changes as follows:

Clockwise turn of bellows: Output increases. (Span becomes wider.)

Counterclockwise turn of bellows: Output decreases. (Span becomes narrower.)

(8) Repeat the procedure of (4) - (7) until required accuracy is attained.

4. CALIBRATION OF ABSOLUTE PRESSURE TRANSMITTER (REFER TO PROCEDURE OF SECTION 3.)

To calibrate a transmitter which has a vacuum measuring range alone or which has a compound measuring range including a vacuum range at a substantial rate, use such devices as vacuum pump and needle valve for the variable pressure source. For pressure measurement, use a digital vacuum manometer or a mercury column. A transmitter which has a compound measuring range of which major portion is a positive pressure range may be calibrated using an input pressure which is percent equivalent of the atmospheric pressure.

5. CALIBRATION OF LIQUID LEVEL TRANSMITTER (MODEL KQP-4)

(1) Fix the torque tube assembly together with the transmitter to a bench by using, for example, a vice as shown in Figure 7.

Note: Exercise care so that no unreasonably large torque is applied to the torque tube.

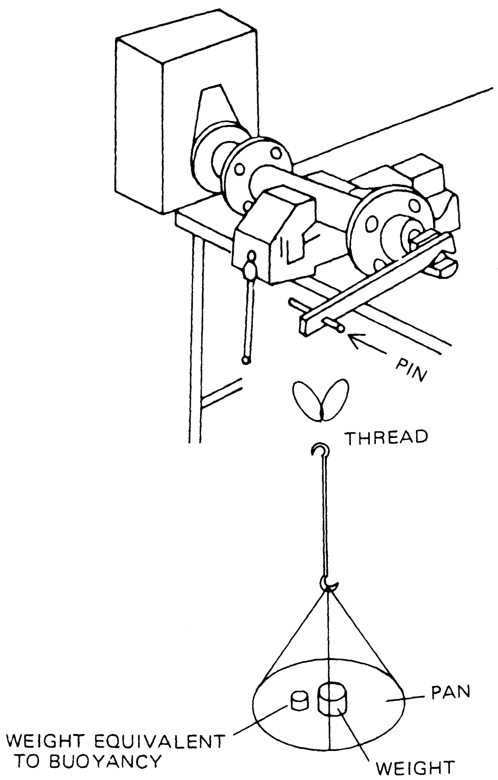


Figure 7

(2) Prepare a weighing pan as shown in Figure 7 and hang it on the pin at the end of the torque tube using a thread or fine wire looped into two circlets.

5.1 Calibration Formula and procedure for Liquid Level Transmission

(1) To calculate the weight (buoyancy) for calibration, use the following formula:

$$F = \frac{\frac{\pi}{4} \cdot D^2 \cdot H \cdot \rho}{1 + \alpha \cdot \pi \cdot D^2 \cdot \rho}$$

where,

F : Calibration weight (grams) corresponding to buoyancy

D : Outer diameter (cm) of float

H : Measuring range (cm)

ρ : Density of the liquid

α : Parameter

2.05×10^{-5} (External or internal chamber, top type; torque arm length 110 mm)

8.93×10^{-5} (Internal chamber, side type; torque arm length 286 mm)

1.09×10^{-4} (Internal chamber, side type; (JPI600, JIS63K); torque arm length 350 mm)

(2) Adjust so that the total weight (W) becomes the same with the weight of the float (3 kg for medium specific-gravity measurement or 4.5 kg for low specific-gravity measurement). (W = Calibration weight + Pan weight + Dummy weight)
When in the above condition, the total weight (W) is corresponding to 0% of the measuring range.
When the weight (F) which is corresponding to the buoyancy is removed, weight (W-F) is corresponding to 100% of the measuring range.

(3) Apply an input pressure corresponding to 100% of the measuring range.

(4) If the output pressure s largely shifted from 100% (1.0 kgf/cm^2), adjust the SPAN CHANGE boss so that the output pressure becomes approximately 100%. As you turn the boss clockwise, the output pressure rises and the span becomes narrower. As you turn the boss counterclockwise, the output pressure falls and the span becomes wider.

(5) Apply an input pressure corresponding to 0% of the measuring range.

(6) If the output pressure is shifted from 0% (0.2 kgf/cm^2), adjust the ZERO ADJ screw so that the output pressure becomes 0%. As you turn the screw clockwise, the output pressure rises, and vice versa.

(7) Apply an input pressure corresponding to 100% of the measuring range.

(8) If the output pressure is shifted from 100%, adjust the SPAN ADJ boss at the bottom of the feedback bellows as follows:

If the output is higher than 100%, turn the boss so that the output becomes lower than 100% by an amount of 1/4 of the shift. For example, if the output is 104%, turn the boss so that the output becomes 100 - 1/4 x 4 = 99(%).

If the output is lower than 100%, turn the boss so that the output becomes higher than 100% by an amount of 1/4 of the shift. For example, if the output is 98%, turn the boss so that the output becomes 100 + 1/4 x 2 = 100.5(%).

The span can be adjusted also by turning the feedback bellows by inserting a pin in the SPAN ADJ PIN HOLE instead of adjusting the SPAN ADJ boss. As you turn the feedback bellows, the span changes as follows:

Clockwise turn of bellows:	Output increases. (Span becomes wider.)
Counterclockwise turn of bellows:	Output decreases. (Span becomes narrower.

(9) Repeat the procedure of (7) - (8) until required accuracy is attained.

Note: For specific-gravity change, ZERO and SPAN adjustment, refer to Sections 2 and 3. Specific-gravity change is corresponding to SPAN change in such sections.

5.2 Calibration Procedure for Boundary Liquid Level Transmission

(1) This procedure is identical with that for liquid level transmission, except that the following formulas should be used:

(a) Total weight W including the two weights, pan and others:

$$W = (\text{Weight of float}) - \frac{\pi}{4} D^2 \cdot L \cdot \rho_1$$

where, ρ_1 : Density of upper liquid

(b) Calibration weight (F) corresponding to buoyancy:

$$F = \frac{\frac{\pi}{4} \cdot D^2 \cdot H(\rho_2 - \rho_1)}{1 + \alpha \cdot \pi \cdot D^2(\rho_2 - \rho_1)}$$

where, ρ_2 : Density of lower liquid

5.3 Calibration procedure for Specific-gravity Transmission

(1) This procedure is identical with that for liquid level transmission, except that the following formulas should be used.

(a) Total weight W including the two weights, pan and others:

$$W = (\text{Weight of float}) - \frac{\pi}{4} D^2 \cdot L \cdot \rho_L$$

where, ρ_L : Low limit of specific-gravity range

(b) Calibration weight (F) corresponding to buoyancy:

$$F = \frac{\frac{\pi}{4} D^2 \cdot H \ (\rho_H - \rho_L)}{1 + \alpha \cdot \pi \cdot D^2 \cdot H (\rho_H - \rho_L)}$$

where, ρ_H : High limit of specific-gravity range

5.4 Adjustment of Stopper

(1) When the instrument is shipped from the factory, the torque tube is installed in the correct angle. When the torque tube housing, bonnet and side flange are detached in the field and assembling them, pay attention to the following:

Adjust the gap at 2.5 mm from the low limit stopper by means of plays of the bolt holes when the float is hung as shown in Figure 8.

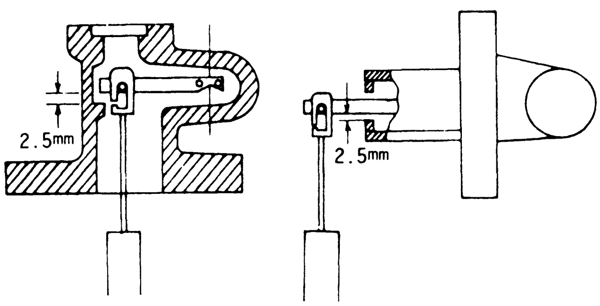


Figure 8

6. CALIBRATION OF LIQUID LEVEL TRANSMITTER (LEVEL KQP-3)

Fix the meter body together with the transmitter to a bench by using, for example, a vice as shown in Figure 9.

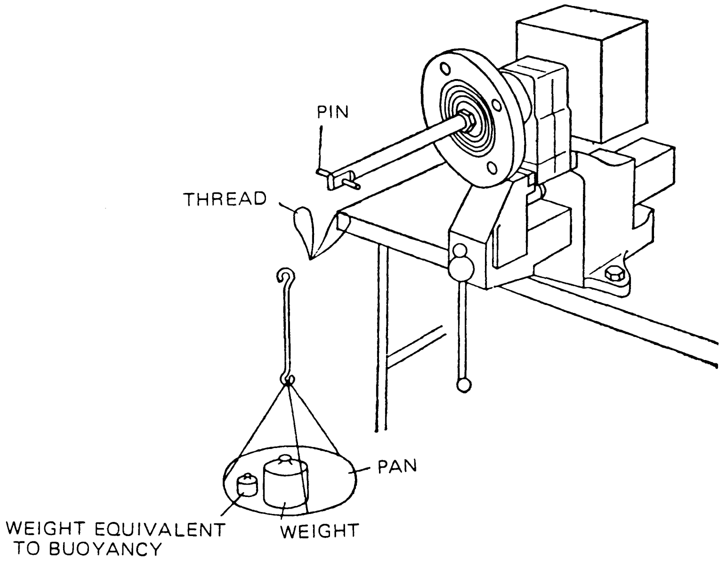


Figure 9

Under the above state, perform a procedure identical with that of Sections 5.1 through 5.3 with the only difference being that the following formula is used for calculation of buoyancy:

$$F = \frac{\pi}{4} \cdot D^2 \cdot H \cdot \rho$$

For adjustment (calibration) keep the damping control fully open.

No stopper adjustment is needed for Model NQP3. When using the NQP3 for boundary liquid level or specific-gravity transmission, use the following formulas for calculation of weight (F) corresponding to buoyancy:

Boundary liquid level: $F = \frac{\pi}{4} D^2 L (\rho_2 - \rho_1)$

Specific-gravity: $F = \frac{\pi}{4} D^2 L (\rho_H - \rho_L)$

7. SETTING OF ELEVATION/SUPPRESSION

Elevation/suppression can be realized by providing as actually required the zero shift which has initially been eliminated as mentioned in Section 1.

After setting an elevation/suppression, apply an input corresponding to 100% of the measuring range and, if the 100% point has been shifted, perform the SPAN adjustment. In this case, the zero point and 100% point should be of the values with the elevation/suppression taken into consideration.

7.1 Setting of Elevation

When all adjustment (without elevation) is over, install the elevation spring assembly on the base plate and beam.

Apply an input corresponding to the required zero point shift and turn the spring adjustment screw with a wrench so that the output pressure becomes 0.2 kgf/cm^2. As you turn the screw counterclockwise (the wrench moves upward), elevation increases.

7.2 Setting of Suppression

Suppression can be set in the same manners in the case of elevation. As you turn the spring adjustment screw clockwise (the wrench moves downward), suppression increases.

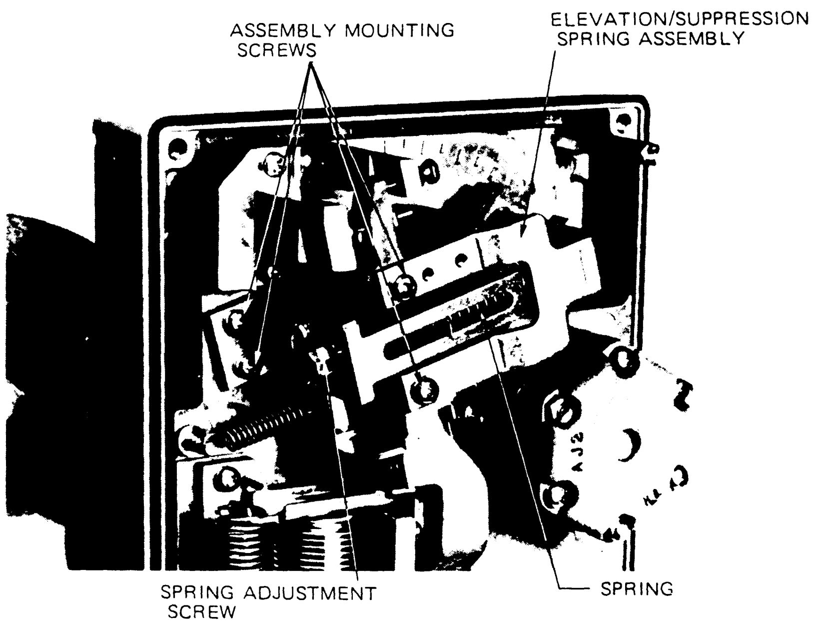


Figure 10

Document Number :	OM2-5220-0000
Document Name :	PREX3000 Series, Liquid Level Meter Series Pneumatic Transmitter Model : KDP/KKP/KQP
Date :	5th edition: Mar. 2013
Issued / Edited by :	Azbil Corporation

Azbil Corporation