

**Liquid Level Meter
Pneumatic Transmitter**

Model KDP/KKP

User's Manual

Azbil Corporation

NOTICE

While the information in this manual is presented in good faith and believed to be accurate, Azbil Corporation disclaims any implied warranty of merchantability or fitness for a particular purpose and makes no express warranty except as may be stated in its written agreement with and for its customer.

In no event shall Azbil Corporation be liable to anyone for any indirect, special or consequential damages. This information and specifications in this document are subject to change without notice.

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Chapter 1. Description

1-1. General

The Pneumatic 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.

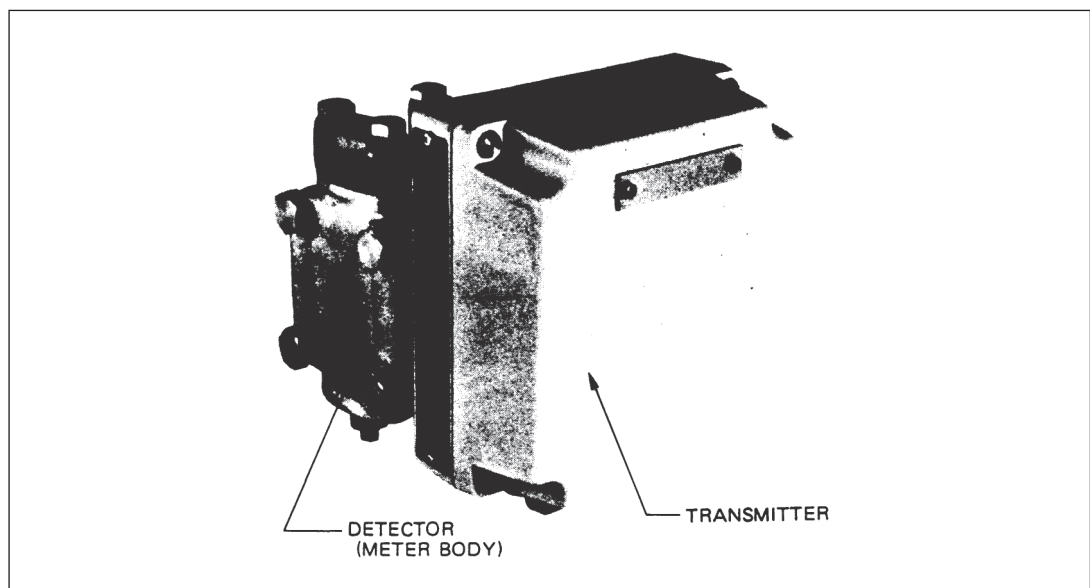


Fig. 1-1.

1-2. Specifications

Air piping connections:	Rc 1/4 or 1/4 NPT
Air supply:	$1.4 \pm 0.14 \text{ kgf/cm}^2$
Output:	$0.2 \text{ to } 1.0 \text{ kgf/cm}^2$
External load:	$\phi 4(\text{ID}) \times 3 \text{ m} + 20 \text{ cc}$ 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)

1-3. Combinations with detector (Meter body)

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

1-4. 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.

1-4-1. Nozzle and flapper

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

1-4-2. 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.

1-4-3. 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.

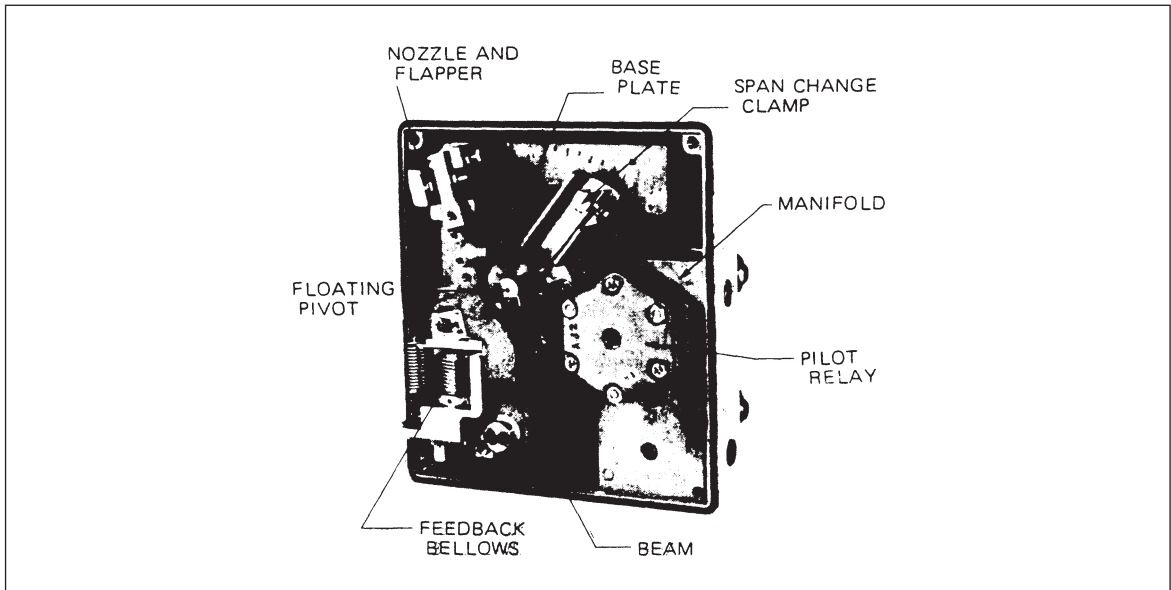


Fig. 1-2.

Chapter 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 Fig. 2-1, 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.

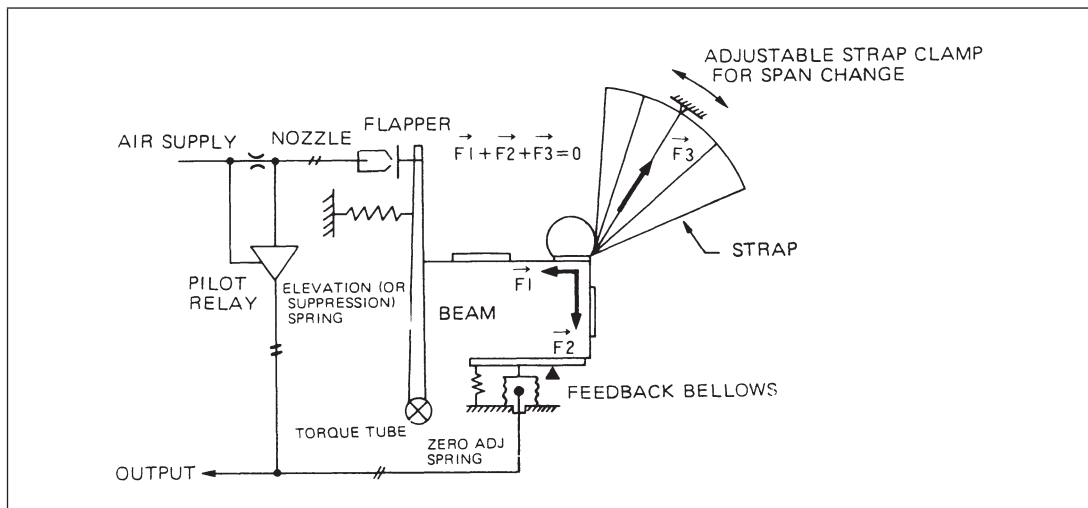


Fig. 2-1.

Chapter 3. Installation and operation

3-1. 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.

3-2. Pressure connection to process

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

3-3. 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.

3-4. 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.

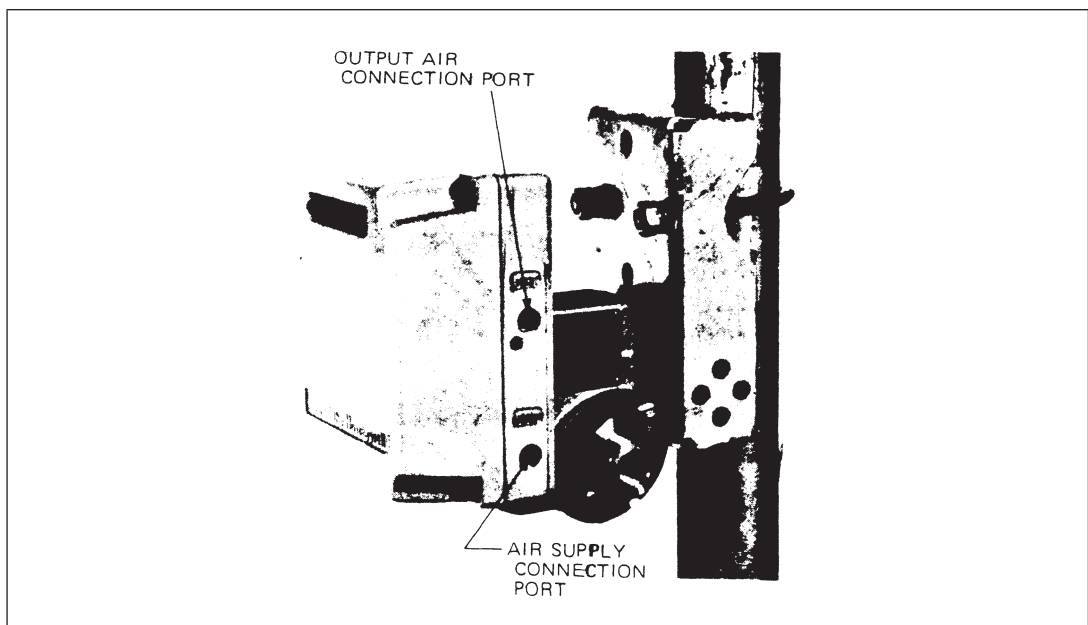


Fig. 3-1. Air Connections

Chapter 4. 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 Azbil 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."

4-1. To replace the pilot relay

Remove the pilot relay by removing the three screws shown in Fig. 4-1

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.

4-2. To service the pilot relay

Remove the pilot relay as described in 4-1 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 Fig. 4-1)
- (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 Chlorothene. 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.

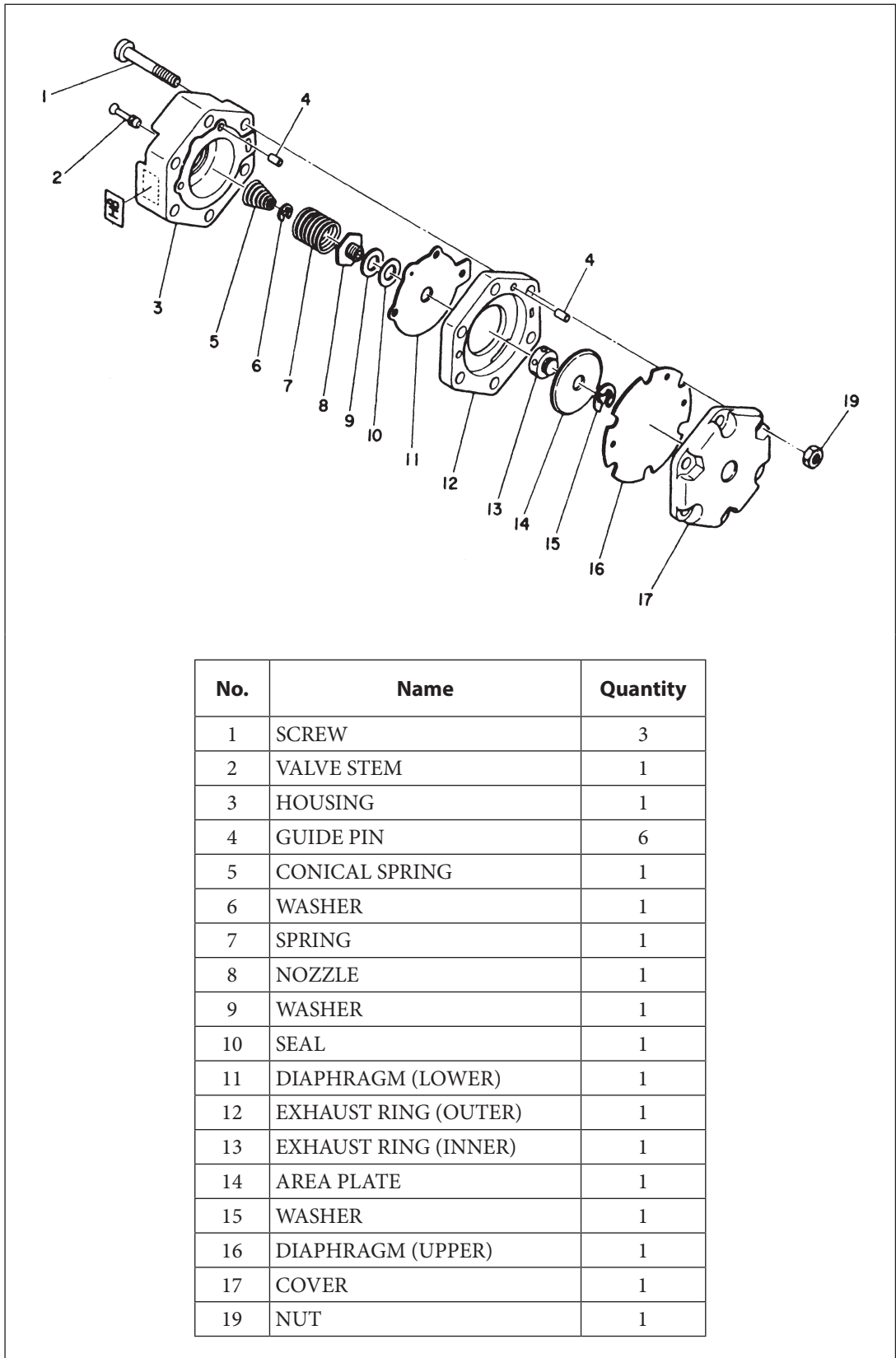


Fig. 4-1. Pilot relay assembly

Chapter 5. Calibration and adjustment

5-1. 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 1.0 kgf/cm² 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/cm² to the output port for calibration when checking the transmitter operation or for adjustment when replacing meter bodies or changing ranges.

5-2. 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/cm²), 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/cm²), 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.

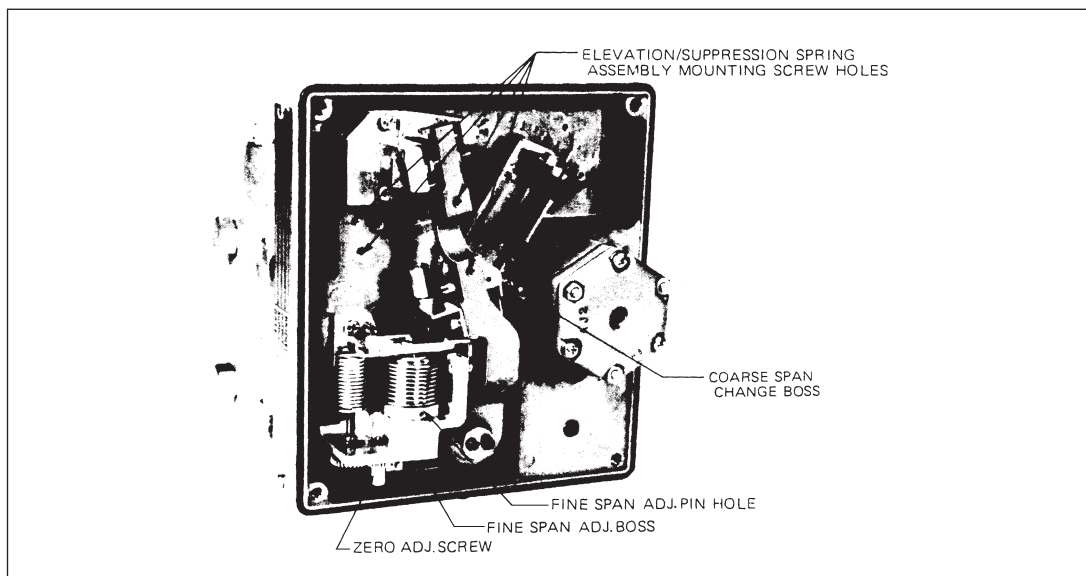


Fig. 5-1.

- (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 $100 - 1/4 \times 4 = 99$ (%)).

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 $100 + 1/4 \times 2 = 100.5$ (%).

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.

5-3. 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/cm²), 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/cm²), 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 $100 - 1/4 \times 4 = 99$ (%).
- 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 $100 + 1/4 \times 2 = 100.5$ (%).
- 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.

5-4. Calibration of absolute pressure transmitter (Refer to procedure of 5-3.)

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.

5-5. 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 5-1.

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.

5-5-1. 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.

5-5-2. 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.

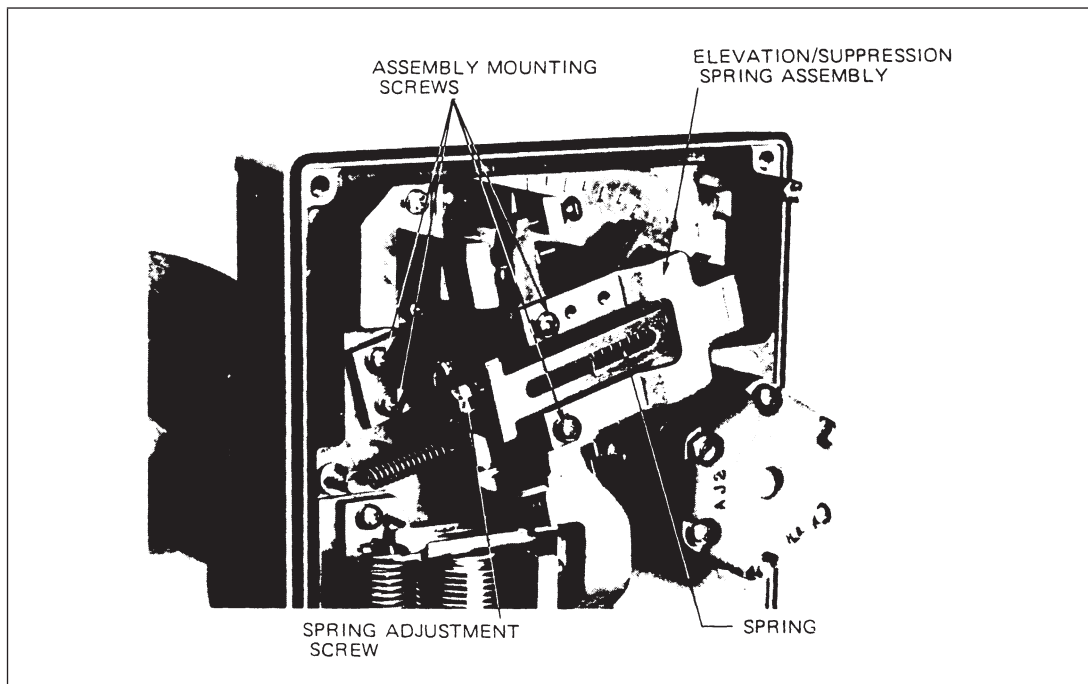


Fig. 5-2.

Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.

You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

1.2 Warranty scope

In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place. Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

- (1) Failure caused by your improper use of azbil product (noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
- (2) Failure caused for other reasons than Azbil Corporation's product;
- (3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;
- (4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;
- (5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or
- (6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

- (1) Regulations and standards or laws that your Equipment is to comply with.
- (2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
- (3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use

Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down. You are required to provide your Equipment with safety design such as fool-proof design,*1 and fail-safe design*2 (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance,*3 fault tolerance,*4 or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.

*2. A design that is safe even if the device fails.

*3. Avoidance of device failure by using highly reliable components, etc.

*4. The use of redundancy.

3. Precautions and restrictions on application

3.1 Restrictions on application

Please follow the table below for use in nuclear power or radiation-related equipment.

	Nuclear power quality*5 required	Nuclear power quality*5 not required
Within a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Cannot be used (except for limit switches for nuclear power*7)
Outside a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Can be used

*5. Nuclear power quality: compliance with JEAG 4121 required

*6. Radiation controlled area: an area governed by the requirements of article 3 of "Rules on the Prevention of Harm from Ionizing Radiation," article 2 2 4 of "Regulations on Installation and Operation of Nuclear Reactors for Practical Power Generation," article 4 of "Determining the Quantity, etc., of Radiation-Emitting Isotopes," etc.

*7. Limit switch for nuclear power: a limit switch designed, manufactured and sold according to IEEE 382 and JEAG 4121.

Any Azbil Corporation's products shall not be used for/with medical equipment.

The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product. However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.

3.2 Precautions on application

you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below. Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

- (1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
- (2) For use of specific purposes, such as:
 - * Nuclear energy/radiation related facilities
[When used outside a radiation controlled area and where nuclear power quality is not required]
[When the limit switch for nuclear power is used]
 - * Machinery or equipment for space/sea bottom
 - * Transportation equipment
[Railway, aircraft, vessels, vehicle equipment, etc.]
 - * Antidisaster/crime-prevention equipment
 - * Burning appliances
 - * Electrothermal equipment
 - * Amusement facilities
 - * Facilities/applications associated directly with billing
- (3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
- (4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
- (5) Machinery or equipment that may affect human lives, human bodies or properties
- (6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification. Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.

In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used. Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals. System products, field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts. For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason. For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice. After manufacturing is discontinued, we may not be able to provide replacement products even within the warranty period.

For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts. For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service. Accordingly, a separate fee will be charged in any of the following cases:

- (1) Installation, adjustment, guidance, and attendance at a test run
- (2) Maintenance, inspection, adjustment, and repair
- (3) Technical guidance and technical education
- (4) Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

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