INSTRUCTION MANUAL FOR

PNEUMATIC LEVEL SENSOR

MODEL: F P 5 1 □
Read and understand this manual for safely usage.

- This manual describes the product of explosion-proof construction. Read the other manuals for the product of standard specifications.
- This manual describes the handling, inspection, and adjustment of the product which model is mentioned on the cover page. Read and understand this manual before handling.
- Follow the additional document and/or direction, submitted by NOHKEN INC. and our distributor or agent, even if the terms are mentioned in this manual.
- Save this manual in proper place being available to refer immediately.
- The specification of product mentioned in this manual may not be satisfied by the condition of environment and usage. Check and consider carefully before using.
- Contact to sales office at NOHKEN INC. for any question or comment about this manual and product.

The followings are the description of the terms in this manual.

<table>
<thead>
<tr>
<th>DANGER</th>
<th>Indicates a potentially hazardous situation which, if not pay attention, will result in death, serious injury or serious disaster.</th>
</tr>
</thead>
<tbody>
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<td>WARNING</td>
<td>Indicates a potentially hazardous situation which, if not pay attention, could result in death, serious injury or serious disaster.</td>
</tr>
<tr>
<td>CAUTION</td>
<td>Indicates a hazardous situation which, if not pay attention, may result in minor or moderate injury or damage to device.</td>
</tr>
</tbody>
</table>

- Indicates prohibited matter. The explanation with this mark shall be followed
- Indicates instructed matter. The explanation with this mark shall be followed.
⚠️ DANGER

Do not modify or disassemble the product. Otherwise, the flammable gas or vapor may be ignited.

⚠️ DANGER

Do not open the terminal cover when powered. Leave terminal box more than 3 minutes to cool down after turn off the power. Otherwise, the flammable gas or vapor may be ignited.

⚠️ WARNING

Install this product in hazardous location Zone 1 and 2, Do not install Zone 0.

Do not cause damage to the enclosure, joint surface, and thread on the cover. The explosion-protection of this product is retained by the strength of pressure for enclosure, wide and length of clearance.

Follow the description of inspection, adjustment, and maintenance in this manual, and not disassemble the parts except it is necessary. Otherwise, the explosion-protection of this product is not retained.

Ensure small screw for earth ground terminal, cover fixing bolt, and etc. Shall be tighten with spring washer. Otherwise, the explosion-protection of this product is not retained.
**WARNING**

Adjustment, inspection, and maintenance for explosion-proof shall be done by the skilled person who has been educated and experienced.

Inspection and maintenance except visual check for this product shall be done where flammable gas or vapor is not occurred.

The electrical instrument for maintenance at hazardous location shall be approved as explosion-proof construction.

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**WARNING**

Turn off the power immediately, if the smoke, strange smell and sound are occurred. Do not use it until the problem is solved.

Ensure the wire is properly connected. The product and connected device may be malfunctioned, damaged, fired, or miner injury and electric shock may be occurred by improper wiring.

Don't use the sensor which is made from resin, when the sensor measures materials with volume resistivity equal to or more than $10^9 \Omega \cdot \text{cm}$. 
<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommend to use the earth terminal inside of the terminal box for grounding. The earth terminal at the surface of terminal box may be deteriorated by the environmental condition of usage.</td>
</tr>
<tr>
<td>The wire or cable for grounding shall be green color or stripe of green and yellow color (compliant with JIS). If not prepared, green color tape shall be installed at the tip of wire or cable to indicate for grounding.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid strong shock and rough handling to this product. The product may be damaged by strong shock as dropping, falling, throwing, knocking, lugging, and etc.</td>
</tr>
<tr>
<td>Follow the specification of operating temperature, operating pressure, switch rating, and etc. Otherwise, the product and connected device may be malfunctioned, damaged, fired, or miner injury and electric shock may be occurred. Check the manual or specification sheet.</td>
</tr>
<tr>
<td>Operation test shall be done before practical usage. If the serious accident is expected to occur by malfunction of product, the other operating principle of product shall be installed in parallel.</td>
</tr>
<tr>
<td>In case of connecting inductive or lamp load to the product, Provide protective circuit to the load to avoid over voltage and over current. If not provide, the contact may be damaged.</td>
</tr>
</tbody>
</table>
**CAUTION**

Do not grab and turn the terminal box, when the plug mounted product is removed from the tank. It may be cause of cutting internal wiring. The plug shall be loosened by the right tool.

Hold the stem very close to mounting point, when carrying, installing, and removing. If hold the terminal box, it may be taken off from the flange or plug, and the product may be damaged by dropping.

**CAUTION**

Check and deeply consider the chemical compatibility for material of product in advance.

The product is 50cm or longer
The product shall be kept in horizontally. The product and other goods be damaged, and miner injury may be occurred by falling.
INTRODUCTION
A) This manual specifies the specification of general product. If you order special product, some details of specification may be different with the manual.
B) We are glad to suggest and advice for Model selection and chemical resistant of material, but final decision has to be made by the customer.
C) This manual has prepared with close attention. Ask sales office at NOHKEN INC. for any question or comment about the contents of this manual.
D) For replacement parts
   The quality of product has frequently improved, so same spare part may not be supplied. In this case, replacement part or product may be supplied. Ask sales office at NOHKEN INC. for details.
E) The contents of this manual are subject to change any time without notice due to the improvement of product.

WARRANTY & DISCLAIMER
A) NOHKEN INC. warrants this product against defect in design, material and workmanship for a period of 1(one) year from the date of original factory shipment.
B) The warranty only covers the damage of products. The secondary and third kind disasters are not covered by NOHKEN INC.
C) NOHKEN INC. shall not be liable for the following.
   C-a) Do not follow the description and direction in this manual.
   C-b) Damage due to improper installation, wiring, usage, maintenance, inspection, storing, and etc.
   C-c) Repair and modification are done by the person who is not employee of NOHKEN INC.
   C-d) Improper parts are used and replaced.
   C-e) The damage is occurred by the device or machine except our products.
   C-f) Improper usage. (See "Proper of usage" in chapter 1 in this manual)
   C-g) Force Majeure including, but not limited to, fire, earthquake, tsunami, lightning, riots, revolution, war, radioactive pollution, acts of God, acts of government or governmental authorities, compliance with law, regulation, and order.

THE TERMS OF WARRANTY AND DISCLAIMER SHALL IN NO WAY LIMIT YOUR REGAL LIGHT.
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1. HANDLING OF EXPLOSION-PROOF

1.1 EXPLOSION-PROOF SPECIFICATIONS

The FP is of flame-proof construction, and has the following specification:

<table>
<thead>
<tr>
<th>Model name</th>
<th>Type designation</th>
<th>Explosion construction and applicable gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP510</td>
<td>FP510(FP511)</td>
<td>d2G4</td>
</tr>
</tbody>
</table>

1.2 INDICATION OF EXPLOSION-PROOF

All technical information such as model name, power supply, manufacturing No., manufacturing date, approval No. and precautions for handling are specified on the terminal box.

1.3 ENVIRONMENT CONDITIONS

The FP can be installed in hazardous locations containing the gas atmosphere which the FP is certified to be explosion-proof in.

The allowable humidity range and temperature range at the installation site are as follows:

- Humidity : 85% RH Max.
- Temperature : 0 to 60 ℃

The temperature range of each electrode is specified in section 4. SPECIFICATIONS.

1.4 EXTERNAL WIRING

To protect the flame propagation through any joint or structural openings in the enclosure, gap width of all joint is specified by rules. Since the FP is the flame-proof type, open the cover only for electrical connections. Any disassembly to joints is prohibited.

1.5 REPAIR AND REPLACEMENT

As a rule, all repair and replacement of explosion-proof version shall conducted only to recover the original state’s factory. To alter specifications, make any modification or disassembly on site is strictly prohibited. That’s why in case of replacement of diaphragm and adjustment of microswitch position, return the FP of Nohken.
2. PURPOSE OF USE
The FP510 is used for liquid level detection such as water, oil, chemicals and so on. It is used for taking out the control signal from alarms or pumps. Do not use in any other applications.

3. DESCRIPTION
3.1 PRODUCT DESCRIPTION
The FP is a diaphragm actuated switch. To operate, the FP is installed on the tank with G1” thread. The microswitch (*) in the FP is actuated by receiving the liquid head pressure (*) in the detecting pipe beneath the diaphragm.

3.2 PRINCIPLE OF OPERATION
The FP is installed vertically on the container top. As the liquid rises, the detecting pipe connected to the FP contacts with liquid. By compression of a captive air column in this pipe, the microswitch operates at the specified position.

4. SPECIFICATIONS
4.1 OPERATING CHARACTERISTICS
① Application : Open type (Max. depth is 3m)
② Switch operating point : 60 ± 10 mm
③ Switch release point : 40 ± 15 mm
(By using 1/2B L=300 mm pipe)

4.2 ELECTRICAL CHARACTERISTICS
① Contact capacity : 250 V 10 A AC
(Resistive load) 250 V 0.2 A DC
② Min. load : 5 V 160 mA DC
③ Life expectancy : 3 × 10⁵ Operation Min.

4.3 MECHANICAL CHARACTERISTICS
① Ambient pressure of diaphragm : 0 to 100 kPa
② Allowable impact : 100 m/s²

*: See section 11 for the word explanation.
4.4 EXPLOSION-PROOF APPROVAL TEMPERATURE
① Ambient temperature : -10 to 60 ℃
② Process temperature : 70 ℃

4.5 CONSTRUCTIONS
① Terminal box protection (*) : IP53
② Type of protection (*) : Flameproof TIIS certification d2G4

4.6 MATERIALS
① Terminal box : AC4A
② Cover : AC4A
③ Chamber : AC4A
④ Diaphragm (*) : CR

4.7 CABLE INLET
① FP510: G 3/4
② FP511: G 3/4 Explosion proof packing type cable gland(*), Cable diameter size φ11.0 to φ15.9

4.8 INSTALLATION
① For container : G1
② For pipe coupling : Rc 1/2

⚠ CAUTION
If the relay is inductive load or lamp load, connect protecting circuit to the load side to avoid overvoltage or overcurrent. If exceeds maximum value, the microswitch shall be damage.

5. HANDLING NOTES
Cautions shall be taken as follows. If not the sensor shall be damaged.

5.1 Avoid physical shock. Dropping, throwing or bumping shall damage the sensor.

*:See section 11 for the word explanation.
5.2 When painting the sensor, do not paint on the nameplate to keep the indication of serial number for future reference when ordering parts. Avoid painting on the thread.

5.3 Do not use or store in a corrosive atmosphere (NH₃, SO₂, Cl₂, etc.). Internal circuit shall be corroded and conduction failure may occur.

5.4 Protect the sensor from dust, dirt and foreign matters. Otherwise the diaphragm in the sensor may be damaged.

5.5 Do not locate near agitator or liquid inlets/outlets. The operation will be unstable.

5.6 Do not install the FP on the pressurized container. Despite the liquid level change, the diaphragm is always receiving the pressure.

5.7 When low level detection, the operating point rises. This is because the air inside the pipe dissolved into the liquid.

6. INSTALLATION

⚠️ WARNING

The allowable hazardous location(*) is Zone 1(*) and 2 (*). Do not install in Zone 0(*).

*:See section 11 for the word explanation.
6.1 UNPACKING

6.1.1 Avoid physical shock. Dropping, throwing or bumping shall damage the sensor.

6.1.2 Make sure the products you ordered is correct. If not, contact Nohken.

6.1.3 Protect the sensor from dust, dirt and foreign matters. Otherwise the diaphragm in the sensor may be damaged.

6.2 INSTALLATION

6.2.1 Do not locate near agitator or liquid inlets/outlets. The operation will be unstable. If inevitable, use stilling tube(*).

6.2.2 When installing, wrench the hexagon part. Do not wrench on the terminal box. Make sure the FP is mounted in horizontal alignment.

6.2.3 Do not use or store in a corrosive atmosphere (NH₃, SO₂, Cl₂, etc.). Internal circuit shall be corroded and conduction failure may occur.

6.2.4 Do not install the FP on the pressurized container. Despite the liquid level change, the diaphragm is always receiving the pressure.

*:See section 11 for the word explanation.
6.2.5 Pipe coupling shall be airtight by applying a sealing compound in paste form. Do not use a seal tape.

6.3 AIR SUPPLYING UNIT

When low level detection, the operating point rises. This is because the air inside the pipe is dissolved into the liquid. We recommend to use the air supplying unit to ventilate. It is also ideal for highly sticky liquids, liquids with many suspended solids and corrosive liquids.

Recommended air source and switch points are shown below.

- Flow rate of air: 0 to 0.3 l/min
- Air pressure: 0 to 50 kPa
- Switch operating point: 40 ± 10 mm
- Switch release point: 30 ± 15 mm

(By using 1/2B L=300 mm pipe)

7. WIRING

7.1 PREPARATION


⚠️ WARNING

In hazardous areas, Do not remove the terminal box cover and connect the cable until atmosphere is to be safe and the power supply is turned off.
7.2 CABLE INLET
Cable inlet is G3/4 (JIS B 0202). The cable must be led into the terminal box housing through the pressure-tight screw-thread coupling.

7.3 WIRING
7.3.1 Use wire in conjunction with JIS C 3307, 600V IV or equivalent.
7.3.2 Use pressure-tight cable conduit in conjunction with JIS C 8305.
7.3.3 Provide the sealing fitting (*) on the flexible fitting (*) near the cable inlet to seal (*) exclusive gas.

7.3.4 Use the flame-proof approved parts for wiring.
7.3.5 Secure each coupling, at least 5 turns, with the lock nut. Do not loosen any connection to avoid ignition.
7.3.6 The earth terminal in the terminal box or the external earth bolt shall be grounded, on the conditions of less than 100 Ω.

**CAUTION**
- For grounding, we recommend to use the earth terminal in the terminal box to prevent from deterioration by atmospheric condition.
- Use the specified color for grounding to identify easily. For example, we recommend to use green.

7.3.7 Terminal screw is M4. Tighten it by using the phillips blade driver. The terminal plate of the FP is shown below.

**WARNING**
Use the spring washer to avoid loosing. Tighten them to preserve flame-proof construction.

*: See section 11 for the word explanation.
7.4 OPERATIONAL CHECK
Before operating your plant, check the sensor operation primary. If unsuccessful, ask Nohken service department.

7.5 COVER INSTALLATION
The cover is designed anti-rotation clamp structure. After the electrical connections, tighten the cover and clamp it with anti-rotation bolt by the hex wrench (size 3).

⚠️ WARNING
- Use the spring washer to avoid loosing. Tighten them to preserve flame-proof construction.
- When tighten the cover, do not remove the O-ring to protect the flame propagation through this joint (*).

8. MAINTENANCE & INSPECTION
Remove the sensor from the container during overhaul period of your plant.

⚠️ WARNING
- Maintenance shall be done by the skilled engineer.
- It shall be in accordance with the Plant Electrical Equipment Flame-proof guide book published by Research Institute of Industrial Safety and all local codes.
- Do not damage any joint or structural openings of the terminal box. To protect the flame propagation, gap width and length of all joint is specified by rules.

8.1 REMOVING

⚠️ WARNING
In hazardous areas, Do not remove the terminal box cover and connect the cable until atmosphere is to be safe and the power supply is turned off.

8.1.2 Remove the cover by using the hex wrench and disconnect all wiring.
8.1.3 Remove the sensor from the container by wrenching the hexagon part.

*: See section 11 for the word explanation.
8.2 MAINTENANCE & INSPECTION
As a rule, all repair and replacement of explosion-proof version shall conducted only to recover the original state's factory. To alter specifications, make any modification or disassembly on site is strictly prohibited. That's why in case of replacement of diaphragm and adjustment of microswitch position, return the FP to Nohken.

8.2.1 Tighten loose screws. Check for damaged parts.
8.2.2 Clean dust, dirt and moisture from terminal box.
8.2.3 Check for corrosion due to condensation, gas and vapor on terminals and wires.

8.3 RE-INSTALLATION
Reinstall the sensor to the container. Refer to section 6.2 INSTALLATION.

8.4 WIRING
Reconnect the cable. Refer to section 7 WIRING.

9. STORAGE
The sensor shall be stored under the following conditions when it is not used for a long time.

9.1 Do not use or store in a corrosive atmosphere (NH₃, SO₂, Cl₂, etc.). Internal circuit shall be corroded and conduction failure may occur.

9.2 Lead wire egress is non-dripproof. Keep the lead wire out of water. Water penetration may cause the bad insulation.

9.3 Protect the sensor from dust, dirt and foreign matters. Otherwise the diaphragm in the sensor may be damaged.

REFERENCE
Keep the sensor in sealed plastic bags with desiccant or other moisture-proof packing.
10. TROUBLESHOOTING

10.1 NO CONTACT OUTPUT WITH LEVEL CHANGE

- Check for miswiring or loose wiring.
  ⇒ Wire correctly. See section 7.
- Sealing of the connection between the detecting pipe and chamber of level switch is not.
  ⇒ Pipe coupling shall be airtight by applying a sealing in paste form. See section 6.
- Detecting pipe or pressure balance pipe is clogged by sticking adhesives.
  ⇒ Clean it regularly. Use the air supplying unit. See section 6.
- Electrical contact is at fault due to low-load or overload.
  ⇒ Replace the microswitch and check the load. Provide the protective circuit if necessary. See section 4.

10.2 CONTACT ALWAYS OUTPUTS WITHOUT LEVEL CHANGE

- Miswiring or short-circuit wiring.
  ⇒ Wire correctly. See section 7.
- Detecting pipe or pressure balance pipe is clogged by sticking adhesives
  ⇒ Clean it regularly. Use the air supplying unit. See section 6.
- Microswitch is broken.
  ⇒ Replace it check the load. Provide the protective circuit if necessary. See section 4.

10.3 CONTACT OUTPUTS AT UNDESIRABLE POSITION

- The tip of the pipe is always under measuring object.
  ⇒ Use the air supplying unit. See section 6.
- Detecting pipe or pressure balance pipe is clogged by sticking adhesives
  ⇒ Clean it regularly. Use the air supplying unit. See section 6.

For replacement of the microswitch, contact Nohken.
## 11. GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microswitch</td>
<td>Miniature switch which consists of a precisely spaced snap-action mechanism with a prescribed force.</td>
</tr>
<tr>
<td>Liquid head pressure</td>
<td>When liquid specific gravity ($\gamma$) is stable, liquid level ($h$) is proportional to the liquid pressure ($P$). This relation can be expressed as $P=\gamma h$.</td>
</tr>
<tr>
<td>Terminal box protection</td>
<td>International protection in conjunction with IEC 529 to preserve dust and water penetration.</td>
</tr>
<tr>
<td>Flameproof Explosion Type</td>
<td>Parts which could ignite are enclosed in a housing which is designed such that transfer of the explosion to the environment is prevented in the event of an ignition.</td>
</tr>
<tr>
<td>Explosion Proof Packing Type</td>
<td>A cable gland equipped with a packing and a clamp for use as a flameproof gland.</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>Rubber to receive liquid head pressure in the detecting pipe.</td>
</tr>
<tr>
<td>Hazardous Area</td>
<td>Areas in which dangerous concentrations of flammable gases/vapors are present or the chances are high. In such areas, explosion protection should be implemented on electrical devices.</td>
</tr>
<tr>
<td>Zone 0</td>
<td>Areas in which dangerous concentrations of flammable gases/vapors are present continuously or long-term under normal operating conditions.</td>
</tr>
<tr>
<td>Zone 1</td>
<td>Areas in which dangerous concentrations of flammable gases/vapors are present occasionally under normal operating conditions.</td>
</tr>
<tr>
<td>Zone 2</td>
<td>Areas in which dangerous concentrations of flammable gases/vapors are present rarely and then only briefly under normal operating conditions.</td>
</tr>
<tr>
<td>Stilling tube</td>
<td>To prevent the FP from the liquid turbulence or stream.</td>
</tr>
<tr>
<td>Sealing Fitting</td>
<td>The sealing fitting is an accessory for a conduit whose inside is filled with fireproof or flame-resistant material to prevent flowage of flammable gases through the conduit.</td>
</tr>
<tr>
<td>Flexible Fitting</td>
<td>A conduit accessory made flexible to connect an electric device and a fixed conduit.</td>
</tr>
<tr>
<td>Sealing</td>
<td>The sealing is to seal up and block off an area to prevent leakage of flammable gases to non-hazardous areas.</td>
</tr>
<tr>
<td>Joint</td>
<td>Junction surface between cover and terminal box and terminal box and terminal plate.</td>
</tr>
</tbody>
</table>
HEAD OFFICE : 15-29,Hiroshiba-cho,Suita-city,Osaka 564-0052,Japan.
              TEL:06-6386-8141  FAX:06-6386-8140

TOKYO BRANCH OFFICE : 67,Kandasakumagashi,Chiyoda-ku, Tokyo 101-0026,Japan.
                      TEL:03-5835-3311  FAX:03-5835-3316

NAGOYA OFFICE : 3-10-17,Uchiyama,Chikusa-ku,Nagoya-city,Aichi 464-0075,Japan.
                 TEL:052-731-5751  FAX:052-731-5780

KYUSHU OFFICE : 14-1,2-chome,Asano,Kokurakita-ku,Kitakyushu-city,Fukuoka 802-0001,Japan.
                 TEL:093-521-9830  FAX:093-521-9834