INSTRUCTION MANUAL FOR

FLAMEPROOF MAGNETIC FLOAT SENSOR

MODEL: FR52□ Series
FR54□ Series

Issued 2012-09-21
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.

| ▼ DANGER | Indicates a potentially hazardous situation which, if not pay attention, will result in death, serious injury or serious disaster. |
| ▼ WARNING | Indicates a potentially hazardous situation which, if not pay attention, could result in death, serious injury or serious disaster. |
| ▼ CAUTION | Indicates a hazardous situation which, if not pay attention, may result in minor or moderate injury or damage to device. |

| ☠️ | 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.

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 $10^9 \, \Omega \cdot \text{cm}$. 

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ADD 3


⚠️ CAUTION ⚠️

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.

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.

⚠️ CAUTION ⚠️

Avoid shock and rough handling to this product. The product may be damaged by shock as dropping, falling, throwing, knocking, lugging, and etc.

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.

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.

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.
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.

Check and deeply consider the chemical compatibility for material of product in advance. The part especially float, which is very thin, may be malfunctioned by miner corrosion.

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.
NOTES TO USERS

1. It is essential that this manual shall be read and understood before installation and use of Model FR Reed type Level Sensors. This manual covers instructions for the installation and adjustment.

2. Specifications are subject to change without any obligation on the part of the manufacturer.

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1. PURPOSE OF USE
NOHKEN has over 20 years of experience in creating custom FR Series level switches for demanding customer requirements. FR Series switches are used extensively in the power, steel, chemical, water treatment and food processing industries. NOHKEN wants to be your company of choice for liquid level controls.

2. SPECIFICATIONS

2.1 Model
(1) Standard version (Type of protection: Flameproof TIIS d2G4)

<table>
<thead>
<tr>
<th>Cable inlet</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Pressure-tight screw-thread coupling method (G3/4)</td>
<td>S: Wetted part material 304 Stainless steel</td>
</tr>
<tr>
<td>1: Pressure-tight packing method (G3/4)</td>
<td>(Float and Float travel stop: 316 Stainless steel)</td>
</tr>
<tr>
<td>2: Pressure-tight screw-thread coupling method (G1/2)</td>
<td>V: Wetted part material PVC</td>
</tr>
<tr>
<td>3: Pressure-tight packing method (G1/2)</td>
<td>P: Wetted part material PP</td>
</tr>
<tr>
<td>Cable inlet: Pressure-tight screw-thread coupling method (G1/2)</td>
<td>HV: Wetted part material CPVC</td>
</tr>
</tbody>
</table>
(2) Special version (Type of protection: Flameproof TIIS d2G4)

FR52☐ ☐ ☐

Cable inlet
0: Pressure-tight screw-thread coupling method (G3/4)
1: Pressure-tight packing method (G3/4)
2: Pressure-tight screw-thread coupling method (G1/2)
3: Pressure-tight packing method (G1/2)

Mounting type
0: Flat face flange
1: Raised face flange
2: Slide flange
3: Sanitary fitting
4: Plug mounted from outside of tank
9: Others

Flange and stem material
S: 304 Stainless steel
S6: 316 Stainless steel
S6L: 316L Stainless steel
V: PVC
HV: CPVC
P: PP
PFL: PFA lining
F4T: PTFE tubing
F6L: FEP lining
F6T: FEP tubing
Z: Others

(3) Standard version (Type of protection: Flameproof TIIS d2G3)

FR54☐ ☐ ☐

Cable inlet
0: Pressure-tight screw-thread coupling method (G3/4)
1: Pressure-tight packing method (G3/4)
2: Pressure-tight screw-thread coupling method (G1/2)
3: Pressure-tight packing method (G1/2)

Material
S: Wetted part material 304 stainless steel
(Float and float travel stop: 316 stainless steel)
(4) Special version (Type of protection: Flameproof TIIS d2G3)

- **Cable inlet**
  - 0: Pressure-tight screw-thread coupling method (G3/4)
  - 1: Pressure-tight packing method (G3/4)
  - 2: Pressure-tight screw-thread coupling method (G1/2)
  - 3: Pressure-tight packing method (G1/2)

- **Mounting type**
  - 0: Flat face flange
  - 1: Raised face flange
  - 2: Slide flange
  - 3: Sanitary fitting
  - 4: Plug mounted from outside of tank
  - 9: Others

- **Flange and stem material**
  - S: 304 Stainless steel
  - S6: 316 Stainless steel
  - S6L: 316L Stainless steel
  - Z: Others
2.2 Standard Specifications

(1) Contact Rating
- Max. contact capacity: 15VA 15W (Resistive load)
- Max. working current: 0.5A AC 0.3A DC (Resistive load)
- Max. working voltage: 220V AC 110V DC (Resistive load)

(2) Life expectancy: Min. 1×10^6

(3) Allowable impact: Max. 100 m/s^2

(4) Type of protection: Flameproof TIIS certification d2G4
                         Flameproof TIIS certification d2G3

(5) Insulation resistance: More than 100MΩ at 500V DC

(6) Withstand voltage: 1500V AC for 1 minute

(7) Others

Table 1

<table>
<thead>
<tr>
<th>Model</th>
<th>Flange size (JIS B2210)</th>
<th>Maximum Pressure(*1)</th>
<th>Explosion-proof approval temperature (*2)</th>
<th>Construction</th>
<th>Specific gravity as measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>52□ S</td>
<td>5K 50A</td>
<td>500 kPa</td>
<td>-10 to +60°C -10 to +100°C</td>
<td>IP65</td>
<td>0.55</td>
</tr>
<tr>
<td>52□ V</td>
<td>5K 80A or equivalent</td>
<td>200 kPa</td>
<td>-10 to +50°C -10 to +80°C</td>
<td>IP65</td>
<td>0.65</td>
</tr>
<tr>
<td>52□ P</td>
<td>5K 80A or equivalent</td>
<td>200 kPa</td>
<td>-10 to +60°C -10 to +80°C</td>
<td>IP65</td>
<td>0.5</td>
</tr>
<tr>
<td>52□HV</td>
<td>5K 80A or equivalent</td>
<td>200 kPa</td>
<td>-10 to +60°C -10 to +80°C</td>
<td>IP65</td>
<td>0.7</td>
</tr>
<tr>
<td>54□ S</td>
<td>5K 50A</td>
<td>500 kPa</td>
<td>-10 to +60°C -10 to +150°C</td>
<td>IP65</td>
<td>0.55</td>
</tr>
</tbody>
</table>

*1 with static pressure
*2 The temperature range that is described in certificate of conformity.

Table 2

<table>
<thead>
<tr>
<th>Model</th>
<th>Float</th>
<th>Relation between Float and Liquid Surface (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>52□ S</td>
<td>φ 49×H50</td>
<td>25mm upper on and 25mm is under the level</td>
</tr>
<tr>
<td>52□ V</td>
<td>φ 65×H80</td>
<td>37mm upper on and 43mm is under the level</td>
</tr>
<tr>
<td>52□ P</td>
<td>φ 65×H80</td>
<td>50mm upper on and 30mm is under the level</td>
</tr>
<tr>
<td>52□HV</td>
<td>φ 74×H80</td>
<td>33mm upper on and 47mm is under the level</td>
</tr>
<tr>
<td>54□ S</td>
<td>φ 49×H50</td>
<td>25mm upper on and 25mm is under the level</td>
</tr>
</tbody>
</table>

* 1.0 specific gravity of the liquid
Special versions can select required mountings.

⚠️ CAUTION ⚠️

In the case of a float made of resin, there is danger that static electricity is generated on a float part. Please remove static electricity regularly.
3. PRINCIPLE OF OPERATION

FR series units contain hermetically-sealed reed switches in the stem and a permanent magnet in the floats. As the float rises or falls with the level of the liquid, the reed switch is activated by the magnet in the float.

4. INSTALLATION

4.1 Unpacking
(1) This unit has been thoroughly inspected and carefully packed at the factory to prevent damage shipment.
(2) When unpacking, exercise due care not to subject the instrument to mechanical shock.
(3) After unpacking, visually check the instrument exterior for damage.
(4) When the length exceeds 1500mm, carry by two or more persons. Otherwise, the switch may be damaged.
(5) Keep sensor clean. Otherwise, detecting errors may be caused.
(6) It doesn’t place in piles.

4.2 Installation site
This unit should be installed in an area which meets the following conditions:
(1) Normal temperatures, with nominal temperature fluctuations.
(2) Low relative humidity and no exposure to moisture.
(3) No corrosive gases (Such as NH₃, SO₂, Cl₂, etc.)
(4) No excessive vibration.
(5) Ample space for maintenance/inspection.
(6) If there is surface wave motion, use a time-delay relay for chattering the switch action. Otherwise, we recommend the installation of a stilling tube. Drill vent holes in the tube and use spacer to keep the float traveling.
(7) This float switch should be located away from strong magnetic fields such as those produced by motors or solenoid valves.
(8) Make sure that the FR should be located away from metallic substances such as steel plate 10cm or more.
(9) Please use caution during installation. Bending or hitting the stem may break the reed switches.
4.3 Installation method

Fig. 5 Example of mounting

(1) In case of flange
Fix with the bolt which was in clad flange and the standard on the side of the tank.
When pressure is taken, it makes not leak out with the gasket.

(2) In case of plug
Install to become perpendicular.

(3) Sensors coated with resin
The sensor coated with resin should not be used for measuring materials of volume resistivity
greater than $10^9 \, \Omega \text{ cm}$ (electro conductivity smaller than $10^{-7}$) to prevent generating electrostatics.
During maintenance or cleaning works, a wet cloth should be used to prevent generating and charging electrostatics.

⚠️ CAUTION

Don’t turn a terminal box.
5. **Wiring**

5.1 Terminal blocks and wiring

<table>
<thead>
<tr>
<th>Actuation Level</th>
<th>Terminal blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ø 1</td>
</tr>
<tr>
<td>1</td>
<td>1-2</td>
</tr>
<tr>
<td>2</td>
<td>1-2</td>
</tr>
<tr>
<td>3</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

- Terminals, from two actuation levels to three actuation levels, are available with common terminal.

**NOTE the following points:**

1. Reed switches are not designed for the direct starting of pumps, valves and alarms. They are susceptible to damage from electric surges. DO NOT EXCEED THE CONTACT RATINGS. Contact should be wired to relays or similar devices.

2. We recommend the use of our relay unit model RE7000. The latching (holding relay) feature allows pumps, valves and other devices to be turned on at one level and off at another. It also contributes to safety since it allows lower voltage and smaller currents to be used with FR.

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**CAUTION**

1. Reed switches are not designed for the direct starting of pumps, valves and alarms. They are susceptible to damage from electric surges. DO NOT EXCEED THE CONTACT RATINGS. Contact should be wired to relays or similar devices. Typical examples are shown below.

2. If the cable length between the FR and load is too long, such as 50m or more, momentary surge current may be produced by stray capacity. Consequently the reed switch is broken. To suppress the surge, place a 0.5 to 5mH coil in series with the load for each reed switch near by the FR.
5.2 Model RE relay unit

We recommend the use of our relay unit model RE. It is single level (alarm) and/or dual level (empty/fill control) relay.

The latching (holding relay) feature allows pumps, valves and other devices to be turned on at one level and off at another. It also contribute to safety since it allows lower voltage and smaller currents to be used with sensor.

For the relay unit Model RE, refer to Instruction Manual.

**NOTE** the following points:

1. Do not connect the plural relay unit to identical switch. Otherwise, the relay unit may be malfunction.
(2) Power supply must be connected in phase.

(3) To avoid malfunction, the wiring distance should be used within specifications. If the wiring distance exceed specifications, the relay unit may be malfunction by stray capacitance between cables or noise.

5.3 Electrical connections for Explosion-proof instrument of the explosion-proof instrument, the terminal box cover is designed in an anti-rotation clamp structure. After the electrical connections and securely clamp it with the autorotation bolts.

**NOTE** the following points:
The electrical wires must be led into the terminal box in the pressure-tight screw-thread coupling method or in the pressure-tight packing method.

**WARNING**
Earth terminal shall be grounded. If it is not grounded, you will get an electric shock.
6. NOTES OF EXPLOSION-PROOF FEATURE

(1) Actuation levels are assumed with water (SG=1.0). If your liquid has a different specific gravity, please specify this when you order.

(2) Maximum allowable impact is 100m/s$^2$. Shocks greater than 100m/s$^2$ may damage the switch. The reed switch's enclosure is made from glass. If the FR is dropped to the hard floor from more than 30cm, the reed switch may be damaged.

(3) Please use caution during installation. Bending or hitting the stem or pulling the lead wires may break the reed switches.

(4) The float travel stop settings are based on how the magnetic field influences the reed switches. When you move the float travel stop, check switch action for float overrun.

(5) This float switch should be located away from strong magnetic fields such as those produced by motors or solenoid valves.

7. INSPECTION AND MAINTENANCE

Periodic inspection are necessary means to keep your FR switches in good working order. Please pay attention to the following.

7.1 Remove sensor from the tank.
(1) The power supply is turned off.

⚠️ CAUTION

In hazardous locations, do not remove the housing cover until atmosphere is determined to be safe, and the power supply is turned off.

(2) It slackens a screw and remove a lock arm. Open a cover and remove wiring.
(3) Remove flange bolts or turn a plug. It pulls a sensor out of the tank.
(4) Put a sensor on the flat place.

7.2 How to inspection and maintenance
Adjustment, inspection and maintenance shall be done by the skilled engineer. Check once or more in the half year or in the year. But, it depends on the use condition.

(1) Never leave the housing cover off. It become damaged or misplaced, order a replacement immediately.

(2) If it has buildup on float and stem, detecting errors may be caused. Keep clean float and stem.

(3) Inspect switches and terminals.

(4) The float travel-stop settings are based on how the magnetic field influences the reed switch. If float overrun, adjust and check the float travel stop.

(5) The life expectancy of reed switches are over $10^6$ operations. They are susceptible to damage from electric surges and mechanical shocks. If these conditions exist, order replacements immediately.

(6) If the float is filled with water or damaged, it must be replaced immediately.

(7) Do not attempt to repair a float.

(8) Vibration may sometimes cause terminal screws to work loose. Check all terminals to be certain that screws are tight.
8. TROUBLESHOOTING

CAUTION

Use the following chart to troubleshoot the malfunctioning sensor. If your remedies are unsuccessful, ask Nohken for repair and replacement.

<table>
<thead>
<tr>
<th>Problems</th>
<th>Possible causes</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floats rises or falls with the liquid level</td>
<td>Miswiring</td>
<td>Wire correctly</td>
</tr>
<tr>
<td>switch de-activated</td>
<td>Cables broken</td>
<td>Replace cables</td>
</tr>
<tr>
<td></td>
<td>Float travel stop is in improper position</td>
<td>Adjust position of float travel-stop</td>
</tr>
<tr>
<td></td>
<td>Reed switch is in improper position</td>
<td>Adjust position of reed switch or float</td>
</tr>
<tr>
<td></td>
<td>Reed switch is damaged</td>
<td>Replace sensor</td>
</tr>
<tr>
<td></td>
<td>Affected by strong magnetic field</td>
<td>Use shield or install in good location</td>
</tr>
<tr>
<td></td>
<td>Liquid immerse in sensor</td>
<td>Replace sensor</td>
</tr>
<tr>
<td>Floats doesn’t rises or falls with the liquid level</td>
<td>Buildup on float or stem</td>
<td>Clean float and stem</td>
</tr>
<tr>
<td></td>
<td>Specific gravity of liquid too light</td>
<td>Change the proper float</td>
</tr>
<tr>
<td></td>
<td>Float is filled with water</td>
<td>Replace float</td>
</tr>
<tr>
<td></td>
<td>Install into the stilling tube, no vent holes</td>
<td>Drill vent holes where it is upper side</td>
</tr>
<tr>
<td></td>
<td>Float is in contact with stilling tube</td>
<td>Use spacer</td>
</tr>
<tr>
<td></td>
<td>Float damaged by over-pressure</td>
<td>Replace float</td>
</tr>
<tr>
<td></td>
<td>Float is swelled or corroded</td>
<td>Replace compatible float</td>
</tr>
<tr>
<td>Switch chattered</td>
<td>Loose cables</td>
<td>Tighten connections</td>
</tr>
<tr>
<td></td>
<td>Waves or disturbances in tank</td>
<td>Use stilling tube or time-delay relay</td>
</tr>
<tr>
<td></td>
<td>Install in wrong location</td>
<td>Install in good location</td>
</tr>
</tbody>
</table>
9. OPTIONAL PARTS

Table 5

<table>
<thead>
<tr>
<th>Name</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Float</td>
<td>52□ S</td>
</tr>
<tr>
<td></td>
<td>52□ V</td>
</tr>
<tr>
<td></td>
<td>52□ P</td>
</tr>
<tr>
<td></td>
<td>52□ HV</td>
</tr>
<tr>
<td></td>
<td>54□ S</td>
</tr>
<tr>
<td>Float</td>
<td>316 Stainless steel</td>
</tr>
<tr>
<td>Travel stop</td>
<td>PVC</td>
</tr>
<tr>
<td></td>
<td>PP</td>
</tr>
<tr>
<td></td>
<td>CPVC</td>
</tr>
</tbody>
</table>

10. GLOSSARY

Glossary for Explosion proof

Flameproof Explosion Type
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.

Explosion Proof Packing Type Cable Gland
A cable gland equipped with a packing and a clamp for use as a flameproof gland.

Hazardous Area
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.

Zone 0
Areas in which dangerous concentrations of flammable gases/vapors are present continuously or long-term under normal operating conditions.

Zone 1
Areas in which dangerous concentrations of flammable gases/vapors are present occasionally under normal operating conditions.

Zone 2
Areas in which dangerous concentrations of flammable gases/vapors are present rarely and then only briefly under normal operating conditions.

Sealing Fitting
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.

Flexible Fitting
A conduit accessory made flexible to connect an electric device and a fixed conduit.

Sealing
The sealing is to seal up and block off an area to prevent leakage of flammable gases to non-hazardous areas.
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