

I N S T R U C T I O N   M A N U A L  
F O R

M A G N E T I C   F L O A T   S E N S O R

M O D E L :   F R

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**NOHKEN INC.**



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# MUST BE READ BEFORE USING

- This manual is for general specifications. Read the other manuals for explosion-proof specifications.
- This manual describes the handling, inspection and adjustment of the sensor. Read and understand this manual before installation.
- Any documents and/or directions from Nohken and the agents aside from this manual shall be preceded.
- Save this manual to refer when you need.
- If you have any questions or comments about this manual and/or the sensor, ask Nohken's sales office.

Signal words in this manual means as follows:

 <b>CAUTION</b>	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
 <b>NOTE</b>	Indicates exceptional cases and attention for handling of sensors.

	Indicates prohibition. The explanation with this manual should always be followed.
	Indicates directions. The explanation with this manual should always be followed.



## CAUTIONS

• Since this sensor is not an explosion-proof construction, do not use where flammable gas, explosive gas or the vapor exists. Otherwise, explosion the gases and/or the vapor may cause serious disasters. Use explosion-proof sensors at hazard areas.



• Do not modify or disassemble the sensor. Otherwise, the sensor may be damaged,



• Operating test shall be conducted before practical use. If malfunction occurs and the accident is predicted, the remedy shall be administrated by using another sensor with different operating principle in parallel.



• To prevent from electric shocks such as lightning and the static electricity, provide conductor or the surge absorber. Otherwise, the sensor may cause malfunction, damage, ignition, electric shock and injury.



## NOTES

• Do not give strong shocks to the sensor. Dropping, throwing, striking and dragging the sensor, for example, are to cause strong shocks and damage the sensor.



• The specifications such as ambient temperature, maximum voltage and the power rating shall meet the conditions. Otherwise, the sensor may cause malfunction, damage, ignition, electric shock and injury. Read and check the clause of specification in the manual or specification sheets.



• Operating test shall be conducted before practical use. If malfunction occurs and the accident is predicted, the remedy shall be administrated by using another sensor with different operating principle in parallel.



• Check the chemical compatibility with the material you want to use. A minor corrosion to the float and the thin thickness part may be chemically effected.



▲ NOTES

• When carrying, installing and removing the liquid level switch, hold the flange or the plug part. Otherwise, the flange or the plug may drop off from the housing and be damaged.



• The sensor which is 50cm or longer  
Do not leave the sensor upright, but lay it down on the floor. Otherwise, the sensor and/or the surrounding things may be damaged or get injured if the sensor falls.



• When connecting inductive load or the lamp load to the Switch output contact.

To prevent overvoltage and overcurrent, provide a protective circuit to the load. Otherwise, the contact may be damaged.



## INTRODUCTION

- A. This manual specifies standard specifications of this product. Some specifications may be different from your product if you order the custom-made product.
- B. A variety of specifications are available to meet your process conditions, such as installation conditions, chemical compatibility, and so on. We are glad to offer suggestions to assist your decision.
- C. If you have any questions or comments for the contents of this manual, ask Nohken's sales office.
- D. Nohken Inc. pursues a policy of continuing improvement in design and performance of this product. We will supply the alternative parts or complete new products required to repair or replacement.
- E. Specifications are subject to change without any obligation on the part of the manufacturer.

# WARRANTY & DISCLAIMER

- A. Nohken Inc. warrants this product against defects in design, material and workmanship for a period of 1 (one) year from the date of original factory shipment.
- B. If defects occurs during the above-mentioned warranty period, Nohken will, at its option, replace or recondition the product without charge. This shall constitute the exclusive remedy for breach of warranty.
- C. Nohken Inc. makes no warranty with respect to:
  - C-a Failure not to comply with instructions of this manual.
  - C-b Failure or damage due to improper installation, wiring, operation, maintenance, inspection and storing.
  - C-c Product which has been in any way repaired, altered or tampered with by others.
  - C-d Product repaired or modified by using undesignated parts, subassemblies and materials.
  - C-e Direct incidental or consequential damages or losses or expenses resulting from any defective product or the use of any product.
  - C-f Objective of the sensor is clearly specified in chapter 1, PURPOSE OF USE.
  - C-g Inevitable accident such as acts of God, force majeure, radioactive contamination and so on.

THIS WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

# NOTES TO USERS

1. It is essential that this manual shall be read and understood before installation and use of the magnetic float sensor. 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

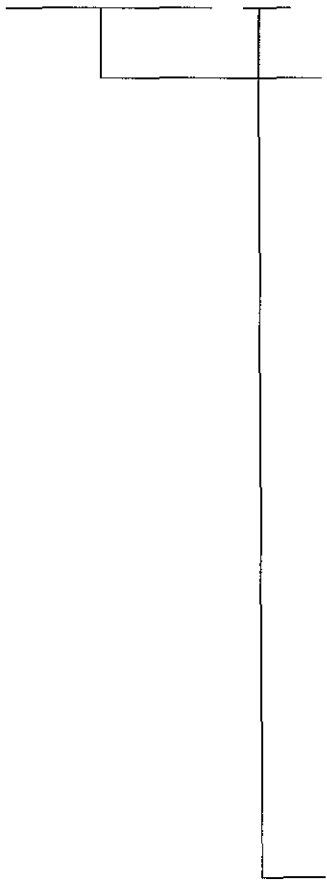
The FR series Magnetic float sensors are manufactured specifically for liquid level detection. The 15VA and 220VA switch ratings are available. The 15VA version is possible up to seven actuation levels and up to five levels with the 220VA version. Both version has the capability to adjust the position of actuation levels in the field.

# 2. SPECIFICATIONS

## 2.1 Model

### (1) Standard version

FR□□ □□□-□P

- 
- 10 : For high viscosity liquids with large stainless steel float and 15VA switch.
  - 30B : Low-cost for water and oil usage with BUNA float and 15VA switch.
  - 30S : General usage with stainless steel float and 15VA switch.
  - 30VS : General usage with PVC float and 15VA switch.
  - 30PS : General usage with Polypropylene float and 15VA switch.
  - 30HVS: General usage with CPVC float and 15VA switch.
  - 60S : 220VA high switch rating with stainless steel float.
  - 60VS : 220VA high switch rating with PVC float.
  - 60PS : 220VA high switch rating with Polypropylene float.
  - 60HV : 220VA high switch rating with CPVC float.

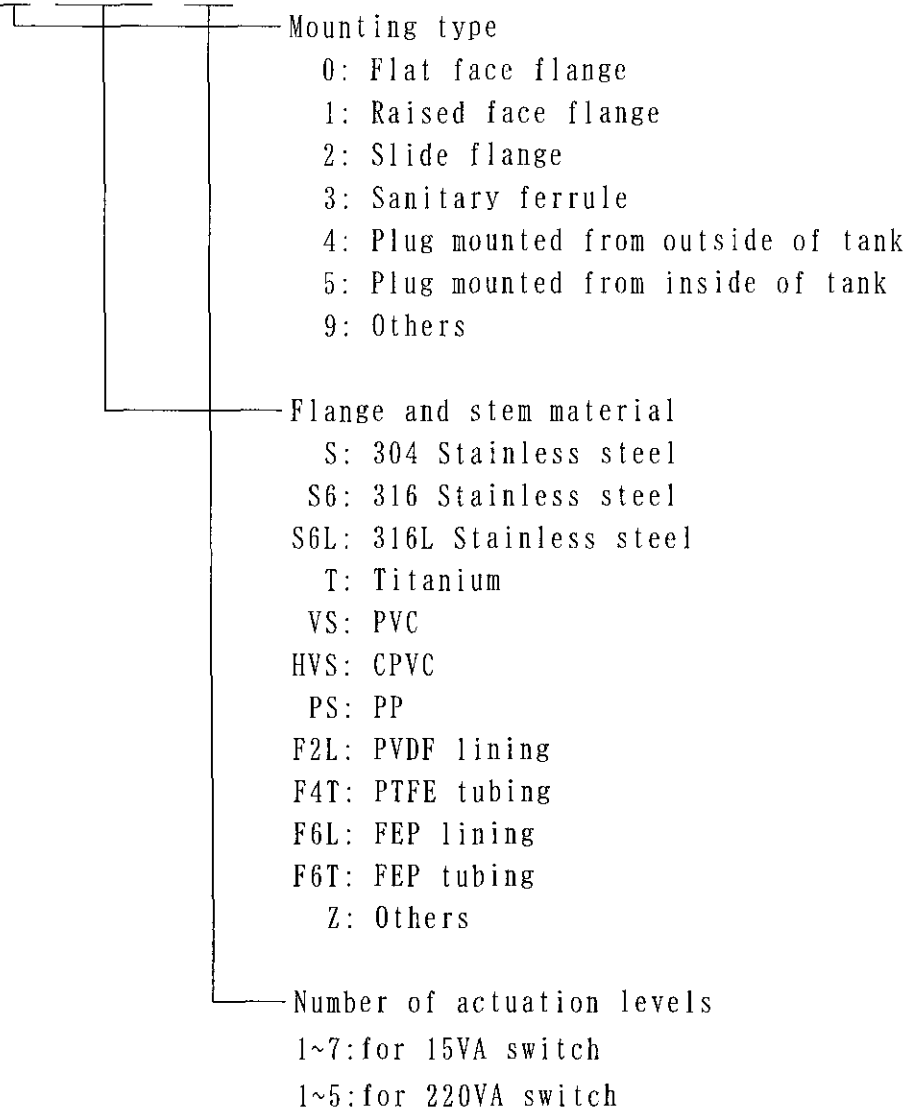
### Number of actuation levels

1~7: for 15VA switch (FR10 and FR30 series)

1~5: for 220VA switch (FR60 series)

(2) Custom switch version

FR 2 □ □□□ -- □ P



2.2 Specifications

(1) Contact Ratings

Table 1

	15VA (Resistive load)		220VA (Resistive load)	
	15VA	15W	220VA	55W
Max. contact capacity	1A AC	1A DC	1A AC	0.5A DC
Max. working current	264V AC	200V DC	220V AC	110V DC

Rating is specified on the name plate at the housing or the housing cover, such as "15VA 1A AC Max."

- (2) Life expectancy : Min.  $1 \times 10^5$
- (3) Allowable impact : Max. 100 m/s<sup>2</sup>
- (4) Insulation resistance : More than 100MΩ at 500V DC  
(for metallic sensor only)



(5) Withstand voltage

: 1500V AC for 1 minute

(for metallic sensor only)

(6) Others

Table 2

float size	float material	Maximum float pressure (*)	Maximum temperature	Specific gravity as measurement	Contact rating
φ98×H63	304 Stainless steel	0.2 MPa	100°C	0.5	15VA
φ50×H45	Foamed NBR+PF	2 MPa	90°C	0.5	
φ49×H50	316 Stainless steel	2 MPa	100°C	0.55	
φ65×H80	PVC	0.2 MPa	50°C	0.65	
φ65×H80	PP	0.2 MPa	80°C	0.5	
φ74×H80	CPVC	0.2 MPa	80°C	0.7	
φ98×H63	304 Stainless steel	0.2 MPa	100°C	0.5	220VA
φ49×H50	316 Stainless steel	2 MPa	100°C	0.75	
φ65×H80	PVC	0.2 MPa	50°C	0.75	
φ65×H80	PP	0.2 MPa	80°C	0.6	
φ74×H80	CPVC	0.2 MPa	80°C	0.8	

(\*) with static pressure

Table 3

float size	float material	Relation between Float and Liquid Surface (*)	Contact rating
φ98×H63	304 Stainless steel	37mm upper on and 26mm is under the level	15VA
φ50×H45	Foamed NBR+PF	26mm upper on and 19mm is under the level	
φ49×H50	316 Stainless steel	25mm upper on and 25mm is under the level	
φ65×H80	PVC	37mm upper on and 43mm is under the level	
φ65×H80	PP	50mm upper on and 30mm is under the level	
φ74×H80	CPVC	33mm upper on and 47mm is under the level	
φ98×H63	304 Stainless steel	35mm upper on and 28mm is under the level	220VA
φ49×H50	316 Stainless steel	18mm upper on and 32mm is under the level	
φ65×H80	PVC	29mm upper on and 51mm is under the level	
φ65×H80	PP	40mm upper on and 40mm is under the level	
φ74×H80	CPVC	23mm upper on and 57mm is under the level	

(\*) 1.0 specific gravity of the liquid

Custom switch versions can select required mountings.

### 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.

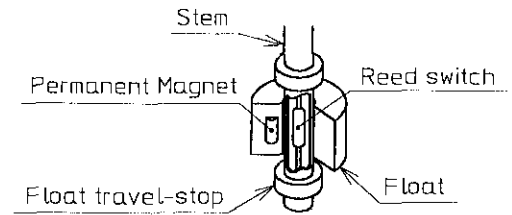


Fig. 1 Construction

### 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.

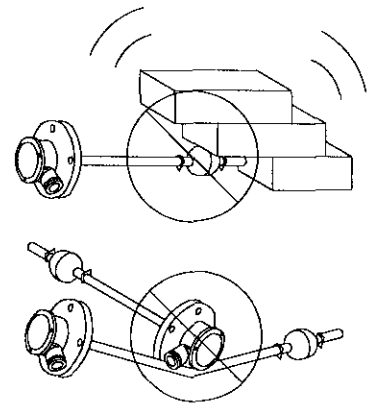


Fig. 2

#### 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  $NH_3$ ,  $SO_2$ ,  $Cl_2$ , 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.

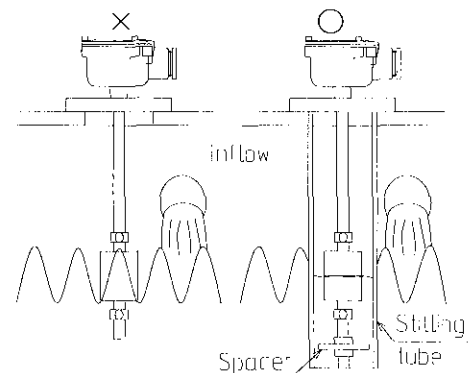


Fig. 3

- (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.

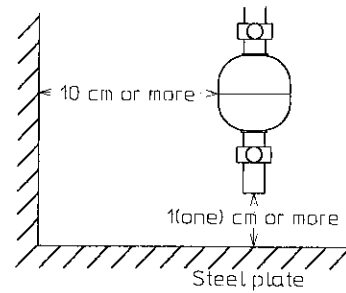


Fig. 4

### 4.3 Installation method

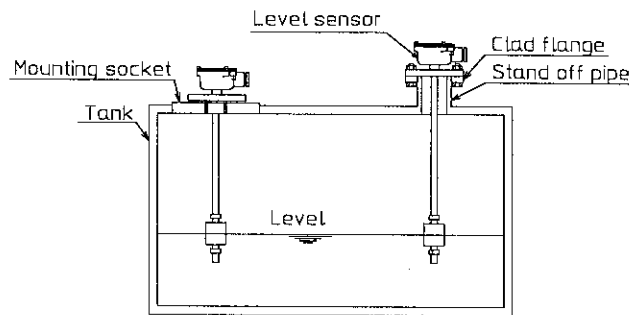


Fig. 5 Example of mounting

- (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.

CAUTION  
 Don't turn a terminal box.

## 5. WIRING

### 5.1 Terminal blocks and wiring

Table 4

Actuation levels	Terminal blocks								Wiring (color)							
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Com.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Com.
1	A-B								black×2							
2	A-B	C-D							black×2	White×2						
3	A-B	C-D	E-F						black×2	White×2	red×2					
4	A-B	C-D	E-F	G-H					black×2	White×2	red×2	green×2				
5	A	B	C	D	E			H	black	White	red	green	yellow			gray
6	A	B	C	D	E	F		II	black	White	red	green	yellow	brown		gray
7	A	B	C	D	E	F	G	H	black	White	red	green	yellow	brown	blue	gray

If you specified optional terminal blocks and/or wiring colors, please check

your order sheet or the drawings you approved.

•Normally, wiring data are indicated at the back of the housing cover.

▲ 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.

DC 30 V or lower

Diode : 100 V 1 A

Resistance : 1-5 kΩ 1/4 W  
Condenser : 0.1 μF 600 V

(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 0.5~5mH coil in series with the load for each reed switch near by the FR.

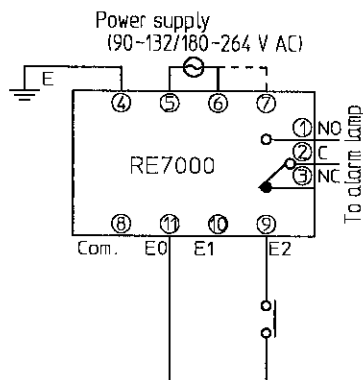
### 5.2 Model RE7000 relay unit

We recommend the use of our relay unit model RE7000. It is single level (alarm) and/or dual level (empty/fill control) relay.

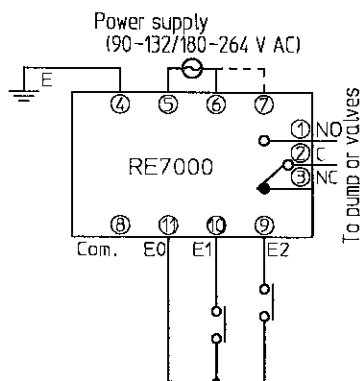
The latching (holding relay) feature allows pumps, valves and other devices to be turned on at one level and off at another. It also contribute to safety since it allows lower voltage and smaller currents to be used with FR.

•SINGLE LEVEL ALARM

•DUAL LEVEL EMPTY/FILL CONTROL



SELECT. SW. H.ON side : High alarm  
SELECT. SW. L.ON side : Low alarm



SELECT. SW. H.ON side : Filling control  
SELECT. SW. L.ON side : Emptying control

Fig. 6

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

### 5.3 Wiring procedure

Proceed as follows:

- (1) Remove the housing cover  
Standard Box: loosen M3 screws. See Fig. 7.
- (2) Bring cables into housing.
- (3) Connect cables to the terminals.
- (4) Make sure that there are no miswirings.
- (5) Re-install and tighten the housing cover to preserve the protection category IP65.

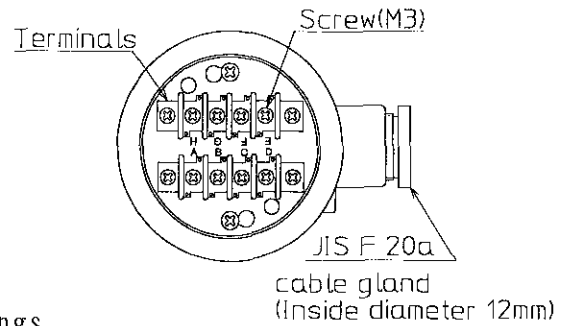


Fig. 7

NOTE the following points:

- Standard Box Fig. 7: Install solderless lugs fitted to M3 screw to the end of lead wires and the inner conductor.
- The cable entry must be properly fitted to preserve the protection category IP65 and to protect the sensor from rain, splashing water, etc.

## 6. TECHNICAL NOTES

- (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  $100\text{m/s}^2$ . Shocks greater than  $100\text{m/s}^2$  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.
- (2) 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) After removing the housing cover, check switches actuation.
- (5) 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.
- (6) 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.
- (7) If the float is filled with water or damaged, it must be replaced immediately.
- (8) Vibration may sometimes cause terminal screws to work loose. Check all terminals to be certain that screws are tight.

# 8. LEVEL ADJUSTMENT

Generally FR model allows adjustment of actuation levels to meet changing operating conditions. Use the following procedure to make adjustments:

- (1) Loosen the mounting screws.

Standard Box: Loosen the terminal plate as Fig. 8 and pull. It becomes off.

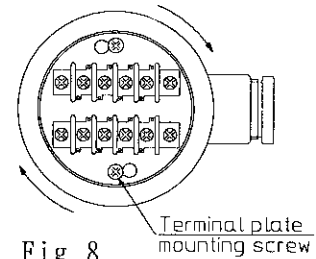


Fig. 8

- (2) Remove the internal circuit and its associated support rod from inside the stem.

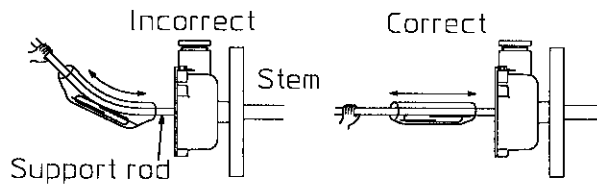


Fig. 9

- (3) Move position of reed switches to new levels.

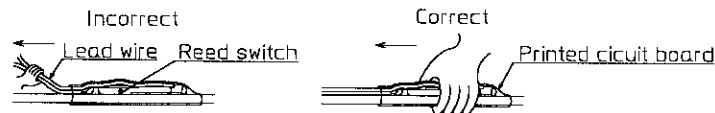


Fig. 10

- (4) Secure reed switches with vinyl tape.

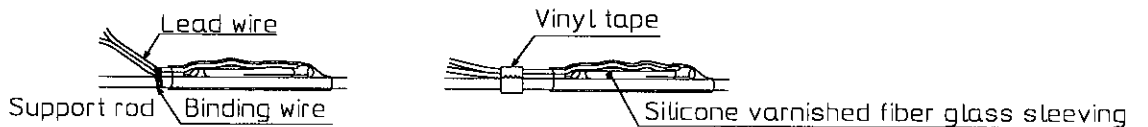


Fig. 11

- (5) Insert internal circuit back into stem.

- (6) Adjust position of floats and float travel stop to match position of switch. Consult Table 5.

Table 5

Float material	Length between float and float travel stop.
304 Stainless steel	5mm
316 Stainless steel	
316L Stainless steel	
Titanium	8mm
PVC, CPVC, PP (for 220VA)	
the others	

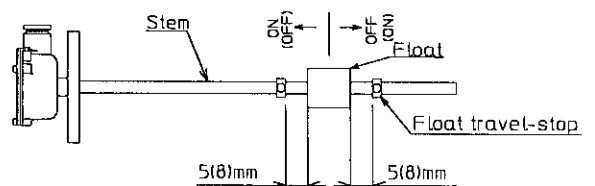


Fig. 12

## 9. TROUBLESHOOTING

▲ CAUTION

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

Table 6

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



# 10. REPLACEMENT PARTS

Table 7

Code	Description	Remarks
Reed switch A	15VA, 15W	Specify the length if you need lead wires.
Reed switch B	110VA, 33W	
Reed switch C	220VA, 55W	
Float A	φ49×H50, 316 Stainless steel	Specify the reed switch rating when you order. The magnet in the float must be changed in accordance with switch rating. For example, Float A for 15VA.
Float B	φ38×H50, 316 Stainless steel	
Float C	φ98×H63, 304 Stainless steel	
Float D	φ48×H50, Titanium	
Float E	φ38×H50, 316L Stainless steel	
Float K	φ50×H45, NBR	
Float M	φ65×H80, PVC	
Float N	φ65×H80, PP	
Float P	φ74×H80, CPVC	
Float R	φ70×H70, PVDF	
Float S	φ75×H100, PTFE	

NOTE: Reed switch C (220VA, 55W) is not available for Float B, K, R and S.

When ordering other parts or the whole FR for repeat, specify the model number and serial (manufacturing) number on the name plate or attach the drawing you approved.

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