

# I N S T R U C T I O N   M A N U A L

FOR

TUNING FORK LEVEL SENSOR

MODEL: V Q 2 0



Revision    2020-01-08



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**Read this manual carefully for safe usage.**

- This manual applies to general purpose equipment. For equipment intended for use in potentially explosive atmospheres, see applicable manuals.
- This manual contains important information on handling, inspection and operation of the equipment indicated on the cover page. Before handling the equipment, read this manual carefully.
- Instructions in documents submitted by Nohken or its representative have higher priority than those in this manual.
- Keep this manual within easy access.
- Depending on environment, the equipment may not satisfy specifications shown in this manual. Check the application conditions carefully beforehand.
- Please contact our sales office for any questions or comments about the equipment or this manual. Sales offices are shown on the back of the manual.

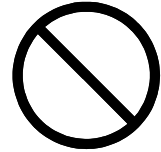
Safety Symbols:

 <b>WARNING</b>	Means a potentially hazardous situation which, if necessary precautions are not observed, can result in death, serious injury and/or considerable material damage.
 <b>CAUTION</b>	Means a hazardous situation which, if necessary precautions are not observed, can result in minor or moderate injury or damage to the device.

	Means prohibited actions.
	Means mandatory actions.

 **WARNING**

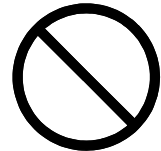
This equipment is NOT intended for use in potentially hazardous atmospheres. Never use it where flammable gas or vapor may be present. Failure to observe this may result in ignition of flammable gas or vapor, causing disaster.



Do not alter or disassemble the equipment, unless you have been instructed to do so by Nohken or its representative.

Failure to observe this may result in:

- malfunction of or damage to the equipment or connected devices;
- ignition;
- electric shock or user injury.



Turn off the equipment before wiring or inspection. Otherwise leakage or short circuit may cause ignition or electric shock.



After wiring is complete, always check for its correctness. Wrong wiring may cause:

- damage to or malfunction of the equipment or connected devices;
- ignition;
- electric shock or user injury.

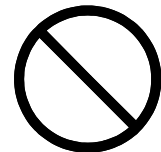


Turn off the equipment immediately in case smoke, unusual smells or sounds are noticed. Do not supply power until problems are solved.



 **CAUTION**

Handle the equipment with care. Do not drop, throw, or give a strong shock to avoid damage.



Observe operation conditions specified in the manual. Use outside the specified conditions may result in malfunction of or damage to the equipment or connected devices, ignition, user injury, or electric shock.



Perform operation tests before actual application to ensure performance. Install back-up instruments based on different technologies if failure of this equipment is expected to result in a serious incident.





## CAUTION

Check carefully for chemical compatibility of materials of construction before installation.



Use the flange, thread or somewhere close to the process connection to handle the equipment. Do not use the terminal box (housing) to avoid dropping the equipment, and resultant damage to the equipment or user injury.



Equipment 50cm or longer:

Lay the equipment when not in use. Otherwise it may fall and damage itself or things around it, and cause user injury.



Always connect the protective terminal inside the housing to the ground. (Grounding resistance: 100Ω max.)  
Otherwise leak may occur to cause electric shock when error occurs.



When connecting to inductive or lamp loads:

Ensure the maximum voltage/current ratings will not be exceeded to avoid damage to the relay contacts.



Use lightning arrestors or surge absorbers to prevent:

- malfunction, damage, or ignition of the equipment and connected instruments;
- electric shock or injury.



## **INTRODUCTION**

- A) This manual applies to standard models. Please note that information in this manual may not be applied to customized versions.
- B) We are willing to help customers select a suitable model or provide information about chemical compatibility of materials used, but the customer is responsible for the decisions made.
- C) We always welcome suggestions and comments about this manual. Please contact our sales office when you have questions or comments.
- D) Component replacement:  
The equipment design is regularly reviewed and improved. The same components therefore may not be available when replacement is required. In such cases, different components or products may be supplied. Please contact our sales office for detail.
- E) The contents of this manual are subject to change without prior notice as a result of improvement of the equipment.

## **WARRANTY & DISCLAIMER**

- A) Nohken warrants the equipment against defect in design or material, and workmanship for a period of one (1) year from the date of original shipment from Nohken's factory.
- B) Nohken will not assume liability for loss nor damage resulting from the use of the equipment.
- C) Nohken will not assume liability for damage resulting from:
  - C-a) not observing instructions in this manual;
  - C-b) installation, wiring, operation, maintenance, inspection, or storing in a manner not outlined in this manual;
  - C-c) unauthorized alterations and repairs;
  - C-d) the use of or replacement with components not provided by Nohken;
  - C-e) devices or instrument other than those manufactured by Nohken;
  - C-f) the use not described in *Chapter 1 Purpose of Use* of the manual;
  - C-g) force majeure including, but not limited to, fire, earthquake, tsunami, lightning strike, riot, commotion, war, armed conflict or terrorist attack, radioactive pollution, act of God, governmental decisions or actions, and compliance with laws and regulations.

THE PROVISIONS OF THIS SECTION DO NO LIMIT YOUR LEGAL RIGHTS.

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# 1. PURPOSE OF USE

Tuning Fork Level Sensor VQ is designed to measure material level in a tank or piping. Do not use it for any other purpose.

# 2. DESCRIPTION

## 2.1 Product Overview

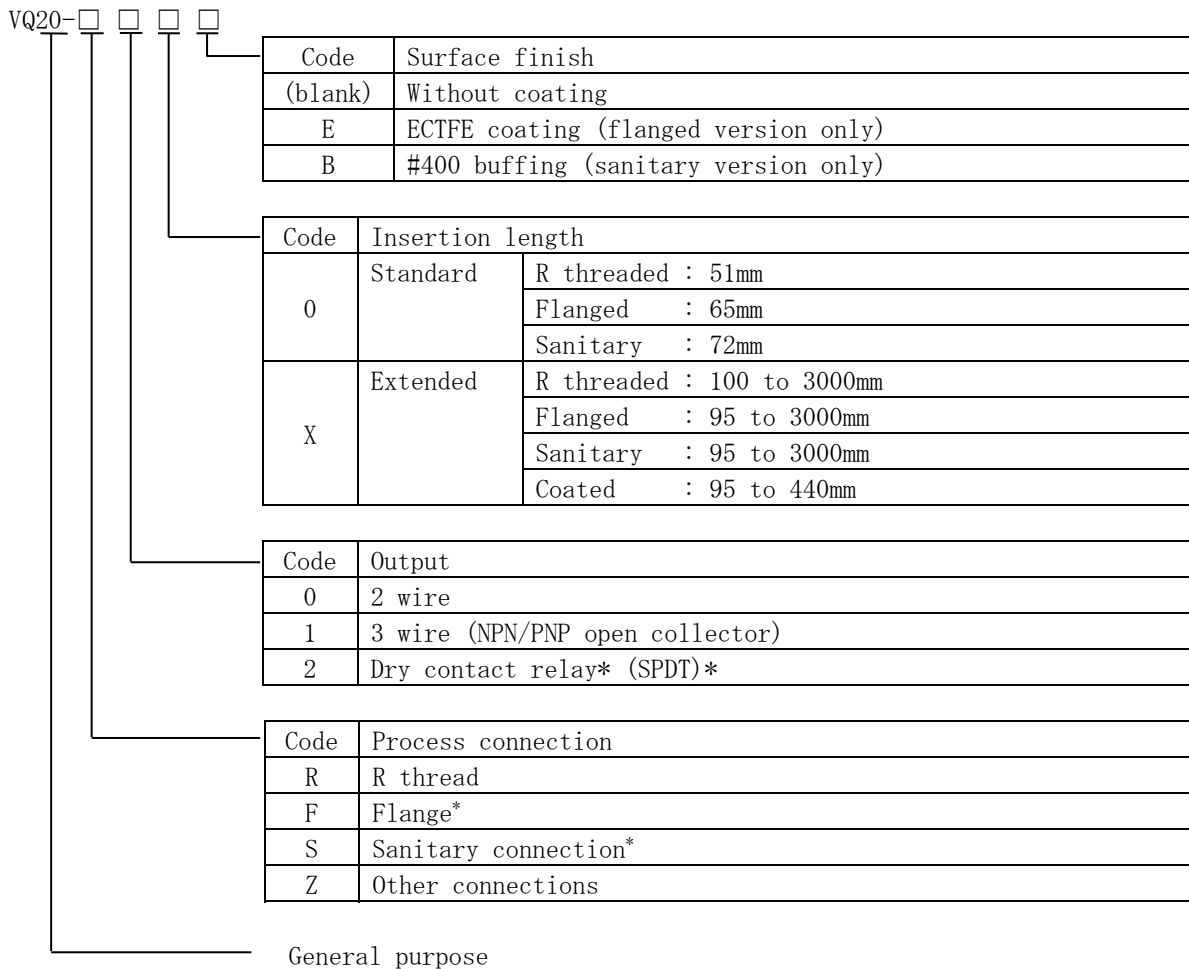
VQ is a compact level sensor ideal for integration into machinery. Wetted parts, the fork\* and process connection, are in 316L stainless steel to offer high corrosion resistance. The cover has a window, so the user can check operation status by LED without opening the cover.

## 2.2 Principle of Operation

The fork assembly incorporates a piezo-electric crystal\*. This crystal oscillates the detecting element, the fork, at a frequency. The frequency changes when the fork is covered with the material. The electronics of the sensor detects this change in frequency, and gives an output to report presence or absence of the material.

# 3. SPECIFICATIONS

## 3.1 Model Numbering



\* See 11. GLOSSARY.

### 3.2 Specifications

#### 3.2.1 Common

Name	Tuning Fork Level Sensor							
Model	VQ20 -R□0	VQ20 -R□X	VQ20 -F□0	VQ20 -F□X	VQ20 -F□0E	VQ20 -F□XE	VQ20 -S□0B	VQ20 -S□XB
Measured material	Liquids							
Operation								
Specific gravity	0.6 to 2.0							
Viscosity	0.2 mPa·s to 10 Pa·s							
Switching point (water) (section 5.2)	approx. 13.5 mm from tip (vertical) approx. 3 mm above the center line (horizontal)							
Hysteresis (water)	approx. 2 mm							
Mechanical characteristics								
Withstand pressure (static)	6 MPa Max. (excluding process connection)							
Vibration resistance (JIS C 60068-2-6)	10 to 58.1 Hz – half amplitude 0.15 mm 58.1 to 150 Hz – 20 m/s <sup>2</sup> acceleration 10 to 150 Hz – 20 sweeps							
Environmental								
Working temperature								
Wetted parts	-40 to +150 °C							
Housing	-40 to +80 °C (no dew condensation), degraded to +50 °C at and below process temperatures +60 °C.							
Humidity	85 %RH Max.							
Protection class								
Wetted parts	IP68 (10 MPa static for 15 minutes)							
Housing	IP65/67							
Material								
Wetted parts	316L stainless steel, nickel based alloy (BNi-2)			316L stainless steel, nickel based alloy (BNi-2), ECTFE (coating, black, 0.1 to 0.4mm thick)		316L stainless steel, nickel based alloy (BNi-2)		
Housing	Glass reinforced PBT (with anti-static agent), PC (window for LED)							
Process connection	Threaded, R1		Flanged, JIS 5K 50A		Flanged, JIS 5K 50A RF		Sanitary ISO 2S or equivalent	
Wetted parts maximum (Section 3.3, Fig. 3)	26 mm	28 mm			28.8 mm		28 mm	
Cable inlet	G 1/2 or equivalent, 11 mm deep							
Approx. mass (insertion length in mm)	0.5 kg	2.2 kg (1000)	1.9 kg	3.6 kg (1000)	1.9 kg	2.6 kg (440)	0.7 kg	2.5 kg (1000)
Housing rotation	330°							



### 3.2.2 Model specific

#### (1) 2 wire

Model	VQ20 -R00	VQ20 -R0X	VQ20 -F00	VQ20 -F0X	VQ20 -F00E	VQ20 -F0XE	VQ20 -S00B	VQ20 -S0XB	
Operating characteristics									
LED (red) operation	ON	- Lights continuously							
	OFF	- 1 flash per 3 seconds							
	delay	- 7 flashes per second							
	overload	- 3 flashes per second twice, and then goes out for 1 second							
	error	- 3 flashes per second for 5 times, and then goes out for 1 second							
Electric characteristics									
Power supply	24 to 240 V AC $\pm 10\%$ , 50/60 Hz 24 to 54 V DC $\pm 10\%$								
Power consumption	approx. 0.5 VA at 100 V AC with output OFF approx. 1.0 VA at 200 V AC with output OFF approx. 0.1 W at 24 V DC with output OFF								
Relay output	2 wire - wet=ON/dry=ON selectable - ON/OFF delay timer selectable								
	Delay timer		Wet = ON			Dry = ON			
	ON delay		approx. 0.5 to 30 sec.			approx. 0.3 sec.			
	OFF delay		approx. 0.3 sec.			approx. 0.5 to 30 sec.			
Output rating	Load current: 12 to 500 mA AC/DC								
	Remaining voltage: 12 V AC/DC Max. with output ON								
Insulation resistance	100 M $\Omega$ Min. at 500 V DC, between power and E terminals								
Withstand voltage	2200 V AC for 5 seconds, between power and E terminals								

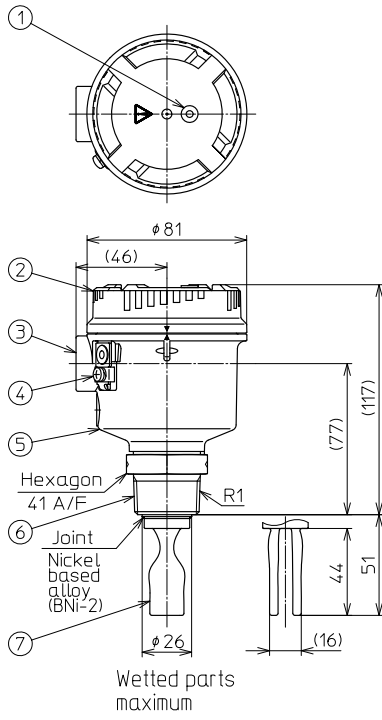
#### (2) 3 wire

Model	VQ20 -R10	VQ20 -R1X	VQ20 -F10	VQ20 -F1X	VQ20 -F10E	VQ20 -F1XE	VQ20 -S10B	VQ20 -S1XB	
Operating characteristics									
LED (red) operation	control output ON		- Lights continuously						
	control output OFF		- 1 flash per 3 seconds						
	delay		- 7 flashes per second						
	error		- 3 flashes per second for 5 times, and then goes out for 1 second						
Electric characteristics									
Power supply	24 V DC $\pm 10\%$								
Power consumption	approx. 0.1 W								
Relay output	3 wire - NPN open collector (OUTPUT 1) - PNP open collector (OUTPUT 2) - Wet=ON/dry=ON selectable - ON/OFF delay timer selectable								
	Delay timer		Wet = ON			Dry = ON			
	ON delay		approx. 0.5 to 30 sec.			approx. 0.3 sec.			
	OFF delay		approx. 0.3 sec.			approx. 0.5 to 30 sec.			
Output rating	Load current : 100 mA DC Max.								
	Load voltage : 26 V DC Max. (OUTPUT 1)								
	Remaining voltage : 1 V DC Max. with OUTPUT 1 closed 2 V DC Max. with OUTPUT 2 closed								
Insulation resistance	100 M $\Omega$ Min. at 500 V DC, between power/output and E terminals								
Withstand voltage	2200 V AC for 5 seconds, between power/output and E terminals								

## (3) Relay

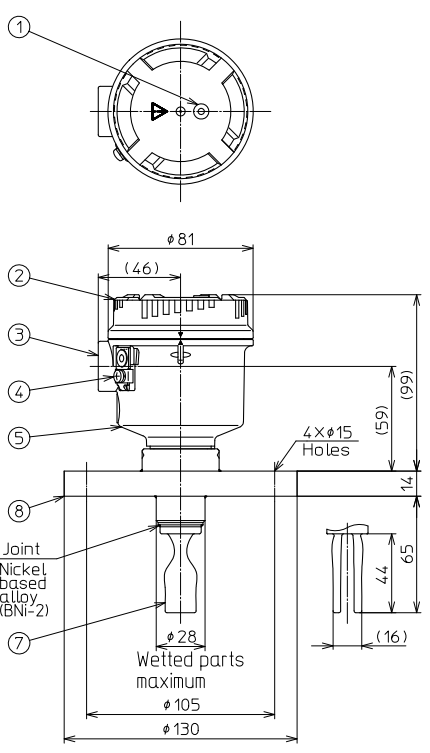
Model	VQ20 -R20	VQ20 -R2X	VQ20 -F20	VQ20 -F2X	VQ20 -F20E	VQ20 -F2XE	VQ20 -S20B	VQ20 -S2XB	
Operating characteristics									
LED (red) operation	relay energized		- Lights continuously						
	relay de-energized		- 1 flash per 3 seconds						
	delay		- 7 flashes per second						
	error		- 3 flashes per second for 5 times, and then goes out for 1 second						
Electric characteristics									
Power supply	100 to 240 V AC $\pm 1$ 0%, 50/60 Hz 24 to 54 V DC $\pm 10$ %								
Power consumption	approx. 0.5 VA at 100 V AC approx. 1.0 VA at 200 V AC approx. 0.1 W at 24 V DC								
Relay output	Dry contact relay (SPDT) - wet=ON/dry=ON selectable - ON/OFF delay timer selectable								
	Delay timer		Wet = on			Dry = on			
	ON delay		approx. 0.5 to 30 sec.			approx. 0.3 sec.			
OFF delay		approx. 0.3 sec.			approx. 0.5 to 30 sec.				
Output rating	Maximum : 250 V, 3 A AC (resistive) 30 V, 3 A DC (resistive)								
	Minimum : 5 V 10 mA DC (resistive)								
Insulation resistance	100 M $\Omega$ Min. at 500 V DC, between power/relay and E terminals								
Withstand voltage	2200 V AC for 5 seconds, between power/relay and E terminals								

### 3.3 Outline Drawing

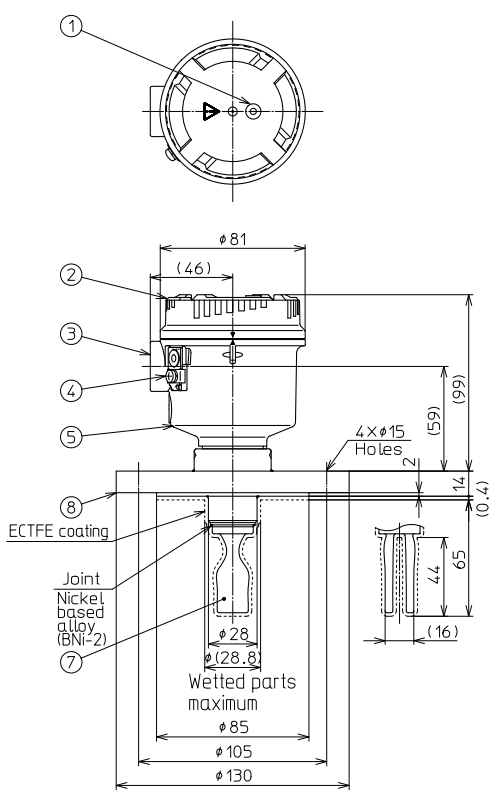


- ① Window for LED – to check operation status by LED
- ② Cover
- ③ Cable inlet (G1/2, 11mm deep)
- ④ External earth terminal (M4)
- ⑤ Housing
- ⑥ Threaded connection
- ⑦ Fork – detects material presence/absence
- ⑧ Flange
- ⑨ Sanitary connection

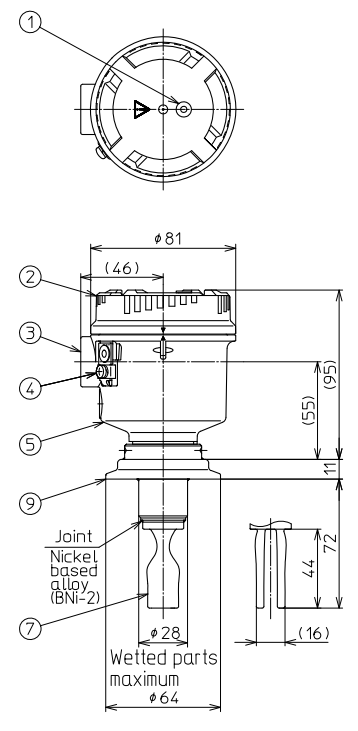
VQ20-R□0



VQ20-F□0



VQ20-F□0E

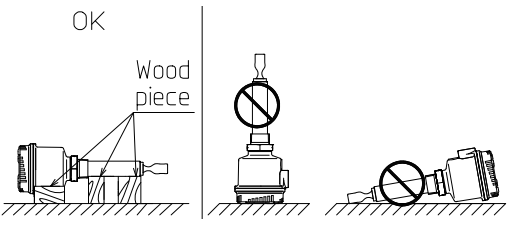
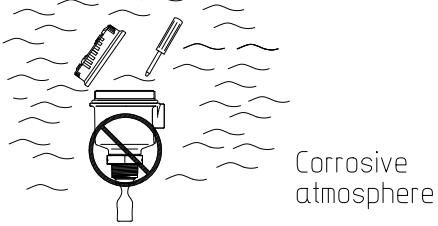
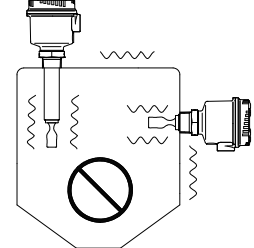
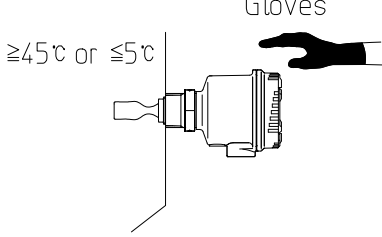
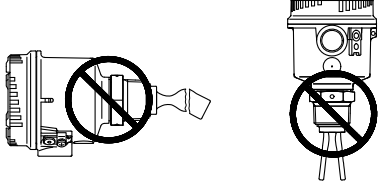
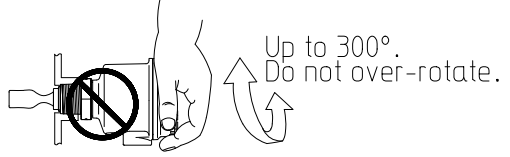


VQ20-S□0B

Fig. 3

## 4. HANDLING NOTES

Observe instructions below when handling the sensor, or faulty operation or user injury may result.

<p>(1) Lay the sensor on a flat surface. Do not stand it to prevent it from falling. Support the sensor with wood piece to avoid rolling, or bent or damaged fork. Always ensure the fork will not be damaged.</p>	<p>OK</p> 
<p>(2) Avoid corrosive atmosphere (<math>\text{NH}_3</math>, <math>\text{SO}_2</math>, <math>\text{Cl}_2</math>). Such atmosphere may penetrate the housing and damage internal components.</p>	 <p>Corrosive atmosphere</p>
<p>(3) Avoid or protect against vibration.</p>	
<p>(4) Wear gloves when the process temperature is <math>\geq 45^\circ\text{C}</math> or higher, or <math>\leq 5^\circ\text{C}</math> or lower to avoid injury.</p>	<p>Gloves</p>  <p><math>\geq 45^\circ\text{C}</math> or <math>\leq 5^\circ\text{C}</math></p>
<p>(5) Do not give a shock to the fork to avoid damage.</p>	
<p>(6) Do not over-rotate the housing. It can be rotated for up to <math>330^\circ</math>.</p>	 <p>Up to <math>300^\circ</math>. Do not over-rotate.</p>

## 5. INSTALLATION



### WARNING

This sensor is not intended for use in hazardous areas\*. Never use it in areas where flammable or explosive gases or vapors may be present.

#### 5.1 Unpacking

- (1) Open the packaging and take out the sensor. Check against nameplate that the sensor is what you have ordered. If not, please contact our sales office.
- (2) Check the sensor for visible damage. If any, please keep the packaging and contact our sales office.
- (3) Do not drop, throw, crush or give a strong shock to the sensor. Be especially careful not to damage the fork.



### CAUTION

Do not drop, throw, crush, or give a strong shock to the sensor when unpacking.



Do not hold the sensor by the fork. Hold it by the body.  
(Fig. 5-1)

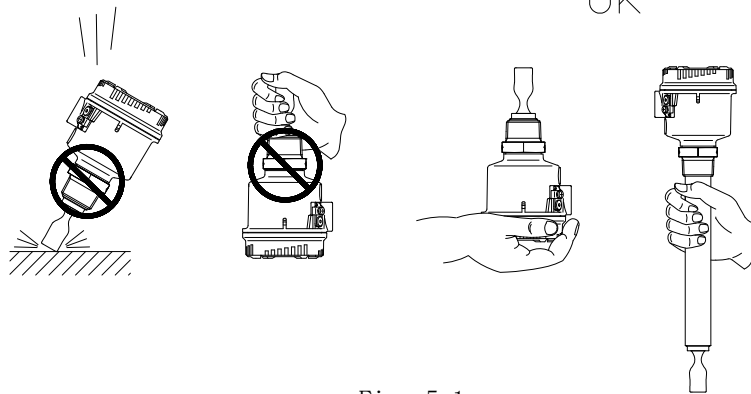


Fig. 5-1

#### 5.2 Switching Point

- (1) Vertically mounted, with water - approximately 13.5mm from the fork tip
- (2) Horizontally mounted, with water - approximately 3mm above the center

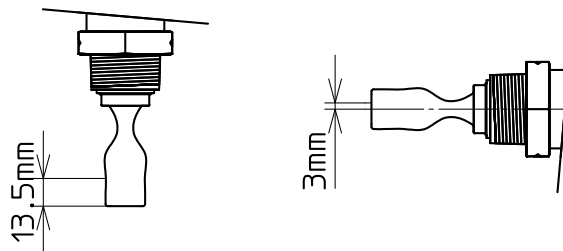


Fig. 5-2

\* See 11. GLOSSARY.

### 5.3 Mounting

Align the fork gap with the flow direction. Use the markings when orienting the sensor.

#### 5.3.1 Threaded version

Use a tool to mount the sensor.

Hexagon on the thread is of 41mm A/F.

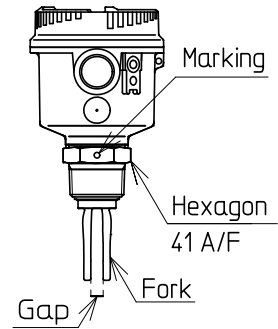


Fig. 5-3

#### 5.3.2 Flanged version

Place the sensor flange on the tank flange, and secure them using a suitable tool and bolts according to the applicable standards. Use a gasket suitable for working conditions to prevent leak. Note that bolts and gaskets are optional.

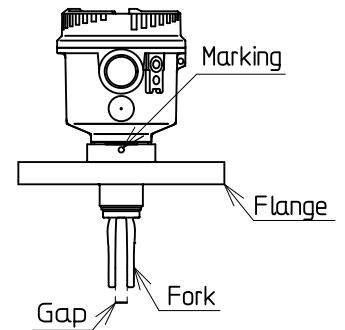


Fig. 5-4

#### 5.3.3 Sanitary version

Use a clamp to mount this version.

Select a gasket suitable for the measured material.

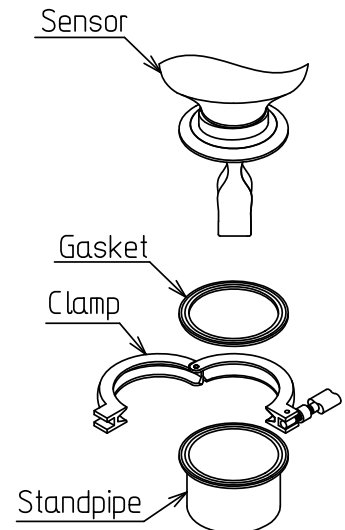









Fig. 5-5

5.4 Handling Notes

 <b>CAUTION</b>	
Never alter the sensor in any way to avoid faulty operation or damage. (Fig. 5-6)	
Do not give a shock to the sensor to avoid faulty operation or damage.	
Ensure the fork protrudes into the tank or piping. Otherwise faulty operation may result due to for example the sensor erroneously reading buildup. (Fig. 5-7)	
Ensure no material buildup on the fork. Clean periodically to avoid faulty operation. (Fig. 5-8)	
Use a tool on the hexagon of the sensor when mounting threaded Version. Never hold the sensor by the housing or pipe. (Fig. 5-9)	
Avoid proximity to inlet/outlet, agitator, or other high flow or bubble sources. Otherwise instable or faulty operation may result. (Fig. 5-10)	

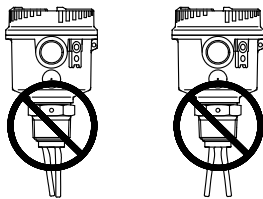
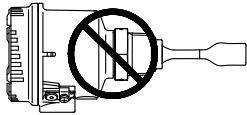
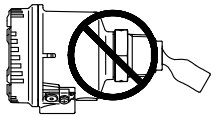
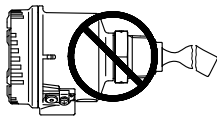


Fig. 5-6

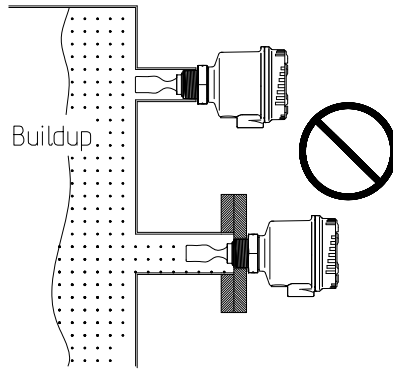


Fig. 5-7

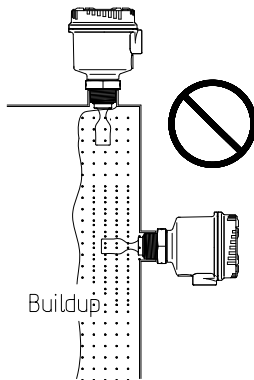


Fig. 5-8

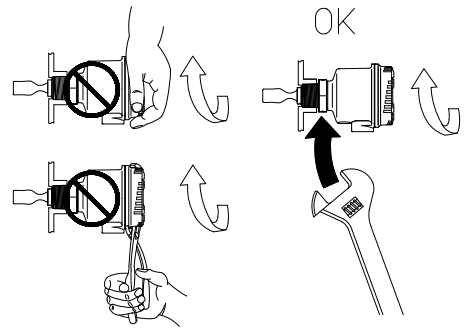


Fig. 5-9

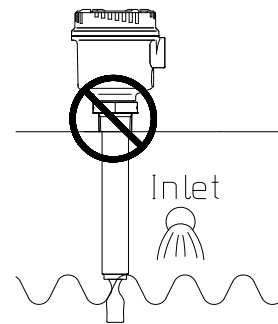


Fig. 5-10

- (1) For horizontal mounting, orient the sensor as shown. Make sure the marking on the hexagon faces upwards or downwards.

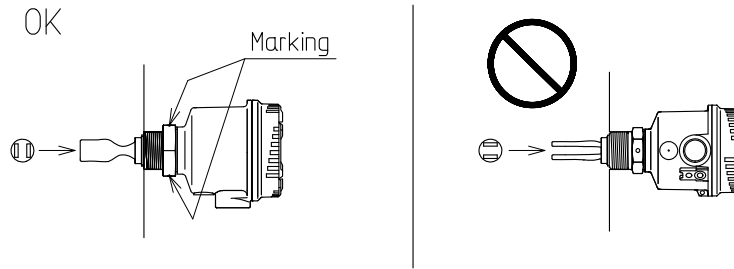




Fig. 5-11



## CAUTION

Incorrectly mounted sensor causes sticky material to remain on the fork. This may cause faulty operation.



- (2) On piping, mount the sensor as shown in Fig. 5-12. Incorrectly mounted sensor may cause cavitation between the tines (Fig. 5-13) and thus faulty operation.

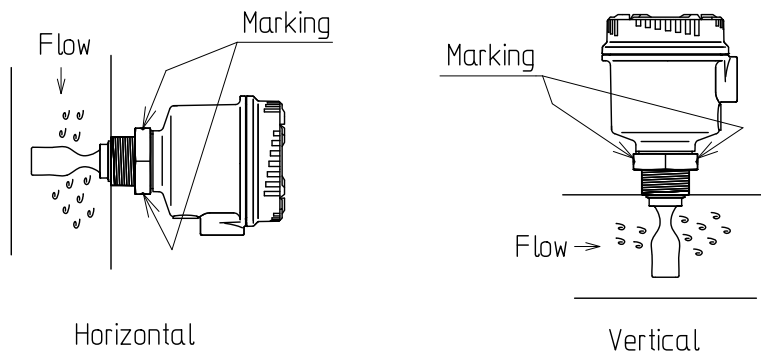


Fig. 5-12

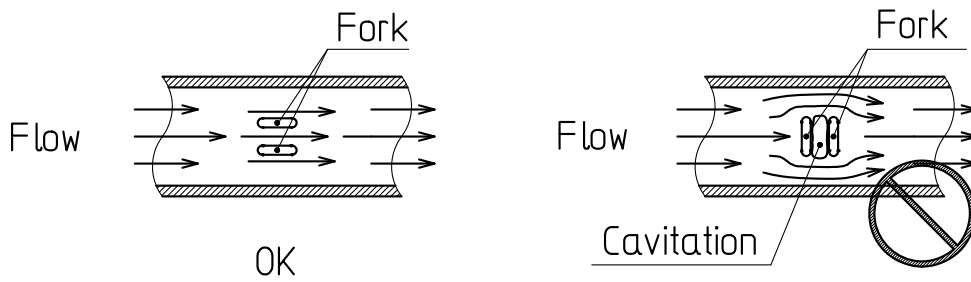


Fig. 5-13

- (3) Avoid bubbles. The sensor may erroneously detect them.



(4) Fig. 5-14 shows mounting examples.

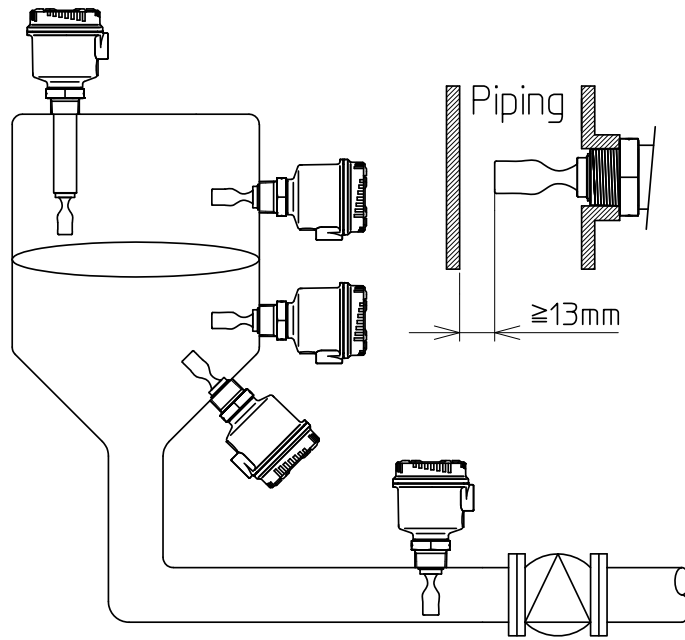




Fig. 5-14

 **CAUTION**

Allow clearance of at least 13mm between the fork tip and the tank/pipe wall. Otherwise faulty operation may result under high flow conditions.



(5) In sticky material applications, response to wet-to-dry may be slower. Response to dry-to-wet will not be affected.

(6) Remove material buildup periodically.

- (7) Ensure that the fork protrudes into the tank or piping. Otherwise faulty operation or slower response may result with sticky material, causing the pump to run dry. (Fig. 5-15)  
 The fork must protrude for at least 27mm in any cases including small piping, and 13mm of clearance between the fork tip and the piping wall must be ensured. (Fig. 5-16)  
 The sensor can be mounted on piping with inner diameter 40mm or larger. 57mm or larger piping is recommended.

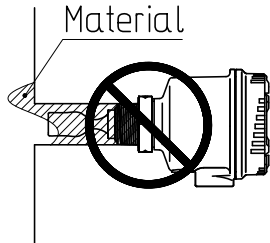


Fig. 5-15

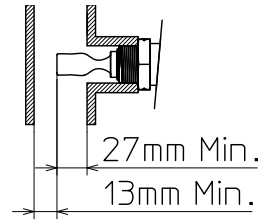


Fig. 5-16

- (8) Housing can be rotated for approximately 330°. Take measures to prevent water or moisture penetration. (Fig. 5-17, 5-18)

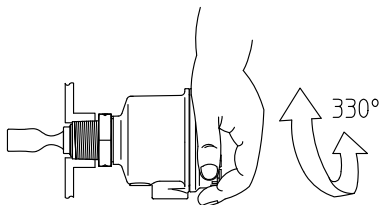


Fig. 5-17

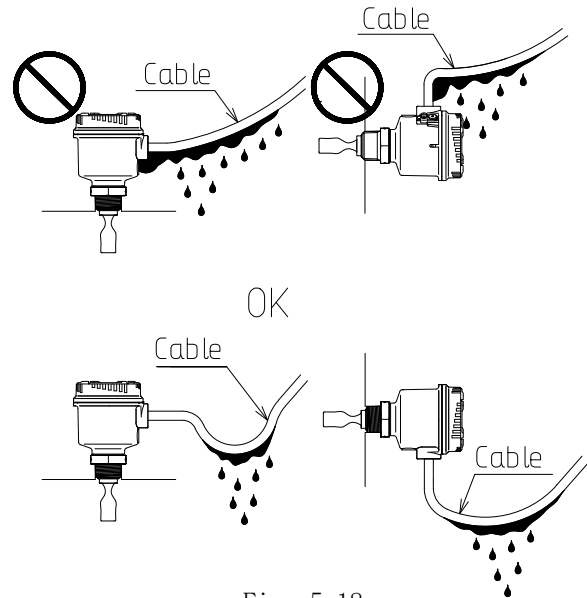


Fig. 5-18

## 6. WIRING



### WARNING

Disconnect power before wiring, or electric shock may result. Ignition or short circuit may also result due to leakage or charged components contacting each other.



Do not startup sensors with fault in protective functions such as protective earth or fuse.

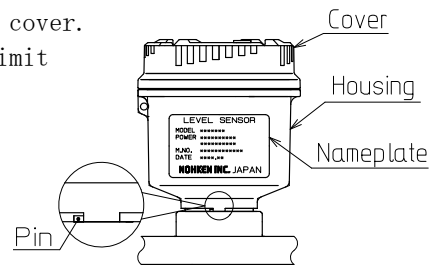


Ensure correct voltage to avoid damage to the sensor or human injury.



### CAUTION

Hold the sensor by the housing when rotating the cover. Holding other components may damage the pin to limit the rotation of the housing.



Use cabling whose conductor area 2.5mm<sup>2</sup> or smaller.



Use a surge absorber\* on devices that can generate surges in the vicinity of the sensor.



Always connect the internal earth terminal to the ground.  
(Grounding resistance: 100Ω Max.)

Connect if necessary the external earth terminal on the housing to the ground as well. (Grounding resistance: 100Ω Max.)



Do not exceed ratings for connected load to avoid damage to the sensor. Add a suitable relay to switch loads exceeding these ratings.

Ratings:

- 2 wire (VQ20-□0□): 500mA AC/DC
- 3 wire (VQ20-□1□): 100mA DC
- Relay (VQ20-□2□): 250V, 3A AC (resistive), 30V, 3A DC (resistive)



Run the sensor cabling as far from power lines as possible to avoid induction. Use a metal conduit if necessary.



Avoid proximity to sources of strong magnetic fields such as motors and solenoid valves, or devices creating high frequency magnetic field such as ultrasonic cleaners and transceivers.



\* See 11. GLOSSARY.

## 6.1 Wiring

### 6.1.1 Cable

Strip the cable tip for 6mm. The sensor accepts conductor size of up to 2.5mm<sup>2</sup>.

Use cable with 0.75mm<sup>2</sup> conductor to jumper terminals.

Terminal screws have a combination head. Use a slotted screwdriver of 0.6 x 3.5mm, or another suitable screwdriver.

If cable lugs are used, select ferrule terminals (insulated bar type cable lug) with 6mm insulation.

### 6.1.2 Parts name

- ① Terminal block – for power line and relay wiring
- ② Fail-safe switch (FS) – switches operation modes
- ③ Delay switch (DELAY) – switches ON, OFF delay timers
- ④ Test button (TEST) – switches operation modes for testing
- ⑤ Delay trimmer (DELAY TIME) – fine tunes delay time
- ⑥ Status LED
  - 2 wire (VQ20-□0□)
  - Lights continuously when the output is ON and flashes when the output is OFF.
  - 3 wire (VQ20-□1□)
  - Lights continuously when the control output is ON, and flashes when the control output is OFF.
  - Relay (VQ20-□2□)
  - Lights continuously when relay is energized, and flashes when relay is de-energized.
- ⑦ Protective earth – to be connected to the ground. (grounding resistance: 100Ω Max.)

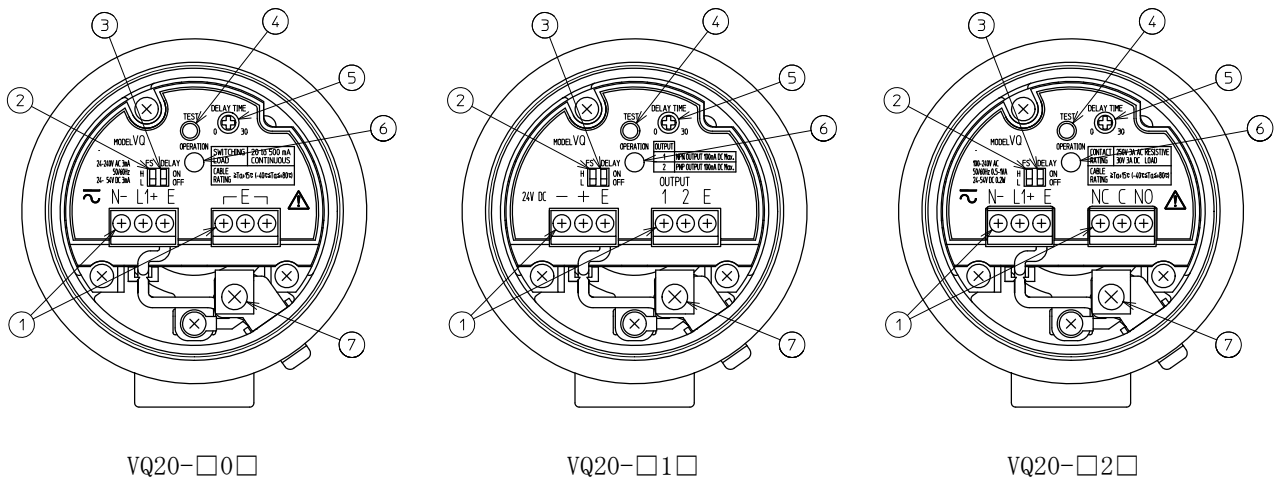








Fig.6-1: internal layout

### 6.1.3 Wiring

Properly connect the wire to the terminals. Use a screwdriver to ensure proper wiring. Observe torque values below.

Torque: 0.4 to 0.5N·m for terminals, 1.2N·m for protective earth

(1) VQ20-□0□

 <b>CAUTION</b>	
When connecting to a relay whose current rating 12mA or lower, reset current 5mA or lower, use a resistor in parallel with the load (bleeder resistor).	
Always connect a relay or other devices between this model and a power supply, or over currents will damage the sensor.	
When connecting to a relay, use one with a protection circuit or add a surge absorber to protect the sensor from reverse voltage.	
When connecting to a relay, the sensor may instantly change output states after power-up or power interruption. Beware that a latching relay will operate in these occasions.	
Do not directly connect to a PLC or a timer relay. Use a relay (VQ20-□2□) or 3 wire (VQ20-□1□) version instead.	

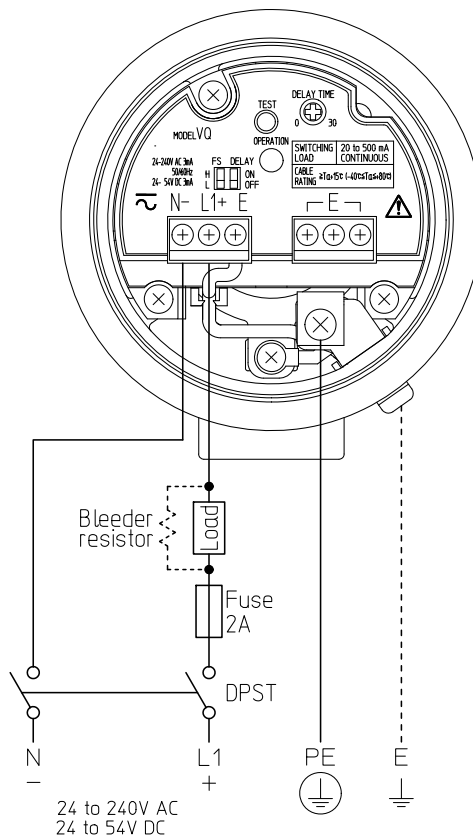


Fig. 6-2: wiring - VQ20-□0□

[Bleeder resistor]

If connecting VQ20-□0□ to a relay whose rating 12mA or smaller, or reset current (\*1) 5mA or smaller, use a bleeder resistor.

\*1 reset current = rated current of relay [mA] x breaking voltage [%] x 0.01

1. Select a resistor that satisfies the following two formulae.

$$\text{Resistance R [k}\Omega\text{]} \leq \frac{(\text{Ira} \times \text{Vrel} \times 0.008)}{5 - (\text{Ira} \times \text{Vrel} \times 0.008)} \times \frac{\text{Vra}}{\text{Ira}} \dots (1)$$

Ira = rated current in mA  
Vra = rated voltage in V  
Vrel = breaking voltage in %

$$12 \leq \text{Ira} + \frac{\text{Vra}}{\text{R}^2} \leq 500 \dots (2)$$

\*2 Resistance R in kΩ must be smaller than the value obtained by formula 1.

2. Power rating of the bleeder resistor must satisfy the formula 3. Select a resistor with as large power rating as possible for when the resistor temperature rises.

$$\text{Power [W]} \geq \frac{\text{Vra}^2}{\text{R} \times 1000} \times 5 \dots (3)$$

Example when MY (OMRON) is used at 200V AC, 60Hz:

Rated current (Ira) – 5.3mA

Rated voltage (Vra) – 200V

Breaking voltage (Vrel) – 30%

$$\text{Resistance R [k}\Omega\text{]} \leq \frac{(5.3 \times 30 \times 0.008)}{5 - (5.3 \times 30 \times 0.008)} \times \frac{200}{5.3} (=12.8)$$

12kΩ is most reasonable as the resistor rating, so apply “12” to formula 2.

$$5.3 + \frac{200}{12} = 22$$

$$\text{Power [W]} \geq \frac{200^2}{12 \times 1000} \times 5 (=16.7)$$

The resistor has to have 16.7W or larger power rating, so a 20W resistor should be selected.

■ Recommended devices

Table 6 shows the recommended bleeder resistors.

Table 6: Bleeder resistor

Manufacturer	Model	Rating		
		100V AC	200V AC	24V DC
OMRON	MY	8.2kΩ, 10W	12kΩ, 20W	0.82kΩ, 5W
	MM	No bleeder resistor required.		
IDEC	RH	8.2kΩ, 10w	12kΩ, 20W	0.68kΩ, 5W
	RY			
Fuji Electric	HH5			0.82kΩ, 5W

(2) VQ20-□1□



## CAUTION

Always connect a load between OUTPUT 1 and 24V DC+, and between OUTPUT 2 and 24V DC-, or over current will damage the sensor.



When connecting to a relay, use one with a protection circuit or add a surge absorber to protect the sensor from reverse voltage.

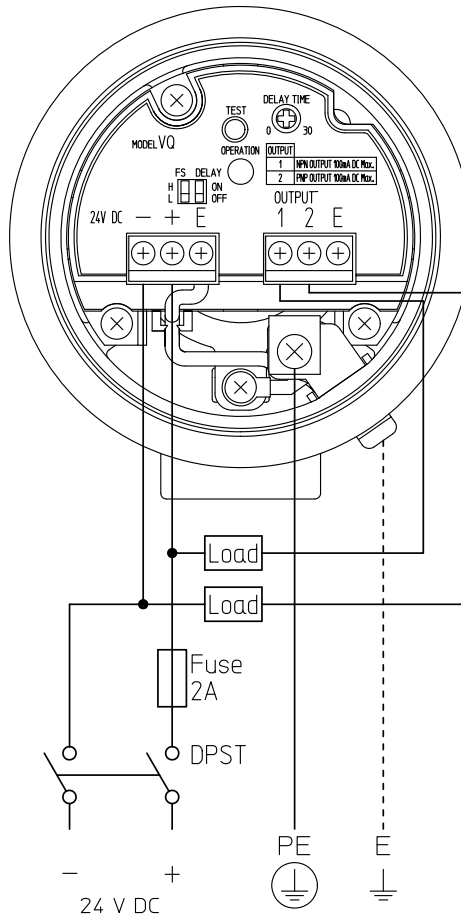


Fig. 6-3: wiring - VQ20-□1□

(3) VQ20-□2□



## CAUTION

When connecting to a relay, use one with a protective circuit or add a surge absorber to protect the sensor from reverse voltage.

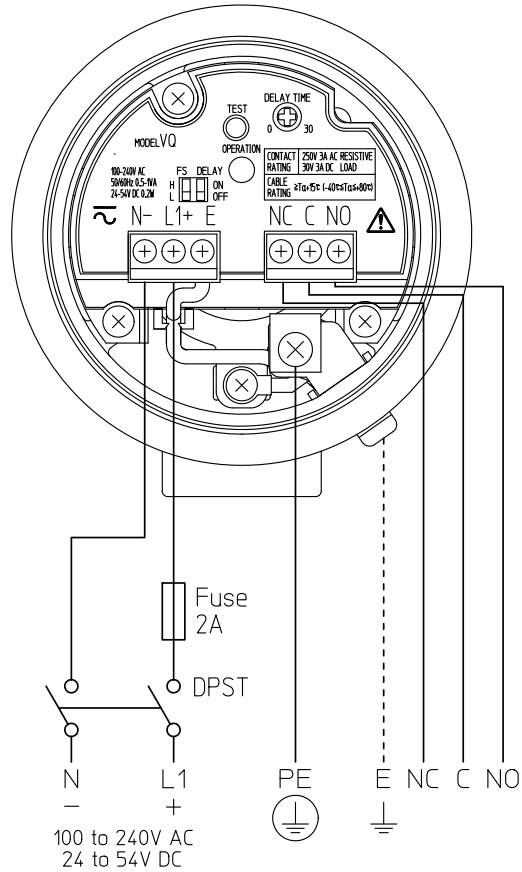


Fig. 6-4: wiring - VQ20-□2□

### 6.2 Cable Inlet

Cable inlet is of G 1/2 or equivalent size and 11mm deep.

Secure the cable by tightening the gland with a suitable tool when a cable gland is used, and using sealing compound when a conduit is used. In either case, lead the cable downwards in front of the inlet to prevent water entry.

This is to prevent entry of dust, debris or rain into the housing. If water or moisture may enter from inside the conduit, putty the inside.

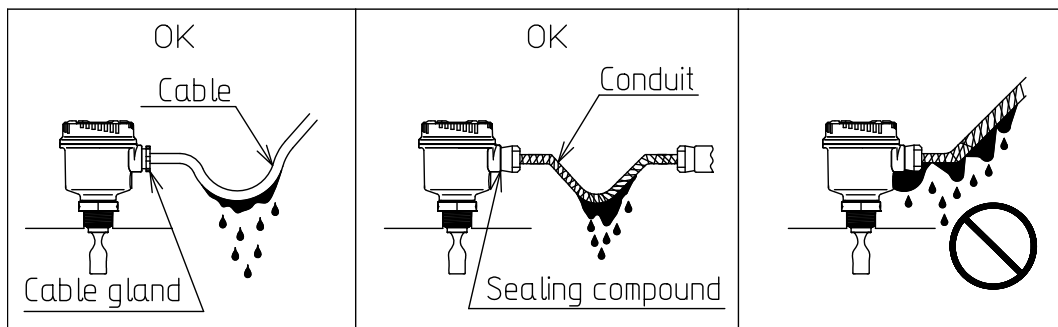


Fig. 6-5



### 6.3 Placing the Cover

Remove dust or debris from inside the housing, and then place the cover.

Hold the sensor by the housing, and rotate the cover. Keep rotating after you feel resistance until the markings on the cover and the housing are in line. The markings not in line means the cover is not properly tightened, and water or dust may enter and cause corrosion or short-circuit.

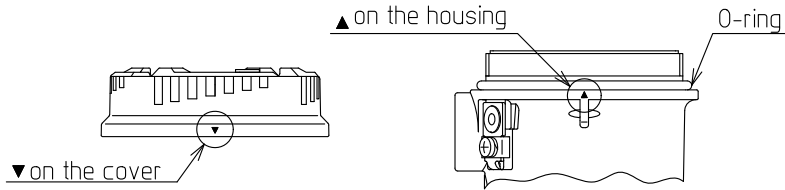


Fig.6-6: markings

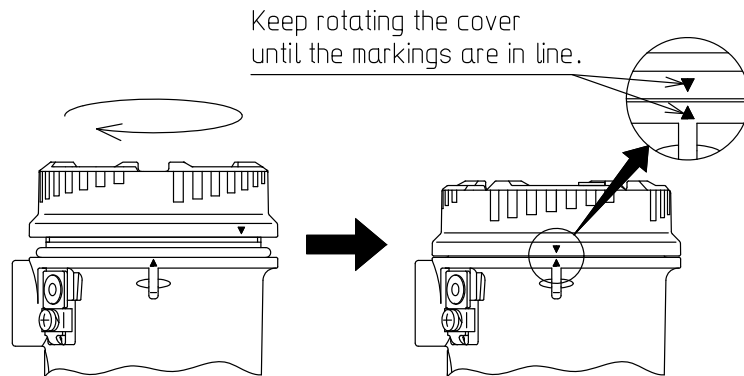


Fig.6-7: securing the cover



## CAUTION

Hold the sensor by the housing when rotating the cover. Holding other components may damage the pin to limit the rotation of the housing.



The rotation should stop when the two markings are in line. Further rotation may damage the cover.



Lubricant is applied to the cover O-ring. If you wish to add lubricant, select one for resin that does not cause chemical crack or cyclic siloxane problems.



# 7. ADJUSTMENT

## ⚠ CAUTION

2 wire version (VQ20-□0□) may instantly change its output states at power-up. Ensure this does not adversely affect connected devices.



Set the operation mode and the delay timer to suit your application.

### 1) Operation mode

Fail-safe switch (FS) determines the operation mode. The sensor offers two modes, “H” and “L”. Figure 7 and Table 7-1 show the detail.

### 2) Delay timer

Delay timer prevents contact bounce by delaying switching for a preset duration of time. Delay switch (DELAY) selects ON or OFF delay timer, and the trimmer (DELAY TIME) sets the delay duration.

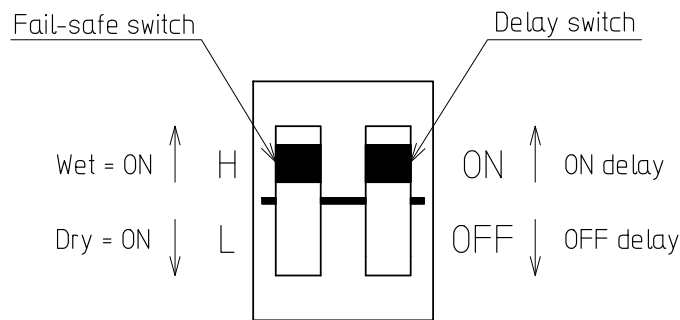


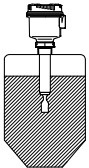





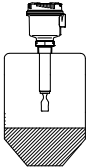





Fig. 7: switches

Table 7-1: operation

	Fail-safe switch	LED	2 wire (VQ20-□0□)	3 wire (VQ20-□1□)	Relay (VQ20-□2□)
	H	○ On continuously	ON	Closed	
	L	☀ Flashes every 3 seconds	OFF	Open	
	H	☀ Flashes every 3 seconds	OFF	Open	
	L	○ On continuously	ON	Closed	

Table 7-2: Delay timer

Delay switch	ON delay time	OFF delay time
ON	approx. 0.5 to 30 sec.	approx. 0.3 sec.
OFF	approx. 0.3 sec.	approx. 0.5 to 30 sec.

	Delay switch	Delay time	LED
	 ON	approx. 0.5 to 30 sec. 	 Flashes 7 times per second
	 OFF	approx. 0.3 sec.	 Flashes 7 times per second
	 ON	approx. 0.3 sec.	 Flashes 7 times per second
	 OFF	approx. 0.5 to 30 sec. 	 Flashes 7 times per second

Turn the trimmer clockwise to lengthen, and counterclockwise to shorten the delay duration. Use a suitable tool to rotate the trimmer. The slot dimensions are as shown.

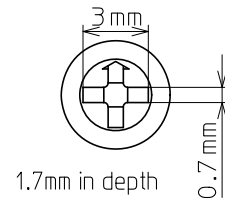








Table 7-3: function table

Fail-safe switch	Delay switch	Operation (1. 2 wire, 2. 3 wire, 3. Relay)
 H	 ON	Wet: 1. ON, 2. Closed, 3. Energized Dry: 1. OFF, 2. Open, 3. De-energized Delay duration: 0.5-30 sec. (Wet to Dry), 0.3 sec. (Dry to Wet)
	 OFF	Wet: 1. ON, 2. Closed, 3. Energized Dry: 1. OFF, 2. Open, 3. De-energized Delay duration: 0.3 sec. (Wet to Dry), 0.5-30 sec. (Dry to Wet)
 L	 ON	Wet: 1. ON, 2. Closed, 3. Energized Dry: 1. OFF, 2. Open, 3. De-energized Delay duration: 0.5-30 sec. (Wet to Dry), 0.3 sec. (Dry to Wet)
	 OFF	Wet: 1. ON, 2. Closed, 3. Energized Dry: 1. OFF, 2. Open, 3. De-energized Delay duration: 0.3 sec. (Wet to Dry), 0.5-30 sec. (Dry to Wet)

Sticky material tends to delay wet-to-dry switching. Dry-to-wet switching is not affected by this.

# 8. MAINTENANCE AND INSPECTION

Maintain the sensor periodically.

- (1) Check for damage such as corrosion and deformation.
- (2) Remove buildup on the fork.
- (3) Remove condensation, dust, or metal particle in the housing.
- (4) Ensure proper wiring. If loose, tighten the terminal screws with a screwdriver.
- (5) Replace corroded terminals and wire.
- (6) Check operation by using the test button (TEST). Pressing TEST reverses operation for easy loop check at maintenance. See Table 8 for correct operation.

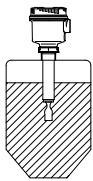


















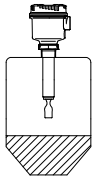




















## CAUTION

Before using the TEST button, ensure the connected devices are not adversely affected.



Table 8: test operation

	Test button	Fail-safe switch	LED	2 wire (VQ20-□0□)	3 wire (VQ20-□1□)	Relay (VQ20-□2□)
	Release 	 H	 On continuously	ON	Closed	 NO  NC
		 L	 Flashes	OFF	Open	 NO  NC
	Press 	 H	 Flashes	OFF	Open	 NO  NC
		 L	 On continuously	ON	Closed	 NO  NC
	Release 	 H	 Flashes	OFF	Open	 NO  NC
		 L	 On continuously	ON	Closed	 NO  NC
	Press 	 H	 On continuously	ON	Closed	 NO  NC
		 L	 Flashes	OFF	Open	 NO  NC

# 9. STORING

Observe the following instructions when storing the sensor before use, or after removing from service. Failure to do so may result in faulty operation or damage to the sensor.

## 9.1 Conditions

- (1) Temperature: -40 to +80 °C (no dew condensation)
- (2) Humidity: 85%RH Max.
- (3) Atmosphere: not corrosive (without NH<sub>3</sub>, SO<sub>2</sub>, or Cl<sub>2</sub>)
- (4) No vibration

## 9.2 Precautions

- (1) Wrap the sensor in sheet and seal it to protect it from moisture and dust.
- (2) If temperature change is enormous, enclose desiccant such as silica gel in the sheet.

# 10. TROUBLESHOOTING

See section 10.1 if the sensor reports a false dry condition.

See section 10.2 if the sensor reports a false wet condition.

If error persists, the sensor may be damaged and replacement required. Please contact our sales office.

## 10.1 False Dry Report


Problem	Possible cause	Corrective action	Reference
LED stays OFF.	Incorrect wiring.	Wire correctly.	6.1.3 (pp. 15-18)
LED flashes every 3 seconds with fail-safe switch set to "H".	Fork is not covered by material.	Relocate the sensor so that the fork will be covered by material.	5.4 (pp. 9-12)
LED stays ON with fail-safe switch set to "L".			
LED stays ON and output indicates dry with fail-safe switch set to "H"	Terminal screws or cabling has problems.	Tighten terminal screws and ensure cabling has no damage.	6.1.3 (pp. 15-18)
LED flashes every 3 seconds and output indicates dry with fail-safe switch set to "L".			
LED flashes 3 times per second twice and then goes out for 1 second.	No load connected. (2 wire, VQ20-□0□)	Wire correctly.	6.1.3 (pp. 15-18)
LED flashes 3 times per second for 5 times and then goes off for 1 second.	Damaged sensor	Replacement required. Contact our sales office.	

## 10.2 False Wet Report

Problem	Possible cause	Corrective action	Reference
LED stays OFF.	Incorrect wiring.	Wire correctly.	6.1.3 (pp. 15-18)
LED flashes every 3 seconds with fail-safe switch set to "L".	Buildup on the fork	Remove buildup and mount the sensor correctly.	5.4 (pp. 9-12)
LED stays ON with fail-safe switch set to "H".			
LED stays ON and output indicates wet with fail-safe switch set to "L".	Terminal screws or cabling has problems.	Tighten terminal screws and ensure cabling has no damage.	6.1.3 (pp. 15-18)
LED flashes every 3 seconds and output indicates wet with fail-safe switch set to "H".			
LED flashes 3 times per second twice and then goes out for 1 second.	No load connected. (2 wire, VQ20-□0□)	Wire correctly.	6.1.3 (pp. 15-18)
LED flashes 3 times per second for 5 times and then goes off for 1 second.	Damaged sensor	Replacement required. Contact our sales office.	

# 11. GLOSSARY

Terms used in this manual are listed below. Those that have already been defined earlier in this manual are not included.

Fork	Detection element. Keeps oscillating during operation, and the change in oscillation frequency indicates material presence or absence.
Piezo-electric crystal	Element that creates strain. Incorporated in the fork to oscillate it.
SPDT	Form C relay, with one pole and two electrodes.  SPDT
Relay	Element with contacts that open or close when energized. Changes states when the fork is immersed or comes out of material surface (with fail-safe switch set to "H").
Flange	Component to mount the sensor on the tank with bolts and nuts.
Sanitary connection	Component to mount the sensor with a clamp.
Surge absorber	Protects circuit from higher voltages than specified.
Hazardous area	Areas where explosive gas or vapor exists or is likely to exist. Equipment used in hazardous areas has to be designed to prevent ignition to such atmosphere. (This sensor is not intended for use in hazardous areas.)

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