INSTRUCTION MANUAL

FOR

FLAMEPROOF

RESISTIVE LEVEL MEASUREMENT

MODEL : LR5□□ series
MODEL : CU2000

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NOHKEN INC.

MUST BE READ BEFORE USING

- This manual is for explosion-proof specifications. Read the other manuals for standard specifications.
- This manual descries 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:

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates an potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
⚠ NOTE	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.

⚠ WARNING

Do not modify or disassemble the equipment. Otherwise, the ignition to an explosive gas may occur.

⚠ WARNING

Before opening the cover, make sure that the terminal box is cooled down.
Otherwise, the ignition to an explosive gas may occur.

⚠ CAUTIONS

- The allowable hazardous location is Class 1 and 2.
Do not install in Class 0.

- This sensor gives the properties of the flameproofness by strength of housing and the gap and length of path.
Therefore, do not damage the housing, joints and the screwed-in parts. Otherwise, the flameproofness can not be protected.

- For inspection, adjustment and maintenance, any disassembly to joints (housing terminal stand and stem) is prohibited.

- Secure bolts and screws by using spring washers against looseness. Otherwise, the flameproofness can not be protected.

⚠ CAUTIONS

- Adjustment, inspection and maintenance shall be done by the skilled engineer.

- Inspection and maintenance shall be in accordance with the Plant Electrical Equipment Flame-proof guide book published by TIIS and all local codes.

- The electrical instrumentation for maintenance shall also be an explosion-proof construction.

⚠ CAUTIONS

- Turn off the power immediately if there is bad smell and/or the strange sound.
  Do not use until the remedy is administrated.

- Make sure that the wiring is correct.
  Otherwise, the sensors may be damaged, ignited or cause an electric shock.

⚠ CAUTIONS

- For grounding, we recommend to use the earth terminal in the housing to prevent from deterioration by atmospheric condition.

- Use the specified color for grounding to identify easily.
  For example, we recommend to use green.

⚠ 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.

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

⚠ 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.

- 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.

- <u>The sensor which is 50cm or longer</u>
  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.

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 written on the front cover.

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.

NOTE TO USERS

First of all, it is essential that this manual should be read and understood before installation and start-up of the Resistance Type Level Sensor. This manual covers instructions for the installation, wiring, maintenance, and troubleshooting.

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1. INTRODUCTION

This Resistance Type Liquid Level Sensor is designed to measure for clean liquid level, such as oil, water and chemicals in tank. The Resistance Type Liquid Level Sensor consists of the sensor(Model LR5□□ series) and the Converter Unit(Model CU2000) that serves as a converter. The Converter Unit converts the total resistance value of the sensor into an electrical signal and output signal 4 to 20 mA DC.

2. SPECIFICATIONS

2.1 Model and Suffix Codes

(1) Sensor model

LR5□ □ □

Code	Wetted parts material
S	Stainless Steel*1
V	PVC(Polyvinyl Chloride)

Code	Cable inlet
0	Flameproof Threaded-joint metal conduit type (G3/4)
1	Flameproof packing type (G3/4)
2	Flameproof Threaded-joint metal conduit type (G1/2)
3	Flameproof packing type (G1/2)

Code	Stem diameter	
	S	V
1	ϕ13.8	ϕ22
2	ϕ27.2	ϕ34

*1 Detail of wetted parts material depends on 「2.2 Standard Specifications」.

(2) Converter Unit model

CU2000

2. 2 Standard Specifications

(1) Sensor

Table 1

Model		LR52□ S	LR51□ S	LR52□ V	LR51□ V
Flange size		JIS 5K100A	JIS 5K 50A	JIS 5K100A	JIS 5K 80A
Stem diameter		ϕ27.2 mm	ϕ13.8 mm	ϕ34 mm	ϕ22 mm
Float dimension		ϕ90mmxH100mm	ϕ49mmxH50mm	ϕ89mmxH150mm	ϕ65mmxH80mm
Maximum pressure		500 kPa	500 kPa	200 kPa	200 kPa
Allowable impact		100 m/s² Max.			
Ambient temperature		-10 to 100 ℃	-10 to 100 ℃	0 to 50 ℃	0 to 50 ℃
Construction		IP65			
Minimum S.G.		0.7	0.8	0.85	0.7
Power supply		0.2 to 3.9 mA DC, 24 V Max. (Power source from CU2000)			
Resolution *2		10 mm			
Accuracy		±0.5 % F.S.(Measuring length < 3000 mm) ±15 mm (Measuring length > 3000 mm)			
Hysteresis		±10 mm			
Total resistance value		(Measuring length mm / Resolution mm) x 20 Ω			
Max. overall length of stem		3900 mm	3000 mm	3900 mm	3000 mm
Material	Terminal box	Aluminium diecasting		Polyvinyl chloride	
	Flange	304 SS	304 SS	Polyvinyl chloride	
	Stem	304 SS	304 SS	Polyvinyl chloride	
	Float	316 SS	316 SS	Polyvinyl chloride	
	Float-travel stop	316 SS	316L SS	Polyvinyl chloride	
Insulation resistance test		1 x 10^8 Ω or more with 500 V DC Megger (Between 1, 2 terminal and E terminal or Non-charge part)			
Withstand voltage test		1500 V AC, 1 Minute (Between 1,2 terminal and E terminal or Non-charge part)			
Cable inlet		JIS F 20a (G 3/4)			

NOTE

*2 Available 5 mm resolution.

The accuracy of 5 mm resolution is ±7.5 mm(Measuring length > 3000 mm)

The hysteresis of 5 mm resolution is ±5 mm.

(2) Model 5□□ □ has been approved as an flameproof instrument after being tested by a public organization in accordance with the Labor Ministry's Industrial Safety Research Institute(RIIS-TR-79-1,Japan). Hence, it can be installed in hazardous location. However, since there are certain restriction as to the handling and environmental conditions of individual units, the cautions indicated on each units or given in the instruction manual must be strictly observed.

Approval type number		Flameproof construction and appricable gas
LR51□ series	LR52□ series	
No. 47544	No. 47545	d2G4

(3) Converter Unit

Table 2

Power source of detector	0.2 to 3.9 mA DC
Allowable resistance of the detector	1.3 kΩ to 12 kΩ
Input	2-Wire(Resistive signal use)
Output signal	4 to 20 mA DC
Load resistance	750 Ω Max.
Zero adjustable range	0 to 8 mA DC
Power supply	90 V to 132 V, 180 V to 264 V AC, 50/60 Hz
Power consumption	2 VA Max.
Accuracy	±0.5 % F.S.
Ambient temperature	0 to 50 ℃
Preservation temperature	-20 to 70 ℃
Working humidity	85 % RH Max.(Get rid of dew)
Insulation resistance test	1 × 10^8 Ω or more with 500 V DC Megger(Between power supply terminal and E terminal)
Withstand voltage test	1500 V AC, 1 Minute(Between power supply terminal and E terminal)
Dimension	W 50 mm × H 84 mm × D 109 mm
Installation method	Plug-in type
Mass	Approx. 350 g

2. 3 Dimensions

(1) Sensor

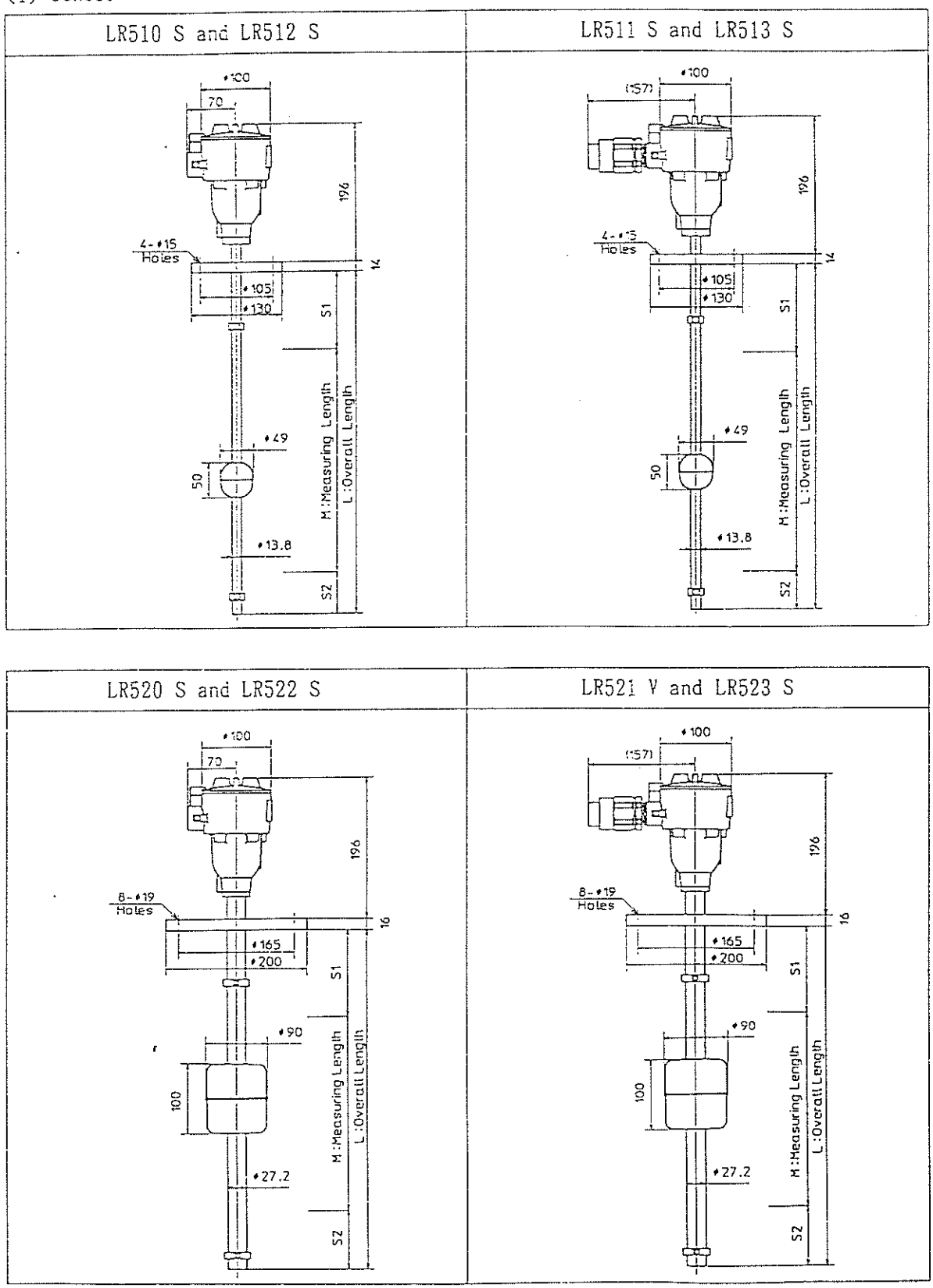

Fig. 1 Drawing of sensor dimensions

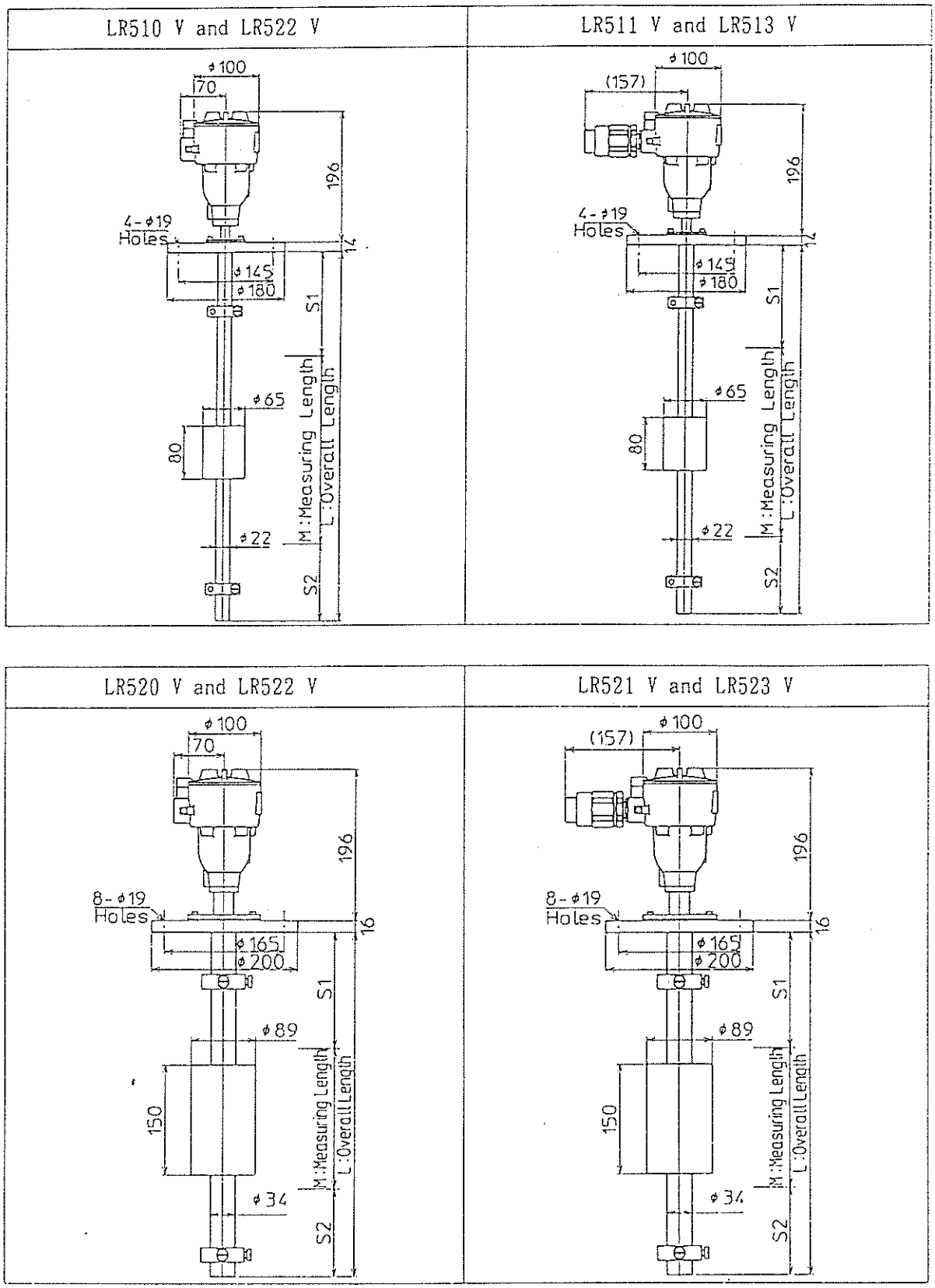

Fig. 2 Drawing of sensor dimensions

(3) Converter Unit

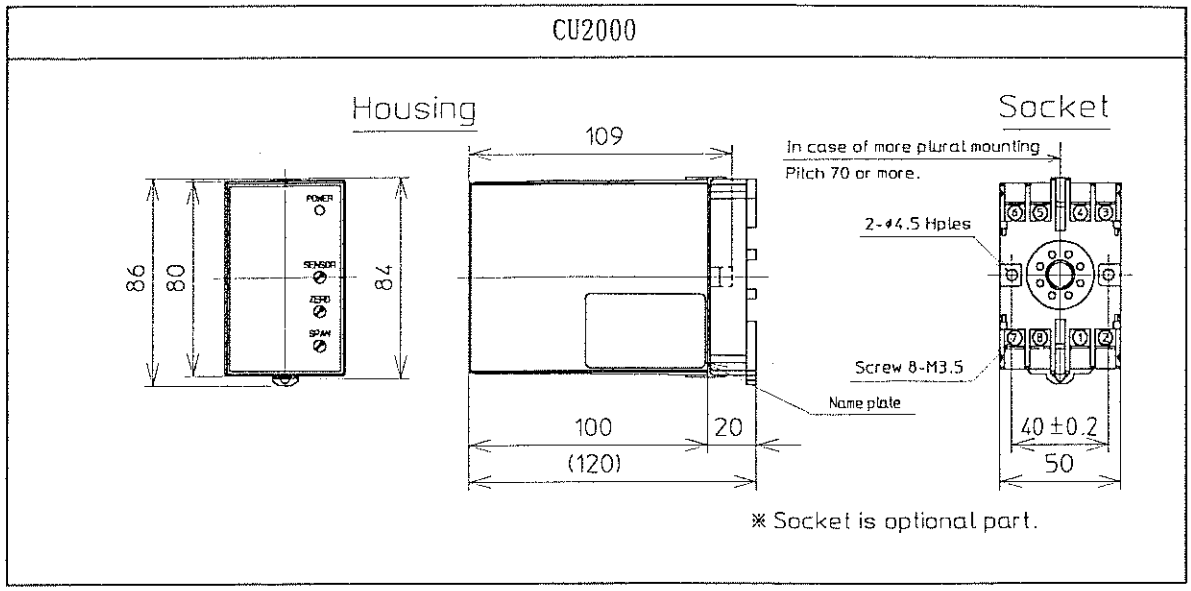

Fig. 3 Drawing of Converter Unit dimensions

3. PRINCIPLE OF OPERATION

The LR series level sensor consists of the float built-in permanent magnet and the stem built-in internal circuit board arranging reed switches, resistances.

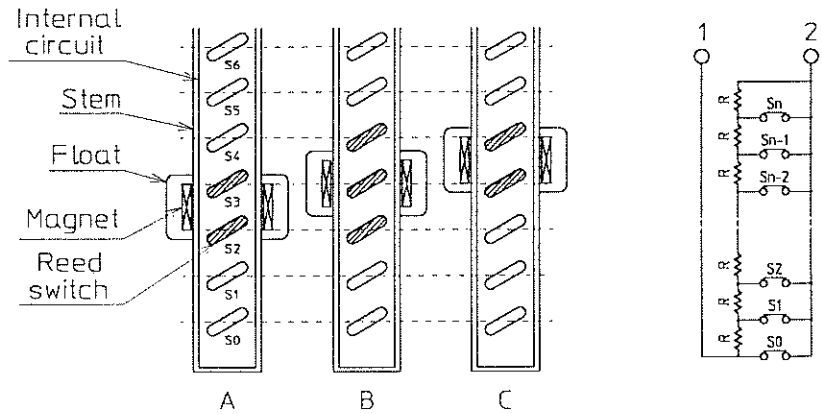

Fig. 4

The float travels freely, between their float-travel stop, rising or falling with liquid level movement.

The reed switches are actuated by the float magnetic field in a "2-3-2 at a time" as the float travels. Accordingly, the total resistance value of internal circuit is changed by float traveling. If supplied constant current I between 1 and 2 terminals, the voltage, between 1 and 2 terminals, will change continuously. If the converter unit connected with the sensor, the converter unit converts total resistance value of sensor into output signal 4 to 20 mA DC .

See Fig. 5 Block diagram.

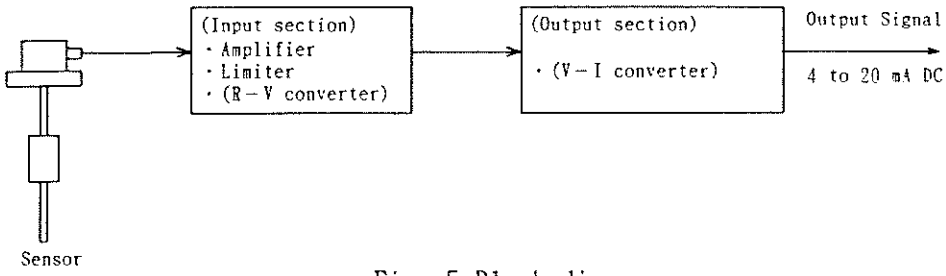

Fig. 5 Block diagram

4. COMPONENT NAMES

4.1 Sensor

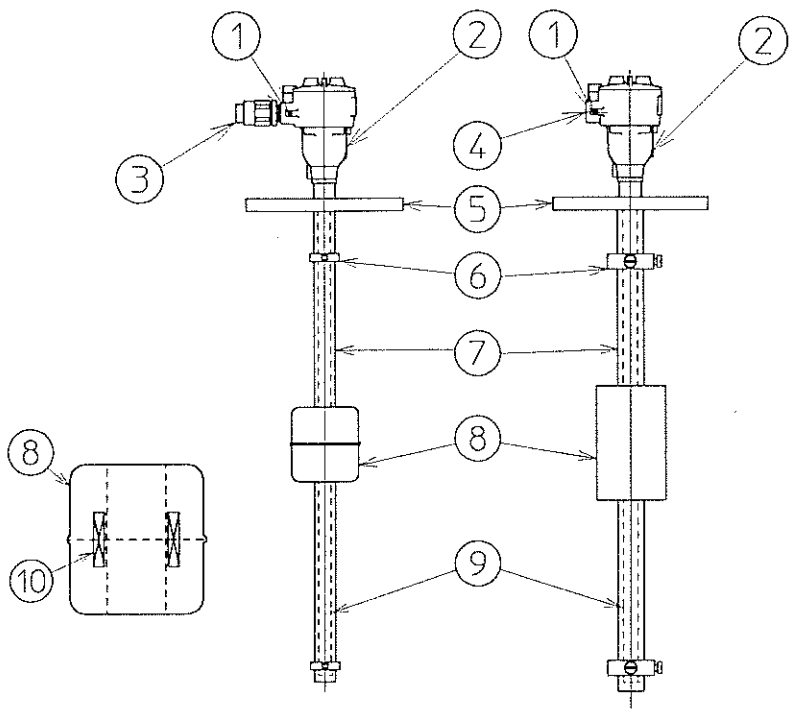

Fig. 6

No.	Name	No.	Name
①′	Earth terminal	⑥	Float-travel stop
②	Terminal box	⑦	Stem
③	Flameproof packing	⑧	Float
④	Cable inlet	⑨	Internal circuit
⑤	Flange	⑩	Permanent magnet

4.2 Converter Unit

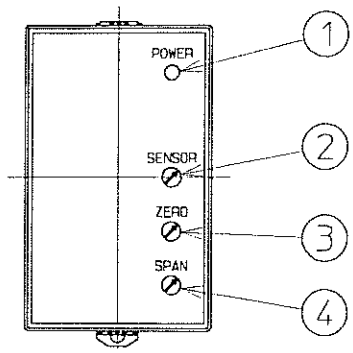

Fig. 7

① Power indication lamp

This lamp light up, when the unit is turned on the power.

② Detector current adjusting trimmer

This is the semi-fixed trimmer for adjusting the current of the power source of the detector with an adjustment range of 0.2 to 3.9 mA DC. Adjust this trimmer for 3 V DC, the maximum voltage of the detector.

③ External output zero adjusting trimmer

This is semi-fixed trimmer for fine zero adjustment of the external output signal(4 to 20 mA DC). Adjust this trimmer to obtain an output of 4 mA DC for input voltage of 0 V DC.

④ External output span adjusting trimmer

This is semi-fixed trimmer for fine span adjustment of the external output signal(4 to 20 mA DC). Adjust this trimmer to obtain an output of 20 mA DC for input voltage of 3 V DC.

5. INSTALLATION

5.1 Unpacking

This unit has been thoroughly inspected and carefully packed at the factory to prevent from damage during shipment. When unpacking, exercise due care not to subject the instrument to mechanical shock. after unpacking, visually check the instrument exterior for damage.

NOTE the following points:

(1) Do not carry the sensor with one hand, use both hands to protect the long stem from bending. (See Fig. 8.)

(2) Hold the float not to hit the stopper or the flange. Otherwise, the magnet inside the float will be cracked. (See Fig. 8.)

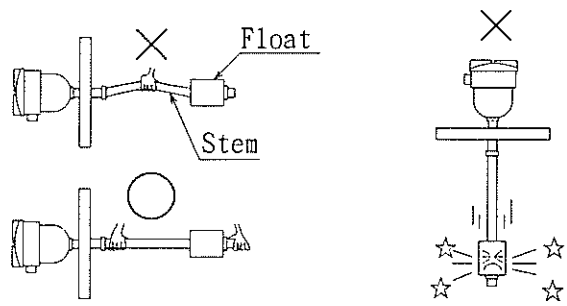

Fig. 8

5.2 Installation Location

This unit should be installed in an area where the following condition.

(1) Provide ample space for maintenance/inspection.

(2) Low relative humidity and no exposure to moisture.

(3) No excessive vibration.

(4) This sensor can be installed in hazardous locations containing the gas atmospheres which the sensor is certified to be flameproof in.

5.3 Installation of Sensor

This sensor mounting method depend on flange mounted type. (See Fig. 9)

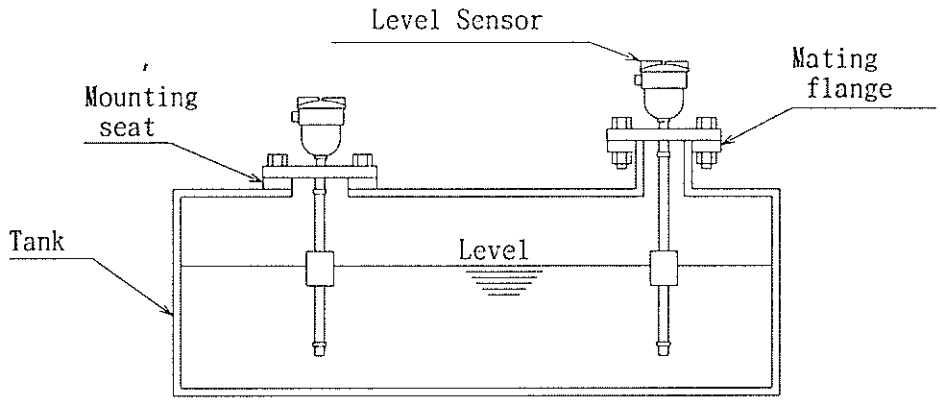

Fig. 9

NOTE the following points:

(1) This sensor should be installed in an area where the ambient temperature range is -10 ℃ to 60 ℃.

> **⚠CAUTION**
>
> Provide appropriate means to guard against moisture if the temperature is low. Otherwise, the sensor may be damaged.

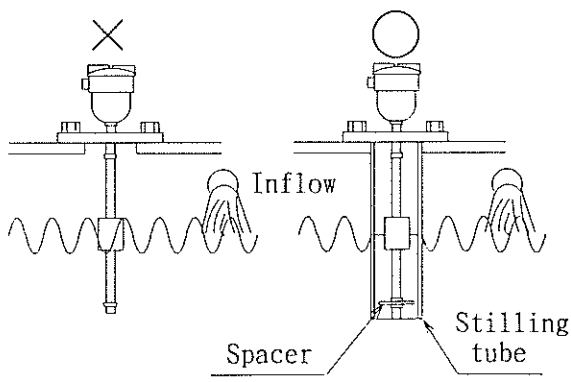

Fig. 10

(2) If there is surface wave motion, we recommend the installation of a stilling tube. Drill vent holes in the tube and use spacer to keep the float traveling. (See Fig. 10)

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

(4) This sensor should be mounted up to vertical.

> **⚠CAUTION**
>
> Do not provide bending or hitting stem during installation. Otherwise, the sensor may be damage.

5.4 Installation of Converter Unit

NOTE the following points:

This Converter Unit should be installed in an area where the ambient temperature is 0 to 50 ℃.

> **⚠CAUTION**
>
> Provide appropriate means to guard against moisture if the temperature is low, Otherwise the converter unit may be damage.

Proceed as follows:

(1) Fix the socket(optional part) on mounting board directly with M4 screws (2 x ϕ4.5 holes, Pitch 40), or insert that into DIN rail(35 mm).

(2) Put in the Converter Unit into the socket.

5.5 Installation of CVVS Cable

2-core CVVS(1.25 mm²) connecting cable shall be used between the sensor and the converter unit. The cable length shall not exceed 300 m(lead wire loop resistance 12 Ω Max.).

> ⚠CAUTION
>
> (1) Do not kink the CVVS cable. Damage can occur causing the sensor and the converter unit to malfunction. The CVVS cable must be laid at a distance of 50 cm or more from the power cable. Otherwise, the sensor and the converter unit may be damaged by induced current.
>
> (2) The CVVS cable should be grounded by JIS Class D Grounded. (Grounded resistance 100 Ω Max.)

6. WIRING

6.1 Sensor Wiring

Normally, wiring data is indicated to the back of terminal box cover.

The sensor wiring should be connected in accordance with the method of wiring flameproof wiring provided in the 『Recommended Practice for Explosion-Protected Electrical Industries』 published by the Labor Ministry's Industrial Safety Research Institute(RIIS-TR-79-1,Japan). Also, the precautions given in this manual must be strictly observed. Proceed as follows:

(1) Loosen setscrew with a allen wrench for M4, and remove Anti-rotation clamp.

(2) Remove the terminal box cover.

(3) Bring the cable into the terminal box.

(4) Connect the cables to the terminals as shown Fig. 11.

(5) Make sure that there is no miswiring.

(6) Reinstall the terminal box cover in accordance with protection category IP65.

(7) Tighten the setscrew securely.

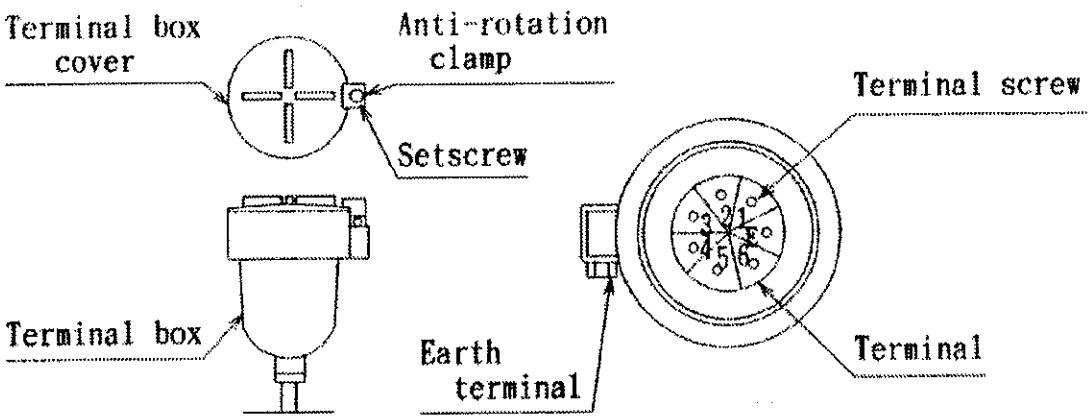

Fig. 11

NOTE the following points:

(1) The gasket size built-in flameproof packing depend on cable outside diameter.

Please specify this when you order. (Refer to Table 3)

Table 3

Model	LR5□0 LR5□2	LR5□1 LR5□3
Cable outside diameter	12.1 ~ 16.0 mm	7.0 ~ 12.0 mm

(2) Install solderless lugs fitted to M3(Converter unit side) and M4(Sensor side) screw to the end of lead wires. (See Fig. 12)

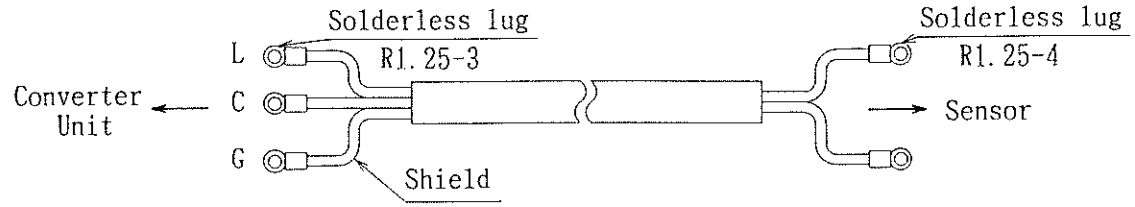

Fig. 12

(3) The cable inlet must be protected the sensor from rain, splashing water and so on.

6.2 Converter Unit Wiring

Proceed as follows:

(1) Connect the cables to the terminals as shown in Fig. 13.

⚠CAUTION

Make sure that the power supply is turned off.

(2) Double-check wiring for correctness.

NOTE the following points:

(1) The cable for relay, output signal and power supply must be used between 0.3 mm² to 1.25 mm².

(2) The terminal screws are used M3 screw.

⚠ WARNING

(1) To avoid injury, connect the power supply to the converter unit, after making connection.

(2) "EARTH TERMINAL" should be grounded. If it is not grounded, you will get an electrical shock.

(3) Make sure that the shield cables are one-point grounded.

(4) This converter unit is designed to operate with maximum load resistance 750 Ω.

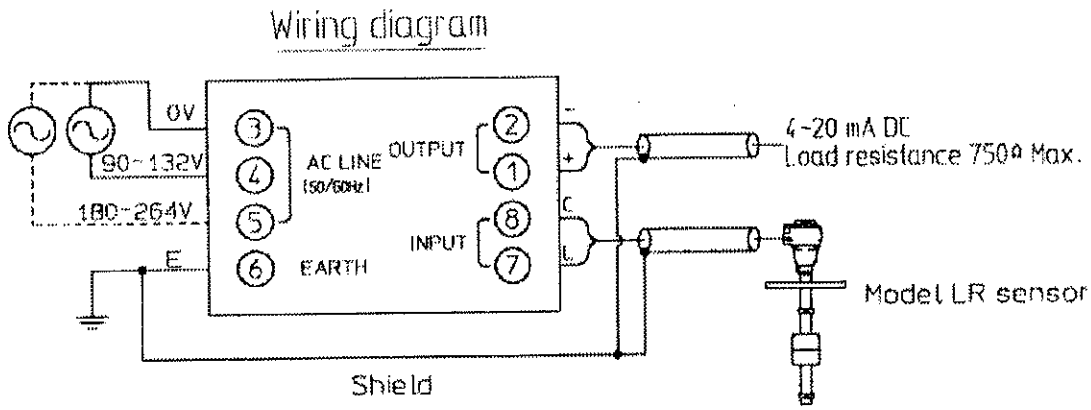

Fig. 13

7. 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 10 m/s². Shocks greater than 10 m/s² may damage the sensor.

(3) The float-travel stop settings are based on how the magnetic field influences the reed switches. Do not move the float-travel stop.

(4) This products must be stored in a day, warm place where condensation of humidity will not occur.

8. ADJUSTMENT

NOTE : The adjusting trimmer of the converter unit have been adjusted specified value before shipment. If it need fine adjustment, adjust output signal in accordance with follows.

Proceed as follows:

(1) Make sure that there are no miswiring.

> ⚠ CAUTION
>
> Supply voltage must match the terminals indicated on the front panel.
> Incorrect voltage miswiring will damage the converter unit.

(2) Connect digital ammeter to output terminals(+ and -).

(3) Turn on the power.

(4) Connect a voltmeter having an internal resistance of 500 kΩ or more between the input terminals(L=Positive side and C=Negative side).

(5) Set the float on highest level and adjust the current adjusting trimmer ② of the detector so that the voltmeter indicates 3 V DC.

(6) Set the float on lowest level and adjust zero point by adjusting trimmer ③ that output signal is 4 mA DC.

(7) Set the float on highest level and adjust span point by adjusting trimmer ④ that output signal is 20 mA DC.

(8) Set the float on lowest level again, and check that output signal is 4 mA DC. If that is not 4 mA DC, re-adjust zero and span points accordance with parts of "8. ADJUSTMENT (6) and (7)".

9. INSPECTION AND MAINTENANCE

The following annual servicing tasks should be carried out on the sensor and converter unit.

> ⚠CAUTION
>
> In hazardous locations, do not remove the terminal box cover until atmosphere is determined to be safe, and the power supply is turned off.

(1) Visual inspection

(a) Remove the sensor from tank carefully.

(b) Ensure there is no damage.

(c) The float-travel stop setting are based on how the magnetic field influence the reed switch. If float overrun, check and reset the float-travel stop.

(d) If the float is filled with water or collapsed, it must be replaced immediately. Do not attempt to repair a float.

(2) Cleaning the sensor.

(a) Never remove the terminal box cover. It become damaged or misplaced, order a reinstallation immediately.

(b) If sediment or other foreign matters are stained between float and stem, detecting errors may be caused. Keep clean float and stem.

(c) Be care of the float orientation when you reassemble the resin float.
If you insert the wrong direction, the sensor may cause false operation.
The correct direction shows the following table.

Float size	Type of marking	Direction
ϕ65×H80	"SWITCH ON"	The marked side must be installed the tip of the stem side(bottom)
marked float	groove	The marked side must be installed the tip of the stem side(bottom)
another float		Do not prescribe

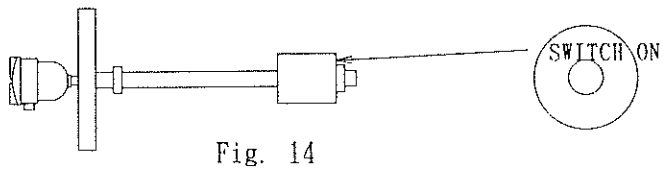

Fig. 14

(3) Sensor operating(See Fig. 15)

After removing the terminal box cover, check switch actuation as follows.

(a) Remove the connection from the converter unit.

(b) Connect a ohmmeter between 1 and 2 terminals.

(c) Travel the float between their float-travel stop, and check the resistance value changes constantly.

(d) If the sensor is normal, the resistance value changes at the rate of 20 Ω for resolution.

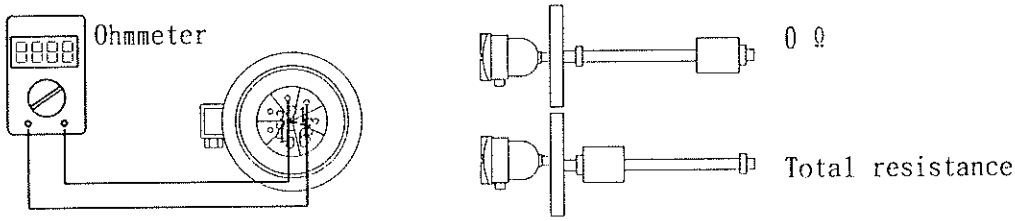

Fig. 15

(4) Converter unit inspection

(a) Don't turn on the power source while the input terminal of converter unit is open.

(b) Turn off power source, when the converter unit is attached or detached from the socket.
If don't turn off, internal electric parts is broken.

10. TROUBLESHOOTING

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

Table 4

Problems	Causes	Solutions
The power lamp does not light	The power supply is not connected.	Ensure the wiring, and connect the power.
Output signal does not change from 4 mA DC.	Line between L and C terminals is short circuit.	Ensure the wiring on this line.
	Sediment or other foreign matter adhere to between float and stem.	Clean the sensor.
	Float is filled with liquid on corrosion.	Replace float after checking corrosion resistance.
Output signal does not change from 20 mA DC.	Sediment or other foreign matter adhere to between float and stem.	Clean the sensor.
	Falling the float form the stem.	Put the float on stem, and tighten the float travel-stop.
Output signal dose not change at somewhere.	Sediment or other foreign matter adhere to between float and stem.	Clean the sensor.
Output signal is over range.	Wiring between sensor and converter unit is disconnected.	Ensure the wiring.

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