EMKOMETER Ltd.	Operating instructions Liquid level sensor	
Ledec nad Sazavou	**Series L21/3-DIAL-xx.xx.xx**	

Contents:

1. Principle and Applications

1.1 Principle

The float sensor consists of a head, neck, wire and a float. Optionally float is coupled to the wire via magnetic follower over guide tube. The liquid level is measured by the float that moves freely along the tube, actuating the follower via a magnetic coupling. The magnetic coupling consists of magnets placed in the float and in the follower. In the case of turbulent levels, extreme temperatures etc., a follower with a more powerful magnetic coupling is used. The follower located in the guide tube is connected to the instrument head by stainless-steel wire. The follower moves through the magnetic field, transmitting the liquid level movement to the instrument head. In simple applications with noncorosive liquids directly connected float is used. The transmission mechanism indicates instantaneous liquid levels on a circular scale, or it controls liquid levels at the desired height by means of the LG´s electronic equipment. Using a resistance transmitter or a transmitter with a potentiometer, it provides an impedance signal or a current output signal.

1.2 Use

Float sensors (hereinafter FS) are designed to measure and control liquid levels in closed and open tanks or in pressure tanks. Some types of instruments, designed and marked for explosion-free atmospheres, can also be used to measure various media in Zone 0. IP 65 allows for safe measurements in the amospheres with aggressive substances. The level gauge is a mechanical-electrical device whose modular construction allows you to create various instruments with different features.

Types of level gauges and their combinations

LG head (basic information)

1.21 Basic options and applications

1.21.1 The instrument is designed for local indications, with no external power supply or electric equipment.

1.21.2 The LG head with electric equipment can control and indicate the liquid level. Some types of level gauges may be fitted with resistance or other transmitters, featuring current or voltage outputs.

1.21.3 A special model for local indications may be fitted with some other components to monitor temperature, technological conditions and liquid level limits. This type of instrument is supplied on request.

2. Description

Various combinations of this float sensor include the following basic components:

2.1 Instrument head

The LG head is a box, indicating liquid level on a scale with a range of 5 m, 10 m or 20 m using two dial pointers. The liquid level is measured by a follower located in the magnetic field of the float. The standard follower for a Ø 38 mm guiding rod is marked LIC030/050. The follower with a more powerful magnetic coupling is marked LIC030/095/M8. The follower for a Ø 20 mm guiding rod is marked LIC015 /050. The head is an aluminium casting with outlets. Two basic head models marked LIH250/175 and LIH170/160 are manufactured most often. On request, the instrument may also be placed in the LIH310/225 head. The first three digits indicate the head diameter in mm. The next three digits indicate the head depth.

2.2 Guide tube

The guide tube is made of stainless steel or polypropylene. The guide tube (commonly called "guide rod") is closed at the bottom, separating the inside of the instrument from media. The tube is suitable for pressure containers up to about 3.5 MPa. The maximum length of the stainless steel model is 20,000 mm (5,000 mm for the polypropylene model). A Ø 20 mm stainless steel tube (outer diameter) is usually used for the 5,000 mm model. A Ø 38 mm tube is used for turbulent levels and the 5,000 mm model. Depending on the method of filling the tanks or at turbulent fluid levels, we recommend fixing stainless steel tubes from the height of 3,000 mm.

The guide rod may also be fitted with a collar only (in insufficient space). This is not possible in pressure vessels.

2.3 Neck

The LIH250/175 (LIH310 / 225) head neck is a connection component fitted with a collar and a turning flange. The flange makes it possible to fasten the guide tube to the tank neck and to turn the instrument so that you can mount it or read the scale. DN50 PN16 flanges acc. to DIN 13 11 60 are commonly used. The DN50 PN40 neck with a tongue/groove may be used for pressure vessels. The LIH170/160 head neck includes a cap nut screwed on the threaded guide tube (Pr.20), which may also be flanged. As for the collet model, the neck is not separate but the collet fitting can be mounted on the guide tube at the desired height.

2.31 The common neck size is 120 mm.

2.32 In some cases, we can offer a neck up to 3,000 mm (possible flooding, low-lying tank, mounting the head higher in the area with a lower degree of explosion protection, high temperature in the tank, etc.).

2.4 Float

Different types of floats have been designed for different fluid densities. The floats for ø 20 mm stainless steel tubes up to 5,000 mm are marked LIF134/180 and LIF082/216. The floats for ø 38 mm stainless steel tubes up to 20,000 mm are marked LIF310/220, LIF235/250, LIF310/220/M8 and LIF235/250/M8. The first three digits indicate the float diameter whereas the next digits indicate the float height incl. the float tube. The LIF235/250/4 is a special quadruplet float to measure liquid gases up to 3.5 Mpa. The L21/3-DIAL235/220/T3 float may be used in pressure vessels (up to 3.5 MPa). It is also possible to measure the interface of liquids or high-viscosity liquid levels using a different float measurement principle. A polypropylene float has been designed for aggressive fluids.

3. Operating Conditions

3.1 Operating Conditions

3.11 The instrument design ensures safe operation in the following areas:

a) cold
b) hot
c) for specified types of instruments in Zone 0, Zone 1 and Zone 2
d) dusty
e) wet

3.12 Ingress protection IP65

3.13 Ambient atmospheric pressure 86 to 106 kPa

3.14 Measured medium density 0.3 to 4 $kg.dm^{-3}$

3.15 Working pressure at the measuring point (SST model) max. 2.2 MPa

If the float has not been designed for this pressure, it is necessary to place it outside the tank during the tests.

3.16 Temperature at the measuring point - 50 C° to + 120 C°

special model -150 C° to + 350 C°

3.17 The working position is perpendicular to the head in the upper position

3.18 For special models, the working position is perpendicular to the head in the lower position.

4. Specification

4.1 Measurement range:

SST model max. 20,000 mm

Polypropylene model max. 5,000 mm

4.2 Scale range for local measurement 0-5 m, 0-10 m, 0-20 m

The scale range is also the basic range to determine the sensor error.

4.3 Special scales with various units (on request): liters, m^3... etc.

4.4 Measurement accuracy (local indication) + 0.2% within the range of 0 to 5 m
+ 0.1% within the range of 0 to 10 m
+ 0.05% within the range of 0 to 20 m

4.5 Insensitivity when the float moves upwards or downwards (change of level in one direction)
max. + 8 mm

4.6 Insensitivity after the float movement direction has been changed 4.61
Filling the tank max. 15 mm +
4.62D Draining the tank max. + 10 mm

Note Whenever the output signal is evaluated, these repeated inaccuracies may be compensated for in the control system.

5. Other data

5.1 Operating mode: permanent
5.2 Product data: technical and metrological data according to 5.31, 5.32
5.3 Instrument identification

5.31 Tag plate (located under the glass on the instrument scale):
(A) Manufacturer´s address
B) Instrument type LBA-XX.XX.XX
(C)Year of production e.g. 2002
D) Serial No. ....
E) Country of origin: Czech Republic

F) 5.32 Product plate (located on the rear cover or on the instrument side)
This plate includes the following additional information such as a wiring diagram, information on built-in components etc.:

Product Reference No. (see technical documentation): NKO1002 / LBA (operating instructions)
This marking is specified by the manufacturer depending on built-in components and the most unfavourable temperature conditions.

5.32 If the protective glass breaks, IP 65 is affected. IP 20 still remains with regard to internal electrical equipment. This defect must be fixed immediately !! In any case, it is necessary to clean and check the instrument and use a new front cover.

6. Storage, delivery and transport

6.1 Storage

The instrument may be stored at an ambient temperature of -20 ^{o}C to +40 ^{o}C and at an ambient humidity up to 75%.

6.2 Delivery
The instrument is delivered with the NKO1002 / L21/3-DIAL operating manual, supplements and other documents as agreed by the manufacturer and the customer.
6.3 Transportation and storage

L21/3 dial type| Emkometer s.r.o., Na Žižkově 1245, 58401 Ledeč n/S., Czech Republic
tel/fax: 569 721 622 | tel: 569 720 539, 569 721 549 | info@emkometer.cz

The instrument is delivered in a box, protecting it from mechanical and thermal damage.

Following the assembly and the final inspection, the float is dismounted from the guide rod/pin rod. The glands are tightened and sealed. Then, the magnetic follower is wrapped in a paper strip, inserted into the measuring head neck and tied to the head neck, the pin and the gasket with string. The lower part of the flange head is taped. The head is connected to the ground covers. The LBH250/175 or LBH310 /225 heads include an internal cover grounding and bolted head covers. The LBH170/160 head includes bolted covers only.

6.4 Recycling

All instrument materials may be disposed of in accordance with applicable laws and standards.
Electrical equipment should not be disposed of with mixed municipal waste but it shoud be stored in special places.

7. Installation/adjustment of mechanical parts, commissioning

7.1 Installation of the guide rod and the float

7.11 General principles

Before installing the instrument, recheck the place for the guide rod and the float. Place the guide rod where the flowing liquid cannot affect measurement accuracy. In the case of turbulent medium levels, we recommend covering this place with a metal sheet or creating a communicating vessel using a slip-on tube over the guide rod. The diameter of this tube has to be large enough not to hinder the free passage of the float.

7.12 Guide rod

Clean the guide rod before it is mounted. If the mounting head is not mounted immediately, cover the guide rod flange. The place above the DN50 PN16 flange or the screwed connection must allow for inserting the guide rod into the flange hole. The guide rod dimensions correspond to the drawings and technical data for local indications.

7.13 Float

After mounting the guide rod´s rotating flange to the connecting flange, slip a float on the guide rod (control welded-on piece is to face the head) and insert the lock pin into the tube hole. Lock the pin against falling out by snapping it in the groove. Make sure that the float passes freely along the entire guide rod. The float has to pass freely during all measurements and even turbulent levels or deflected rods must not hinder its free passage.
Dismount the float and the guide rod likewise. Before dismounting them, make sure that there is no pressure, dangerous fumes etc. in the tank.

7.2 Mounting/dismounting of the instrument head

7.21 Installation/adjustment of mechanical parts

The LBH head is packed in a plastic container. Attached to this head there is a seal and a pin to lock the guide rod. Before mounting the head, dismount the back or front cover. Dismount the seal ring and the follower lock. Pull up the follower and check the inner mechanical parts. Clean the guide tube inside throuthout and put a seal on the flange.

7.22 Mounting the follower in the tube

Put the head next to the flange and pull the follower carefully up. With one hand, release the wire to pass freely from the FS head. Do not jerk the follower and do not release the wire too much as the wire must no be looped.

Insert the follower slowly into the guide rod hole. Using the mounting spring, move the magnetic follower through the flange into the non-magnetic guide rod. After that, drop the follower by pulling the wire out of the LBH head while checking its free passage throughout the tube. Once the follower stops

at the top of the magnetic coupling, pull about 1 meter of the wire out of the head with one hand. Pull up the follower about 300 mm above the magnetic coupling with the other hand. Move your hand holding the follower quickly down so that the follower passes through the top magnetic field to the coupling center. Following this manipulation, there are be two possibilities. By releasing and pulling the cable, you can find out if the follower is fixed in the magnetic coupling. If the follower does not hang on the cable but it is fixed, the follower is placed in the correct working position. If the follower hangs on the wire after falling under the magnetic coupling, pull the follower up to the magnetic coupling center. Check the follower position by pulling upward at a force of about 0.15 kg (Ø 20 mm rod) or 0.45 kg (Ø 38 rod). If you cannot pull the follower, its installation has been made properly.

7.23 Dismounting the follower

When dismounting the FS head, pull the wire by force to release the follower from the magnetic coupling. The magnetic coupling holds the follower and the float by a magnetic coupling force (about 0.15 kg for a Ø 20 mm rod and 0.45 kg of a Ø 38 mm). In the case of a double magnetic coupling, this force is 1.6 times greater. After this inspection, move the follower throughout the guide rod, watching the instrument in operation. If the instrument or pointers jerk, dismantle and recheck the inside of the guide rod and the head. If there is no common defect such as impurities in the tube (head) or looped or stranded wires, contact the manufacturer.

7.24 Mounting the sensing head

Mount the head to the guide rod. Ensure easy access to the scale and to the electrical equipment. Set the instrument pointers. To set a zero position when the float is at the stop pin, loosen the screw and set the pointers as necessary. We recommend measuring the actual level. Increase the liquid level in the tank by about 500 mm and measure the actual liquid level using a measuring rod. Loosen the pointer screws and set the measured value decreased by about 4 mm on the scale using small and large pointers. By shifting the pointers, you can set the mean value, decreasing the actual measurement error. Tighten the pointer screws and fasten the front cover.

7.25 Error correction

The magnetic coupling counteracts the float in the liquid (friction between the rod and the follower and friction between the float and the rod), causing level measurement differences whenever the liquid level rises or drops. Depending on the the type of loat and medium, this difference may be up to +15 mm in the extreme positions when the movement direction is changed. After about 30 minutes (at the turbulent level sooner) or when the float starts moving in a certain direction, this error returns to the normal insensitivity limit (about + 8 mm). This limit is affected by the kind of measured liquid, ambient atmosphere etc.

Since this inaccuracy repeats regularly, the error may be assessed by comparing the data measured e. g. using a measuring rod and a specific float sensor. The measured insensivity of the instrument is directly proportional to the output signal of the level gauge. The error may be compensated using software or a compensation table.

8. Setting the electrical parts, service and repairs

In general:

Mount and adjust the electrical equipment depending on the type of instrument and rear board electronics. Use one or more terminal plates. Connect the grounding cable through the crimp eyelet to the rear plate (see the marking). Make connections according to the wiring table fixed to the instrument´s rear cover.

8.1 Setting the L21/3-DIAL-xx.xx.xx sensor (switches only)

When setting the microswitch contacts, proceed as follows:

- Dismount the head from the connecting flange and put it on its side next to the tube neck

- Pull the follower out of the magnetic coupling and insert the wire slowly into the instrument head.
- h1 (h2) - common minimum level, h4 (h3) - common maximum level

8.11 Adjusting the H1, H2, H3, H4 levels
- according to the pointer indicator, move down to the desired h2 level
- loosen two screws of the cam bracket and move the leading edge of the cam so that the S2 microswitch contact is closed.
- watch the moving cams while emptying the tank. Select the edge of the cam actuating the sensor and directing its leading edge to the microswitch roller in the down movement.
- after adjusting the cam, tighten the screws and check the setting by directing the leading edge to the roller again.
- adjust the h1 level in the same way

8.12 Setting the two-level switching (using a single cam switch, which consists of two panels). For each level, there is one cam (molded panel). For example, adjust the maximum level. Loosen the S4 microswitch cam and turn the leading edges of both the cams against each other. One of the leading edge will be used to switch the upper level. Tighten the cams lightly and adjust the minimum level. Loosen the screw, hold the adjusted cam and use the leading edge of the other cam to switch the lower level. Retighten both the cams. One switch can provide us with information on emergency conditions at the upper and lower levels etc.

8.13 Other cam applications

It is also possible to use the upper edges of the cams to measure liquid levels.

8.14 Adjustment check

After adjusting the instrument, pass the wire throughout the measurement range. Make sure that the contacts are closed at the level indicated by the pointers. Check the cams for switching. The other leading edge of the cam (e.g. S4) should not close the contact on the other side of the leading edge when reaching the h1 level. The other leading edge of the cam (e.g. S1) should not close the contact on the other side of the leading edge when reaching the h4 level.
Hysteresis adjustment - max. 2% of the range.

8.2 Setting the L21/3-DIAL-xx.xx.xx sensor (switches and el. output)

8.21 See paragraph 8.1 for switch settings

8.22 When setting the electrical output, proceed as follows:

Connect the instrument to the Aripotu board output. Connect the power supply. You may mount/dismount the head in the same way as when setting the contacts. Pull out the wire up to the actual lower level (the float is at the stop pin). Deduct this value on the scale. Stop the float movement in the extreme position. Set the screwdriver in the coupling groove. By turning the screwdriver, set the extreme stop position using the mechanical coupling (turn the tansmitter shaft). Set the electrical signal slowly so that it matches the lower level adjusted by the pointers. If the tank is full, assemble the sensor and turn the mechanical coupling to set the electrical signal of 0 (4) to 20 mA, 0 to 10V, 0-100 (1000) ohms. The converter board features the default value (e.g. 0 to 4,225 mm = 4 to 20 mA in the questionnaire). The el. output may be trimmed by ZERO/SPAN potentiometers.
Trim the sensor resistance output by the mechanical coupling only.
When checking the sensor setting, turn the mechanical coupling to match the actual values indicated by the pointers. Pass through the measurement range slowly, making shure that the signal level matches the value indicated by the pointers. Only in the case of a deviation in the upper position, set the output signal level by the transmitter potentiometer. Repeat this step in both extreme positions several times until the upper and lower signal levels are equal to the values indicated by the pointers.

8.3 Closing the instrument after the adjustment

Drop the follower back into the magnetic coupling and check its position. Check the flange gasket and mount the instrument back on the flange. Recheck the position of cables and tighten the glands. If non-standard glands are required, consult the manufacturer. Place the cover gasket and sealing rubber rings under the bolts and fasten the FS rear cover.

8.4 Service and Maintenance

8.41 Routine inspection and maintenance after about 1 year of operation

Make sure that the output signal values, pointer indications and actual values measured using e.g. a measuring rod are the same.

8.42 Basic maintenance after about 3 years of operation

Make sure that the output signal values, pointer indications and actual values measured using e.g. a measuring rod are the same.

Depending on the recommended time of operation and operating conditions, proceed as follows.

Unscrew the back cover and remove screws on the head neck. Put the instrument next to the tube and pull up the follower. By using the spring, dry and clean the guide tube. Recheck the mechanical parts on the instrument´s rear panel visually. If there are no rusty surfaces on the components, tighten the screws and check the terminal box. If necessary, replace the head gasket or rubber O-rings and tighten the cable gland. Drop the follower into the magnetic coupling and remount the instrument. If the components on the rear plate are rusty or the gasket has been damaged, execute a medium repair.

8.43 Medium repair after approx. 6 years of operation

The medium repair is executed by the manufacturer. The instrument is dismounted and all components are checked. The gear assembly is lubricated and the magnetic coupling, the spring, the wire and all the gaskets are replaced. If necessary, the same refers to the follower, the microswitch and the transmitter.

8.44 Instrument service life and maintenance (depending on the spring life)

Depending on the atmosphere in which the FS works (moisture, acid vapors, gasoline, sudden weather changes, machine vibrations, spring durability etc.), we recommend keeping the period of recommended basic maintenance. Under heavy-duty conditions, we recommend executing a medium repair at least once a year. If the instrument is used frequently, this period depends on the maximum spring life. For example, if the instrument is used with expansion tanks, replace the instrument spring before finishing about 15,000 cycles. When measuring in the tanks with frequent level changes, service the instrument and replace the wire and the spring regularly.

8.45 General repair and trim/range changes etc.

The general repair and trim/range changes (modular system) should be made by the manufacturer.

The float level gauges are assembled by the manufacturer or authorized assembly centers.

See the list of assembly centers provided by the manufacturer.

8.46 L21/3-DIAL-xx.xx.xx repairs are executed exclusively by the manufacturer.

Otherwise, the customer shall lose the warranty on the instrument and the manufacturer shall not be liable for its safe use.

8.5 Specifications are subject to change without prior notice.

8.6 The instrument is serviced and installed by the manufacturer or authorized companies. Contact the manufacturer for the list of assembly centers.

Mechanical part standard code

L21/3/.../.../.../.../... ev. L21/3/9000/EDN25PN16/N/NO/B
0. 1. 2. 3. 4. 5.

0. Range

1. Device connection, DN-PN flanges

E top connection, indicator on the side of the tank
F top connection, indicator on the top of the tank

2. Material used

N stainless steel AISI 316 L
PP polypropylene
other material on request

3. Application extent

NO normal
EX in explosion hazard areas
ZO contaminating, sedimenting and crystallizing liquids

5. Special features

A local indication by slider
B local indication by dial/rail

Dial indicator standard code

L21/3-DIAL- xx. x x x. x

- 01 – up to 5m
- 02 – up to 10m
- 03 – up to 20m
  - 0 – number of level switches
  - 2 – 2 level switches
  - 4 – 4 level switches
    - 0 – no microswitch
    - 1 – 1 microswitch
    - 3 – NO zone
    - 9 – Ex zone
      - 0 – no el. output
      - 1 – 4-20 mA, 2 wires
      - 2 – 4-20 mA, 4 wires
      - 3 – 0-10 V, 4 wires
      - 4 – 0-100R
      - 5 – 0-1000R
      - 9 – customized

Custom versions available upon request

10. Quality Warranty

10.1 The manufacturer´s warranty is valid for 24 months under the Commercial Code (§ 429 et seq.). Any defects caused by faulty materials or design during the warranty period shall be repaired free of charge. Send the instrument in the original or equivalent packaging to the manufacturer.
10.2 The warranty does not cover any damage caused by unauthorized interference with the instrument, failure to observe the technical and operational conditions specified by the manufacturer, mechanical damage and incorrect assembly procedures.

10.3 Specifications are subject to change without prior notice. Any changes shall be listed in the attached document.

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