Ekorex – Consult, spol. s r.o. **Company ID No.: 47451394**	**User's Manual** MAREG liquid level sensor	**NKO0802/ BVC Ex**
Na Lužci 657 **Lázně Bohdaneč**	**Type** BVC-XX.XX.XX Ex	

User's manual approved on behalf of the manufacturer:	Date, stamp, signature
Petr Kohoutek - Company Director	01/08/2002

This manual contains instructions, guidelines and pictures necessary for putting this device in operation and use, and for safe assembly, disassembly, maintenance, installation and adjustment.

This user's manual is supplied with each device.
Contents:

ANNEXES:

1. Functionality and use

1.1 Functionality

The Mareg "BVC" type level sensors consist of a head, pipe, and float. The pipe is hermetically sealed in order to make sure that the inner space is separated from the liquid. The float moves freely on the pipe. The inner space of the device is closed with a screw-on lid equipped with a rubber o-ring. Magnetic level sensors are placed inside the pipe (7,10, and 20 mm apart), and they gradually connect or disconnect resistors in line. Based on the level of the liquid the float moves on the pipe. The float uses magnetic field and sensor to indicate the liquid level. The input signal is processed with an electric current converter to current between 4 and 20 mA. Single float may be used for basic measurements. As a default, the stopper has been set by the manufacturer a split second behind the time when the relay switches on. Number of sensors, placement as well as the level of output signal may be selected in the device order form. On the device questionnaire form it is necessary to specify the location of individual measuring locations and the direction from which the float will calculate and control the liquid level.

1.2 Product use

The Mareg product types BVC Ex may be used for various measuring applications and step liquid level controlling procedures, offering up to four different levels. Based on the product type, you may use the device to control and measure liquids such as water, flammable liquids, acids, aggressive substances etc. High electric protection class (IP 65) allows the device to be used in harsh weather conditions. Based on a special agreement, the device may be fitted with a special sensor Pt100 and with a linear converter providing output between 4 and 20 mA.
You may use up to two stopper rings, two different floats (weight balanced) and also a combination of outputs "Open" - "Closed", which will allow you to use the device for other control and regulation processes. This combination may also be used to measure inter-levels. The manufacturer lends the float to a customer to test-measure the lower liquid level and based on the customer requirements the manufacturer produces a properly weight-balanced float, so it may be submerged and used to measure the lower liquid level. After this solution is applied, the user must take into account submerging of the float at the relevant interfacial tension line, changes in the density of the liquid, etc. The manufacturer may also produce a float which may be gradually weight balanced (weight adding) at the measuring location (nonmagnetic ferrous metal must be used to add the weight to the float). In such scenario, the customer is for responsible for properties of such product (the manufacturer cannot affect changes in physical properties of the liquid - temperature changes, interfacial liquid tension, density and viscosity changes etc.). In this case, the user must understand that it is only possible to measure in segments of the whole measuring interval, i.e. in segments between specific levels and the top regulated level. Two separate devices that measure the lower level / upper measured level regulation, and lower level regulation and continuous upper level measuring, etc.
The sleeve, guiding pipe and float contain mechanical components only and may be placed in zone 0.
If required, you may use a model with a separate guiding/measuring pipe, which may be installed in the reservoir. The result evaluation head with terminals may be placed at a separate location, where the operating personnel may inspect the level of the liquid and control the activity of the device, etc. (cable is used to connect both parts).

The device may also be placed at the bottom section of the reservoir (measuring head facing downwards), and you may use auxiliary pipes for the measurement (the so-called "continuous container") and place the head of the device closer to the operator, offering better connection options and control of the technological process. You may use sleeve extension to bring the head out of the dip or out of the zone classified as explosion hazard. The lower section of the device may measure in environments classified as zone 0 and the head of the device with electronics and with intrinsic safety system may be used to measure in zone 1(2).

Thanks to the high protection level, the sensors are resistant to environmental changes in terms of humidity and are still able to perform measurements with high accuracy. Sensors do not remember statuses. When the float moves to a different level, the sensor goes back to its original mode. If you use a combined regulation device with limited components control, keep in mind that sensors are very sensitive and are able to measurable levels with high precision and repeatability. After the probe of the reed relay switches on - when the float moves away from the previously measured liquid level, the probe is (due to the influence of magnetic field interruption) at least 50 mm away from its original position (based on the float type). Similarly, when the probe moves downwards, it is approximately (again due to the influence of magnetic field) 20 mm away from the previous level (based on the floor type). Therefore, it is necessary to account for this type of hysteresis during installation of sensors as well as during the actual measurement process.

2. Description

The sensor is fitted with the following basic components:
Each device is equipped with a head, float and measuring pipe. Devices are fitted with a stainless steel guiding pipe / stem and a float. The head of the device is made of aluminium cast, which is attached with a stainless steel pipe. The pipe is sealed with a weld to make sure that the inner space is separated from the liquid. The float moves freely on the pipe. The inner space of the device is closed with a screw-on lid equipped with a rubber o-ring. The pipe is fitted with magnetic limit sensors. The float moves freely along the pipe - based on the level of the liquid, and uses magnetic field to indicate the level of the liquid.

2.1 Head of the device

The head is made of cast aluminium. Contacts and terminals are interconnected inside the head. Terminals allow you to make different type of connections. The device may be connected as switching terminal against common coupling or you may select four independent terminal connection method.
The head is usually available in two basic sizes/models. BVH080060 and BVH100135. The BVH100135 head is a robust cast piece with a screw-on lid. The head complies with IP 66 protection class and the BVH080060 head is fitted with a standard lid (aluminium cast piece with a rubber seal and lid) and complies with protection class IP 65.
The device is also fitted with an electrical current converter providing output between 4 and 20 mA, used to measure proportional output from the resistor line. In order to provide output and control of limit levels you may also use outputs provided by the converter - the step / incremental output, also measured in mA. The device may also be fitted with passive components such as the Pt 100 sensor, linear converter providing output for Pt100 or with other components based on customer requirements (special model/design).

2.2 Guiding pipe

The guiding pipe is made of stainless steel. The guiding pipe (commonly referred to as "guiding rod") is closed at the bottom and separates the inner part of the device from the liquid. The pipe may also be used in pressurized vessels up to 1.6 MPa. Maximum length of a stainless steel pipe is 5,000 mm. Up to the length of 5,000 mm, the pipe outer diameter is usually 20 mm. Based on the filling method, or if you have to deal with turbulent fluid level, we recommend using a pipe starting at 3,000 mm in length. The guiding rod may also be fitted with a collar only (low-height type - cannot be used in pressurised vessels).
A rod attached with probes is inserted inside the pipe. During adjustments or inspection you may remove the rod with probes from the pipe. To do so loosen the M3 screw. Probes in the resistance decade /line are fixed. After loosening the screw, combined components used for limit switching may be moved along the rod up to 50 mm downwards and about 100 mm upwards.

2.3 Sleeve

It is a connection member fitted with a threading or collar and rotating flange. The flange allows the guiding pipe to be attached to the bottleneck of the reservoir, and at the same time, it allows the device to be turned to suitable position for installation. The flange may be type DN50 PN16 according to ČSN 13 11 60. For pressurized reservoirs you may use sleeve DN50 PN40 with a collar fitted with a tongue and groove. The size of the collar is usually 120 mm.

2.32 In certain cases we may also offer sleeves up to maximum of 3,000 mm (allowing the sleeve to be submerged in liquid, low-set reservoir, head placement in a separate room with lower explosion hazard, high temperature in the reservoir, etc.). Special design is done after agreement with the manufacturer (equipment, float, etc.).

Clamping, welded thread fitting and assembled flange is designed to be attached to the lid of the reservoir and it is included in the delivery - based on agreement with the customer. Clamping thread fitting allows the pipe to move freely along its entire length and to turn the head of the device as required. Clamping flange is not suitable for pressurized vessels. Rubber o-ring is placed between the pipe and the inner wall of the clamping fitting to provide seal and to prevent vapours from escaping.

2.4 Float

2.41 The manufacturer offers different types of floats for different liquid densities. Floats types BLP094110 and BLP083097 are used for pipe diameters between 20 mm and 5,000 mm. Special float types BLP094210 and BLP083210/S01 (xx) are used for measuring viscous liquids and liquid gases. The first three numbers in the label code represent the diameter of the float, and the following numbers represent the height of the float and the float pipe. If agreed with the customer, the device may also be used to regulate inter-levels or highly viscous liquids, provided that different floating device is used.
2.42 Up to two floats and two stopper rings may be used for measurements. As a default, the stopper has been set by the manufacturer a split second behind the time when the relay switches on.
2.43 Specially designed devices may be used to measure high density and high viscosity liquids. These types of devices are fitted with fixed floating device. The float is attached to a moving arm and does not move along the guiding rod. Device fitted with a float attached to a moving arm may be installed in various positions - on its side, at the bottom, or it may be used for top measurements. Another special model with a fixed pipe may also be used to measure viscous liquids. Both types offer option to remove extension pieces. Sediments deposited by viscous liquids may be easily removed from the extension piece, or the entire extension may be replaced. In this case, the limited measured liquid level "Mh" is limited to the maximum length of 500 mm. Other situations may be addressed after an agreement with manufacturer.

3. Operational conditions

3.1 Operational conditions
3.11 The design of the device provides safe use and operation in environments specified in ČSN EN 3303 00 :
a) Cold environments
b) Hot environments
c) zone 0 (pipe and float) zone 1, zone 2 /for certain device types - connection head/
e) dusty environments
f) wet environments

3.12 Protection (based on type)	IP65 /IP66
3.13 Atmospheric pressure around the device head	86 to 106 kPa
3.14 Measured liquid/media:	Density 0.55 to 4 (xx) kg.m^{-3}
3.15 Operating overpressure at the measuring point	
-Stainless steel version	maximum 1.6 MPa
-Testing overpressure	max. 2.2 MPa

If the float is not designed for this type of pressure, it is necessary to place it outside of the reservoir during testing

3.16 Ambient temperature	
The measured medium temperature	-30 ^{o}C to +100 ^{o}C
Temperature at the measuring location	T4
Designed to be used in explosive environments	
3.17 Working position	horizontal
3.18 Special design – working position	is perpendicular to the head in bottom position
3.19 Type of operation	permanent

4. Technical specifications

4.1 Measuring range - stainless steel design	max. 5,000 mm
4.2 Insensibility	+ 8 mm
4.3 Power supply	12-28V /DC (4 to 20 mA)
Maximum switching voltage (combined device, each terminal)	max. 40 V AC/DC/100 mA
4.4 Basic error	± 2 mm
4.5 Additional errors	0.02 % /1°C
4.6 Insulation resistance	10^{10} Ohms
4.7 Switching speed	0.2 ms
b) Life Expectancy	
5 V DC, 10 mA	5 x 10^{7}
10 V DC, 100 mA	10^{7}
50 V AC	5 x 10^{7}

Note: – when evaluating output signal, repeated inaccuracies may be compensated for by the control system.

5. Other information

5.1 Type of operation	permanent
5.3 Device label	

5.31 Manufacturer label (located on the cast head):
a) manufacturer identification, including address

b) Device type BVC-XX.XX.XX Ex
c) year of manufacture for example 2002
d) serial number Serial No. ……..
e) manufacturer specifications – country of origin – Made in Czech republic
c) General label (located on the rear lid or on the machine side):
a) manufacturer reference number Technical documentation file No. - NKO0802/ BVC Ex (valid User's manual)
d) Label necessary due to safety reasons Temperature range - T4
e) The general label may feature other necessary information - for example, a wiring diagram, information about built-in components, etc.

General label usually contains the following basic information:

5.4 Basic requirements for the use in explosive environments:

5.41 Basic evaluation of explosion hazard based on risk analysis applicable to level limit switch, type BVC –XX.XX.XX – Ex:

5.42 Aluminium alloy used to manufacture the head and lid does not contain more than 7,5 % of magnesium. Based on the type, the head and lids comply with safety class IP 65 and IP66.

5.43 The head of the sensor may be placed in zone 1 (maximum allowed zone), only if all outside intrinsic-safe wirings guarantee safe operation and comply with category 1 and 2, and are designed for zone 0 or 1. If any built-in component is fitted with an outside intrinsic safety device complying with category 3 and designed for zone 2, the head of the sensor must be placed (at the most) in zone 2.

5.44 The sleeve, guiding pipe and float contain mechanical components only and may be placed in zone 0.

5.45 The float is made of stainless steel and moves freely along the stainless steel pipe. The speed of the float movement depends on the level of the liquid. Frictional temperature may be safely ignored. If the float gets stuck in its upper position and then suddenly released, it hits a stopper ring or stainless steel pin. Therefore, only contact between two stainless steel materials occurs. The same may apply if one pipe is used for several floats. As required by ČSN EN 13463-1 and by additional technical documentation, suitable intrinsic-safe materials have been used during the manufacture of this device.

5.46 Static electricity discharge - all metal parts are connected together and anchored to an outside grounding terminal.

5.47 If converter Pt 100 type R - xx.xx. EExi, is used, it must be approved and equipped with ES Certificate type No. FTZÚ 02 ATEX 0227X, specifying non-explosive hazard level Ex II 1G EEx ia IIB T4. If converter Pt 100 type R - xx.xxis. EExi, is used, it must be approved and equipped with ES Certificate type No. FTZÚ 02 ATEX 0227X, specifying non-explosive hazard level Ex II 1G EEx ia IIB T4.

5.48 Additional electrical component must only be regarded as contact components or tongue welds, controlled with resistors or with magnets inside the float. These elements are insulated against metal parts of the sensor and are resistant to 500 V/50 Hz test voltage. These specified devices are regarded as so-called "simple apparatuses" pursuant to item 5.4 of ČSN EN 50 020 standard issued in October 1996.

According to par. 5.4. of ČSN EN 50 020, a passive element is an element, which is not able to generate or accumulate electric energy exceeding 1.5 V, 0.1 A, or 25 mW. It may be regarded a simple apparatus, which may be connected to intrinsic safe circuit, provided that the circuit is not fed with energy exceeding the specified limiting values. Due to this reason the intrinsic safety of the entire loop will not be affected.

The necessary requirements for safe use of simple apparatus is installation of intrinsic safe circuitry fitted with Zener barrier or with a separation converter with approved ES certificate. According to ČSN EN 50 020 the intrinsic safety of a circuitry is classified according to the used separator, which means that usually EEx ib is used for Zener barrier, and EEx ia for separation converter. Based on the above specified standard, thermal classification is T4, or possibly T6 for devices containing only contact/terminal components.

5.49 Overall evaluation of the device:

5.49.1 In terms of electric potential, the device does not have its own and effective ignition source.

5.49.2 In terms of mechanical design, the device does not have its own and effective ignition source.

6. Storage, delivery and shipping

6.1 Storage
The device may be stored in temperature range from -20 °C to +40 °C, with maximum relative humidity of the surrounding air 75 %.
6.2 Delivery
The device is delivered with the following documentation: NKO0802 / BLC Ex User's manual including applicable annexes or with additional documentation if agreed between the manufacturer and customer.
6.3 Transport and storage
Products are delivered in packaging which provides sufficient stability and protection against mechanical and temperature variations.
The device is shipped as follows:

After assembly and final inspection, the float is attached to the guiding pipe.
The device is shipped in a packaging unit fitted with a label specifying the manufacturer and the customer.

6.4 Recycling
Each device may be separated based on individual material types and as required by Waste management regulations SM - 15 and therefore, it can be safely stored or disposed of.

7. Installation / disassembly, mechanical adjustments and startup

7.1. Assembly, startup, operation and use, service

Installation of limiting devices is done by the manufacturer or by other companies authorized by the manufacturer to do so. Due to the simplicity of the device, other professional companies may also perform the installation.

7.2 In general, the device does not require any operations or maintenance. However, the manufacturer recommends to perform inspection of the device and its configuration settings after 2 or 5 years of operation. This shall depend on operational conditions - aggressive environment, vibration etc.. The device is not equipped with its own fuse or switch.

7.3 Repairs are done by the manufacturer. The device is removed and subjected to applicable inspection and setting.

7.4 The manufacturer reserves its right to change technical parameters at any time.

7.5 Service and installation is done by the manufacturer or by a company authorized by the manufacturer to do so. The list of servicing companies as well as installation or maintenance could be agreed directly at the company headquarters.

8. Electrical adjustments, service and repairs

1.1 Installation and adjustment of electrical components is rather simple, and it is done by the manufacturer or by other companies authorized by the manufacturer to do so. Due to the simplicity of the device, other professional companies may also perform the installation. The switching level has been preconfigured based on parameters specified in the order form.

1.2 The manufacturer reserves its right to change technical parameters at any time

1.3 Service and installation is done by the manufacturer or by a company authorized by the manufacturer to do so. The list of servicing companies as well as installation or maintenance could be agreed directly at the company headquarters.

1.31 Regular inspection and maintenance (approximately after one year of operation)
In general, we inspect whether the readout on the visual display, the output signal and measured values match (for example, measured by the measuring pipe).

8.42 Basic maintenance (approximately after 5 years of operation)

We inspect whether the status of the measured medium and the output signal matches values measured by the measuring pipe. Based on the recommended service life and based on conditions where the device operates, we select the proper maintenance.

8.43 Midterm device repair (approximately after 7 years of operation)

Midterm repairs are completed by the manufacturer. The device is removed and all components are inspected. Screws and screw couplings are lubricated, switches are replaced, seals and transmitting device are inspected. All seals are replaced.

8.44 Service life and maintenance (based on individual needs and spring service life)

Based on the environment where the device operates (humidity, acid vapours, gases, sudden weather changes, or changes in the surrounding environment, vibrations, spring life service, etc.), we will recommend the basic maintenance interval. If the device is used in harsh environment, with recommend at least one midterm service per year (applies to the above specified environments). If the device is used very often, the maintenance interval is based on the maximum life expectancy of relevant switches.

8.45 Complete repair/rebuild and device component update, etc.

We recommend complete repair / rebuild and update of device components (possible thanks to modular design of the device) completed at the manufacturer's facility since the operation could be completed during one day and the device delivered back to the customer (depending on the status of the device and on the scope of its repair).

8.46 Installation of the device is done by the manufacturer or by other companies authorized by the manufacturer to do so. Repairs are done exclusively by the manufacturer.

Should the customer attempt repairs, he may lose warranty and the manufacturer will not guarantee save operation.

8.5 The manufacturer reserves its right to change technical parameters at any time

8.6 Service and installation is done by the manufacturer or by a company authorized by the manufacturer to do so. The list of servicing companies as well as installation or maintenance could be agreed directly at the company headquarters.

9. Table of available models of liquid level sensor BVC-XX.XX.XX Ex

See Appendix NKO0802/BVC Ex /4

10. Quality warranty

9.1 The manufacturer guarantees the device for 12 months, as required by the Commercial Code (Par. 429 et seq.). Defects occurred during the warranty period due to clearly defective material or workmanship will be repaired for free, provided that the device is sent back to the manufacturer in its original or suitable packaging. If the repair is done at the customer facility, the manufacturer will charge for the travel cost and repair time according to valid price list of the manufacturer.

9.2 The warranty does not cover defects caused by unauthorized tempering with the device, by failure to comply with the technical and operational requirements specified by the manufacturer, by forced mechanical damage and incorrect installation procedures. Further, the warranty does not cover defects due to incorrect installation process done by unauthorized installation company.

9.3 The manufacturer reserves its right to change the product design or to make changes in the product documentation. Any modifications will be attached in a form of an Annex to the applicable product documentation.

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