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1 Subject of specification

This specification used in conjunction with other technical specifications of LOTOS Group S.A. establishes the minimum requirements for the design, manufacture of level instruments

2 Scope of validity

This specification applies to the preparation of tender documents, inquiries and contracts concerning new investments and modernization projects planned by LOTOS Group S.A.

It shall also be a basis for preparing both detailed specifications and inquiries for individual or package unit supplies.

2.1 Deviations

Any deviation from this specification and the relevant specifications, standards and related documents including proposals, which the bidder claims to be economically and / or technically superior solutions, must be submitted in writing for review and approval by Grupa LOTOS SA. Non-approved exceptions are not acceptable by Grupa Lotos S.A.

The supplier must report in writing any ambiguity in this or any other specifications of Grupa LOTOS SA or non-compliance with the referred documents / standards and obtain a written explanation from Grupa Lotos SA.

3 Hierarchy of documents

In case of conflicts existing between this specification and other documents, the following order of precedence shall govern:

- The current Polish legislation
- Terms of purchase order / contract and other requirements agreed in writing with GLSA
- Data Sheets approved by GLSA
- This specification
- Other Specifications
- Drawings and other documents
- Standards

4 Definitions and designations

GLSA - Grupa LOTOS S.A.

GUM - Główny Urząd Miar (Polish authority for measurements)

DCS - Distributed Computer Control System

PLC - Programmable Logic Controller

ESD - Emergency Shut Down System

URL - Upper Range Limit

HTG - Hydrostatic Tank Gauging. Hydrostatic method of level measurement in tanks, employing several pressure transmitters and temperature transmitters

RTG - Radar Tank Gauging, radar method of accurate level measurement in tanks

Float - measuring element floating on surface of liquid

Displacer - displacing element, buoyancy pressure acting on displacer changes accordingly to depth of its immersion

5 Description

All specific features of given measurement type, scope of application and limitations apply to solutions that are most frequently used in industry. In each case, and particularly in relation to conditions of an instrument usage, detailed arrangements with manufacturer or supplier are deciding. One should also follow requirements of plant licensor if they are stronger than requirements of this specification, or condition of guarantee. Licensor requirements differing from this specification shall be approved by GLSA.

All component equipment of level measurement must be suitable to continuous work in ambient conditions present on location site.

Instruments mounted on pipelines and devices must be made according to PED European Union Directive N° 97/23/EC, Pressure Equipment.

In course of measurement method selection, one should give priority to instrument types and methods of their assembly that exclude production down time in cases of measuring instrument maintenance or servicing.

Local instruments must be accessible from ground level, from platform, or fixed ladder in special cases, for service of instruments that are very seldom operated. Connections of assembly pipe (standpipe) and instruments have to be made directly to vessel, connecting to piping is not allowed. Free liquid run-off to instrument shall be ensured.

Taking into consideration possibility of calibrating, remote level measurements shall be associated with local measurements – by means of magnetic level gauge or glass level gauge. This requirement can be omitted in case of underground tanks. It shall be foreseen, level instruments can subject to legalization

Diaphragm separators shall be used in case of aggressive media or high viscosity. In case of using separators; mechanical distance shall be foreseen on tap connections. The reason is protection against high medium temperature.

The applied medium in capillaries not only has to meet a requirement of medium temperature but also the requirement of the min. environmental temperature -25°C.

Gold membranes shall be used for hydrogen or gasses and liquids containing hydrogen.

Other installation requirements are defined in specification GLSA 3020.

5.1 Local measurements

5.1.1 Application

- In cases required by Standard, for example for boilers. Indication to control room shall be transferred by using TV/camera.
- Main measurements for auxiliary vessels, where installing of remote measurements is purposeless
- Auxiliary measurements, in addition to remote measurements employed. Measuring range of local instruments must enclose measuring range of remote measurement, in order to enable its calibration or activities related to legalization.

5.1.2 Gauge glasses

Applicable in cases when use of magnetic level indicators is impossible and/or is specifically required by standard applicable to vessel under consideration.

Depending on liquid transparency, reflective or transparent level indicators shall be used. Separate lighting of level indicators shall be provided.

Construction: chamber made of solid material and forged cover made of glass resistant to temperature changes. Asbestos-free gaskets made of material adequate to design pressure and design temperature. Use of gaskets made of graphite, filled with graphite or made of mica is preferred. Connections furnished with ball valves, quick-closing, which are activated in case of leakage on glass except for crystallising liquids or that of very high viscosity.

Disadvantage of glass level indicators is discrete change of nozzles distance, due to adding subsequent segments.

The length of the one segment shall be not longer than 3 m.

5.1.3 Magnetic level gauges

5.1.4 This is level gauge type that is preferred for GLSA units.

Application:

- in places, where use of glass level indicators is not recommended because of toxicity or other hazardous media features,
- in places, where cracking of glass can result in fire or explosion hazard
- in places, where media properties render readout on glass level indicator difficult
- in cases where measuring range exceeds capacity of level glass gauge

Limitations of use:

- when use of glass level indicator is required by standard
- if liquid properties or parameters do not allow for application of magnetic level indicators.
- The length of the one segment shall be not longer than 3 m.

5.1.5 Mechanical float level indicators

Application

Level measurement in tanks that are inaccessible from side or bottom, for example, underground ones or embedded in excavations

Construction: ball or cylindrical type float, moving on guide pipe. Magnetic transmission of movement to guide pipe interior. Flanged assembly of instrument on nozzle on vessel top. Indications on dial.

Level measurement in storage or buffer tanks

Construction: a float installed inside guide pipe mounted outside the tank. Movement of float travelling with surface of liquid is transferred by rope through gear mounted on top of the tank, to indicator fitted at side of the tank on 1.5 m height. Float travel transferring rope is installed in protecting pipe.

5.2 Displacer type measurement

GLSA prefers use of measurements with external displacer chamber. Requirements for construction of stand pipe described in specification GLSA 2020 of piping discipline – Attachment No: 24.

5.2.1 Application

- For level and level interface measurements in range up to 1830 mm, for liquid of low viscosity and not containing large suspended solids
- Displacer installed inside tank shall be used when displacer temperature must be equal to fluid temperature. In case of high sensitivity requirement and for phase interface measurement for liquids of small density difference, however the design shall allow access to displacer without shutdown of process. This solution can be applied in case, where it is not possible to use transmitter with external chamber and after GLSA approval.
- Displacer shall be installed vertically, and its centre shall correspond to normal liquid level. Measuring range corresponds to displacer length. Guide pipe use is required.
- The displacer suspension elements shall be expanded to decrease temperature on the transmitter wherever the liquid temperature exceeds 200°C

5.2.2 Construction

- Displacer made of 316 SS steel, torque tube made of 316 SS steel or Inconel, unless materials offered by manufacturer are better in particular application.
- External displacer chamber and guard of torque tube housing made of steel corresponding to material class of vessel.
- Connections of displacer chamber: 2", connection class as per vessel class. For instruments installed on standpipe, type and size of connections shall be used as per specifications GLSA 3020 and 2020 shall is used. Flanged connections positioned horizontally (side-side) are preferred.
- For construction with displacer located inside vessel, the displacer has to be mounted in guide pipe with protection against displacer falling to the bottom of vessel.
- Flanged connections from the top of tank: 4"; connection class as per vessel class.
- Vent and drain connections: ¾" NPT.
- Material certificate 3.1 according to PN-EN 10204 for displacer chamber.
- Certificate of pressure test. Test pressure 1.5 of design pressure.

5.2.3 Transmitter

- Transmitter mounted in a rotary head. In case of high fluid temperature, adequate extension of displacer suspension shall be used that allows for decreasing of transmitter temperature.
- Output signal 4-20 mA + additional digital HART. Two-wire transmitter
- Total accuracy: better than 0.5%.
- For explosion hazardous area, intrinsically safe design shall be used as the basic protection. Certificate according to ATEX.
- Class of protection against dust and water – minimum IP65.
- Transmitters have to be furnished with local LCD indicators, integral with transmitter or mounted remotely. Range of indications 0-100%.

5.3 Level measurements with use of pressure differential method

GLSA prefers application of capillary type diaphragm seal transmitters.

5.3.1 Application:

- For level and level interface measurements in arbitrary measuring range and ranges exceeding those for displacer type. This type may be used for pressurized vessels as well as for open tanks.
- Limitation of use is large change of fluid density. Solutions providing density changes correction are discussed in point dealing with measurements on storage tanks.

5.3.2 Connection types

- ½" NPT connections. Applied for clean liquids of low viscosity, which do not contain suspended matters, not crystallizing.
- Connections with diaphragm seals. In case of fluid that are crystallising after being chilled, extended diaphragm shall be used; for remaining cases flushed diaphragm shall be used. For open tanks, transmitter mounted directly to connection, if this is admissible considering fluid temperature. For remaining cases separators with capillary tubes shall be used. Diaphragm and seal liquid selection according to fluid type and its temperature.
  For diaphragm seals, flushing rings can be employed for application, where they are required and after GLSA approval. In addition, capillaries shall be protected with shield (peshel type). For details of connection refer to specification GLSA 3020.

  Supplier shall provide material certificate 3.1 according to PN-EN 10204 for diaphragm seals and flushing rings.

5.3.3 Transmitter

- Output signal 4-20 mA + additional digital HART or DE signal. Two-wire transmitter
- Total accuracy: better than 0.5%.
- For explosion hazardous area, intrinsically safe design shall be used as the basic protection. Certificate according to ATEX.
- Class of protection against dust and water – minimum IP65.
- Transmitters have to be equipped with local LCD indicators, integral with transmitter or mounted remotely in exceptional cases. Range of indications 0-100%.

5.4 Capacitance type measurement

Note: in this point continuous measurements are discussed.

Use: applications where DP or displacer type measurement cannot be used, for example in case of highly viscous liquids, liquids contaminated with solids.

Limitations of use: variable dielectric constant or conductivity of process fluid

Specification:

- Electrode coated with material that is resistant to action and deposition of process fluid.
- Additional bottom side fastening in case of long electrodes, according to manufacturer standard.
- Replaceable sensor cartridge (preamplifier) in a sensor head. Preamplifier supply in signal line. 4-wire design that requires separate power supply is not allowed.
- Intrinsically safe signal connection from preamplifier to signal conditioning module (secondary element) with ATEX certificate.
- Signal conditioning module installed in control room: output signal 4-20 mA. Installation in standard 19" rack.
- Total accuracy: 2% of measured range.

- Class of protection against dust and water for head with preamplifier – IP65 as minimum.
- Connection of probe 2", class corresponding to that of tank.

5.5 Float type measurements

Simple float type measurements are mainly used as local measurements. Such instruments can be additionally equipped with transmitter for remote indications, if required.

High quality float type measurements are mainly used for level measurements in large tanks. Construction is based on mechanical solutions, which require careful maintenance and are of relatively short service life. Application according to process requirements.

5.6 Radar measurements

Measurements with sender / receiver that do not contact with liquid are used, as well as guided wave measurements. Application for level and level interface measurement is possible. Application of instruments with guide antenna is preferred, because of lower signal transmission suppression. In each case guide pipe shall be used.

Radar measurements of high accuracy class for storage tanks are described in chapter 4.8.

Application:

- for underground tanks
- in cases of variable density of liquid
- in cases where properties of liquid make displacer or pressure differential measurement impossible.
- version of high accuracy are used for measurements in storage tanks, refer to chapter 4.8

Limitations of use:

- foaming or highly wavy surface, for example in case of mixer application; in such circumstances instruments with leading antenna shall be used, and/or external standpipes,
- vapours of variable density in pressurized vessels

Specification:

- Antenna type adequate to specific application
- Wave-guide instruments coated with material resistant to corrosive action and deposition of process fluid,
- Bottom side fastening in case of long electrodes according to manufacturer standard and also vessels construction, process fluid taken into account.
- Output signal 4-20mA + HART, intrinsically safe with ATEX certificate
- Supply: 24V=, two-wire transmitter
- Total measuring accuracy: 2.5 mm
- Class of protection against dust and water for head with transmitter – IP65 as minimum.
- Connection of probe 2", class corresponding to that of tank.

5.7 Level switches

Application

- When use of continuous measurement is purposeless, or when independent signalling of level limits is required besides continuous measurement.
- For starting and stopping of pumps cooperating with tanks
- Emergency Shut Down System (ESD): float or displacer type indicators with external chamber shall be used
- Alarm: it is allowed to use all types of switches, providing that they are properly selected for fluid type and process conditions, as well as providing that they are installed in such a way, so as plant shutdown for maintenance or servicing purposes is not required.

5.7.1 Level Switches of float or displacer type

Process connection:

Switch with external chamber: nozzles 2", spacing 356 mm, and connection class as per vessel class; in case of assembling on standpipe, 1" connections shall be used. Trip point shall be in the middle of nozzles distance, unless detail specification defines otherwise. Hysteresis shall be according to detail specification. Drain and vent connections: ¾" NPT.

Material: External chamber: according to material class of tank. Float or displacer: 316 SS, unless materials offered by manufacturer are better for specified fluid. Material certificate 3.1 according to PN-EN 10204 shall be provided.

Output signal: intrinsically safe proximity sensor or SPDT gold plated contact. Signal of proximity sensor must conform to EN 60947-5-6 (DIN 19234), suitable to connecting directly to DCS or PLC input.

Protection class: at least IP65

5.7.2 Vibration level switches

Vibration level switches can be connected at side or top of a vessel, providing that their maintenance or service will not require process unit shutdown. Immersion length shall be selected to assure alarm trip point specified (vertical assembly), or to suit nozzle length (horizontal assembly, particularly important on horizontal cylindrical vessel).

Process connection: 2" flanged connection class according to vessel class.

Construction: suitable to length of nozzle and its location.

Output signal: intrinsically safe, conforming to EN 60947-5-6 (DIN 19234), for connecting directly to DCS or PLC input.

Protection class: at least IP65.

5.7.3 Capacitance type switches

Capacitance switches can be connected at side or top of a vessel, providing that maintenance or service will not require process shutdown. Immersion length shall be selected correspondingly to point of level signalling (vertical assembly), or to nozzle length (horizontal assembly, particularly important on cylindrical jacket of tank).

Process connection: 2", connection class according to vessel class.

Construction: suitable to length of nozzle and its location.

Output signal: intrinsically safe, conforming to EN 60947-5-6 (DIN 19234), for connection to signal module conditioner located in control room. Signal module conditioner output: SPDT contact.

Protection class: at least IP65.

5.7.4 Radar switches

Application:

- for underground tanks
- in cases of variable liquid density

Limitations of use:

- foaming or highly wavy surface, for example in case of mixer application; in such conditions guided wave instruments shall be used, and/or external standpipes,
- vapours of variable density in pressurized vessels

Specification:

- Antenna type adequate to specific application
- Wave-guide of instruments coated with material resistant to corrosive action and deposition of process fluid,
- Output signal: intrinsically safe, conforming to EN 60947-5-6 (DIN 19234), for connecting directly to DCS or PLC input.
- Class of protection against dust and water for a head with transmitter – at least IP65.
- Connection of probe 2", connection class as per vessel class
- Protection class: at least IP65

5.7.5 Nuclear switches

Refer to point 4.9

5.8 Level measurements in buffer and storage tanks

One of the important features is a large volume of liquid contained in tank and wide ranges of level measurement, which requires high accuracy of measurement for more precise volume determination; in case of tanks for custody transfer, measuring error must not exceed 1 mm. In case of buffer tanks, where precise knowledge of volume is not necessary, previously described methods of level measurement can be employed, but with less accuracy class. When high accuracy of volume and/or mass measurement is required, then specialized measuring systems for single tanks and tank farms must be employed.

Level transmitters used in buffer and storage tanks shall have certificate of EC type approval.

Measuring system shall also provide measurement of water level that accumulates at bottom of the tank.

Below given specification regards solely measurements dedicated for tanks.

5.8.1 RTG – Radar Tank Gauging

Fixed roof tanks

As far as it is possible, protective pipe shall be always used. Transmitters can be mounted without a separate still pipe, provided that, wave beam can be so adjusted, that it is uninterrupted by structural, internal parts of a tank. The wave beam shall be directed strictly vertically. Manufacturer shall specify

allowable vertical deflection of beam, necessary to avoid tank wall interference. Such deflection must be taken into account during instrument calibration.

Floating roof tanks

Transmitter must be mounted in still pipe of 150 to 300 mm in preferred diameter. The diameter is specified by manufacturer and must incorporate application and regulations related to fiscal metering of liquid (excise tax, GUM approval, etc).

Spherical tanks

Measurement shall be installed in guide pipe of standard diameter 150 mm. Final diameter is specified by designer, who must incorporate recommendation of instrument manufacturer for used application.

Special requirements

- In case of pressurized vessels, instrument must automatically take into account change of vapours density.
- Gauging hatch as reference points for instrument calibration must be mounted inside the tank. Level of studs must be determined with accuracy <0.5mm.
- Measuring system shall include measurement of average liquid temperature, consisting of several vertically arranged sensors. Number of sensors depends on height of specific tank; standard of measuring system manufacturer shall be employed. Number of sensors cannot be fewer than 2 and spacing 3m, unless dimensions of vessel determinate less spacing.
- If measuring system works in explosion hazardous area, it must be in Ex execution, defined in detailed specification. Intrinsically safe design is preferred, certificate according to ATEX.
- Accuracy. Total accuracy of measurement shall be better than ±1mm. Measuring system must have certificate of independent body, NMI or PTB for example.
- Local indicator is required, which is installed next to the tank, on 1.5 m height.
- In case when level measurement is used for custody transfer, tank volume calibration must be completed according to valid regulations. Also, measuring system must be approved by GUM.

5.8.2 HTG – Hydrostatic Tank Gauging

This method is not recommended for use in GLSA, and its application always requires GLSA approval.

HTG is used when product storage and transfer is executed on the basis of its mass. This is less accurate measurement as compared to radar transducer use.

HTG system is composed of several, high-class pressure and temperature transmitters, of accuracy at least ±0.02 of URL.

Location of transmitters

First pressure transmitter (P1) shall be installed on level corresponding to 0% of range, and at least 150 mm above drain nozzle. Second pressure transmitter (P2) shall be installed at least 3 m above the first transmitter. Third transducer (P3) is used for pressure vessels. P1 and P2 transmitter, as well as temperature transmitter shall be installed along the same vertical line.

HTG transmitter receives signals from pressure transmitter and temperature transmitter, and then on the basis of standard computational formulas, recalculates them on mass, density, volume and level of liquid. Execution of recalculations is possible in DCS, if connecting of individual measurements to control room is purposeful. In such case HTG transmitter can be omitted.

5.8.3 Master computer and interface with DCS

The use of specialized master computer is necessary in case when several corrections in radar measurement of single tank are taken into account, as well as in case when single RTG or HTG measuring system covers several tanks.

Master computer executes all necessary calculations and provides data transfer to DCS or other computer system. In case of transferring to DCS, RS485 connection and Modbus protocol shall be employed. Details are to be agreed with DCS supplier.

Master computer constitutes integral part of system being certified by independent body, as NMI or PTB, as well as by GUM (Main Office of Measures) (in case of custody transfer system).

5.8.4 Independent alarm of minimum and maximum level

System of minimum and maximum level alarm that is independent from measuring system shall be used in tanks. Float switches are preferred. In case when such switches are the part of ESD loop, switches shall be with external chamber.

5.9 Nuclear type measurement

In a view of cost and potential hazard to operating staff, radiometric measurements, both continuous meter and level switches, are used in such cases when all other measuring methods fail, as well as in cases that require reducing number of nozzles – for example, in highly toxic media tanks. Level measurement is possible both for liquids and for solids. They employ effect of beam intensity reduction, resulting in radiation absorption by substance, which level is measured. It can be used only in reasonable cases.

Basic requirements:

- The instrument must conform to Atomic Law requirements.
- Exposure of operating staff to nuclear radiation shall be restricted to minimum. This requires use of detectors of high sensitivity. Application of scintillation counters is preferred.
- One should employ sources of radiation type and energy that as adapted to material type inside tank, and material of walls.
- Radiation sources of long half-life period shall be used. Following sources ^{60}Co [Cobalt] –6,5 years or ^{137}Cz [Cez] – 15 years are preferable.
- Containers used for radiation source have to be furnished with mechanism of beam closing for period of installation, dismantling and transportation.
- Receiver has to provide automatic compensation of radiation source activity drop.

6 Relevant documents

Any “Technical Specification” issued by GRUPA LOTOS S.A. listed in Contract Files.

7 Standards and regulations

Designing, manufacturing and assembly shall conform to latest editions of standards and regulations given below.

Only specific standards, connected with level measurements are quoted here. Remaining standards concerning control and instrumentation are given in specification GLSA 3010 – General requirements.

PN-EN 12952-7 Water-tube boilers and auxiliary installation – Part7: Requirements for equipment for the boiler.

Off.J. N° 21 pos. 125 Minister of Economy, Labour and Social Policy Regulation of 22.01.2008 on metrological requirements that measuring vessels should conform to

Off.J.N° 3 pos. 18 Nuclear Law (As amended); Act of 29.11.2000 (Dz.U. of 18.01.2001)

96/29/EURATOM Basic safety standards for the protection of health of workers and the general public against the dangers arising from ionizing radiation

8 Enclosures

- Enclosure No.1 Documentation requirements
- Enclosure No.2 Instrument data sheets

9 Record of changes

No.	Date	Description	Introduced by
1		This specification entirely replaces the former LOTOS Group S.A. standard No. PR 07 340 with the same title.	M. Domaniewski
2	4.05.2011	1.Correction of item 2.1. 2.The maximum length is restricted up to 3 m – item 4.1.2 and 4.1.4. 3.High liquid temperature requirements added – item 4.2.1. 4. Vibration level switches location requirements added– item 4.7.2. 5.Capacitance type switches location requieremts added – item 4.7.3.	M. Baryła
3	30-11-2013 (rev. 2)	Review, update, standardize and changes to the Standard within scope of order No. OK/990/2012	Editorial board coordinated by T.Wróbel
-	31-08-2015	Page layout corrections, no contents changes.	T. Wróbel

Grupa LOTOS S.A.	**ENCLOSURE No. 1**	Spec. No.
	Documentation requirements	3440

	WITH BID	WITH DELIVERY	NOTES
MANUFACTURER'S DATA SHEET	Yes	Yes	
LIST OF DEVIATIONS TO INQUIRY SPECIFICATIONS	Yes		
LIST OF SPARES RECOMMENDED FOR 2 YEARS OPERATION WITH ITEMIZED PRICES	Yes		
LIST OF SPARES RECOMMENDED FOR COMMISSIONING AND PROVISIONAL ACCEPTANCE TEST	Yes		
TEST CERTIFICATES		Yes	If specified
MATERAIL CERTIFICATES ACCORDING TO PN-EN-10204 3.1		Yes	If specified
CERTIFICATES ISSUED BY OFFCIAL ORGANIZATIONS FOR EQUIP. TO BE UTILIZED IN HAZARDOUS AREAS	Yes	Yes	If applicable
CERTIFICATES ISSUED BY OFFICIAL ORGANIZATIONS FOR EQUIPMENT TO BE UTILIZED FOR CUSTODY TRANSFER	Yes	Yes	If applicable
OUTLINE AND DIMENSIONAL DWGS, ELECTRICAL ARRANGEMENT	Yes	Yes	
ELECTRICAL DIAGRAMS		Yes	
INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTION MANUALS		Yes	
DOCUMENTS IN ELECTRONIC VERSION ON CD		Yes	
INSPECTION BOOK	Yes	Yes	If specified
FABRICATION QUALITY CONTROL PLAN		Yes	If specified
MANUFACTURERS DECLARATIOOPN OF CONFORMITY WITH EU DIRECTIVES		Yes	
MANUFACTURING CERTIFICATES		Yes	If specified
CALIBRATION CERTIFICATE		Yes	If specified
HYDROSTATIC TEST REPORT		Yes	If applicable