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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 flowmeters.

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 GLSA
- Data Sheets approved by GLSA
- This specification
- Other Specifications
- Drawings and other documents
- Standards

4 Definitions and designations

GLSA - Grupa LOTOS S.A.

DCS - Distributed Control System

PLC - Programmable Logic Controller

ESD - Emergency Shut Down System

SIS - Safety Instrumented System

SIL - Safety Integrity Level

GUM - Główny Urząd Miar (Polish authority for measurements)

Orifices - definitions comply to PN-EN- ISO 5167 standard, Measurements of fluid stream with use of orifices.

Parshall Channel - measuring element for open channels with horizontal contraction and additional leap of channel bottom

Displacement flowmeters - flowmeters that are counting measured portions of fluid

Target flowmeters - flowmeters that are using force of flowing fluid exerted on drag disk placed in pipeline

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 shall also follow requirements of plant licensor if they are stronger than requirements of this specification, or condition of guarantee. Special requirements of licensor that are differing from this specification have to be approved by GLSA.

Instruments embedded in pipelines must be manufactured according to PED - European Community directive No 97/23/EC, Pressure Equipment.

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

Local instruments must be accessible from ground level, from platform, or fixed ladder.

5.1 Difference pressure flowmeters

Limitations of use:

- flows of Reynolds number less than 4000, high level of contamination, in case of high viscosity liquids possibility of impact device application depends on pressure drops that are allowable from technological point of view
- required high accuracy of measurement, better than 1.5 %
- high ratio of maximum flow to minimum flow (rangeability), exceeding 5:1, which mainly comes from square rooting of pressure drop to get flow rate. In case of high rangeability it is necessary to calculate measurement error at minimum flow and evaluate of this error acceptability in specific case
- impossibility to provide required straight runs

Note:
Application of flow conditioners compatible with PN EN ISO 5167 Standard is allowable only in particular cases, where obtaining of straight runs required by the standard is impossible. In each case it must be properly justified and requires GLSA approval.

The base for designing, calculating and furnishing is PN EN ISO 5167 standard. Normal conditions for gas flow measurements: 0ºC, 101.325 kPa (abs). Calculations of difference pressure elements shall be executed by means of well-proofed software, for example CONVAL, TNflow, InstruCalc, or SPI. Other software may be used on condition of obtaining GLSA approval in advance.

Preferred pressure drop ranges are: 16 kPa for gases and 25 kPa for liquids.

Horizontal lengths of pipelines for impulse routes shall be considered for D and D/2 pressure tappings.

5.1.1 Orifices

Sharp-edged orifice with flange pressure taps, symmetric, coaxial. This type of orifice is a standard one for flow measurement, providing that permanent pressure drops allowed by process would not be exceeded.

Note: measuring orifices of special design can also be used for bi-directional flows.

Range of application:

- flow ratio (β beta) from 0.25 to 0.7. For diameters of pipelines exceeding 500 mm and requirements of small pressure drop, the flow ratio of 0.75 is allowed. Remaining requirements according PN EN ISO 5167 standard
- 2" < DN < 20"

Material: AISI 316 or equivalent as a standard, special materials when such requirements come from pipeline class.

Thickness of orifice: minimum 4 mm.

Marking: on upstream side of nameplate – at least Tag Number, material, nominal diameter and bore diameter.

Connections: ½" NPT.

Holes: draining or venting

Drain hole is used for measurements of steam and gases, where danger of condensation is likely. Vent hole is used for measurements of liquids, where saturation with gas or evaporation takes place. (The holes are not defined in PN-EN ISO 5167 standard, but specified in ISA standard; their usage subjects to GLSA decision)

Note: In cases where computations reveal that sharp-edged orifice cannot be used, it is allowed to use quadrant edge orifices and sharp-edged orifices with corner taps, or chamber type orifices.

Quadrant orifices are used for viscous liquids of Reynolds numbers in range of 500 <Re < 10^5, with base tolerance of 1.5 – 2.0%.

PN-EN ISO 5167 standard does not cover chamber orifices, and their usage requires written approval of GLSA.

5.1.2 Meter runs

Meter runs are used in two cases:

a) required measurement accuracy is better than 1%
b) DN of pipeline (or measuring section) <2". In this case computations shall be executed according to ASME-MFC-14M-2003 standard.

Meter runs can be used, unless better solutions cannot be applied (GLSA opinion is required)

For small diameters the following lengths of meter runs shall be used: 900 mm for DN 1", 1300 mm for DN 1-1/2"

5.1.3 Integral orifice plates

Such solution shall be used for diameters of pipelines below 1". Measuring instrument consists of meter run with integrally mounted differential pressure transmitter. Design according to supplier standard is then used.

Supplier proposes design taking into account design pressure and design temperature for specified measurement point.

This type of measurement can be used, when other solutions cannot be applied after GLSA approval.

5.1.4 Long radius nozzles

The advantage of nozzles is lower permanent pressure drop, which gives significant economic benefits for large flows. In a view of higher cost of nozzle, its usage is allowable only in the cases where orifice cannot be used because of exceeding of β value, or allowable residual pressure loss. This applies in particular to high-pressure steam flow measurements.

5.1.5 Venturi tube

Venturi tubes shall be used only in cases, when higher cost of the instrument is justified by lower residual pressure loss, increased accuracy of flow measurement and possibility of application for fluids with suspended solids.

Allowable internal diameters of pipeline and ranges of β value are precisely defined in PN EN ISO 5167 standard.

Note: Special designs of Venturi tubes for air channels, which are designed and offered by suppliers of industrial furnaces, are also allowed.

5.1.6 Pitot tube (for example, Annubar)

Multiple hole, averaging tubes are currently exclusively used, of several brand names, for example Annubar of Emerson Company.

Usage:

Mostly for large diameter pipelines and where process restriction of residual pressure loss exists, as well as for pure gases and liquids of small viscosity. Design, selection and calculations according to supplier's standards.

5.1.7 Other difference pressure elements for pipelines

Other difference pressure elements, V-Cone for example, can be used only within package units delivery frameworks, when this is required by package unit supplier / manufacturer.

5.1.8 Difference pressure elements for open channels

Flows in open channels can be measured with use of weirs, or flumes. The latter solution is used in Parshall measuring channel.

In Parshall channel, besides basic horizontal contraction, there is additional vertical leap of channel bottom that makes installation of this measuring instrument in existing channel difficult. Size of Parshall channel is defined by its width in maximum contraction. Flow is defined on the ground of liquid level measurement in specified point of the channel. In order to enable usage of standard conversion tables, manufacturer or supplier of the channel must strictly adhere to all design dimensions.

5.1.9 Restriction orifices

Restriction orifices do not measure the flow but limit it.

Types of restriction orifices:

- Single stage, single opening restriction orifices. This is preferred type. Installation between standard flanges, according to pipe class.
- Multi-stage restriction orifices. They shall be used at very high pressure drops, when throttled flow occurs as well as for noise level reduction. Design with flanged connections shall be used.

Each stage shall constitute separate element, connected to other stages or to pipeline with flanges. Class of flanges according to pipe class.

- Multi-hole restriction orifices. They can be used as a part of control valve unit, in order to limit pressure drop on the valve and to reduce noise level. Using them as independent elements requires GLSA approval.

5.1.10 Transmitters

- Single pressure difference transmitter is used for standard process measurements, when less than 5:1 rangeability is required.

For rangeability exceeding 5:1 two transmitters shall be employed, with ranges selected such that whole measurement range can be covered in optimum way.

Basic requirements for transmitters are given in specification GLSA 3410, Pressure measurements.

5.1.11 Compensation of pressure and temperature changes

Compensation of pressure and temperature changes (gases and gas-saturated liquids), or only temperature (liquids without dissolved gases) shall be employed, when mass flow accuracy better than 2% is required, or flow corrected to normal conditions.

For high requirements for total accuracy of mass flow measurement, multivariable transmitters can be used, unless they have a possibility of temperature and pressure measurement transfer to DCS via digital communication. Otherwise, separate pressure and temperature measurement must be used.

5.2 Positive displacement flowmeters

Positive displacement flowmeter measures the volume flow rate of a continuous flow by momentarily entrapping a segment of the fluid into chamber of know volume and releasing that fluid back into stream on the discharge side of the meter. Several constructional solutions exist: piston flowmeters, oval gear positive displacement flowmeters, bi-rotor flowmeters, vane flowmeters, chamber flowmeters, and rotor flowmeters. The oval and chamber type flowmeters are of primarily use.

Oval gear positive displacement flowmeters

Application:

- for liquid flow measurement, including viscous liquids > 10 cSt
- for custody transfer system
- for fuel loading station
- for local indication: measuring and counting of liquid flow

Limitations and special conditions of application:

- shall not be used for contaminated liquids, and that of high temperatures
- degasifiers shall be installed upstream the counter; this is obligatory requirement in case of custody transfer system in loading stations
- high pressure drops on the flowmeter

Basic requirements:

- Measuring accuracy 0.1% for fiscal custody transfer systems, 0.5% for remaining ones
- Rangeability 10:1 as a minimum
- Rotation pick-up of magnetic type

- Frequency output signal
- Local counter of total flow for applications, where liquid batches are measured (for example, fuel loading stations)
- Material and class of connection: according to pipeline specification
- For custody system: type approval and calibration certificate

Chamber flowmeters (gas meters)

Application:

- for measurements of non-aggressive gases, including natural gas in particular
- for custody transfer measurements
- for local indication: for measuring and totalising of gas flow

Limitations and special conditions of application:

- shall not be used for aggressive gases
- high pressure drops on the flowmeter

Basic requirements

- Measuring accuracy 0.1% for fiscal custody transfer, 0.5% for remaining ones
- Rangeability 10:1 as a minimum
- Rotation pick-up of magnetic type
- Frequency output signal
- Local counter of total flow for applications, where fluid batches are measured (for example, gas distribution stations)
- Material and class of connection: according to pipeline specification
- For custody transfer system: type approval and calibration certificate

5.3 Target flowmeters

In the simplest version such flowmeter can be used as flow indicator. For continuous measurement, there is used the strain gauges, which measures force acting on a target. Output signal has non-linear characteristics, close to square root one.

Target flowmeters are not recommended for use in GLSA.

Application:

- for flow measurements of clean and dirty liquids, for viscous liquids as well as some slurries,
- as flow indicator.

Limitations and special conditions of application:

- shall not be used for custody transfer system
- it is necessary to use straight sections of length equal 10 to 30 of pipeline diameters on upstream side

Basic requirements:

- Measuring accuracy 1% to 5%

- Rangeability 10:1 as minimum.
- Linear output signal 4-20 mA + HART.
- Material and class of connection: according to pipeline specification.

5.4 Turbine flowmeters (turbines)

Note: Use of turbine flowmeter is not recommended and requires GLSA approval in every case.

5.4.1 Axial turbine flowmeters

In industrial applications basic type of turbine flowmeter is flowmeter with single, axially mounted impeller. The flowmeter is composed of part that is installed in pipeline, with sensor of pulses generated by impeller and transmitter.

The turbine measures volumetric flow.

Range of application:

- Clean liquids and gases, of stable flow, low viscosities ranging from 10cSt up to 100cSt (in special designs up to 200 cSt)
- Sizes in range from ¼" up to 24", flow rates from 0,025 m^3/h up to 25500 m^3/h
- High accuracy class is required (0.25%), custody and fiscal measurements. Wide measuring range is also required: rangeability 10:1 (typical) up to 100:1 (maximum, in certain cases)
- Fluid temperature range up to 250ºC. At low and high media temperature, a model with separately mounted transducer is required
- Pressure range up to 20 MPa
- Transmitters can feature pulse output (better accuracy), or current 4-20 mA)
- For explosion hazardous area, explosion proof Ex models are available

Limitations of use:

- Liquids containing suspensions and of corrosive nature to materials of body, impeller or bearings
- High price, particularly for models of high accuracy
- They are not suitable for measurements of quick-changing flows

5.4.2 Other types of turbine flowmeters

Turbines with impeller of 1 to 2 inches in diameter, which is radially inserted to pipelines of 2" to 30" in diameter. Lower measuring accuracy, strongly depending on installation quality and on flow profile. Turbines of such design are frequently used in capacity of water meters.

5.4.3 Basic requirements concerning turbine flowmeters

- Transmitter integrated with turbine, unless this is impermissible considering fluid temperature.
- Output signal 4-20 mA + additional digital HART,. Two-wire transmitter. Optional standardized frequency output.
- Total measuring accuracy: better than 0.5%
- Rangeability according to specified measuring range
- The flowmeters have to be calibrated by supplier for range and fluid type defined in specification. In particular cases calibration certificate is required

- For explosion hazardous areas, intrinsically safe design is used as the basic protection. Certificate according to ATEX.
- Class of protection against dust and water – minimum IP65
- Unless required another by technological conditions, 316 SS material is the proper one. Material certificate 3.1 according to PN-EN 10204
- Bearings made of abrasion resistant materials
- Certificate of pressure test. Test pressure 1.5 of design pressure
- The instrument must conform to 97/23/EC directive, Pressure equipment
- Transmitters have to be furnished with integrated LCD displays. Indications in engineering units

5.5 Variable area flowmeters

In process applications, only variable area flow meters with metal measuring tube shall be used. Glass designs can be only used for auxiliary measurements, for example measurement of sample flow into analyser if processes do not determinate differently (refer to specifications GLSA 3510 and 3530).

Variable area flow meters are used mainly for local measurements and less important remote measurements, as well as in applications where check of product colour is required. Variable area flow meter measures volumetric flow.

5.5.1 Scope of application

- For clean liquids, which are not forming deposits nor crystallizing
- For less important measurements and in cases of installation limitations: there is no requirement regarding straight sections of pipeline
- Range of diameters from ½" up to 6"
- Range of flow rates: for water 0.04 l/h up to 150 m^3/h, for air 0.5 l/h up to 3000 m^3/h
- Range of pressures up to 600 lbs class, exceptionally up to 900 lbs
- Range of temperatures: up to 300ºC

5.5.2 Limitations of use

- Can be installed only on vertical pipeline with flow direction from bottom to top.
- Low measuring accuracy for variable area flow meters on process lines
- Readouts below 10% of range are impossible in practice

5.5.3 Basic requirements for variable area flow meters with transmitter

- Metallic construction for process measurements, material of tube according to pipeline specification.
- Inlet from bottom side, flanged connection in accordance with pipeline class. For analytic purposes, as well as in special cases, NPT connections are used in process instruments.
- For analysers, AISI 3166 SS material shall be used for measuring tube, unless technological conditions require another one.
- Certificate of pressure test. Test pressure 1.5 of design pressure
- Material certificate 3.1 according to PN-EN 10204
- The instrument must conform to 97/23/EC directive, Pressure equipment

- Class of protection against dust and water for transducer – minimum IP65
- Variable area flow meters must be calibrated by supplier as per the range specified in data sheet. In special cases certificate of calibration is required
- Output signal 4-20 mA + HART (or DE), two-wire transmitter
- Instrument accuracy class: at least 2%, in special cases 1%.
- For explosion hazardous areas, intrinsically safe design is used as the basic protection. Certificate according to ATEX

5.6 Corioliss mass flowmeters

This is one of the most technically advanced measuring instruments. High accuracy and repeatability of measurement are its highest advantages. Besides, it does not require additional measurements of pressure and temperature for correction purposes.

This kind of measurements is preferred for use in GLSA

5.6.1 Range of application

- Mass flow measurement is required where large changes of process parameters or changes of media exist, as well as simultaneous measurements of additional process variables – density, volumetric flow, temperature
- High accuracy class is required (better than 1%), balance measurements
- Wide measuring range is required (rangeability 40:1 up to 500:1, at reduced accuracy 1.25% for minimum of range)
- Measurement of corrosive liquids and those containing solid particles
- Range of pressure up to 600 lbs class, exceptionally up to 900 lbs; possible pressure class depends on flowmeter diameter
- Range of temperature up to 260ºC (up to 350ºC for some types only)
- Range of diameters 1/8” up to 10”
- There are no special requirements regarding installation nor requirements regarding straight sections of pipeline

5.6.2 Limitations of use

- Maximum diameter 8”
- Relatively high pressure drop. Acceptable pressure drop is defined by process department

5.6.3 Basic requirements for Corioliss mass flowmeters

- In case of flow alone measurement: frequency signal (preferred), or 4-20 mA output signal + HART.
- If several variables are measured, selection of signal(s) depends on arrangements regarding specific project
- Accuracy class of instrument: for liquids at least 0.2%, and in special cases 0.1%. Particular attention shall be paid on accuracy required at minimum value of the range
- For explosion hazardous areas, intrinsically safe design is used as the basic protection. Certificate according to ATEX
- Class of protection against dust and water – minimum IP65

- Sensor tube material at least 316 SS. Material certificate 3.1 according to PN-EN 10204 for measuring tube
- Flowmeters must be calibrated by supplier as per the range specified in data sheet. In special cases certificate of calibration is required.
- Certificate of pressure test. Test pressure 1.5 of design pressure
- The instrument must conform to 97/23/EC directive, Pressure equipment
- Transmitters have to be furnished with integrated LCD displays. Indications in engineering units
- In case of the steam heating, heating tube shall be arranged so that includes the entire measuring pipe (U shape)
- The heating tube must be moved away from measuring cables. 10 mm distance is a minimum
- A mounting hole with the diameter 50mm greater than the co-processor of the insulated Coriolis with integrated co-processor shall be foreseen. The measuring pipe insulation hole diameter shall be kept as narrow as possible to limit the influence of the temperature of the media and heating tube on the co-processor work and to avoid it's damaging.

5.7 Thermal mass flowmeters

Note: Application of thermal flowmeter requires GLSA approval in each case.

5.7.1 Range of application

- Mass flow measurement is required, at slow changes of process parameters or changes of media.
- Wide measuring range is required (rangeability 30:1)
- Range of pressures up to 10 MPa
- Range of temperature up to 260ºC
- Range of diameters starting from ½". Special designs are possible for large flue and air channels
- There are no special requirements regarding installation nor requirements regarding straight sections of pipeline

Note: Flow indicators are based on similar principle of operation.

5.7.2 Limitations of use

- Application limited to clean gases and liquids (in restricted range). For contaminated gases or gases containing water, multi-sensor constructions are used.
- Certificates of instrument calibration are required, and also legalization in special cases.

5.8 Ultrasonic flowmeters

For process measurements, ultrasonic flowmeters are used, based on Doppler effect (worse accuracy), and on the duration time of signal transmission. Another division takes into account flowmeters that are built-in pipeline, and flowmeters, which sensors are fixed outside a pipeline.

5.8.1 Range of application

- When high accuracy class is required, balance and custody measurements. Flowmeters built-in pipeline shall be used, with two or three pairs of senders – receivers. In case of instruments for custody transfer, type approval issued by GUM (Main Office of Measures) is required

- For medium accuracy class, fluid contaminated with solid particles, built-in pipeline flowmeters shall be used with single sender– receiver pair
- Pipelines of large diameters. Flowmeters with senders–receivers mounted outside pipeline walls shall be used
- When very low pressure drop on instrument is required
- For bi-directional flows

5.8.2 Limitations of use

- Stream velocity must be greater than 0.5 m/s
- Long straight sections, particularly for flowmeters with sensors fixed outside the pipeline (5 to 30 pipeline diameters)
- Temperature of measured fluid up to 180ºC

5.8.3 Basic requirements for ultrasonic flowmeters

- Output signal: frequency signal for flow, 4-20 mA for other measured variables.
- Accuracy class of instrument in case of flowmeters with several pairs of sender – receivers: for liquids at least 0.5%, in special cases 0.2%. Particular attention shall be paid on accuracy required at minimum value of the range
- For explosion hazardous area, intrinsically safe design shall be used as the basic protection. Certificate according to ATEX
- If temperature limitations do not exist, then transmitter integrated with signal sender shall be used
- Accuracy class of protection against dust and water – minimum IP65.
- Sensor tube material at least AISI 316 SS. Material certificate 3.1 according to PN-EN 10204 for measuring tube
- In case of sensors mounted outside pipeline, securing with bands and clamps; welding is impermissible
- Flowmeters shall be calibrated by supplier as per the range specified in data sheet. In special cases certificate of calibration is required
- Certificate of pressure test. Test pressure 1.5 of design pressure
- The instrument must conform to 97/23/EC directive, Pressure equipment
- Transmitters have to be furnished with integrated LCD displays. Indications in engineering units

5.9 Magnetic flowmeters

5.9.1 Range of application

- Application only for conducting liquids
- When minimal pressure drop is required, a liquid is contaminated and of high viscosity
- When high accuracy class is required, 0.5%
- When wide measuring range is required (rangeability 30:1)
- Range of pressures up to 5 MPa
- Range of temperature up to 230ºC Range of diameters from 1/8” up to 96”

5.9.2 Limitations of use

- Flow velocity must be greater than 0.3 m/s, conductivity of media > 0,5 μ S/cm
- Gas bubbles or ferrite contaminations cannot be present.
- Straight section on upstream side (10 diameters of pipeline)

5.9.3 Basic requirements for magnetic flowmeters

- Output signal: 4-20 mA + HART.
- Accuracy class of instrument at least 0.5%. Particular attention shall be paid on accuracy required at minimum value of the range.
- Flowmeters must be calibrated by supplier as per the range specified in data sheet. In special cases certificate of calibration is required.
- For explosion hazardous areas, intrinsically safe design is use used as a basic protection. Certificate according to ATEX.
- If temperature limitations do not exist, then transmitter integrated with signal sensor shall be used.
- Accuracy class of protection against dust and water – minimum IP65.
- Sensor tube material at least AISI 316, material of lining end electrodes according to manufacturer standard for given process fluid. Material certificate 3.1 according to PN-EN 10204 for measuring tube.
- Certificate of pressure test. Test pressure 1.5 of design pressure.
- The instrument must conform to 97/23/EC directive, Pressure equipment.
- Transmitters have to be furnished with integrated LCD displays. Indications in flow engineering units.

5.10 Vortex type flowmeters

5.10.1 Range of application

- Clean liquids, gases and steam, Reynolds number >20000; limited use for contaminated liquids.
- When accuracy class better than 1% is required.
- When required measuring range exceeds capacities of constriction measurement (possible rangeability of Vortex is 10:1)
- Range of pressures up to 10 MPa
- Range of temperature up to 230ºC
- Range of diameters from 2” up to 12”

5.10.2 Limitations of use

- Pipeline vibrations influence, requires scrupulous installation.
- Influence of alternate current interferences.
- Straight section on upstream side (10 to 20 diameters of pipeline)

5.10.3 Basic requirements for Vortex flowmeters

- Output signal: 4-20 mA + HART.

- Accuracy class of instrument at least 1.0. Particular attention shall be paid on accuracy required at minimum value of the range
- Flowmeters must be calibrated by supplier as per the range specified in data sheet
- For explosion hazardous area, intrinsically safe design shall be used as basic protection. Certificate according to ATEX
- If temperature limitations do not exist, then transmitter integrated with signal sender shall be used
- Accuracy class of protection against dust and water – minimum IP65
- Sensor tube material at least AISI 316. Material certificate 3.1 according to PN-EN 10204 for measuring tube
- In special cases, certificate of calibration is required
- Certificate of pressure test. Test pressure 1.5 of design pressure
- The instrument must conform to 97/23/EC directive, Pressure equipment
- Transmitter has to be furnished with integrated LCD displays. Indications in engineering units

5.11 Flow switch

Flow switches can utilize each of methods used for continuous measurement. On GLSA units the following flow indicators application is recommended:

- Target flow indicators – the use is permissible in auxiliary units (plants) only, where no accuracy class is required
- Flow indicators utilizing Doppler effect
- Flow indicators utilizing pressure drop on orifice

In all cases flow indicator can be installed only on main stream.

Process connection:
According to manufacturer standard.

Materials: AISI 316 SS, unless standard materials used by manufacturer are better for specified fluid. Material certificate according to PN-EN 10204.

Output signal: intrinsically safe proximity detector, or gold plated SPDT contact. Signal of proximity detector must conform to EN 60947-5-6 (DIN 19234) requirements, for direct connection to DCS or PLC input.

Protection class: at least IP65.

5.12 Cable glands

Each flow transmitter and switch shall be delivered with suitable cable gland M20x1.5

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 flow measurements are quoted here. Remaining standards concerning control and instrumentation are given in specification GLSA 3010 – General requirements.

PN-EN ISO 5167-1	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full. Part 1: General principles and requirements.
PN-EN ISO 5167-2	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full. Part 2: Orifice plates.
PN-EN ISO 5167-3	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full. Part 3: Nozzles and Venturi nozzles
PN-EN ISO 5167-4	Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full. Part 1: Venturi tubes

ASME-MFC-14M Measurement of Fluid Flow. Using Small Bore Precision Orifice Meters.

PN-ISO 1070	Measurement of fluid flow in open flumes. Slope – area method.
PN-EN ISO 6416	Measurement of liquid flow in open channels. Measurement of discharge by the ultrasonic (acoustic) method

Directive 2004/22/EC, Measuring instruments

8 Enclosures

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

9 Index of revisions

No.	Date	Description	Introduced by
0		This specification entirely replaces the former LOTOS Group S.A. standard No. PR 07 320 with the same title.	M. Domaniewski
1	30-11-2013 (rev. 1)	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. N^{o}
	Documentation requirements	3420

	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 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 DECLARATION OF CONFORMITY WITH EU DIRECTIVES		Yes	
MANUFACTURING CERTIFICATES		Yes	If specified
CALIBRATION CERTIFICATE		Yes	If specified
HYDROSTATIC TEST REPORT		Yes	If applicable