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1 Subject of specification

This specification used in conjunction with other technical specifications of LOTOS Group S.A., establishes minimal requirements regarding designing and execution of automatics cable connections.

2 Scope of validity

This specification shall be used when preparing both quotations and Purchase Orders concerning planned LOTOS Group S.A. new investments and modernizations.

It shall also be a base for preparation of other detailed specifications and quotations relevant for package units or other equipment deliveries.

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.

SOV - Solenoid valve

Cable capacity – the capacity measured between individual cores, or between cores and screen, value given by cable manufacturer

Cable inductance – the inductance measured between individual cores, or between cores and screen, value given by cable manufacturer

Cable resistance to inductance ratio – the value given by cable manufacturer, used interchangeably to inductance in order to compare against certificate of intrinsically safe circuit transceiver

5 Description

5.1 Basic requirements

The cables have to be adapted to lying both in overhead trays and in cable channels buried with sand. Each cable must be fabricated in single section, connecting of cables outside junction boxes is impermissible.
Required flexibility class: at least 2 according to IEC-60228
Both internal insulation as well as an external jacket of cable must be made of high quality materials and show excellent resistance to chemicals, oil, high temperature, ultraviolet radiation, humidity and ageing.
The cable must be manufactured to work in temperatures of –25°C ÷ 70°C range at least. In case of compensation cables, required working temperature is determined by detailed specification.
The cables have to be fire retardant and shall not cause flame propagation. In special cases, detailed specification determines survival time (30, 60, or 90 minutes). In closed rooms, halogen free flame retardant cables shall be used.
Leading multiple signals of various rated voltages in single cable is impermissible, with exception to special cables if they are recommended and delivered by instrument supplier.
Rated resistance of lead for all measuring cables, expressed in Ω/km at 20 ℃, shall be as follows:
0,5mm²<39 0,75mm²<26 1,0mm²<19,5 1,5mm²<13,3
Voltage levels Uo/U: 300/500 V
Insulation resistance at 20°C shall be not less than 100 MΩ/km.
Identification of cables: cable type shall be marked on its external jacket with 10 m spacing.
It is necessary to specify external diameter for all cables, along with allowable deviation.

5.2 Cable design

5.2.1 Signal cables

All signal cables shall be fabricated as double (pair), triple, or quad cables.

Single cables (1x2, 1x3, 1x4)

Leads	strand, minimum 7 cores made of non-galvanised copper, 1.5 mm^2
Leads insulation	Fire retardant polyethylene (PE), 0.35 mm minimum thickness
Twists	Minimum 20 twist per meter
Wrapping	Polyester foil of 0.2 mm minimum thickness, with 20% overlap
Shielding of a pair	100% coverage with aluminium coated polyester band and tin plated, copper drain lead 0.5 mm2
External jacket	Fire retardant, oil resistant polyvinyl chloride (PVC), thickness 1.4 mm
Minimum bend radius	10 x d (d = external diameter)
Armour	no armour

Single cables for solenoid valves (SOV) and 24 V=

Leads	Non-galvanised copper wire, 2.5 mm^2. Wire cross-section areas depending on allowable voltage drop, to be finally determined by detailed specification
Leads insulation	Fire retardant, oil resistant polyvinyl chloride (PVC), 0.35 mm minimum thickness

External jacket	Fire retardant, oil resistant polyvinyl chloride (PVC), 1.4 mm minimum thickness
Minimum bend radius	10 x d (d = external diameter)
Armour	Armoured cable.

Multi-pair cable (multi-triple, multi-quad)

Leads	7 cores made of non-galvanised copper, 0.5 mm^2
Leads insulation	Flame retardant polyethylene (PE), thickness 0.35 mm
Twists	At least 20 twists per meter

Wrapping of pairs (triples, quads)Polyester foil, minim thickness 0.2 mm with 20% overlap

Shielding of pairs	100% coverage with aluminium coated polyester band, and 0.5 mm^2 drain lead
Cable shielding	copper mesh braid
External jacket	Flame retardant, oil resistant polyvinyl chloride (PVC), thickness 1.4 mm
Minimum bend radius	10 x d (d = external diameter)
Armour	no armour

It is necessary to use multi-pair cables:

24-pair

12-pair

8-triple

6-quad

Application of cables with different number of pairs, triples, quads, requires GLSA approval.

5.2.2 Control cables (for binary signals)

Leads	multi-core, made of non-galvanized copper, 0.5 mm^2
Leads insulation	Polyvinyl chloride (PVC), 0.35 mm minimum thickness
Number of leads	according to order specification
Numbering of leads	1, 2, 3, and so on
Cable screening	copper mesh, band/wire
External jacket	Flame retardant, oil resistant polyvinyl chloride (PVC), 1.4 mm thickness, black colour.
Armour	No armour

5.2.3 Compensation cables

Note: Multi-pair compensation cables may be used only in exceptional cases. Application of multi-pair cables requires GLSA approval.

Leads	1.5 mm^2 wire, material matched to thermocouple type, according to IEC 60584-1 standard

Leads insulation	Fire retardant, oil resistant polyvinyl chloride (PVC), 0.35 mm minimum thickness
Twists	Minimum 20 twists per meter
Wrapping	Polyester foil, minimum thickness 0.2 mm, with 20% overlap
Shielding of pair	100% coverage with aluminium coated polyester band, and tin plated copper wire 0.5 mm^2.
External jacket	Fire retardant, oil resistant polyvinyl (PVC), thickness 1.4 mm
Minimum bend radius	10 x d (d = external diameter)

5.2.4 Special cables

The cables that interconnect individual parts of specific measuring instrument (e.g. oxygen analyser and its electronic module). The requirements concerning such cables are determined by the instrument supplier.

In particular cases, fire-resistant cables fabricated according to IEC60331 may be needed, which application necessity arises from experience related to safety, HAZOP or insurance company recommendations. Exclusively mineral insulation can be used for them.

Armoured pliable cables (external armour), used for measurements on machines. Machine supplier standard or measuring instruments supplier standard is used.

Cables for data transmission systems are covered by Specification N° 3710.

5.2.5 230 V~ power supply cable

3x1.5mm^2 cable for 230V 50Hz supply

Note:	Cables with larger cross section areas of leads are specified by electrical branch, specification N° 4500.
Leads	Wire made of non-galvanized copper, 1.5 mm^2.
Leads insulation	Fire retardant, oil resistant polyvinyl chloride (PVC), minimum thickness 0.35 mm or XLPE insulation
External jacket	Fire retardant, oil resistant polyvinyl chloride (PVC), thickness 1.4 mm, black
Armour	Yes

Note: For 230 V ~ supply, single cables are exclusively used.

5.3 Special requirements for intrinsically safe circuits cables

Minimum test voltage between a lead and ground, a lead and screen, as well as screen and ground, is equal to 500 V~ or 750 V=.
The supplier must specify parameters required for circuit conformity check against intrinsic safety standard, and certificate of intrinsic safety for equipment constituting part of intrinsically safe circuit: capacity, inductance, or inductance – resistance ratio.
The supplier has to give maximum values of the above parameters for offered cables:
Maximum values for parameters:

- capacity 200 nF/km
- inductance 1,0 mH/km, or
- inductance – resistance ratio 30 μH/ Ω

Note: Detailed specification can determine more stringent requirements, if this is necessary for the sake of routes' length, or requirements / data of intrinsic safety certificates for equipment.

5.4 Identification of cables and cores, colour scheme

230V ~ supply cables: black external jacket, cores: brown phase lead, blue neutral lead, yellow-green protective PE lead.

24V= supply cables and SOV cables: black external jacket, red positive lead, blue negative lead.

Pair signal cables, non-intrinsically safe: grey external jacket, white positive lead, black negative lead.

Pair signal cables, intrinsically safe: light-blue external jacket, white positive lead, black negative lead.

Multi-pair, multi-triple, multi-quad cables: colour scheme of leads the same as for single cables, and additionally numbering of pairs in colour contrasting with insulation colour.

- Compensation leads: according to PN-EN 60584 standard, Thermoelements:

- J type thermocouple: black (+) and white (-), black jacket
- K type thermocouple: green (+) and white (-), green jacket
- N type thermocouple: pink (+) and white (-), pink jacket
- R type thermocouple: orange (+) and white (-), orange jacket
- S type thermocouple: orange (+) and white (-), orange jacket

Caution: For intrinsically safe circuits, the jacket is light-blue for all thermocouple types.

- Leads for resistance thermometers: according to PN-EN 60751 +A2 standard:

- Bi-wire connection: red and white
- Three-wire connection: red, red and white
- Quad-wire connection: red, red, white and white.

Project tagging cables shall be according to specification GLSA 3030.

5.5 Cable test

Each cable drum shall be subjected to the following tests:

- Leads and screens continuity
- Insulation between leads shall withstand 600 V DC test through one minute.
- Inductance (only for intrinsically safe cables) between cores of each pair shall be determined in microhenries per km.
- Capacity (only for intrinsically safe cables) between cores of each pair shall be determined in nanofarades per km.
- Resistance of each lead in pairs shall be determined in ohms per kilometre.
- Fire resistance test shall be completed according to IEC 60332-1 and IEC 60331 standards.
- The test protocols shall be delivered together wit cables.

5.6 Preparation to shipment

- The supplier is fully responsible for proper cable preparation for shipment.
- Each drum shall be equipped with shield, preventing cable damage.
- Along with an offer, the supplier shall submit method of cable packaging.

5.7 Cable drums

Marking of cable drums

Each drum shall be factory marked with bi-side fastened metal plate, containing stamped on inscriptions: cable type, number of cores, pairs, triples or quads, cable length on the drum, producer's name, order number and ordinal number of cable.

The cable on drum shall be wound in such a way, that both its ends are accessible. Both cable ends shall be protected with thermoshrinkable caps.

Length of cable on drums

Length of cable on drums shall contain within –0 +3% of specified length.

Length of cable must be marked on the cable jacket starting from the interior of the drum.

6 Relevant documents

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

7 Standards and regulations

Design, execution and assembly shall comply with the latest edition of below listed standards and regulations.

Only specific standards, relating to control and automatics cables are listed here. The remaining standards relating to P&I are given in specification No 3010 – General requirements.

European Union Directives

94/9/WE	Protective equipment and systems intended for use in explosion hazard zones.

Standards:

PN-EN 60079-14	Electrical apparatus for potentially explosive atmospheres. General requirements
PN-EN 60079-25	Explosive atmospheres. Intrinsically safe electrical systems
IEC 60227-1	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V-Part 1: General requirements
PN-EN 60228	Cores of leads and cables.
PN-IEC 60331-11	Tests for electric cables under fire conditions - Circuit integrity - Part 11: Apparatus - Fire alone at a flame temperature of at least 750 °C
PN-IEC 60331-12	Tests for electric cables under fire conditions - Circuit integrity - Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of

	rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm
PN-IEC 60331-21	Tests for electric cables under fire conditions - Circuit integrity - Part 21: Procedures and requirements - Cables of rated voltage up to and including 0,6/1,0 kV
PN-IEC 60331-23	Tests for electric cables under fire conditions - Circuit integrity - Part 23: Procedures and requirements - Electric data cables
.PN-IEC 60331-25	Tests for electric cables under fire conditions - Circuit integrity - Part 25: Procedures and requirements - Optical fibre cables
PN-IEC 60331-31	Tests for electric cables under fire conditions - Circuit integrity - Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm
PN-IEC 60332-1	Tests on electric and optical fibre cables under fire conditions. Part 1-1: Test for vertical flame propagation for a single insulated wire or cable.
PN-IEC 60332-2-1	Tests on electric and optical fibre cables under fire conditions - Part 2-1: Test for vertical flame propagation for a single small insulated wire or cable – Apparatus
PN-IEC 60332-2-2	Tests on electric and optical fibre cables under fire conditions - Part 2-2: Test for vertical flame propagation for a single small insulated wire or cable - Procedure for diffusion flame
.PN-IEC 60332-3	Tests on electric and optical fibre cables under fire conditions.
PN-EN 60445	Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals, conductor terminations and conductors
IEC 60502-1	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) – Part 1: Cables for rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV) - Edition 2.1; Consolidated Reprint.
PN-EN 60584-1	Thermoelements. Characteristics

8 Record of changes

No.	Date	Description	Introduced by
1		This specification entirely replaces the former LOTOS Group S.A. standard No. PR 07 381 with the same title.	M. Domaniewski
2	4.05.2011	1.Correction of item 2.1. 2.Correction of item 4.1. 3.Distance between descriptors on the cable jackets are changed from 1m up to 10 m – item 4.1. 4.Lenght cable marking are added – item 4.7.	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