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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 optical fibre lines.

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 Departures

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.

2.2 Exclusions

This specification does not cover:

- Cable ways [underground conduit, trenches, cable trays, etc., which are included in Spec. No 3730]
- Optical fibre active devices
- Optical fibre installations [inside buildings]

The specification doesn't determine destination of lines, transmitted capacity nor quality of transmission.

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

4.1 Definitions

Fibre optic cable – the cable that contains optical fibres for telecommunication signals' transmission.

Fibre optic line – telecommunication line built of fibre optic cables.

Fibre optic joint - accessory used for permanent connecting of optical fibres by means of clamping.

Fibre optic mode – characteristic type of electromagnetic wave, induced by optical band radiation in an optical fibre

Joint closure (cable box) – complete accessory set for permanent connection of two (or more) installation sections of fibre optic cables.

Installation section – fragment of fibre optic line limited with distribution frames.

Fibre optic distribution frame (stand alone, wall mounted or cabinet with patch panels) – a device enabling switching over optical fibres and connecting station cables to them, which is mounted on each end of installation section.

Half-connector – plug-in part of fibre optic connector, mounted on the end of station cable (pigtail, patchcord).

Spare cable storage box – an element containing stocks of cables winded in loops, so as to enable pulling them out in safe way on the installation section.

Fibre optic transmission bandwidth – frequency of electric signal that modulates light wave, and resulting in 3dB optical power drop on fibre optic output, in relation to unmodulated light component.

Terminating optical cord (pigtail) – short section of single fibre station cable, terminated on one end only with plug (half-connector).

Connecting optical cord (patchcord) – short section of single fibre station cable, terminated on both its ends with plugs (half-connectors), serving for connecting of teletransmission equipment with fibre optic patch panel, or connecting of measuring instruments.

Optical fibre – transmitting element of fibre optic cable in the form of fibre, enabling light wave transmission.

Single-mode optical fibre – fibre that can transmit only single fibre optic mode.

Multi-mode optical fibre – fibre that can transmit more fibre optic modes.

Warning band – a band, usually made of polyethylene, in yellow colour, laid over cable or cable pipeline, in order to warn about cable being buried below. Warnings such as " UWAGA! KABEL ŚWIATŁOWODOWY"! or " UWAGA! KABEL TELEKOMUNIKACYJNY" shall be durably put on the band.

Warning locating band – a band containing locating element, for example steel band.

Unit attenuation of fibre optic – a quantity determining decrease of optic signal power after passing of 1 km long fibre optic.

Reflective attenuation (reflectance) – quotient, expressed in dB, of light power emitted from laser and reflected power, resulting from optical inhomogeneity caused by fibre optic connector.

Fibre optic path – way of optical signal terminated with connectors on fibre optic distribution frame.

Line fibre optic track (usually dual-path) – two fibre optic ways with line teletransmission devices

Adapter (coupler) – central part of fibre optic connector, serving for coaxial joining of two half-connectors, secured in the field of distribution frame.

Cable strength member – internal element of cable increasing its resistance to impact of tensile and bending forces.

Fibre optic joint – place of connection of optical fibres.

Fibre optic connector – device used for connecting of optical fibres in separable way, usually consisting of two plugs (half-connectors) and adaptor (coupler).

Separable fibre optic connector – connection of optical fibres with use of fibre optic half-connector, demountable.

Permanent fibre optic joint (splice) – fixed connection of optical fibres made by means of splicing or jointing.

Fibre optic cable joint – place of fixed connection of fibre optic cables, made by means of complete joint (muff) closure.

4.2 Designations

GLSA Grupa Lotos S. A. S.A.

OTK opto-telecommunication cable (fibre optic cable)

Js matched cladding single-mode fibres [standard]

Jp dispersion- shifted single-mode fibres

Jn non-zero dispersion-shifted single-mode fibres

G5 multi-mode [graded-index] fibres G50/125

G6 multi-mode [graded-index] fibres G62,5/125

One shall use designations of GLSA objects according to 6120 standard, given in chapter 5 of this specification.

5 Description

5.1 Designing of lines

Fibre optic line can be composed of:

- Cable pipelines and secondary conduits
- single-mode and multi-mode line cables
- single-mode and multi-mode station cables
- Spare cable storage boxes and frames
- patch panels for termination of cables.

Requirements for efficiency of fibre optic line have been given in Enclosure 7.1. Line route as well as destination and type of cables will follow from project. In every case design and bill of quantities shall be prepared, according to provisions of p. 6.1 and shall be approved by GLSA. expert for fire protection.

In order to meet basic requirements of Health and Safety at Work and Fire Safety regulations, in course of designing stage the particular attention shall be paid to possibility of gases spreading in cover tubes of fibre optic cables, as well as flammability of line elements majority.

5.2 Components

5.2.1 Secondary conduit and pipelines

- Secondary conduit is laid along telecommunication primary conduit and in cable manholes. Its task is to protect fibre optic cables being pulled into it against mechanical damages.

- If primary conduit system on given section is missing, fibre optic cables shall be installed in cable pipelines made of polyethylene tubes, laid directly in ground.
- On trestle bridges or in so-called moguls, protecting tubes shall be laid in cable trays [p.2.2].

In order to provide adequate protection of cables, it is necessary:

- to lay pipelines on suitable depth,
- to lay warning band over the pipelines,
- to use protecting tubes in places of crossings or located next to other utilities equipment,
- to facilitate of pulling fibre optic cables in and out from cover tubes.
- to select carefully materials for building of secondary conduit and pipelines,
- to put only single cable in each tube.

For single cable fibre optic line, cable pipeline shall also contain reserve duct. In order to ensure long-life functionality, secondary conduit and cable pipelines shall be sealed both during building stage and operation stage. Such sealing shall be confirmed with protocols.

5.2.2 Fibre optic cables

Depending on environmental conditions, it is necessary to use cables of adequate construction.

- Outdoor cables – outside buildings (telephone conduit, cable trench, metal tray on pipe rack or in open duct)
- Station cables – inside buildings, in telecommunication premises.

By default, universal cable type (indoor/outdoor) shall be selected.

On the area of GLSA works, suspending of cables or laying of external [line] cables without cover tubes is not foreseen. In capacity of outdoor cables reinforced cables shall be used, for example with strengthening element (FRP rod) and aramide yarn.

Station cables can be:

- multi-fibre, when used for extending of line cables inside buildings,
- single- or double-fibre, when they constitute element of fibre optic cords

Station cables shall contain optical fibres of transmission parameters that are suitable for co-operation with optical fibres in line cables, for which they will serve as extensions. Lengths of fabricated sections shall result from project.

Multimode fibre optic cables with fibre diameter of 50 μm (OM3) are used in GLSA. Any deviation from the general rule shall be agreed in writing with GLSA

5.2.3 Optical fibres

Selection of number and types of fibres according to their unit attenuation and dispersion characteristic shall be done during design stage of line, when preparing power balance and determining necessary transmission bandwidth. Selection of number and types of optical fibres in the cable profile shall result from foreseen line destination and telecommunication traffic.

5.2.4 Cable joints

In a view of relatively short installation sections, joining of cables outside buildings is not foreseen.

5.2.5 Terminations

Each fibre shall be terminated at distribution frame. Task of this device is connecting of fibre optic tracks with station devices, as well as switching fibre optic paths between areas. Fibre optic distribution frames shall enable termination of cables containing fibres used for waves of various lengths and for transmission of various capacity. In the block of frame the area of connectors, the cable terminations' cassette and the storage area shall be distinguished.

Area of connectors is composed of line half-connectors and station half-connectors. Switching-over shall be executed with use of patchcords of such length, which enables accomplishing of each connection within frame. Cassettes for cables shall enable adapting and fastening of fibres from line and station cable sides, as well as arranging and fastening of fibre splices shields.

5.2.6 Safety at work

Distribution frames shall protect operating staff against accidental exposition to laser light action, by means of warning marks, and by closing of connectors when disconnecting them. For this reason connectors shall be installed skew on the frame area, and the frame blocks must be unequivocally marked with hazard symbols warnings, with inscription: UWAGA! NIEWIDZIALNE PROMIENIOWANIE LASEROWE!

5.3 Materials

5.3.1 HDPE tubes

For construction of secondary conduit and cable pipelines one shall use HDPE tubes. It is recommended to use tubes furnished with pre-installed pull-in cord or cable, as well as pre-lubricated tubes. Dimensions of tubes used for secondary conduit shall be 32/2mm. For cable pipelines construction, tubes of 32/2,9 mm dimensions shall principally be used.

5.3.2 Line cables

Basic type of cable shall be dielectric (d), loose-tube cable, both as duct cable and reinforced cable. Cores of cables shall be filled and water-proof. Cables shall contain optical fibres in loose tubes. Other types of dielectric cables, of equivalent quality, are also allowed. Placing of the same type of fibres but of different manufacture in single cable is not allowed. Each tube must contain optical fibres of the same type only.

Each fabricated cable section must be marked with manufacturer stamp, containing literal symbol of cable, manufacturer name and year of production, extruded or printed on external jacket. Cable marking shall specify running length of cable with 1,0 m spacing. Fabricated cable sections shall be coiled on drums made of metal or other materials of equivalent properties, which do not undergo distortions under influence of external factors, such as humidity, temperature variations, etc. Cable ends shall be protected against humidity penetration and fastened on drum in a way enabling easy access for testing of their transmission properties. During storage cables shall be protected against mechanical damages and impacts, as well as against direct sunlight and precipitations.

Each packaging shall be furnished with certificate that specifies cable type, number and type of optical fibres, their manufacturer, fabrication length of cable, unit attenuation, reflectometric charts, coefficient of optical elongation. Other data, such as cable profile, dispersion, etc., can also be required on request of Orderer.

5.3.3 Optical fibres

Parameters of fibres shall conform to ITU-T Recommendations and requirements of harmonized PN-EN standards.

5.3.4 Station cables

Cables shall contain fibres in tight tubes with buffering layer, of 0,9±0,1 mm in diameter. Station cables shall be made as unfilled. Single and dual fibre cables do not require internal coating. For multi-fibre station cables, polyethylene internal coating can be used. The cables shall have strengthening layer made of aramide yarn. External jacket of station cable shall be made of halogen-free plastic, preventing fire spreading.

Temperature requirements:

- operating temperature range: -10°C to +60°C
- temperature range during installation 0°C to +50°C
- storage temperature range -30°C to +60°C

Section of single-fibre station cable of 30 m length, under tensile force of 150 N acting during 5 min, shall not reveal attenuation change of more than 0,2dB. After withdrawal of tensile force action, change of attenuation shall also withdraw with 0,05 dB accuracy.

Station cables containing fibre optics shall be colour coded as follows:

- single-mode Js - yellow
- single-mode Jp - red
- single-mode Jn - red
- multi-mode G5 - orange
- multi-mode G6 - green

Multi-mode station cables shall be delivered in lengths resulting from project requirements.

1- and 2- fibre station cables can be delivered as pigtails or patchcords in lengths resulting from project, and packed together with fibre optic connectors.

5.3.5 Storage boxes

Minimum capacity of 30 m. Mounted next to joint closure (muffs). Furnished with durable nameplate, conforming to designations adopted in GLSA.

5.3.6 Joint closures

Construction of joint closures shall ensure easy arrangement of all optical fibres inside (together with their reserves), while not exceeding allowable bend radius of fibres. Joint closures located over ground shall be resistant to direct sunlight action, or placed in cable boxes adapted for this purpose. Joint closures shall enable repeated opening, as well as outputting branch cables without need for cable cutting and preparing new connections of fibre optics, and without need for replacing of whole jointing fixtures. It is recommended to use joint closures with single-side cable entry, sealed with thermo-shrinkable bands and thermo-fusible adhesive.

5.3.7 Distribution frames

- Construction

Construction shall enable its installation in rooms adapted for this purpose. Made of metal, in protective anti-corrosion coatings. Metal structure shall be earthed. Distribution frame shall enable easy entry of line cables and their pigtails, as well as quick detection and location of defects of fibre optic tracts and terminating or feed through devices, by connecting of measuring instruments to them. Construction of patch panel shall enable fastening of cables and routing them in way that ensures allowable bend radiuses of cables and fibres. Boxes and cabinets of distribution frames shall be equipped with doors.

- Capacities

Box-type fibre optic frame shall enable termination and switching of six (6) fibres at least. Patch panel of 19-inch standard shall enable termination and switching of sixteen (16) fibres at least. Fibre optic patch panel shall be mounted in 19" rack (hang or standing cabinet). Use of other optical fiber distribution frames or/and patch panel requires in any case GLSA written approval.

- Equipment

Number of connectors in block shall correspond to capacity of brought in fibre optic cables. Connectors shall be durably marked and described in block card of the frame. For both cable types LC type connections shall be used. For single-mode cables SC standard connectors shall be used. For multi-mode cables connectors of ST standard shall be used. Expansion of existing distribution frames shall be made with application of connectors used up to now, particularly of FC/PC standard.

Cassettes shall be made of hardly flammable, halogen-free material, of dimensions enabling arranging of fibre optics reserves at bend radiuses not less than 35 mm. The cassette shall be easily accessible during assembling of junctions and arranging of reserves. Field of reserves shall enable arrangement of station cables in lengths enabling free execution of assembly and installation works.

- Environment requirements

Closed rooms, ambient temperature from +5°C to 40°C, relative humidity not greater than 80% at 20°C, and not greater than 90% at temperature exceeding +30°C. Packed equipment shall withstand transport conditions at ambient temperature –30°C to +60°C and relative humidity up to 98%.

- Labelling

Frame shall be furnished with nameplate specifying its producer, year of production, as well as type designation and capacity. On connector field strip, numbering field shall be present. Frame shall be furnished with durable designation plate conforming to marking scheme adopted in GLSA.

5.4 Construction of lines

5.4.1 Cable ways

Construction of lines is possible only after primary conduit, completion of trenches for pipelines, and supporting structures for cables, such as ladders, trays, etc. have been made available. Such elements shall meet requirements set in Specification N° 3730.

It is required to check occupancy and patency of primary conduit openings indicated in project. It is also required to check technical conditions of cable manholes as well as completeness of fixtures installed in them. Routes, selection and fastening of trays on pipe racks and in open ducts are also to be checked. Particular attention shall be paid on:

- adaptation of rooms for distribution frames
- crossings of lines with terrain utilities elements
- protections at entrances into buildings
- execution of cable shafts and ducts

5.4.2 Cable conduit and pipelines

Bundles of 2 to 4 cover tubes are to be pulled into free openings of primary conduit. Use of openings partially occupied by other cables is allowable. Tightness of conduit and pipelines shall be provided by means of adequate materials and accurate assembling, with use of sealing materials. This applies to all tubes, both for cables and reserved. Therefore cover HDPE tubes shall be laid at temperature not

lower than –5°C. In case of works execution at lower temperature, adequate heating of tubes shall be provided.

Cable storage boxes shall be installed in indicated manholes or special containers. Tubes brought into manholes or containers shall be sealed, and manner of assembly shall ensure protection of their interior against sludging. Location of storage boxes (containers) shall be adequately marked at the site.

5.4.3 Pipe racks/ducts

Fibre optic lines on pipe racks and in cable ducts, which are located outside of explosion hazardous area, shall by led in polyethylene protective tubes placed in cable trays. The method shall be avoided inside explosion hazardous area. Inside explosion hazardous area strengthen fibre optic cables for outdoor applications shall be placed directly in cable trays.

5.4.4 Testing of cables

Prior to attempting to installation and assembly works, all fabricated sections of cables shall be subjected to detailed external visual inspection for damages. One shall check proper protection of cable ends against moisture penetration, as well as protections against damages of cables themselves on drums, with attention paid also to cable bends with too small radius.

One fabricated cable section, randomly selected from cable lot shall be tested, which includes:

- visual inspection with measurement of external diameter and elipticity of cable,
- optical continuity and unit attenuation.

If improper cable handling prior to its delivery on site is suspected, then reflectometric measurements of the cable for conformity to manufacturer's documentation are necessary. A lot can be acknowledged as conforming to requirements, if testing results are positive. Even though single negative result is obtained, testing procedure shall be repeated on doubled number of samples, with execution of these tests which results were negative in previous test. Should next negative result is obtained; the cable lot shall be considered as not conforming to requirements of specification.

5.4.5 Allocation of cables

It is necessary to set installation sequence of individual cable sections, both as for cable types intended for specific sections in line, and for length of installation sections. Therefore it is necessary to check lengths and construction of cables in order to confirm their consistency with design documentation.

5.4.6 Assembly of distribution frames

Prior to installing, delivered distribution frames shall be visually inspected for mechanical strength, completeness of housing and supporting structure, aesthetics, lack of sharp edges, quality of protective coatings. A frame shall be considered faulty even though single improper element has been found in result of inspection. Line cables brought into the frame shall be marked with record number of line, according to Specification N° 6120. Pigtails shall be marked during assembly with numbers of fibres by means of tags placed next to connectors and fixed junctions. Patchcords shall be marked during assembly with working numbers by means of tags placed on both ends. Complete information about connections within the frame shall be placed on inner side of the door.

5.4.7 Measurements of single-mode cables

After full completion of lines' assembly, in order to obtain reflectometric diagrams it is necessary to perform reflectometric measurements on all fibres for 1310 nm and 1550 nm wavelengths, from both sides of section between fibre optic patch panels. Splices revealed during measurements, which do not meet requirements, shall be corrected. Reflectometric measurements on assembled line shall enable determination of :

- total optical length of line,
- total attenuation of line,
- unit attenuation of whole line and its component sections,
- attenuation of connections.

5.4.8 Measurements of multi-mode cables

During testing of cabling it is necessary to measure transmission parameters, showing ability to transmission of 10/100/1000 Mbps signals. Reflectometric measurements are not planned. Only measurement of unit attenuation and length of optical tracts for compliance with project is required. All measurements are to be done bidirectional. Cumulative report, containing results of measurements for all member fibres in cable, shall be elaborated.

5.5 Acceptance of lines

5.5.1 Measurements of single-mode cable

Following measurements shall be performed on assembled fibre optic section:

- measurements of transmission parameters of optical paths with reflectometric method
- measurements of resultant attenuance of paths with transmission method
- measurement of fibre optic joints reflectance.

On technically justified request of GLSA services, it is foreseen to perform measurement of chromatic dispersion factor of optical fibres in completed line, in order to calculate real transmission band. Full range of measurements is performed for each optical path being put in operation. Measurements of reflectance are not conducted on reserve fibres.

For each optical fibre within installation section, it is necessary to measure attenuance between fibre optic distribution frames. The measurement shall be done for both optical bands, i.e. 1310 nm and 1550 nm, in both directions of transmission. Purpose of this measurement is checking of joint attenuance of cable along with separable joints, and confirming of compliance with calculated power balance, resulting from project. Measuring eqipment shall contain stabilized light source generating 1310±20 nm and 1550±20 nm waves, at spectral width (FWHM) < 10 nm.

Measurements of resultant transmisson band of optical path are performed during acceptance tests of completed optical fibre line, if required transmission band is wider than half of band theoretically calculated for specific path. This measurement boils to measurement of averaged value of chromatic dispersion coefficient.

Measurement of separable joint reflectance allow for estimate of connections' correctness, especially those located close to laser light source. This measurement can be completed by means of reflectometer or with use of directional coupler.

5.5.2 Measurements of multi-mode cables

Attenuance of 10% of fibres shall be checked for compliance with reports submitted by Contractor. Design can foreseen other percentage of pathes to be checked within acceptance measurements.

5.5.3 Acceptance tests

The tests, led by technical services of contractor and GLSA supervision, consist in checking of lines completion compliance with requirements contained in technical documentation, with consideration to changes and additional agreements. Protocols of technical tests, along with other documents stating compliance of lines completion with requirements, constitute grounds for submitting lines to commissioning. Mode of commissioning execution results from regulations of building law.

5.5.4 Test results evaluation

Optical fibre line submitted to testing can be acknowledged as completed according to requirements of this specification, if tests performed according to 4.5.1, 4.5.2 and 4.5.3 points have given positive results. The elements, which in result of tests have been given negative assessment, shall be corrected or replaced, and then re-submitted for acceptance.

5.5.5 As-built documentation

In process of acceptance, Orderer shall obtain:

- Design documentation of lines with changes made to it,
- Factory documentation of cables, distribution frames and fixtures
- Declarations of conformity issued by manufacturer or suppliers
- Protocols of measurements (including reflectometric ones)
- Detailed drawings with designations of optical fibre lines.

6 Relevant documents

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

7 Standards and regulations

It is in each case understood that quoted standards, regulations, directives and orders are of their latest editions, along with amendments, annexes and supplements in force.

7.1 Building regulations

LAW of July 7th 1994, Building law (Dz.U. 1994 nr 89 poz. 414).

1. Dz.U. 1996 nr 103 poz. 477 - Minister of National Defence order of August 2nd 1996, on technical conditions that building objects other than buildings, serving State defence, and their location should adhere to.
2. Dz.U. 2005 nr 243 poz. 2063 as amended - Minister of Economy order of 21 November 2005 r. on technical conditions that liquid fuels bases and stations, far-reaching pipelines for petroleum and petroleum products transport, and their location should adhere to.
3. Dz.U. 2005 nr 243 poz. 2063 as amended - Minister of Economy order of July 30th 2001, on technical conditions that gas networks should adhere to.
4. Dz.U. 2012 nr 0 poz. 462 - Minister of transport, construction and maritime economy order of 25 April 2012, on detailed scope and form of building project.
5. Dz.U. 2012 nr 0 poz. 463 - Minister of transport, construction and maritime economy order of 25 April 2012, on establishment of geotechnical conditions of building objects foundation.
6. Dz.U. 1995 nr 25 poz. 133 - Minister of Spatial Economy and Building of February 21st 1995, on type and scope of geodetic and cartography studies as well as geodetic actions in force in building industry.
7. Dz.U. 2002 nr 108 poz. 953 as amended - Minister of Infrastructure order of June 26th 2002 on building, erection and dismantling register, information board and advertisement containing data regarding safety at work and protection of health.
8. Dz.U. 2003 nr 132 poz. 1231 - Minister of Infrastructure order of June 23rd 2003, on model of obligatory inspection protocol.
9. Dz.U. 2003 nr 120 poz. 1134 - Minister of Infrastructure order of July 3rd 2003, on building object register.

10. Dz.U. 2003 nr 120 poz. 1130 - Minister of Infrastructure order of June 23rd 2003, on model and method of keeping record of building objects being started and put to use.

LAW of April 16th 2004 on building products (Dz.U. 2004 nr 92 poz. 881)

11. Dz.U. 2004 nr 195 poz. 2011 - Minister of Infrastructure order of August 11th 2004, on compliance assessment systems, requirements that notified bodies participating in compliance assessment should adhere to, as well as method of building products marking with CE mark.
12. Dz.U. 2004 nr 237 poz. 2375 - Minister of Infrastructure order of October 14th 2004, on European technical approvals and Polish entities authorised to issuing them.
13. M.P. 2004 nr 32 poz. 571 - Minister of Infrastructure announcement of July 5th 2004, on schedule of mandates granted by European Commission on elaboration of European harmonized standards, as well as guidelines to Europeans technical approvals, along with object scope of these mandates.
14. M.P. 2004 nr 48 poz. 829 - Minister of Infrastructure announcement of May 18th 2011, on schedule of organizational bodies of European Union Member States authorized to issuing of European technical approvals, as well as schedule of guidelines to European technical approvals.
15. Dz.U. 2004 nr 198 poz. 2041 - Minister of Infrastructure order of August 11th 2004, on methods of building products compliance declaring as well as method of marking them with building mark.
16. Dz.U. 2004 nr 249 poz. 2497 as amended - Minister of Infrastructure order of November 8th 2004, on technical approvals and organizational bodies authorized to issuing them.
17. Dz.U. 2011 nr 87 poz. 486 - Minister of Infrastructure order of April 8th 2011, on method of keeping National Registry of Questioned Building Products.
18. Dz.U. 2009 nr 144 poz. 1182 - Minister of Infrastructure order of September 2nd 2009, on checking of building products that are introduced into turnover.
19. Dz.U. 2011 nr 23 poz. 122 - Minister of Infrastructure order of January 25th 2011, on samples of building products that are introduced into turnover.

7.2 Polish Standards

Polish Standards, regarding telecommunication line elements have been specified, excluding standards connected with manufacturing of optical fibres and cables.

Item	Standard N°	Title of standard
1.	PN-EN 50377-2-1	Connector sets and interconnect components to be used in optical fibre communication systems - Product specifications - Part 2-1: Type FC-PC terminated on IEC 60793-2 category B1 singlemode fibre
2.	PN-EN 50377-6-2	Connector sets and interconnect components to be used in optical fibre communication systems. Product specificationsSC-RJ single mode terminated on IEC 60793-2-50 category B1.1 and B1.3 singlemode fibre, category U
3.	PN-EN 60794-1-1	Optical fibre cables -- Part 2: Indoor cables - Sectional specification
4.	PN-EN 60794-1-2	Optical fibre cables -- Part 1-2: Generic specification - Basic optical cable test procedures
5.	PN-EN 60794-2 (all parts)	Optical fibre cables -- Part 2: Indoor cables - Sectional specification
6.	PN-EN 60794-3 (all parts)	Optical fibres cables -- Part 3: Sectional specification - Outdoor cables
7.	PN-EN 60825-2	Safety of laser equipment. Part 2: Safety of optical fibre communication systems.
8.	PN-EN 60869-1	Optical fibre attenuators. Part 1: General specification.

9.	PN-EN 60874-1	Connectors for optical fibre and cables. Part 1: General specification.
10.	PN-EN 60874-1-1	Fibre optic interconnecting devices and passive components - Connectors for optical fibres and cables - Part 1-1: Blank detail specification
11.	PN-EN 60874-17	Connectors for optical fibre and cables. Part 17: Specification of optical fibre connector. F-05 type.
12.	PN-EN 60874-19	Connectors for optical fibre and cables. Part 19: Type specification of optical fibre connector. SC-D(uplex) type.
13.	PN-EN 60875-1	Wave-nonselective optical fibre branching elements. Part 1: General requirements.
14.	PN-EN 60876-1	Optical fibre spatial switches. Part 1: General specification.
15.	PN-EN 61073-1	Mechanical splices and fusion splices shields for optical fibres and cables. Part 1: General specification.
16.	PN-EN 61202-1	Optical fibre insulators. Part 1: General specification.
17.	PN-EN 61269-1	Optical fibre terminations. Part 1: General specification.
18.	PN-EN 61269-1-1	Optical fibre terminations. Part 1-1: Preliminary detailed specification.
19.	PN-EN 61274-1	Optical fibre adapters. Part 1: General specification.
20.	PN-EN 61274-1-1	Optical fibre adapters. Part 1-1: Preliminary detailed specification.
21.	PN-EN 61280-4-1	Basic procedures for optical fibre telecommunication sub-systems testing. Part 4-1: Cable networks and lines. Measurement of multi-mode optical fibre cable lines attenuation.
22.	PN-EN 61280-4-2	Basic procedures for optical fibre telecommunication sub-systems testing. Part 4-2: Optical fibre cable networks. Attenuation of single-mode optical fibre cable lines.
23.	PN-EN 61281-1	Optical fibre telecommunication systems. Part 1: General specification.
24.	PN-EN 61313-1	Optical fibre passive elements and cables. Part 1: Functionality acceptance. General specification.
25.	PN-EN 61314-1	Optical fibre output load capacity. Part 1: General specification.
26.	PN-EN 61314-1-1	Fibre optic fan-outs. Blank detail specification
27.	PN-EN 61315	Calibration of optical fibre power meters
28.	PN-EN 61663-1	Lightning protection. Telecommunication lines. Part 1: Optical fibre systems.
29.	PN-EN 61744	Calibration of optical fibre sets for chromatic dispersion testing
30.	PN-EN 61746	Calibration of optical reflectometers working in time domain (OTDR).
31.	PN-EN 61753-1-1	Operating standard of optical fibre connectors and passive elements. Part 1-1: General specification and manual. Connecting elements (junctions).
32.	PN-EN 61754-1	Optical fibre interfaces. Part 1: General information and introduction.

33.	PN-EN 61754-4	Optical fibre interfaces. Part 4: SC type connectors family.
34.	PN-EN 61754-4-1	Fibre optic connector interfaces. Type SC connector familySimplified receptacle SC-PC connector interfaces
35.	PN-EN 61754-13	Optical fibre interfaces. Part 13: FC-PC type connectors family

7.3 Recommendations of ITU-T

Below given regulations apply to network parameters, so as to completed networks ensure adequate quality of telecommunication services.

Transmission media - Characteristics. Recommendations:

G.650 Definition and test methods for the relevant parameters of single-mode fibres

G.651 Characteristics of multimode graded index fibre optic cable.

G.652 Characteristics of a single-mode fibre optic and cable

G.653 Characteristics of a dispersion-shifted single-mode fibre optic and cable

G.654 Characteristics of a cut-off shifted single-mode fibre optic and cable

G.655 Characteristics of a non-zero dispersion shifted single-mode fibre optic and cable

8 Enclosures

- Enclosure 1. Requirements for fibre optic cables
- Attachment 2. Block diagram of GLSA single-mode ring - example
- Attachment 3 Part I and II. Block diagram of GLSA multi-mode ring - example

9 Record of changes

No.	Date	Description	Introduced by
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

Category of fibre in cable	Maximal attenuation [dB]			
	850 nm	1300 nm	1310 nm	1550 nm
OS1	-	-	1,0	1,0
OS2	-	-	0,4	0,4
OM1	3,5	1,5	-	-
OM2	3,5	1,5	-	-
OM3	3,5	1,5	-	-
OM4	3,5	1,5	-	-

Category of fibre in cable	Minimal modal band length [MHz x km]		Length of wave cut-off	
	850 nm	1300 nm	1310 nm	1550 nm
OS1	-	-	< 1260 nm	
OS2	-	-	< 1260 nm	
OM1	200	500	-	-
OM2	500	500	-	-
OM3	1500	500	-	-
OM4	3500	500	-	-

NOTES:

- Fibre parameters according to standard PN-EN 60793
- Mechanical and environmental requirements according to standard PN-EN 60794

Cables with fibres of other categories may be use exceptionally.