

GENERAL SPECIFICATION

TELECOMMUNICATIONS

GS EP TEL 191

Telecom Fibre Optic System Design

04	05/2015	Organisation change – January 2015
03	10/2013	Standards update (ITU G.657) and corrections
02	10/2009	Title modification, and withdrawn cable route specification
01	10/2008	Standards update and corrections
00	10/2006	First issue
Rev.	Date	Purpose of the revision

Document update realised by
standards coordination
Reorganisation 2015

Owning entity: SG/SI

Managing entity: SG/SI/AFT

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1. Scope

The present specification shall allow Contractor to design telecom fibre optic systems according to Company needs. Main requirements for cable and terminal equipment design, supply and installation are pointed out. Contractor shall detail each point at bid and design stages.

For telecom offshore fibre optic cable installation refer to **GS EP TEL 190**.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
CISPR 22	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
ETSI EN 300 386	Electromagnetic compatibility and Radio spectrum Matters (ERM); Telecommunication network equipment; ElectroMagnetic Compatibility (EMC) requirements
IEC 60331	Fire resisting characteristics of electrical cables
IEC 61000-4	Electromagnetic Compatibility (EMC) Part 4: Testing and Measurement Techniques
IEC 60079-28	Protection of equipment and transmission systems using optical radiation
ITU-T G.651	Characteristics of a 50/125 µm multimode graded index optical fibre cable
ITU-T G.652	Characteristics of a single-mode optical fibre and cable
ITU-T G.653	Characteristics of a dispersion-shifted single-mode optical fibre and cable
ITU-T G.654	Characteristics of a cut-off shifted single-mode optical fibre and cable
ITU-T G.655	Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable
ITU-T G.657	Characteristics of a bending-loss insensitive single-mode optical fibre and cable for the access network
ITU-T G.694.2	Spectral grid for WDM application: CWDM wavelength grid
ITU-T G.695	Optical interfaces for coarse wavelength division multiplexing applications

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Reference	Title
ITU-T G.702	Digital Hierarchy Bits Rates
ITU-T G.703	Physical/Electrical Characteristics of Hierarchy Digital Interfaces
ITU-T G.704	Structure of the synchronous frame
ITU-T G.706	Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in G.704
ITU-T G.707	Network Node Interface for Synchronous Digital Hierarchy (SDH)
ITU-T G.711	Pulse code modulation (PCM) of voice frequencies
ITU-T G.712	Transmission Performance Characteristics of PCM Channels
ITU-T G.773	Protocol suites for Q-interfaces for management of transmission systems
ITU-T G.783	Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks
ITU-T G.784	Synchronous digital hierarchy (SDH) management
ITU-T G.785	Characteristics of a flexible multiplexer in a synchronous digital hierarchy environment
ITU-T G.803	Architecture of transport networks based on the synchronous digital hierarchy (SDH)
ITU-T G.805	Generic functional architecture of transport networks
ITU-T G.811	Timing characteristics of primary reference clocks
ITU-T G.813	Timing characteristics of SDH equipment slave clocks (SEC)
ITU-T G.823	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy
ITU-T G.825	The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)
ITU-T G.826	End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections
ITU-T G.828	Error performance parameters and objectives for international, constant bit rate synchronous digital paths
ITU-T G.872	Architecture of optical transport networks
ITU-T G.911	Parameters and calculation methodologies for reliability and availability of fibre optic systems
ITU-T G.957	Optical interfaces for equipments and systems relating to the synchronous digital hierarchy
ITU-T M.3010	Principles for a Telecommunication Management Network
ITU-T M.3100	Generic Network Information Model

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP EXP 101	Pre-commissioning and Commissioning specification
GS EP EXP 103	Pre-commissioning and Commissioning Engineering
GS EP EXP 105	Pre-commissioning Execution
GS EP EXP 107	Commissioning Execution
GS EP TEL 180	Telecommunication network pre-cabling
GS EP TEL 190	Offshore optical fibres based telecommunications
GS EP TEL 700	Telecommunications Engineering services

3. Network Architecture

The network architecture shall be adapted to Company requirements, in terms of:

- Application interface and bit rate
- Availability and confidentiality of data stream
- Flexibility of the network
- Use of existing infrastructure.

The optical transport network architecture shall comply with [ITU-T G.803](#), [ITU-T G.805](#) and [ITU-T G.872](#).

SDH technology shall be preferred to multiplex and transport traffic between independent Company sites over a shared backbone. Other solutions may be proposed for dedicated fibre interconnection of sites.

Aggregate interface base case capacity shall be 10 Gb/s per production site.

3.1 Application interface

According to Company needs, the traffic ports shall be:

- PDH E1 (2.048 Mb/s)
- Data RS232, RS422 or RS485 interfaces
- Voice interfaces (analog or digital interface)
- Ethernet (10/100 Mb/s) and Gb/s Ethernet
- Video Interface (PAL, NTSC, MPEG...).

Or any other interface according to project specific requirements.

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3.2 System Availability

Contractor shall guarantee **99.999%** availability on the network.

System lifetime shall be at least 25 years, with required availability. The parameters and calculation methodologies for reliability and availability of fibre optic systems shall comply with [ITU-T G.911](#) standard.

3.3 Network topology

According to Company requirements and local constraints, the following architecture shall be proposed for the network:

- Linear or point-to-point
- Ring Topology
- Meshed Network.

3.4 Network Protection

According to the topology, Contractor shall describe the network protection used (SNCP, MSP, optical transport layer protection mechanism...).

Protection mechanism shall be described (optical switching time, fibre pairs or wavelength dedicated to protection, possibility to carry low priority traffic on protection fibres, single or multi-failure behaviour...).

3.5 Network Security

Contractor shall issue a data security, and confidentiality plan, when on a third party shared infrastructure.

3.6 System Synchronisation

Contractor shall provide all necessary GPS Primary Reference Clocks (PRC), Synchronization Source Units (SSU), and Timing Distribution Units necessary to maintain the [ITU-T G.811](#) quality integrity of the network using 2Mbits clock output.

Contractor shall ensure a stable synchronization source for the network segments during a loss of the PRC synchronization/timing signal:

- All equipment shall be able to switch automatically to a correct synchronisation source
- Each equipment shall have at least two synchronisation sources.

In case of failure of both synchronisation sources, SDH equipment shall be able to maintain a [ITU-T G.813](#) timing quality, should SDH architecture be used.

Alarms of synchronous elements must be deported to SDH nodes through dry contacts. Alarm cables must be connected to terminal blocks on the MDF.

3.7 System Performance

System performance shall comply with [ITU-T G.826](#) and [ITU-T G.828](#).

The error performance of a trunk is to be specified and measured at all available bit rates (10 Gb/s, 2.5 Gb/s or 2 Mb/s levels) to be consistent with the method of monitoring error performance of an SDH/PDH signal.

The system shall be designed to guarantee a maximum bit error rate of 10^{-9} over the system life.

The System shall provide a jitter and wander performance that shall meet the objectives outlined in ITU Recommendations [ITU-T G.813](#), [ITU-T G.825](#) on STM-N interfaces, and [ITU-T G.823](#), [ITU-T G.783](#) on PDH interfaces.

4. Optical System Design

4.1 Communication Distances

Communications distances shall define the need for a repeated, or non repeated system.

Lengths	Amplification	WDM	Bit Rate
0 - 150 km	No	Almost unlimited	10 Gb/s per λ
150 - 300 km	In terminal stations	16 λ or 32 λ	10 Gb/s per λ
300 - 550 km	Without repeaters, but with optical amplifiers	16 λ or 32 λ	10 Gb/s per λ down to 155 Mb/s per λ
> 550 km	Repeaters required	16 λ or 32 λ	10 Gb/s per λ

Unrepeated systems, which are much easier to install and maintain, shall therefore be preferred over repeated system.

4.2 Optical power budget

The system design shall comply with the system power budget.

The power budget shall take into account and detail assumptions for:

- Fibre attenuation, splice losses, connectors losses
- Interface output power and sensitivity, wavelength number, in-line equipment quantity (Repeaters, BU)
- System ageing
- System repairs (Terrestrial network shall be designed for a Cable Repair Margin of 3.0 dB on all optical segments within the network. Cable repair margin for submarine systems shall be detailed according to segment cable length and water depth)
- Existing infrastructure optical fibre characteristics
- 1 dB End-of-Life margin
- FEC improvement
- Final capacity of the network.