Tata Steel Technical Standard
S2651001 Supply, Erection and commissioning of network infrastructure cabling (fiber optics & copper)

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Information and changes

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1 Introduction

1.1 General

This document describes the technical requirements for the supply, erection and commissioning of network infrastructural cabling and related passive network components like cabinets and connection facilities. The requirements are based on official standards and best practices on the market and aims to be supplier and support independent. From the norms and standards specified the latest version will be applicable.

1.2 Scope

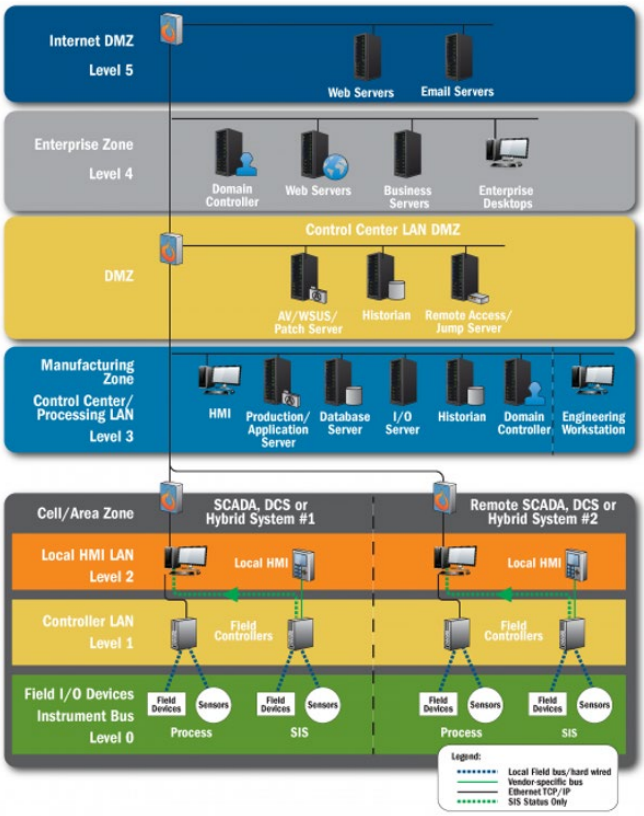
The defined technical requirements are applicable for all network cabling and passive connection components, for automation, computer and/or CCTV applications, in office as well as production environment. Depending on the environment different requirement can apply.

Within TATA steel this cabling infrastructure is configured in levels as shown below (as per IEC 62443).

Within a Works Unit of Tata Steel IJmuiden the following separate networks exists:

- Level 0-2 : Installation network, covering instrumentation, machine automation (PLC's/DCS) and operator interface (SCADA/HMI)
- Level 3: Production network (IJMProd, CCTV) covering order management, logistic, scheduling etc.
- Level 4-5: Office network

These 3 defined groups are physically separated networks within TATA Steel. This implies each group has its own infrastructure and routers/switches



IEC 62443 Reference model

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1.3 Process

The cabling infrastructure is managed within Tata Steel IJmuiden by TSN-IT Network & Voice Services, so support can be guaranteed after handover. Installation contractor or work unit will hand-over the fiber installation documentation according to the TSIJ requirements to TSN-IT Network & Voice Services. This means that during the start of project or extension of the cable infrastructure this department must be contacted to align:

- This standard
- Topology
- Registration of the components (like cable number, cabinet number, fiber number, etc.)

Third party contractors are not allowed to make extensions to cabinets or cables in the existing infrastructure.

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2 Cabling regulations

All newly installed data cabling (fiber optic and copper) must be in accordance with the Construction Product Regulations (CPR) standards. In the Netherlands the NEN 8012-1 / NEN 8012-2 standard must be followed. In short, this standard describes the characteristics of a cable in regards to its reaction to fire and its resistance to fire.
As of July 1 2016, cables need to have a CE marking and a Declaration of Performance (DoP).

3 Fiber Optic Cable Requirements

3.1 Definitions

3.1.1 Cable construction types (see appendix 2)

Fiber optic cabling can be divided in the following types:
Infrastructural cabling (on campus between buildings (CD–BD) and within buildings (BD-FD))
Infrastructural cables are defined as fiber optic cabling between cabinets, routed inside and/or outside through (different) rooms/areas.
Floor cabling (short distance within buildings on floors (FD-ID)
Floor cables are defined as fiber optic cabling installed in dedicated cable routing between cabinets in one room (mostly) like an E-room or server room.
Patch cords
Patch cables are defined as fiber optic cabling inside cabinet(s) between different active or passive components (like patch panels and switches, preferably inside the same cabinet)

3.1.2 Fiber types

Two fiber optic types exist:
Multimode Fiber (MM)
MM is used for relatively short distances, up to 550m.
Singlemode Fiber (SM)
SM is used for distances up to 80km.

3.2 Cable construction Requirements

3.2.1 Infrastructural / Floor Cabling

- Loose tube, maximum of 12 fiber per inner tube
- Longitudinally and transversely waterproof according IEC 60794-1-22 F5B
- Meets at least CPR classification cca, s1a, d1, a1 (EN 50575 / NEN 8012-1 / NEN 8012-2) when used indoor
- Halogen-free according IEC 60754-1
- Min. tensile Load (N) 1800 (operation)/3200 (installation) according IEC 60794-1-21 E1
- Min. long term Crush (N/10cm) 2000 according IEC 60794-1-21 E3
- Suitable for a temperature range of -20°C to +70°C during operation
- Totally dielectric
- Rodent protection
- UV resistant
- Predicted lifetime of > 30 years

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3.3 Fiber Optic Requirements

3.3.1 Multimode Fiber requirements

- Core material: Silica (50/125 µm)
- Capable to transport maximum data speeds / performance of 10Gbps
- Suitable for wavelengths between 850 nm & 1300 nm
- Meet IEC 11801 3rd edition class 50/125 OM3 / EN 50173-3 standard
- Meet IEC 60793-2-10, OM3 multimode quality standard
- Attenuation coefficient of max. 2,8 dB/km (at 850 nm)
- Attenuation coefficient of max. 0,7 dB/km (at 1300 nm)
- Core coating according the KPN colour code (see appendix 1)

3.3.2 Singlemode Fiber requirements

- Core material: Silica (9/125 µm)
- Capable to transport data speeds / performance of 10Gbps
- Suitable for wavelengths between 1310nm & 1550 nm
- Meet IEC 60793-2-50, class B1.3 or ITU G.652.D OS2 Product specification
- Meet the fiber attributes of ITU-T primary G.657.A1 or higher, secondary G.652.D
- Attenuation coefficient of max. 0,35 dB/km (at 1310 nm)
- Attenuation coefficient of max. 0,22 dB/km (at 1550 nm)
- Core coating according the KPN colour code (see appendix 1)

3.3.3 ZIP Cords

Outer casing	Color	Thickness
- Multimode OM2	Orange	3mm
- Multimode OM3	Turquoise	3mm
- Singlemode G.652.D	Yellow	3mm

3.4 Connections

3.4.1 End-to-end fiber connections

End-to-end fiber connections do not contain patch cables between patch panels. If a fiber connection consists of multiple cables, an intermediate cabinet with splice facilities needs to be used.

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3.4.2 Connectors

Multimode

For Multimode (MM) floor cabling (FD-ID, see appendix 2) Ultra Physical Contact (UPC) Straight Tip (ST) type connectors shall be used on both ends meeting following requirements:

Insertion Loss (IL)	typ 0,25 dB (in accordance with IEC 61300-3-4 / Grade-B)
Return Loss (RL)	50 dB (in accordance with IEC 61300-3-6 / Grade-2)

Color of a ST connector is beige.

Singlemode SC

For singlemode (SM) building backbone cabling and floor cabling (BD-FD-ID, see appendix 2) Ultra Physical Contact (UPC) Subscriber Connector (SC) type connectors shall be used on both ends meeting following requirements:

Insertion Loss (IL)	typ 0,2 dB (in accordance with IEC 61300-3-4 / Grade-B)
Return Loss (RL)	typ 50 dB (in accordance with IEC 61300-3-6 / Grade-2)

Color of a SC connector is blue.

Singlemode E2000

For singlemode (SM) campus backbone cabling (CD-BD, see appendix 2) Angled Physical Contact (APC) Subscriber Connector (E200) type connectors shall be used on both ends meeting following requirements:

Insertion Loss (IL)	typ 0,15 dB (in accordance with IEC 61300-3-4 / Grade-B)
Return Loss (RL)	min 70 dB (in accordance with IEC 61300-3-6 / Grade-2)

Color of a E2000 connector is green.

3.4.3 Pigtails

General

- Quality: Grade-B
- Pre-fabricated (cores including connectors)
- Connections between cable fibers and pigtails shall be executed by fusion splicing

Multimode

- Fibers in accordance with 3.3.1
- Connectors in accordance with 3.4.2

Singlemode

- Fibers in accordance with 3.3.2
- Connectors in accordance with 3.4.2

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4 Copper Cable Requirements

4.1 Definitions

4.1.1 Cable types (appendix 2 as reference)

Copper cabling can be divided in the following types:

Industrial cabling (within buildings (FD-TO))

Industrial cables are defined as copper cabling installed in dedicated cable routing inside an industrial environment and as such subjected to moisture, heat, mechanical stress etc.

Office cabling (short distance within buildings on floors (ID-CP-TO)

Office cables are defined as copper cabling installed in dedicated cable routing used inside an office environment and application.

Patch cabling

Patch cables are defined as copper cabling inside cabinet(s) between different active or passive components (like patch panels and switches, preferably inside the same cabinet).

4.2 Cable Requirements

4.2.1 General requirements

- Core material: Stranded bare copper
- Number of cores : 8
- Core diameter at least AWG24
- Per 2 cores twisted to a pair
- 4 pairs in separating element
- Foil shielded (FTP)
- Cat. 6a according ANSI / TIA-568-C.2
- Meets at least CPR classification cca, s1a, d1, a1 (EN 50575 / NEN 8012)
- Halogen-free according IEC 60754-1
- Suitable for a temperature range of 0°C to +40°C during operation (office requirement)
- Predicted lifetime of > 30 years

4.2.2 Additional Copper Patch Cabling

- Pre-fabricated (cable including connectors)
- Self-extinguishing according IEC 60332-1-2
- Halogen-free according EN 50267 (IEC 60754)
- Low smoke emission according IEC 61034-1
- Suitable for a temperature range of 0°C to +40°C during operation (office requirement)

4.2.3 Additional Industrial requirements

- Shielded
- Additional mechanical reinforced
- Oil and heat resistant where applicable
- UV resistant
- Suitable for a temperature range of -20°C to +80°C during operation

4.2.4 Connectors

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- RJ45 (Male)
- Cat. 6a according ANSI / TIA-568-C.2
- Pin assignment 1:1 acc. TIA 568B (includes the color coding)

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5 Passive Component requirements

5.1 Patch Cords

- Pre-fabricated (cable including connectors. For connectors see 3.4.2)
- ZIP cord (specifications see 3.3.3)
- Dry (gel-free)
- Totally dielectric
- Non – metallic
- Self-extinguishing according IEC 60332-1-2
- Halogen-free according EN 50267 (IEC 60754)
- Low smoke emission according IEC 61034-1:2006
- Suitable for a temperature range of 0°C to +40°C during operation

For patch cords multiple connector combinations can be applicable. A multimode patch cable has an ST connector on the patch panel side.

For patch cords multiple connector combinations can be applicable. A single mode patch cord always has an SC connector on the patch panel side.

5.2 Cabinets

5.2.1 For central distribution (FIST)

Description	2.2m Cross-connect frame, patching on the left
Material Type	Galvanized steel (min. 1.5 mm)
Capacity	56 FACT elements
IP class	unspecified
Height	220 mm
Width	1050 mm
Depth	300 mm
Number of doors	3
Access	Front
Spare space	> 20 %
cable inlets	Bottom. Non-functional holes must be closed
Internal wiring	Colour coded (EN 60204) and tagged at both ends
Internal components (excluding fiber components)	IP-20

5.2.2 For local distribution (BUDI-M)

Material Type	LSZH thermoplastic
Capacity	36 splice cassettes
IP class	IP-54
Internal wiring	Colour coded (EN 60204) and tagged at both ends
Internal components (excluding fiber components)	IP-20

5.2.3 For end user connection (WPK)

Material Type	LSZH thermoplastic

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Capacity	12 fiber connections
IP class	IP-20
Connections	SC-Duplex or single ST connectors

5.2.4 For end user connection (WPC)

Material Type	Powder coated steel
Capacity	12 fiber connections
IP class	unspecified
Connections	SC-Duplex or single ST connectors
Mounting	DIN Rail

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5.3 Fiber Connection provisions

5.3.1 **Fiber connection modules** (see appendix 3 for detail)

- Fiber Architecture Cabling Technology (FACT)
- Generic Splice Shelf (GSS3)
- SOSA2 (Splice Only Sub Assembly),
- Capacity for 96 fibers (cable to cable, per GSS)
- 19” mounting
- Operating Temperature -5 °C to +45 °C

5.3.2 **Fiber Splices trays**

- For central distribution (FACT) : 2 or 4 Single element (SE) cassettes
- For local distribution (BUDI) : 4 or 8 Circuit element (SC) cassettes
- SOSA2 (Splice Only Sub Assembly),
- For splice fusion connections
- In a single cassette only 2 fibers (1 connection) may be splice-fused

5.3.3 **Fiber patch panels**

- Fibre management rings & splice bridge
- 19” mounting
- Sliding tray
- Fiber Splice tray(*)
- For 24 single ST or 12 SC-Duplex or 24 single E2000 connectors
- Operating Temperature -5 °C to +45 °C
- Port identification

5.3.4 **Fiber Optical splice protection**

- Heath shrink version
- Length 60 mm
- Material acryl
- Corrosion resistant
- Double coating (1 for fiber, 1 for protector)
- Fiber coating separated from protector
- Protector stainless steel

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6 Installation (Erection) Requirements

6.1 Cable Identification

Each cable shall be tagged with a TATA cable number on both ends.
Tags and fastening shall be durable and water, ozone and UV light resistant.
Fiber cable numbers must be requested by TSN-IT Network & Voice Services

6.2 HDPE tubes (CD-BD)

Fiber optic cabling, when used underground, shall be installed in HDPE tubes. (CD-BD)
For these tubes the following requirements shall be met:

- Diameter 40 mm
- Colour: blue
- Terminated on both ends with jack moon seals ensuring a Water-tight and air-tight sealing, suitable conduit or cable support
- For new main HDPE routes, a second loose identical HDPE tube shall be installed for redundancy purposes.
- Outdoor installed (in ground) HDPE tube shall be identified with a TATA identification number including date of installation and have a guaranteed readability of 30 years. They shall be installed on both ends, and at least every 3 m.
- HDPE tubes numbers must be requested by TSN-IT Network & Voice Services
- GWI (GrondWerkInstructie) of Site Facilities should be followed (see Tata Steel IJmuiden intranet)

6.3 Cable routing (BD-FD-ID)

Cable trays and secondary cable routing
A spare space of 20% of the total section of a cable tray is required for future cables.

For the cable routing segregation as stated below is required:

- Category 1 [level 1] LV Sensitive - Measuring cables, data cables, control network cables and Remote I/O bus cables, fiber optic cabling. For Category 1, closed cable trays shall be used when required by environmental conditions.
- Category 2 [level 2] LV Low power - Control systems I/O, DC control and power supplies. For Category 2 open cable tray shall be used
- Category 3 [level 3] LV Power
- Category 4 [level 4] HV Power (>1000V)

For Category 3 and 4 open cable trays or cable ladders shall be used.

All cable trays, ladders, conduits and construction materials (e.g. fasteners, brackets) shall be constructed with Hot Dip Galvanized materials unless specified otherwise. Cable tray parts shall have a galvanic interconnection.
Both sides of passages of cables/cable supports through fire retention barriers shall be made fire retardant for at least 60 minutes and with certified solutions / components (e.g. according to EN 1363-1).

All secondary cable routing installed by the CONTRACTOR shall be connected to the existing grounding facilities for earthing- / equipotential bonding. The execution shall comply with the latest version of the HD (IEC) 60364 / NEN 1010 for LV.

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7 Testing Requirements

7.1 Fiber Optic Cabling

7.1.1 General

Certification of new Fiber Optic cabling is necessary to ensure the intended application. To validate correct installation and functionality of all glass fiber connections, the theoretical fiber attenuation shall be validated against the measured values.
Connection Identification numbers (GL number) and start and end panels numbers must be requested by TSN-IT Network & Voice Services

The required measurements shall be executed by certified personnel and with certified measuring devices. According to the ISO/IEC 14763-3 (Testing of Optical Fiber) standard.

Each measurement shall be reported by means of an individual test sheet, containing at least the following information:
General:

- Name of the tester including certificate fiber testing
- Company of the tester
- Type of measurement equipment including calibration certificate

Per measurement:

- Connection identification (GL number)
- Start and End panel
- Date
- Total length of the connection
- Calculated fiber attenuation values
- Measured fiber attenuation values
- Measured reflection (Optical Return Loss)
- The pass / fail thresholds used for validating the connection

7.1.2 Multimode test requirements

For determination of the theoretical fiber attenuation (Fa) the following formula shall be used:

Range	Formula (Fa)
850 nm	2,8 x yy km (yy length cable) + 2 x 0,3 (for 2x connector pair) + z x 0,1 (z = fusion splices)
1300 nm	0,7 x yy km (yy length cable) + 2 x 0,3 (for 2x connector pair) + z x 0,1 (z = fusion splices)

The following values used shall be used within the formula:

Item	850 nm	1300 nm
Fiber attenuation	Max 2,8 dB / km	Max 0,7 dB / km
Connector connection	Max. 0,3 dB / pair	
Fusion splice (z)	Max 0,1 dB / fusion	

The Multimode fiber connections shall be **single sided** measured (OTDR) according to the ISO 11801. Each individual connection (connector and/or fusion splice) will also have to meet the norm. It's not allowed to compensate a "bad" fusion splice/connector with a "good" one.

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7.1.3 Singlemode test requirements (ITU-T- G.650.3)

Singlemode SC test requirements

For determination of the theoretical fiber attenuation (Fa) the following formula shall be used:

Range	Formula (Fa)
1310 nm	0,35 x yy km (yy length cable) + 2 x 0,4 (for 2x connector pair) + z x 0,1 (z = fusion splices)
1550 nm	0,22 x yy km (yy length cable) + 2 x 0,4 (for 2x connector pair) + z x 0,1 (z = fusion splices)

The following values used shall be used within the formula:

Item	1310 nm	1550 nm
Fiber attenuation	Max 0,35 dB / km	Max 0,22 dB / km
Connector connection	Max. 0,4 dB / pair	
Fusion splice (z)	Max 0,1 dB / fusion	

Singlemode E2000 test requirements

For determination of the theoretical fiber attenuation (Fa) the following formula shall be used:

Range	Formula (Fa)
1310 nm	0,35 x yy km (yy length cable) + 2 x 0,3 (for 2x connector pair) + z x 0,1 (z = fusion splices)
1550 nm	0,22 x yy km (yy length cable) + 2 x 0,3 (for 2x connector pair) + z x 0,1 (z = fusion splices)

The following values used shall be used within the formula:

Item	1310 nm	1550 nm
Fiber attenuation	Max 0,35 dB / km	Max 0,22 dB / km
Connector connection	Max. 0,3 dB / pair	
Fusion splice (z)	Max 0,1 dB / fusion	

For Singlemode connections where **existing** cables are part of the entire connection, an attenuation of 0,4 dB / km (1310 nm) or 0,3 dB / km (1550 nm) are accepted values.

The Singlemode fiber connections shall be **dual sided** measured (OTDR) according to ISO 11801. Each individual connection (connector and/or fusion splice) will also have to meet the norm. It's not allowed to compensate different a "bad" fusion splice/connector with a "good "one.

7.2 Copper Cabling

The Copper network cabling need to be qualification tested, covering bandwidth qualification, cable length and wire mapping.

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8 Hand-over procedure

If cabling is installed by an Installation contractor other than the existing maintenance contractor and need to be part of the existing 24/7 maintenance contract the following process and requirements are mandatory.

8.1 Process

Before the cable infrastructure is taken into operations the steps below need to be followed:

- Test reports of all installed connections (see 7.1) are part of the acceptance of the fiber-optic installation. All reports will be checked by TSIJ on behalf of or with support of the current maintenance support contractor
- Inspection on site will be part of the acceptance process

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Appendix 1: Color coding Fiber Optic Cabling Tata Steel IJmuiden

Coding	KPN (TSIJ standard)
1	RED
2	WHITE
3	YELLOW
4	BLUE
5	GREEN
6	VIOLET
7	BROWN
8	BLACK
9	ORANGE
10	TURQUOISE
11	PINK
12	NATURAL

1	RED
2	ORANGE
3	YELLOW
4	GREEN
5	BROWN
6	BLACK

1	RED
2	BLUE
3	GREEN
4	YELLOW

Tube coding 6 VZLT (2 fibers per tube)

Tube	Color
1	RED
2	BLUE
3	GREEN

Tube coding 48/96 VZLT (8/12 fibers per tube)

Tube	Color
1	RED
2	GREEN
3	BLUE
4	YELLOW
5	WHITE
6	GREY
7	BROWN
8	VIOLET

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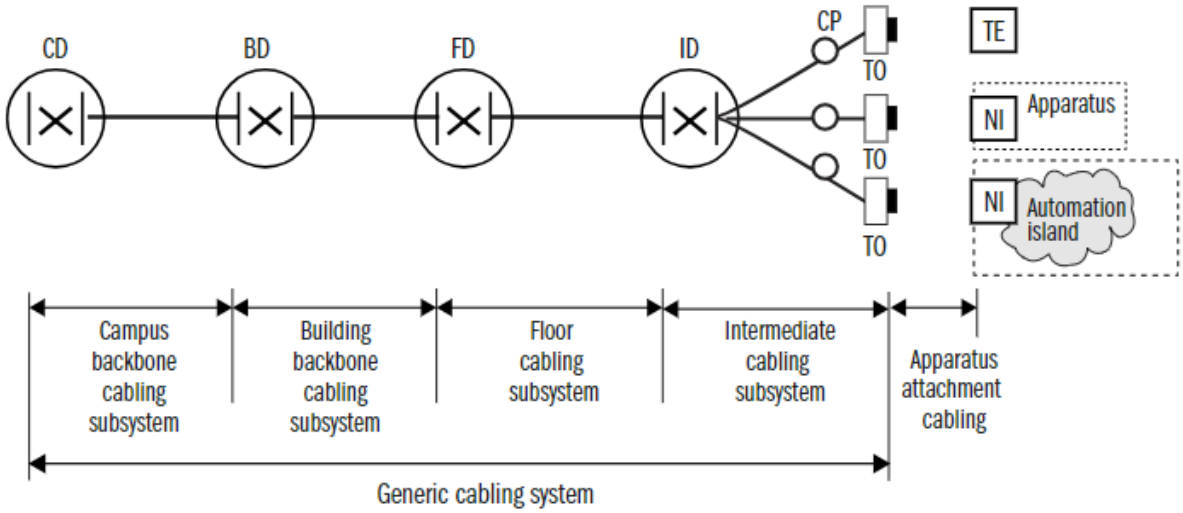
Appendix 2: ISO/IEC Cabling Topology Model 11801



LEGEND:

CD = Campus Distributor	CP = Connection Point (optional)
BD = Building Distributor	TO = Telecommunications Outlet
FD = Floor Distributor	TE = Terminal Equipment
ID = Intermediate Distributor	NI = Network Interface

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Appendix 3: FIST/FACT Cabinet specifications

Fist cabinet high 2200

FIST-GR3-R-150/300-22-2	CS6177-000	FIST-GR3 FIST® Fiber Distribution Rack with one 150 mm and one 300 mm side ducts
FIST-GR3-D-150-22-2	CZ9821-000	FIST® GR3 Door kit for 150mm side duct, 150mm wide, 2200mm high
FIST-GR3-D-300-22-2	CZ9825-000	FIST® GR3 Door kit for 300mm side duct, 300mm wide, 2200mm high, Lock not included
FIST-GR3-D-600-22-2	CZ9827-000	FIST® GR3 Door kit for 600mm central section, 600mm wide, 2200mm high, Lock included
FIST-GR3-T-150	CZ9047-000	FIST® GR3 Top cover kit for standard 150mm wide and 300mm deep side duct
FIST-GR3-T-300	CW5887-000	FIST® GR3 Top cover kit for standard 300mm wide and 300mm deep side duct
FIST-GR3-T-600	CK8631-000	FIST® GR3 Top cover kit for 600mm wide and 300mm deep central section
FIST-GR3-P-300-22	CS9084-000	FIST® GR3 kit of two side or back panels, 300 mm wide, 2200 mm high

Fist cabinet high 1800

FIST-GR3-R-150/300-18-2		FIST-GR3 FIST® Fiber Distribution Rack with one 150 mm and one 300 mm side ducts
FIST-GR3-D-150-18-2	CZ6555-000	FIST® GR3 Door kit for 150mm side duct, 150mm wide, 1800mm high
FIST-GR3-D-300-18-2	CZ6559-000	FIST® GR3 Door kit for 300mm side duct, 300mm wide, 1800mm high, lock included
FIST-GR3-D-600-18-2	CZ6561-000	FIST® GR3 Door kit for 600mm central section, 600mm wide, 1800mm high, Lock included
2976D002611901		Door 1.8-600 ASSY
FIST-GR3-T-150	CZ9047-000	FIST® GR3 Top cover kit for standard 150mm wide and 300mm deep side duct
FIST-GR3-T-300	CW5887-000	FIST® GR3 Top cover kit for standard 300mm wide and 300mm deep side duct
FIST-GR3-T-600	CK8631-000	FIST® GR3 Top cover kit for 600mm wide and 300mm deep central section
FIST-GR3-P-300-18	CZ5737-000	FIST® GR3 kit of two side or back panels, 300 mm wide, 1800 mm high

Internals

FACT-ACCBPL28E	760239956	FACT® back plate, for mounting up to 28 FACT elements in GR3 frame
FACT-ACCBPL4E	760239955	FACT® back plate, for mounting up to 4 FACT elements in GR3 frame

Fiber storage

FACT-4E-SPL-S12	760239970	FACT® Fiber Optic Splice Panel, gray, 4E high, loaded with 24 trays for holding up to 12 SMOUV type splices per tray
FACT-ACCCTUMP24	760239900	FACT® Cable Termination Unit (CTU) trumpet for 24 pigtails with diameter between 1.8 mm and 2.4 mm

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