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SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Optical infrastructures – Infrastructure including node elements (except cables)

Requirements for passive optical nodes – Outdoor optical cross-connect cabinets

Recommendation ITU-T L.206

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ITU-T L-SERIES RECOMMENDATIONS

ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

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Recommendation ITU-T L.206

Requirements for passive optical nodes – Outdoor optical cross-connect cabinets

Summary

Recommendation ITU-T L.206 refers to outdoor optical cross-connect cabinets deployed as passive optical nodes in outdoor environments. It deals with the cabinet housing, internal fibre management system, cable attachment and termination system, and also specifies the mechanical and environmental characteristics.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T L.206	2017-08-13	15	11.1002/1000/13296

Keywords

Enclosures, interconnection, optical cross-connect cabinets, outside plant, passive optical nodes.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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Introduction

Cabinets are widely used for protection of cross-connection points among multiple cables in outdoor environments. A cabinet along with internal functional assemblies can be referred to as an outdoor cross-connect cabinet.

An optical cross-connect cabinet comprises a mechanical structure (cabinet housing) for mechanical protection and environmental sealing of internal systems, a fibre management system for guiding and managing the fibres and fibre connections inside the node, and a cable attachment and termination system for attaching and terminating the cable ends. Patch cords, splitters and other passive optical devices are optional accessories of a cabinet. The optical cross-connect cabinet will:

– work as a cross-connection area in outdoor plant;

– protect the fibres, fibre joints and optical devices from the outdoor environment at ground level (normally, on a concrete base) and above ground (e.g., wall mounted or pole mounted by steel supports);

– provide for the organization of the fibre joints, passive devices and the storage of fibre overlength (excess fibre length);

– provide electrical bonding and grounding of the metal parts of the cable sheath and strength members.

This Recommendation specifies the requirements of optical cross-connect cabinets and the means for characterization and evaluation of the performance of cabinets according to the principles of [ITU-T L.200]. This includes mechanical performance, sealing performance and optical stability of the product which simulate the effect of environmental factors or interventions related to network maintenance and reconfiguration. It contains a basic test programme for the cabinet that is globally applicable. Additional requirements may be agreed between customer and supplier to reflect local or special conditions. All functions and features that a product may contain should be reflected in the mix of test samples that are subjected to the test programme.

Recommendation ITU-T L.206

Requirements for passive optical nodes – Outdoor optical cross-connect cabinets

1 Scope

This Recommendation:

– refers to optical cross-connect cabinets as passive optical nodes in outdoor environments;

– deals with the cabinet housing as well as the fibre management system, and the cable attachment and termination system;

– specifies mechanical and environmental characteristics of the optical cabinets;

– specifies characteristics of the fibre management system;

– provides a test plan for the performance evaluation of outdoor optical cross-connect cabinets;

– supplies the simulation of the effect of interventions related to network maintenance and reconfiguration;

– gives a checklist for a systematic product characterization according to [ITU-T L.200].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T G.652] Recommendation ITU-T G.652 (2016), *Characteristics of a single-mode optical fibre and cable*.

[ITU-T G.657] Recommendation ITU-T G.657 (2016), *Characteristics of a bending-loss insensitive single-mode optical fibre and cable*.

[ITU-T K.11] Recommendation ITU-T K.11 (2009), *Principles of protection against overvoltages and overcurrents*.

[ITU-T K.47] Recommendation ITU-T K.47 (2012), *Protection of telecommunication lines against direct lightning flashes*.

[ITU-T L.200] Recommendation ITU-T L.200/L.51 (2003), *Passive node elements for fibre optic networks – General principles and definitions for characterization and performance evaluation*.

[ITU-T L.361] Recommendation ITU-T L.361/L.64 (2012), *ID tag requirements for infrastructure and network elements management*.

[IEC 60529] IEC 60529:2013, *Degrees of protection provided by enclosures (IP Code)*.

[IEC 61300-2-1] IEC 61300-2-1:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-1: Tests – Vibration (sinusoidal)*.

[IEC 61300-2-4] IEC 61300-2-4:1995, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre/cable retention*.

[IEC 61300-2-5] IEC 61300-2-5:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-5: Tests – Torsion*.

[IEC 61300-2-9] IEC 61300-2-9:2017, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-9: Tests – Shock*.

[IEC 61300-2-12] IEC 61300-2-12:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-12: Tests – Impact*.

[IEC 61300-2-22] IEC 61300-2-22:2007, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*.

[IEC 61300-2-26] IEC 61300-2-26:2006, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-26: Tests – Salt mist*.

[IEC 61300-2-33] IEC 61300-2-33:2012, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures – Part 2-33: Tests – Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures*.

[IEC 61300-2-34] IEC 61300-2-34:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-34: Tests – Resistance to solvents and contaminating fluids of interconnecting components and closures*.

[IEC 61300-2-37] IEC 61300-2-37:2016, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-37: Tests – Cable bending for fibre optic closures*.

[IEC 61300-3-1] IEC 61300-3-1 (2005), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-1: Examinations and measurements – Visual examination*.

[IEC 61300-3-3] IEC 61300-3-3:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-3: Examinations and measurements – Active monitoring of changes in attenuation and return loss*.

[IEC 61300-3-28] IEC 61300-3-28:2012, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-28: Examinations and measurements – Transient loss*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 optical cross-connect cabinet: A cabinet with an integrated fibre management system to protect the cross-connections of optical fibre cables.

3.2.2 cabinet housing: The outer shell of a cabinet, including lockable doors and not including the fibre management system or the cable attachment and termination system. Its main functions are protection and sealing of its contents.

3.2.3 fibre management system (organizer system): The whole of the means and features that guide and store fibres and passive devices inside a node, at any location where they are not protected by the cable sheath. In a cabinet, the optical fibres are properly managed and guided from where cables enter the node until their exit.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ID Identification

IP Ingress Protection

ME Multiple Element (mass storage)

OA Outdoor Above ground

OG Outdoor Ground level

SC Single Circuit

SE Single Element

SF Single Fibre

SMC Sheet Moulding Compound

SR Single Ribbon

5 Conventions

None.

6 Characteristics of optical cross-connect cabinets

6.1 General requirements

The general structure of optical cabinets is shown in Figure 1.

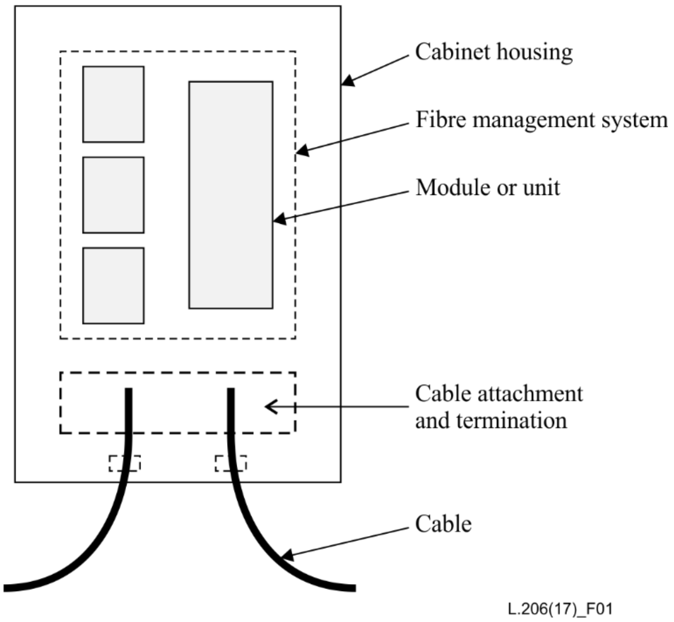

Figure 1 – General structure of optical cabinets

Each cabinet should comply with the general requirements as listed in clause 8 of [ITU-T L.200].

Figures I.1 to I.4 show examples of cabinets to illustrate their structures and internal fibre organization systems.

6.2 Cabinet housing

The following should be considered:

– dimensions should be compatible with internal contents and installation site. Generally, the maximum height of cabinet should be less than 1.6 m;

– the doors should be re-openable for installation, maintenance or reconfiguration. The opening angle of the door should not be less than 110° and the lock on the door should have sufficient protection ability;

– the protection level of the cabinet housing should comply with the requirements of IP54 or higher degrees in [IEC 60529];

– the cabinet housing should be made from high strength materials to provide sufficient mechanical strength, e.g., metal or sheet moulding compound (SMC; sheet form glass-fibre reinforced polyester material processed by compression moulding);

– the metallic parts of the cabinet housing should be electrically bonded and grounded;

– the housing should allow access for multiple cable ends. The cables may be of different sizes or types. Normally, the cables enter the cabinet from the bottom of the housing via cable entry holes. The apertures between cables and the housing should allow sealing by putty or other materials to ensure adequate performance, and the sealing material should be easily removable for reconfiguration;

– the housing should stand and be fixable on a concrete base or steel supports;

– if the housing is limited to use in certain applications and environments in the network, any limitations should be clearly indicated to the user – a detailed characterization of features and compatibility of a cabinet can be assessed using the checklist in Appendix II;

– if necessary, a cabinet can be equipped with an access control system that makes remote door control (via a dedicated network) available;

– materials that will be exposed to solar radiation should be resistant to ultraviolet light. All polymeric materials that are exposed to the environment should be sufficiently resistant to fungi. Metallic parts should be corrosion resistant when exposed to the salt mist test [IEC 61300-2-26].

6.3 Fibre management system (organizer system)

The fibre management system is an integral part of an optical cross-connect cabinet. The system comprises units or modules and support frames that have means for routing and holding fibre joints, fibre overlength, patch cords and other possible passive devices (splitters, adapters, etc.) in an orderly manner, and should minimize fibre strain.

Compatibility and features of fibre management system can be assessed by using the checklist in Appendix II. The desired optical stability type can be selected according to [ITU-T L.200].

6.3.1 Functions of the fibre management system

The functions of the optical fibre management system are:

– to provide means for routing, storing and protecting fibre joints or other passive devices in a predetermined order, from one cable sheath end to another;

– to provide means for installation, reconfiguration and expansion of fibre circuits, to make the cabinet a flexible optical cross-connection point;

– to separate circuits up to a certain degree as defined in [ITU-T L.200]. This will limit the risk of interruption of traffic to those fibres that belong to the same group of circuits (see [ITU-T L.200]: single fibre (SF), single circuit (SC), single ribbon (SR), single element (SE) or multiple element (ME). For an optical cross-connect cabinet, a separation degree higher than SE is preferred;

– to provide means for storing the fibre overlength required for jointing and for possible re-jointing in the future;

– to ensure that the fibre bend radius is not less than 30 mm in general applications with ITU-T G.652 fibres. For special applications, a minimum bend radius of 20 mm can be agreed between customer and supplier (in order to maintain mechanical reliability and minimize losses in the network, the cumulative length of fibre exposed to this smaller bend radius should be limited to less than 2 m per fibre link). In the case of ITU-T G.657 fibres, smaller bend radius is allowed (see [b-ITU-T G-Sup.59] for guidance on optical fibre and cable reliability);

– to provide easy identification and access to any connectors and stored fibre joints for maintenance and reconfiguration, all optical connectors (including optical adapters and plugs) should be labelled clearly and uniquely to identify their routes. Electronic identification (ID) is optional, which should comply with the requirements of [ITU-T L.361].

The materials used for making the management system should be compatible with the other materials in the cabinet and the degreasing agents as recommended in the installation instructions.

6.3.2 Modules of fibre management system

The fibre management system may contain the following modules:

a) Splice modules

Splice modules, normally in the form of trays, are used for storing and protecting fibre splices and fibre overlength.

Splice modules can store splices of the fibres from the ingoing and outgoing cables together (direct splicing modules) or can store splices of the fibres from the ingoing and outgoing cables to pigtails.

In some cases, the splice modules can store the splitter components which are then spliced to the fibres of the cables or pigtails.

b) Distribution modules

Distribution modules, normally in the form of trays, have fibre distribution function that allows a cross-connection between the ingoing and outgoing fibres by using patch panels. Typically, patch cords are used in cross-connection between the distributing modules.

c) Storage modules for cable overlength (excess cable length)

Storage modules, normally in the form of winding wheels, are capable of storing cable overlength of patch cords and pigtails. Normally, storage of fibre overlength is done in the splice modules.

d) Splitter modules

Splitter modules, normally in the form of trays with splitters inside or individual splitters, are capable of splitting optical power into different branches of the network. In most cases, the splitter ports are connectorized to allow fast installation or reconfiguration.

Several functions of different modules can be combined into one module. For example, some modules have combined the splicing and the distribution function into one "splice and distribution module".

Modules in the form of trays may be organized in one of the following ways:

– lateral sliding from a frame – similar to removing a book from a shelf;

– lateral rotation about a vertical axial – similar to turning a blade out of a pen knife;

– hinging – similar to turning pages in a book.

All movements of the trays should proceed in a predetermined and controlled way in order to reduce optical losses or interruption of traffic during organizer manipulations.

6.3.3 Configurations of optical fibre management system

Various configurations of the fibre management system in the cross-connect cabinet are possible: a) to h).

a) Direct splice without splitters

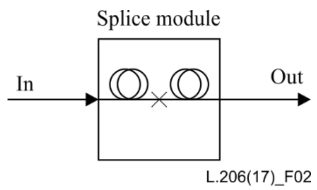

Figure 2 – Direct splice without splitters

b) Direct splice with splitters

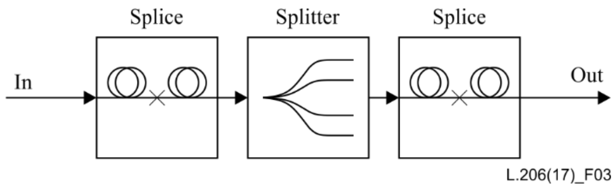

Figure 3 – Direct splice with splitters

c) Interconnect without splitters

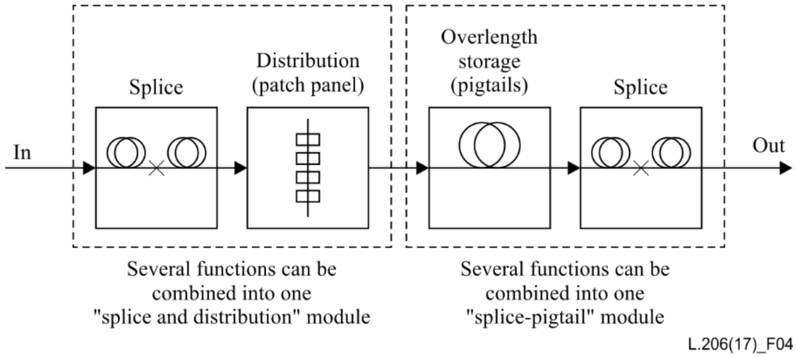

Figure 4 – Interconnect without splitters

d) Interconnect with splitters

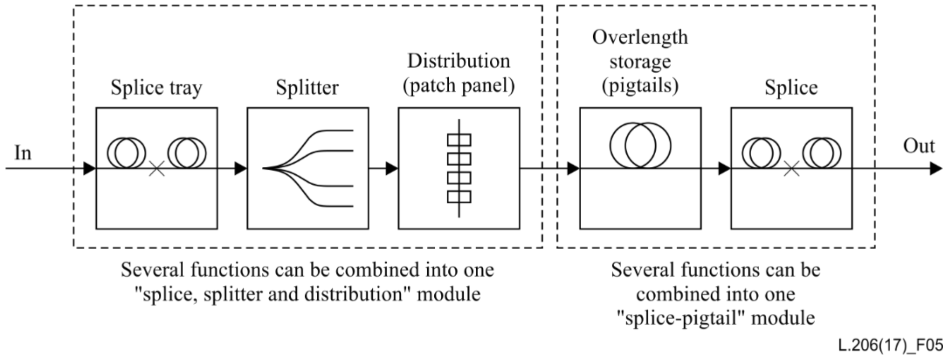

Figure 5 – Interconnect with splitters

e) Cross-connect without splitters

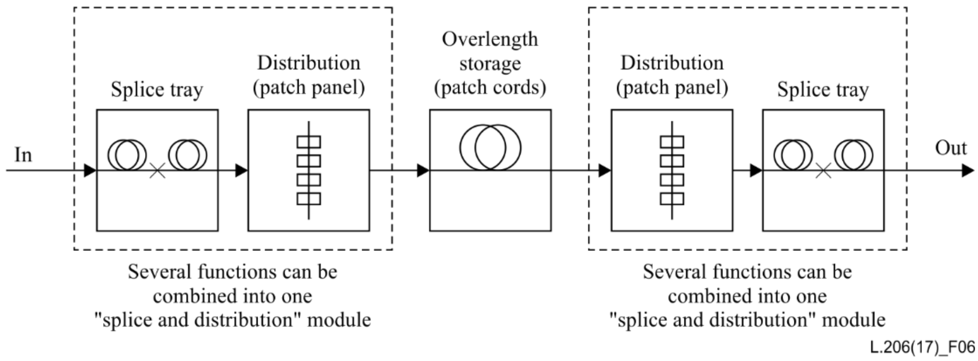

Figure 6 – Cross-connect without splitters

f) Cross-connect with splitters integrated in modules with splice tray and patch panel

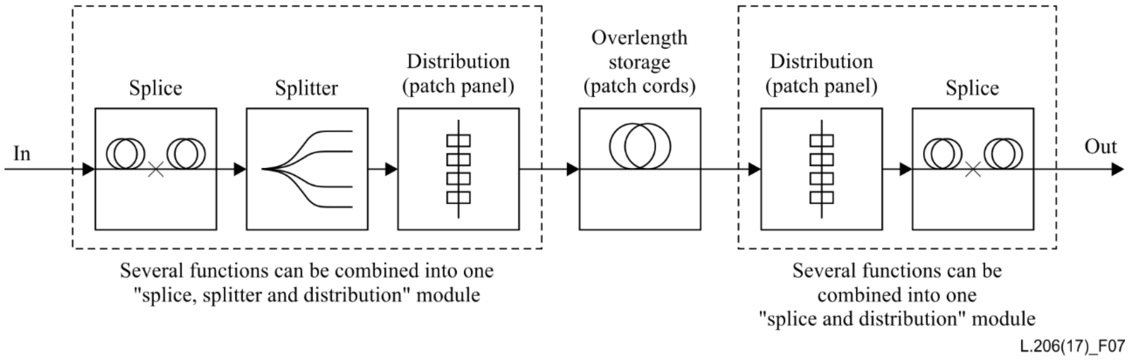

Figure 7 – Cross-connect with splitters integrated in modules with splice tray and patch panel

g) Cross-connect with individual pigtailed splitter modules

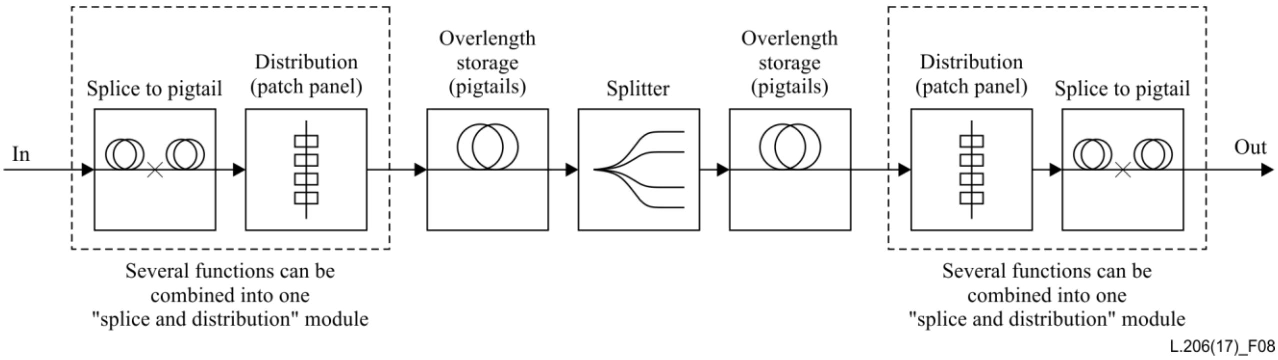

Figure 8 – Cross-connect with individual pigtailed splitter modules

h) Cross-connect with individual splitter and distribution modules

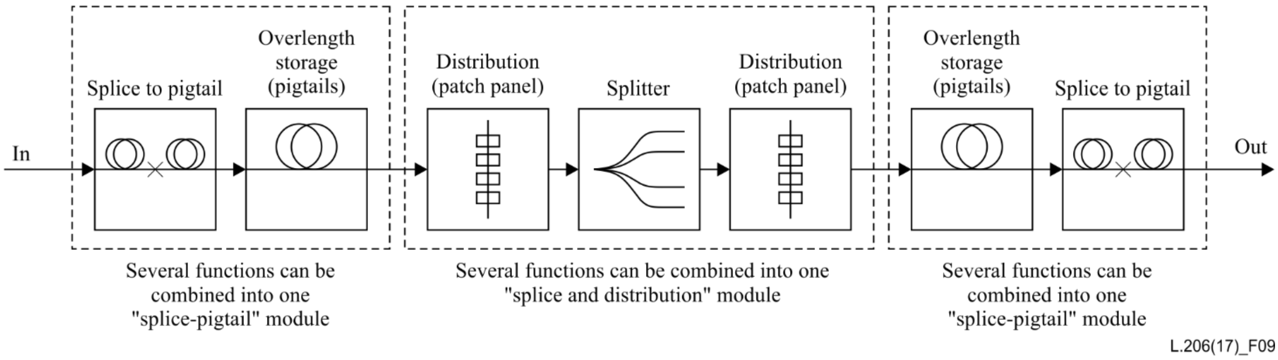

Figure 9 – Cross-connect with individual splitter and distribution modules

If required, the fibre management system can be divided into multiple subsystems and stored in separate regions in the cabinet so that multiple telecommunication operators can share the subscriber cables and the space inside the cabinet. In this case, the separated regions should be independently lockable and easy to identify.

6.4 Cable attachment and termination system

The following characteristics of cable attachment and termination system should be considered:

– the system should allow for attachment of all cables entering the cabinet. The cables may be of different sizes or types;

– the system should allow for good bonding and grounding for metallic elements of cables, while the cable metallic elements should be insulated to other metallic parts of the cabinet. The method of achieving electrical continuity will vary with the type of cable sheath and the type and location of the strength members. Further information is given in [ITU-T K.11] and [ITU-T K.47];
– the system should be installed near the cable entry points in the cabinet, normally the lower section of the cabinet inner housing;
– the system should allow the addition or removal of cables with no interruption to service on other cables;
– the materials used in the system should be compatible with the other materials in the cabinet and the degreasing agents recommended in the installation instructions.

7 Performance evaluation test programme

The complete test programme for an optical cross-connect cabinet consists of:

– a basic test programme for the applicable environment (see Annexes A and B);
– a number of additional requirements according to local standards when necessary (see [ITU-T L.200] and the checklist in Appendix II).

For specific products, alternative test conditions to those given in Annex B may be agreed between customer and supplier.

Tests should be executed according to IEC 61300-2-series test methods where available.

The performance test programme of an optical cross-connect cabinet should:

– evaluate the product for two groups of criteria: mechanical and sealing evaluation, and optical stability (see Annex A);
– simulate the effects of exposure to:
  • the environment in which it will be installed,
  • an intervention at the node;
– simulate installation or maintenance conditions;
– evaluate all available features of the product.

When an optical cross-connect cabinet is suitable for both outdoor above ground (OA) and outdoor ground level (OG) environments (see [ITU-T L.200]), it should pass the most severe conditions of either environment. As an alternative, the tests that are different for each of these environments may be duplicated at both settings.

Two types of optical stability can be selected (see clause 6.2.1 of [ITU-T L.200]). For products that may be subject to an intervention on a live network, dynamic optical stability is recommended.

8 Sample preparation

A representative number of test samples is to be prepared, taking into account the following parameters:

– all product features and compatibility (see checklist in Appendix II);
– applicable sizes of cables;
– sealing performance test samples should be installed at −15°C, room temperature or +45°C;
– optical performance test samples should be installed at room temperature;

– for mechanical evaluation, a fresh sample should be prepared for each different test; if a failure occurs when consecutive testing is applied on the same sample, the failed test may be repeated on a fresh sample.

Appendix I of [ITU-T L.200] illustrates how optical samples can be prepared. Due to their complexity, consecutive testing on the same sample is most practical.

Annex A

Performance evaluation criteria

(This annex forms an integral part of this Recommendation.)

A.1 Mechanical and sealing evaluation

The performance evaluation criteria should be satisfied during or after performing the tests specified in Annex B.

A.1.1 Sealing performance

International Standard: [IEC 60529].

Conditions: Conditions according to protection degree of the cabinet (IP54 or higher).

Requirement: Meet the requirements of the protection degree of the cabinet (IP54 or higher).

A.1.2 Visual examination

International Standard: [IEC 61300-3-1].

Conditions: Examination of product with the unaided naked eye.

Requirement: No defects or physical damages that would affect product performance.

A.2 Optical evaluation

NOTE 1 – All optical losses indicated are referenced to the initial optical signal at the start of the test.

NOTE 2 – An incoming fibre is defined as a part of an optical circuit containing the fibre entering the product, spliced to a fibre leaving the product. One optical circuit can contain many incoming fibres. Light will sequentially flow through all the incoming fibres.

NOTE 3 – Fibre type used for single mode: ITU-T G.652 D fibre. The applications with other fibre types (e.g., ITU-T G.657 fibre) will be qualified by similarity since most fibre types are equally or less sensitive to bending compared to ITU-T G.652 D fibre.

A.2.1 Change in insertion loss (attenuation) (static optical stability)

International Standard: [IEC 61300-3-3] Method 1.

Conditions: Source wavelength: 1 310 nm, 1 550 nm and 1 625 nm

Requirement: **If only splices are part of the optical path**:

$\Delta IL \leq 0.2$ dB (1 310 nm/1 550 nm) per incoming fibre during the test (excursion loss);

$\Delta IL \leq 0.5$ dB (1 625 nm) per incoming fibre during the test (excursion loss);

$\Delta IL \leq 0.1$ dB (1 310 nm/1 550 nm/1 625 nm) per incoming fibre after the test (residual loss).

If optical connectors are part of the optical path:

ΔIL ≤ 0.2 dB (1 310 nm/1 550 nm) per incoming fibre during the test (excursion loss);

ΔIL ≤ 0.5 dB (1 625 nm) per incoming fibre during the test (excursion loss);

ΔIL ≤ 0.2 dB (1 310 nm/1 550 nm/1 625 nm) per incoming fibre after the test (residual loss).

If optical splitter is part of the optical path:

ΔIL ≤ 0.5 dB (1 310 nm/1 550 nm) per incoming fibre during the test (excursion loss);

ΔIL ≤ 0.8 dB (1 625 nm) per incoming fibre during the test (excursion loss);

ΔIL ≤ 0.5 dB (1 310 nm/1 550 nm/1 625 nm) per incoming fibre after the test (residual loss).

A.2.2 Transient loss (dynamic optical stability)

International Standard: [IEC 61300-3-28].

Conditions: Source wavelength: 1 310 nm, 1 550 nm and 1 625 nm (measurements at 1 550 nm and 1 625 nm are particularly important for dynamic transient loss. 1 310 nm is optional, subject to agreement between customer and supplier), unpolarized; Detector bandwidth: (0-1 500) Hz.

Requirement: **If only splices are part of the optical path**:

ΔIL ≤ 0.5 dB (1 310 nm/1 550 nm) during the test measured in the life circuit (transient loss);

ΔIL ≤ 1.0 dB (1 625 nm) during the test measured in the life circuit (transient loss);

ΔIL ≤ 0.1 dB (1 310 nm/1 550 nm/1 625 nm) after the test in the life circuit (residual loss).

If optical connectors are part of the optical path:
ΔIL ≤ 0.5 dB (1 310 nm/1 550 nm) during the test measured in the life circuit (transient loss).
ΔIL ≤ 1.0 dB (1 625 nm) during the test measured in the life circuit (transient loss).
ΔIL ≤ 0.2 dB (1 310 nm/1 550 nm/1 625 nm) after the test in the life circuit (residual loss).
If optical splitter is part of the optical path:
ΔIL ≤ 0.5 dB (1 310 nm/1 550 nm) per incoming fibre during the test (excursion loss).
ΔIL ≤ 1.0 dB (1 625 nm) per incoming fibre during the test (excursion loss).
ΔIL ≤ 0.5 dB (1 310 nm/1 550 nm/1 625 nm) per incoming fibre after the test (residual loss).

Annex B

Performance test programme for ground level and above ground cabinets

(This annex forms an integral part of this Recommendation.)

For tests in this annex, the test settings are applicable for cabinets used in both environments OG and OA unless specifically marked. All testing is at room temperature unless otherwise stated. When sealing performance evaluation for dust and water ingress is required, it can be performed after all related tests have been finished, instead of after each of the tests. In optical evaluations in clause B.2, the requirements for static or dynamic optical stability are to be agreed between customer and supplier, and the appropriate optical performance criteria are to be selected accordingly.

B.1 Mechanical and sealing evaluation

B.1.1 Static load (crush test) on the top of cabinet

International Standard:	[IEC 61300-2-10]
Conditions:	Vertical load (N): 1 750 (Pa) × Cabinet width (m) × Cabinet depth (m) and minimum 500
	Application: uniformly distributed on the top surface
	Test time: 10 min.
Performance criteria:	Sealing performance; Visual examination

B.1.2 Static load on cabinet door

International Standard:	[IEC 61300-2-10]
Conditions:	Vertical load: 200 N
	Point of application: far end of the top of opening door, at the most extreme point that creates the highest moment
	Test time: 10 min
Performance criteria:	Sealing performance; Visual examination

B.1.3 Resistance to side load

International Standard:	None
Conditions:	Fully equipped cabinet and in installed condition
	Force (N) = 1500 (Pa) × Width (m) × Height (m)
	Point of application: most extreme point located away from attachment pointsDirection: in the axis that will generate the highest moment, performed in the two directions.
	Duration: 5 s
Performance criteria:	Visual appearance

B.1.4 Cable retention force

International Standard:	[IEC 61300-2-4]

Conditions:	Install cables of appropriate type on the cabinet Load per cable: *D*/45 mm × 1 000 N (maximum 1 000 N), where *D* is the cable outer diameter in millimetres Test time: 1 h per cable
Performance criteria:	Visual appearance

If the performance of the cable attachment and termination system is not influenced by other components, the system can be taken down from the cabinet to do the test.

B.1.5 Cable bending

International Standard:	[IEC 61300-2-37]
Conditions:	Bending angle ±30° or maximum bending force 500 N is reached Point of application: 400 mm from the cable entry of the cabinet. For cables with a very rigid construction (e.g., slotted core cables, armoured cables), the clamping distance may need to be increased to 1 000 mm. Keep angle for 5 min at each extreme position. Number of cycles: five per cable
Performance criteria:	Visual appearance

B.1.6 Cable torsion

International Standard:	[IEC 61300-2-5]
Conditions:	Install cables of appropriate type on the cabinet Torsion angle ±90° or maximum torque 50 N m is reached Torque application: 400 mm from the cable entry of the cabinet. For cables with a very rigid construction (e.g., slotted core cables, armoured cables), the clamping distance may need to be increased to 1000 mm. Duration at extreme position: 5 min Number of cycles: five per cable
Performance criteria:	Visual appearance

If the performance of the cable attachment and termination system is not influenced by other components, the system can be taken down from the cabinet to do the test.

B.1.7 Impact

International Standard:	[IEC 61300-2-12] Method B
Conditions:	Impact tool: Steel ball Mass: 1 kg Drop height: 1 m Test temperatures: (−15 ± 2) °C and (+45 ± 2) ºC; Location: at the centres of the cabinet at 0° (the centre of the front door), 90º, 180º, 270º around the longitudinal axis, and on top of the cabinet Number of impacts: one per location.
Performance criteria:	Sealing performance; Visual examination: No evidence of cracks and deformations, surface protective layer (if there is one) does not fall off, scratches on surface can be ignored

B.1.8 Temperature cycling (OG and OA)

International Standard: [IEC 61300-2-22]

Conditions (see Note): Lowest/highest temperature: (−40/+65 ± 2) °C
Humidity: uncontrolled
Dwell time: 4 h
Transition: 1 °C/min
Number of cycles: 12

Performance criteria: Sealing performance; Visual appearance

NOTE – Temperature ranges for temperature cycling are typical values. Adaptations to specific local conditions can be agreed between customer and supplier. Humidity could also be considered.

B.1.9 Re-entries

International Standard: [IEC 61300-2-33]

Conditions: Open all cabinet doors to maximum angle and close at each re-entry

Aging between each re-entry: at least one thermal cycle (see clause B.1.9)

Number of re-entries: five

Performance criteria: Sealing performance; Visual appearance

B.1.10 Salt mist

International Standard: [IEC 61300-2-26]

Conditions: Exposure to a salt mist of 5% NaCl in water
Test temperature: (+35 ± 2) °C
Duration: 5 days

Performance criteria: Visual appearance: No evidence of corrosion

The salt mist test can be selectively performed on components, parts and materials that are at potential risk of corrosion, instead of the whole cabinet.

B.1.11 Resistance to aggressive media (as needed)

International Standard: [IEC 61300-2-34]

Conditions: Exposure to: HCl at pH 2
NaOH at pH 12

Duration: 5 days

Performance criteria: Visual appearance: No evidence of corrosion, swelling or cracks

The resistance to aggressive media test can be selectively performed on components, parts and materials that are at potential risk of corrosion, instead of the whole cabinet.

B.2 Optical evaluation

Construction of optical samples is according to Appendix I of [ITU-T L.200].

B.2.1 Intervention at a node

International Standard: [IEC 61300-2-33]

Conditions:	Execute all manipulations that will normally occur for this product during an intervention after initial installation. A list of typical manipulations can be found in Appendix II of [ITU-T L.200]
Performance criteria:	Visual appearance; Static: Change in attenuation (residual loss) Dynamic: Transient loss

B.2.2 Vibration

International Standard:	[IEC 61300-2-1]
Conditions:	Sweep range: (5-500) Hz sinusoidal at 1 octave/min Crossover frequency: 9 Hz – amplitude below 9 Hz: 1.2 mm – acceleration above 9 Hz: 4 m/s^2 (~0.4*g*) Direction: three mutually perpendicular axes Duration: 10 cycles (5-500-5) Hz/axis
Performance criteria:	Visual appearance Static: Change in attenuation (residual loss) Dynamic: Transient loss

B.2.3 Shock

International Standard:	[IEC 61300-2-9]
Conditions:	Wave form: Half sine Duration: 11 ms Acceleration: 50 m/s^2 (~5*g*) Direction: three mutually perpendicular axes Number of shocks: three up and three down per axis
Performance criteria:	Visual appearance Static: Change in attenuation (residual loss) Dynamic: Transient loss

B.2.4 Temperature cycling (OG and OA)

International Standard:	[IEC 61300-2-22]
Conditions (see Note):	Lowest/highest temperature: (−40/+65 ± 2) °C Humidity: uncontrolled Dwell time: 4 h Transition: 1 °C/min Number of cycles: 12
Performance criteria	Visual appearance Static: Change in attenuation (excursion and residual loss)

NOTE – Temperature ranges for temperature cycling are typical values. Adaptations to specific local conditions can be agreed between customer and supplier. Humidity could also be considered.

Appendix I

Sample illustrations of cabinet structure

(This appendix does not form an integral part of this Recommendation.)

Figures I.1 to I.4 show examples of cabinets to illustrate their structures and internal fibre organization systems. In practice, the design of cabinet structure and internal modules varies.

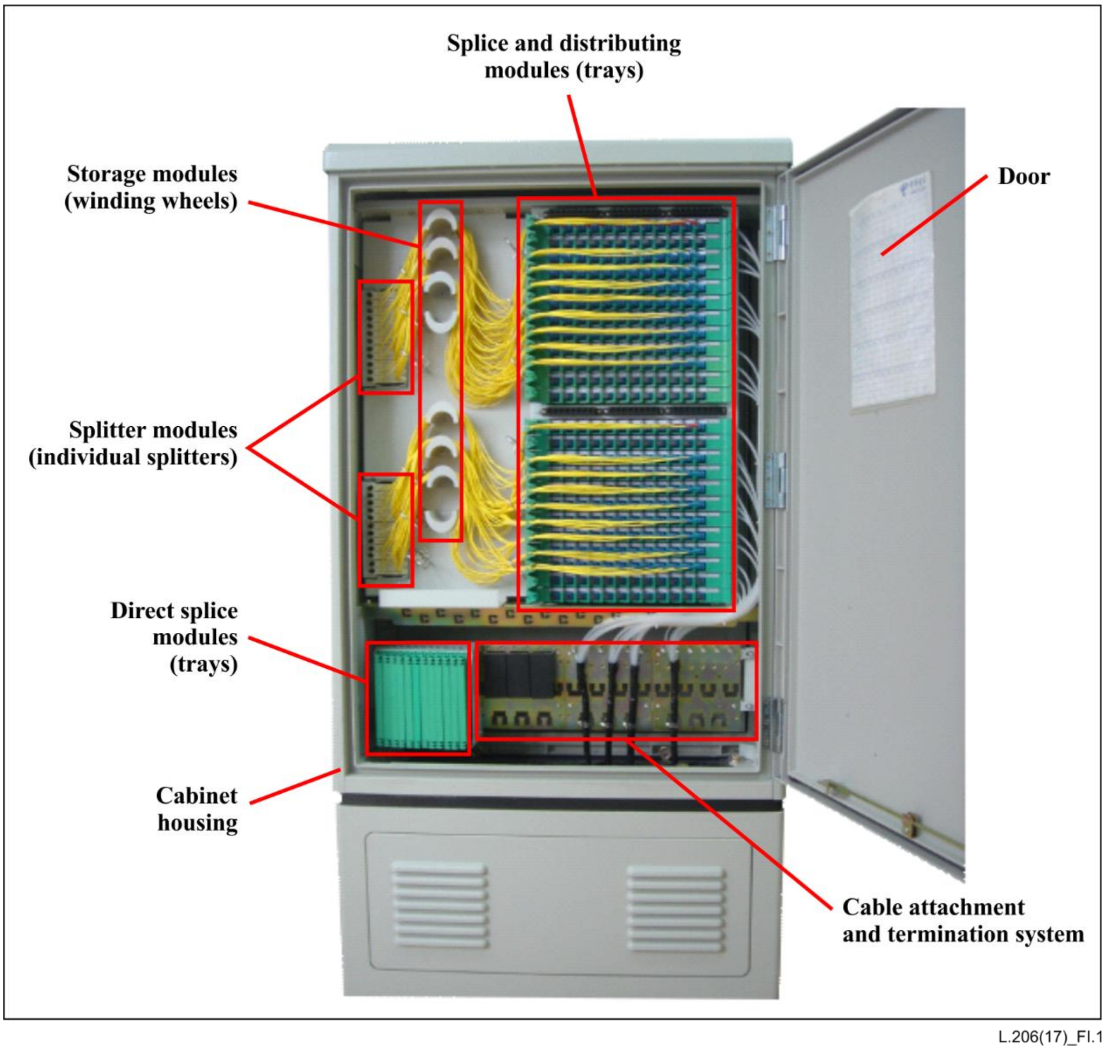

Figure I.1 – Cabinet structure example I

Available configurations of optical fibre management system (see clause 6.3.3) of example I in Figure I.1:

– direct splice without splitters;

– cross-connect without splitters;

– cross-connect with individual pigtailed splitters.

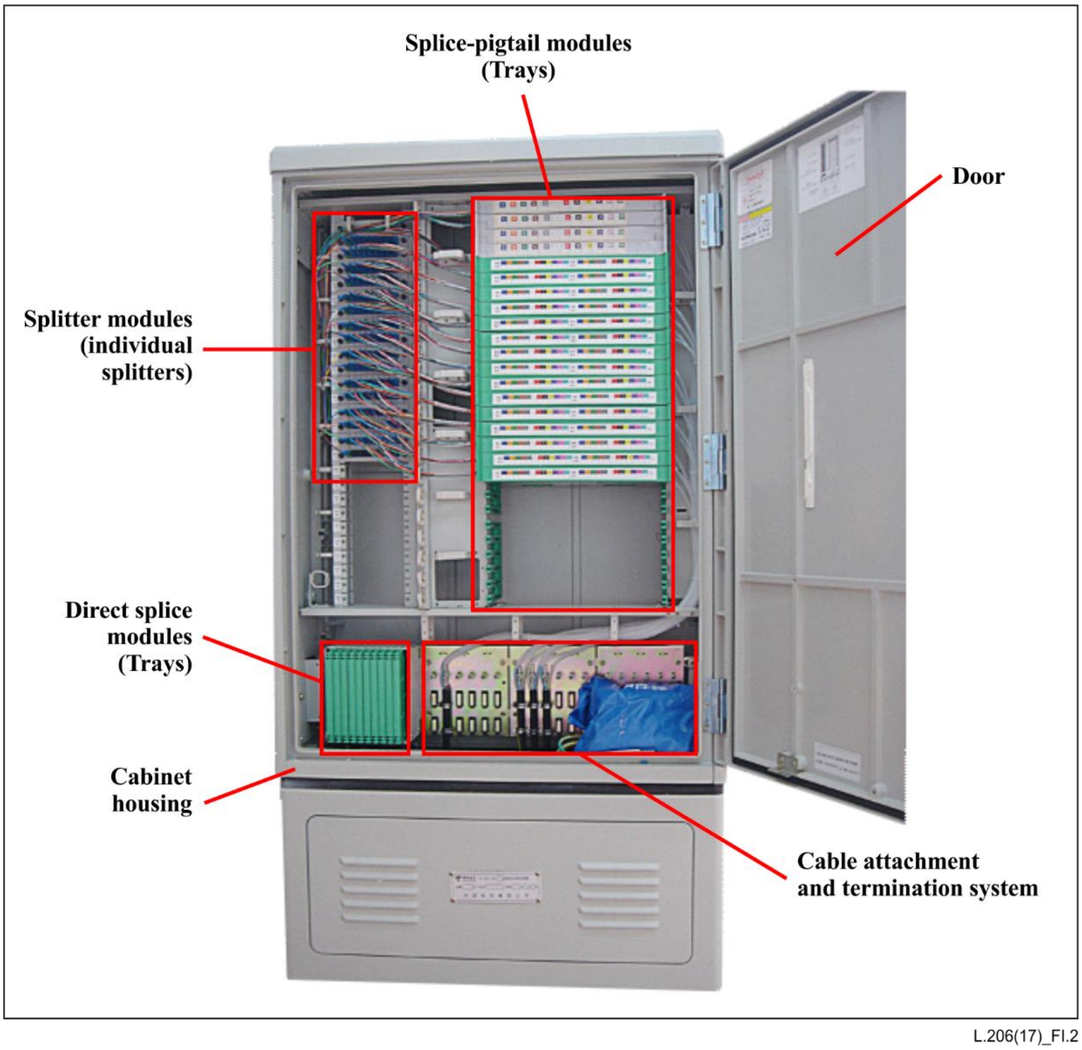

Figure I.2 – Cabinet structure example II

Available configurations of optical fibre management system (see clause 6.3.3) of example II in Figure I.2:

– direct splice without splitters;

– cross-connect with individual splitters integrated in distribution modules.

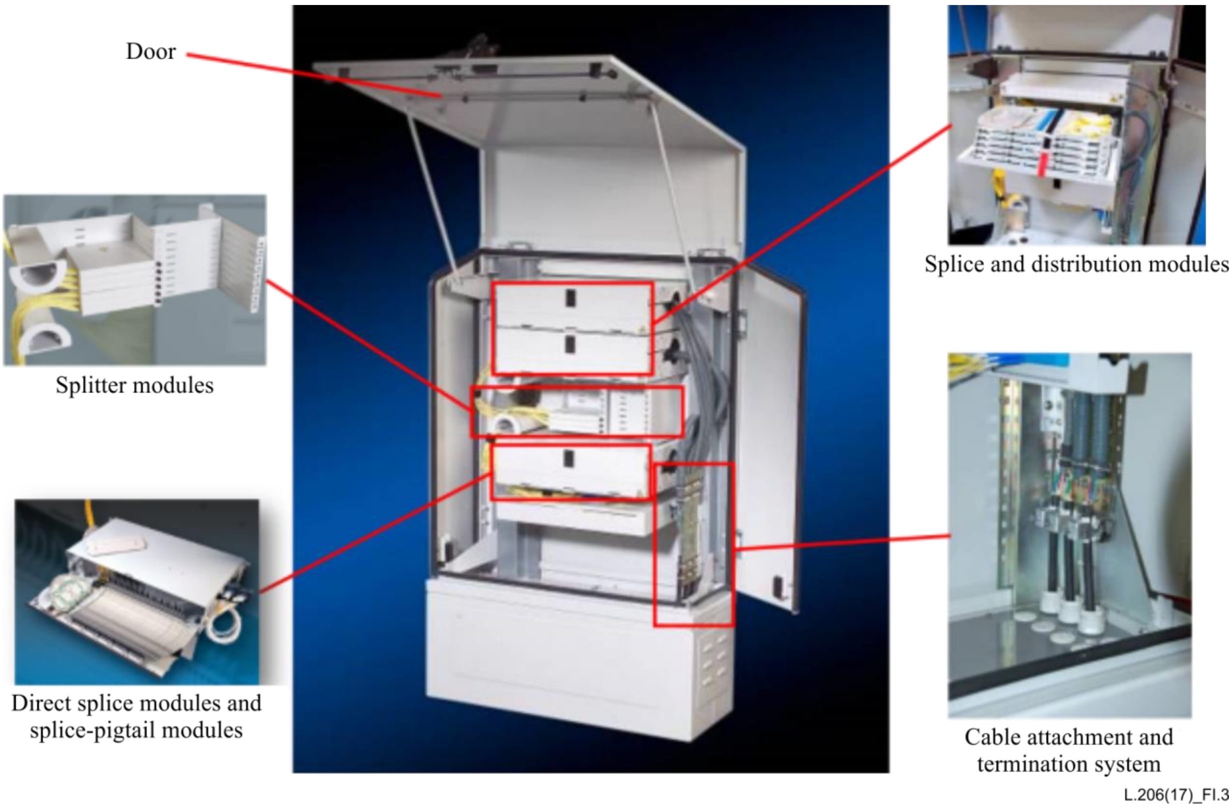

Figure I.3 – Cabinet structure example III

Available configurations of optical fibre management system (see clause 6.3.3) of example III in Figure I.3:

– direct splice without splitters;

– direct splice with splitters;

– interconnect without splitters;

– interconnect with individual pigtailed splitters;

– cross-connect without splitters;

– cross-connect with individual pigtailed splitters.

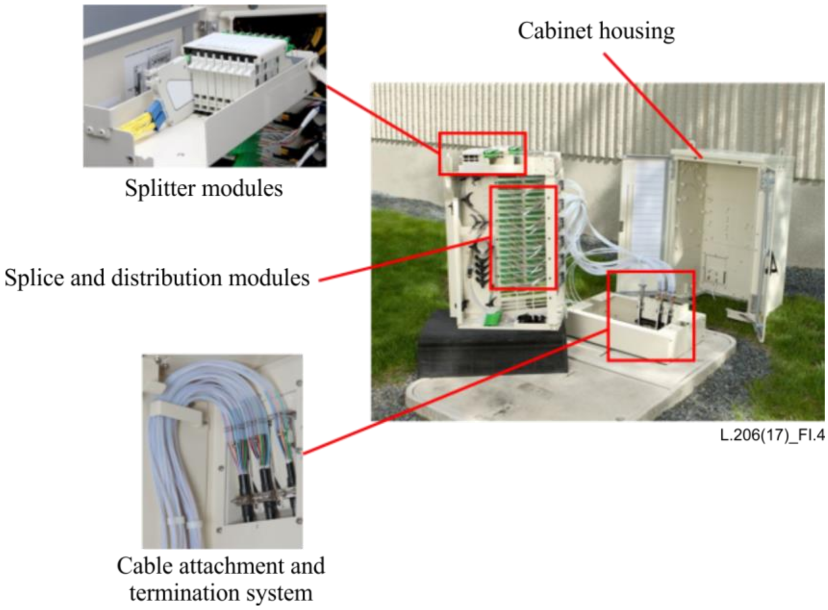

Figure I.4 – Cabinet structure example IV

Available configurations of optical fibre management system (see clause 6.3.3) of example IV in Figure I.4:

– cross-connect with individual pigtailed splitters.

Appendix II

Product characterization checklist

(This appendix does not form an integral part of this Recommendation.)

This checklist facilitates the systematic characterization of the features and capabilities of an optical cross-connect cabinet. It reflects the parameters that are described in [ITU-T L.200]. It may be useful for preparation of the test programme of products as well as product descriptions for tenders and purchasing specifications, comparison of different or competitive products and creation of commercial information and ordering guides.

Product name: ....

Material of cabinet housing

☐ Metal

☐ SMC

☐ Other: ……..

Application environment(s) (see clause 7.1 of [ITU-T L.200])

☐ OG Outdoor ground level

☐ OA Above ground level

☐ E Extreme (describe differences versus a basic environmental class)

Ingress protection (IP) protection class

☐ IP54

☐ IP55

☐ Other: ……..

Optical functionality and compatibility (see clause 6 of [ITU-T L.200])

– ***optical stability level****:*

☐ Static

☐ Dynamic (transient free)

– ***wavelength*** (see clause 6.3 of [ITU-T L.200])

☐ 1 310 nm

☐ 1 550 nm

☐ 1 625 nm

☐ Other: ……..

– ***cable construction*** (see clause 6.1.1 of [ITU-T L.200])

☐ Loose buffer tube

☐ Micro-sheath

☐ Central core

☐ Slotted core

☐ Blown fibre

☐ Break out cable

☐ Interfacility cable

☐ Optical Power Ground Wire (OPGW) cable
☐ Other: ....

– ***fibre type, fibre grouping, fibre coating*** (see clause 6.1.2 of [ITU-T L.200])

☐ Multimode

☐ Single mode

☐ Single fibre

☐ Ribbon 4

☐ R8

☐ R12

☐ R24

☐ other: …......................

☐ Primary coated (~250 µm)

☐ Secondary coated (~900 µm)

– ***passive devices*** (see clause 6.1.3 of [ITU-T L.200]):

☐ Splice type: ☐ Fusion

☐ Mechanical (brand/type): ....

☐ Splice protector type:

☐ Heatshrink (min/max dimensions): ....

☐ Mechanical (brand/type) :..

☐ Connectors: specify brand/type: ....

☐ Branching devices: (describe type, split ratio etc.): ....…………

Delivered as preassembled/prefibred modules ☐ yes ☐ no

☐ Other passive devices: (describe) ....

Delivered as preassembled/prefibred modules ☐ yes ☐ no

– ***fibre storage and separation level*** (see clause 6.2.2 of [ITU-T L.200])

	Circuit separation level				
	ME	**SE**	**SR**	**SC**	**SF**
☐ Uncut fibre (looped fibre)	☐	☐	☐	☐	☐
☐ Splices	☐	☐	☐	☐	☐
☐ Passive optical components	☐	☐	☐	☐	☐
☐ Other:	☐	☐	☐	☐	☐

Additional or special requirements and features

– ***storage/transport conditions*** (see clause 7.2 of [ITU-T L.200])

☐ Normal: public transport – indoor storage

☐ Special handling/transport: ....

☐ Special storage: ....

– ***additional (conditional) requirements*** (see Appendix III of [ITU-T L.200]):

☐ Bullet/shotgun proof according to: ....

☐ Earthquake resistance according to: ....

☐ Freeze-thaw resistance according to: ....

☐ Fire-related performance according to: ....

  ☐ Fire retardancy according to: ....

  ☐ Halogen free according to: ....

  ☐ Low smoke emission according to: ....

☐ Electrical grounding and shield continuity according to: ....

  ☐ Current surge according to: ....

  ☐ Insulation resistance according to: ....

  ☐ Contact resistance according to: ....

☐ Rodent resistance according to: ....

☐ Termite resistance according to: ....

☐ Steam resistance according to: ....

☐ Cable blocking according to: ....

☐ Other: .... according to: ....

Bibliography

[b-ITU-T G-Sup.59] ITU-T G-series Recommendations – Supplement 59 (2016), *Guidance on optical fibre and cable reliability*.

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