INTERNATIONAL TELECOMMUNICATION UNION

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CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANTS

METHODS OF TERMINATING METALLIC CABLE CONDUCTORS

ITU-T Recommendation L.9

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation L.9 was published in Volume IX of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation L.9

METHODS OF TERMINATING METALLIC CABLE CONDUCTORS

(Melbourne, 1988)

1 General

Metallic cable conductor terminations are installed at various locations within the cable network. The type of terminal and termination device utilized at these locations is dependent on various factors relating to the specific installation:

- type of cable and conductor being terminated;
- location and purpose of the termination;
- number or quantity of terminations required;
- type of service or transmission link involved;
- flexibility and protection requirements.

Basically, all exchange, repeater (amplifier or regenerator), and major cross-connection point terminations are of the "fixed" type utilizing wrapping, soldering of insulation displacement connection (IDC) techniques.

Local distribution and customer terminations utilize a mixture of "fix" and "temporary" (screw terminal) type terminations depending on individual conditions. Where required, over-voltage protection may be provided as an integral component of the terminating device or a separate "add-on" facility.

Within a cable network, two methods of terminating cables are available. These may generally be referred to as the direct and indirect methods.

Direct termination implies that the conductors associated with a particular cable connected directly to the terminal forming the "end" of the cable circuit, e.g. the cable conductor and terminal are directly coupled.

Indirect termination implies that the cable conductor is connected to the end terminal via a device that incorporates a preformed or manufactured termination.

Direct terminations are usually utilized in end terminals such as at the exchange main distribution frame (MDF) and customer premises, although some direct terminations are used in the customer distribution cable area. In most other mid-point terminations (distribution cabinets and pillars, repeater housings and termination points for trunk carrier and coaxial cables), indirect terminations utilizing devices with pre-terminating tail cables are spliced into the basic bearer cables.

The electric conducting parts of terminating devices will be of metal such as copper, brass or other similar alloys suitably plated to resist corrosion and other environmental effects and provide good electrical connection, either by contact, pressure, soldering or wrapping.

Various insulating materials (plastic extrusions and resin moulding) provide the mechanical mounting and electrical insulation of the metallic components.

2 Termination types

2.1 *Termination types for symmetric pair conductors*

2.1.1 *Wire-wrapping type*

In this type the conductor is wire-stripped and cut, inserted in a wire-wrap tool and wire-wrapped around the terminal point.

2.1.2 *Solder-on-type*

In this type the conductor is wire-stripped and cut, then inserted in the terminal slot and soldered.

2.1.3 *Wrap-and-solder type*

In this type, after wrapping, the conductor is soldered to the cut end of a terminal.

2.1.4 *Binder-post type*

There are different forms of this type:

a) Termination by means of screws. The conductor is wire-stripped, cut and fastened with screws by means of a screwdriver.

b) Termination by means of nuts. The termination consists of a fixed threaded brass post containing washers and a threaded hex nut. The conductors are terminated between the washers.

2.1.5 *Insulation displacement contact (IDC) type*

In this type, generally the conductor is installed and pressed into a U-element contact by means of a special tool.

The U-element contact has different forms and is the most frequently used terminating type.

2.1.6 *Termination for unused conductors*

This termination is made by means of plastic connectors without U-element contacts and is used for the protection of unused conductors in a pedestal or splice closure.

2.2 *Termination types for coaxial conductors*

2.2.1 *Connectors types*

Coaxial pairs are terminated in connectors mounted on a metallic diaphragm for accessing the repeater housing of the terminal equipment.

The connector joins the stiff coaxial tube to the flexible one leading into the housing or exchange, and is provided with a device for pneumatic insulation.

2.2.2 *Direct-joint type*

A joint between the air core tube and the flexible coaxial cable is made at times.

3 Termination use

The types of termination mentioned above are used in different devices and locations for terminating cables in all their applications: main distribution frame, regenerating equipments, cabinets, terminal boxes and subscriber's premises.

These devices present some physical characteristics which may vary greatly from country to country, although their technical features (i.e. electrical and environmental requirements) are very similar.

4 Requirements for MDF terminating devices

The basic requirements of the exchange MDF terminating device include the provision for:

- fixed termination of external cable conductors, in multi-pair units (usually 100), and associated jumper cross-connection leads;
- ease of termination, and retermination where necessary, of cable and jumper cross-connection conductors;
- overvoltage protection by add-on or plug-in triode gas protectors;
- circuit isolation by insertion or removal of an appropriate device;
- independent circuit accessing and testing, on equipment and line sides;
- circuit paralleling;
- earthing point or buses;
- ratio of O/G (outgoing) to I/C (incoming) circuit terminating capability of at least two;
- multi-point pair access connection (plugs and leads);
- colour coding of special circuits;
- fanning strips and jumper guides;
- permanent circuit indentification numbering;
- good visibility.

4.1 *Technical requirements*

The design, construction and materials utilized in the terminating device must provide for an expected service life up to 40 years. Devices must be compatible with the existing MDF construction and utilization practices, interchangeable with the existing termination devices, and maintain or increase current circuit density per unit area.

The line side terminals shall be required to terminate the existing range of copper external cable conductors extending from 0.32 mm to 0.90 mm diameter, plastic insulated with solid or cellular forms of insulation. The terminals on the equipment side shall be required to terminate the existing range of copper internal cable conductors.

Reliable retermination of conductors in the order of 100 to 200 times over the life of the system shall be possible. Prior termination of larger conductors shall not affect the subsequent termination of a second thinner wire.

The line side terminating device on which line cables terminate should allow for the installation and acceptance testing of external cables (automatic simultaneous access, via the MDF termination, to all pairs of a 100-pair, or other, terminating unit.).

Terminating equipment shall be able to withstand the effects of normal concentrations of moisture, sodium chloride, hydrogen sulphide, sulphur dioxide, ammonium chloride and formic acid which may penetrate or originate in buildings.

Terminating equipment shall be expected to operate satisfactorily in temperatures ranging from –10°C to 50°C with daily ambient fluctuations of up to 15°C. Upper temperature limits shall be assumed to prevail for 25% of total time. Yearly averge relative humidity of 75% is to be assumed with maximum values not exceeding 95%.

In addition to the above, terminating equipment will be required to satisfy the following test requirements:

- cold;
- dry heat;
- damp heat;
- accelerated damp heat;
- vibration;
- storage;
- mould growth;
- corrosion test;
- robustness of terminals.

4.2 *Safety requirements*

Terminating systems will need to be designed with safety and security in mind. To this end, designs should:

- minimize the likelihood of unintended electrical contact and/or accidental dislocation of wires;
- use plastic materials with an oxygen index of at least 28, determined in accordance with international standards;
- use plastic materials which do not emit hazardous fumes or smoke when heated;
- avoid sharp corners and edges.

4.3 *Electrical requirements*

All the terminating blocks should have proper electrical characteristics in order to minimize the risk of personal injury to staff, customers and public from electrical causes, arising from the installation, operation, and maintenance of the devices.

If necessary, proper values should be recommended for:

- insulation resistance;
- voltage-proof test;
- capacitance between pairs of terminals.

5 Requirements for cable termination devices

5.1 *Electrical characteristics of terminations*

The main electrical characteristics for termination devices specified by most Administrations are:

- dielectric strength;
- insulation resistance;
- reflection index (coaxial only);
- contact resistance.

These characteristics are different for coaxial-pair terminations, long-distance symmetric-pair cables and local symmetric-pair cables.

5.2 *Environmental requirements of terminations*

The requirements should be specified for at least 20 years of field operation in stationary use at partially weather-protected locations. The IEC Standards should be followed in the areas of:

- temperature cycling, lower and upper limits;
- change of temperature;
- damp heat, steady state;
- standard climatic sequence;
    1) dry heat,
    2) damp heat, cyclic,
    3) cold,
    4) damp heat, cyclic,
- gas-tightness;
- shock or vibration.