INTERNATIONAL TELECOMMUNICATION UNION

CCITT L.13

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLE AND OTHER ELEMENTS OF OUTSIDE PLANT

SHEATH JOINTS AND ORGANIZERS OF OPTICAL FIBRE CABLES IN THE OUTSIDE PLANT

Recommendation L.13

Geneva, 1992

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation L.13 was prepared by Study Group VI and was approved under the Resolution No. 2 procedure on the 31st of July 1992.

CCITT NOTE

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

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SHEATH JOINTS AND ORGANIZERS OF OPTICAL FIBRE CABLES IN THE OUTSIDE PLANT[1)]

Introduction

When optical fibre cables are not continuous from one terminal to the next, optical fibre cable joints are required. A cable joint includes fibre joints[2)] and sheath joints. Optical fibre joints are covered in a separate Recommendation L.12. Further information is provided in the CCITT Manual "Construction, installation, jointing and protection of optical fibre cables".

Basically a sheath joint comprises a mechanical structure (closure) that is attached to the ends of the sheaths joined and covers the fibre joints, a means for attaching and sealing to the sheaths, and a means (organizer) for protecting the fibres and fibre joints within the closure. The optical fibre sheath joint shall:

— restore the integrity of the sheath, including mechanical continuity of strength members when required;

— protect the fibre joints from the environment in all types of plant (aerial, direct buried, in ducts and tunnels, and underwater);

— provide for the organization of the fibre joints and the storage of excess fibre; and

— provide electrical bonding and grounding of the metal parts of the sheath and strength members where required. 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 Recommendations K.11, K.25 and CCITT Manual "Protection of telecommunication lines and equipment against lightning discharges".

This Recommendation acknowledges that the cable sheaths used with optical fibre cables are of similar design to those used with copper cables. Thus, the methods used for jointing optical fibre cable sheaths are based on those used in sheath joints for conventional copper cable; reference may be made to the Handbook "Outside plant technologies for public networks", Recommendation L.10, "Optical fibre cables for duct, tunnel, aerial and buried applications" and other L-Series Recommendations.

1 Scope

This Recommendation:

— refers to the jointing of optical fibre cables that are used for telecommunication networks, in duct, tunnel, buried, aerial, and underwater installations;

— deals with the design of optical fibre cable sheath closures and organizers;

— deals with mechanical and environmental characteristics of the optical fibre cable joints concerned;

— deals with characteristics of optical fibre organizers.

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1) This Recommendation does not cover joints in undersea cables.

2) This Recommendation uses the term "fibre joint" which is the same as the term "fibre splice" used in IEC documentation.

2 Characteristics of optical fibre cable closure

2.1 *Design of cable closure*

Closure designs employ cold or hot processes based on the sealing methods used. Cold processes do not require heat whereas hot processes do. Mastic, tapes, grommets, o-rings, cured rubber shapes, pastes, potting compounds, and adhesives are cold processes. Thermoshrinkable materials and polyethylene injection welding are the primary hot processes. The heat source may be electrical resistance heating, infrared heating, hot air, or a gas flame. Regardless of which of these processes is used, the following shall be considered:

— the materials used for making the cable joint shall be compatible with themselves and with the materials of the sheath. Further, to prevent corrosion, or other electro/chemical damage the materials shall be compatible with other materials normally used in the outside plant;

— a closure shall be mechanically strong;

— a design may allow for jointing together more than two cable ends. The cables entering the closure may be of differing sizes and/or types. For example: some of the cables may be small customer service cables;

— a design may allow for jointing together cables not at the end of a cable; for example a joint of a branch or customer service cable to a through cable in the middle of a cable length;

— it is desirable that closures can be reopened when necessary and remade without interruptions to working circuits;

— a single design, which may be used for all of the above applications;

— if a design is limited to certain applications and environments in the network, any limitations shall be clearly indicated to the user;

— if joint sealing encapsulant is used, information is required for adjustments in setting time due to variations in ambient temperature and humidity;

— if a heat source is required to seal the closure and/or closure to the sheath, a suitable heat source (gas flame or electrical power) needs to be available at the jointing points. Consideration shall be given to control of the heat source to protect personnel and prevent damage to the closure or cable;

— if the closure is in pressurized plant, it shall be able to hold the operating pressures safely and without leaking. In addition, a means shall be provided to reduce the pressure for safe re-entry.

2.2 *Mechanical characteristics*

The mechanical characteristics shall be considered according to the conditions of the installation. Wherever appropriate, test methods according to IEC 1073-1 shall be used in this section.

2.2.1 *Bending*

After installation, the closure may be subjected to bending stresses due to dynamic conditions encountered by the cables and shifts in the earth in directly buried applications. The closure shall maintain a seal to the cable sheaths and the cable jointing system shall prevent transfer of excess strains to the enclosed fibres.

2.2.2 *Creep (axial tension)*

Dynamic conditions, especially in aerial and duct plant, and shifts in the soil in directly buried applications may cause cyclic and static tensile loads in the cable. These tensile loads shall be supported by the closure without losing the seal to the sheaths and transferring excessive strains to the fibres.

2.2.3 *Crush and impact*

The closure may be subjected to crush and impact both during installation and operational life. The closure shall protect the fibres and fibre joints under normal crush and/or impact loading experienced during the life of the cable system. In certain circumstances, for directly buried closures, additional protection may be provided, for instance, by placing the closure in a loose sleeve.

2.2.4 *Torsion*

Under dynamic conditions during operation, the cable may be subjected to torsion. The closure shall be able to transmit the torque across the joint while maintaining seals to the cable sheaths. The transmitted torques shall not be transferred to the fibres or fibre joints.

2.3 *Environmental characteristics*

The environmental characteristics shall be considered according to the conditions of the installation.

2.3.1 *Temperature variations*

During their operational life, cable joints may experience severe temperature variations. The closure shall be able to withstand the temperature variations without loss of function, damage to the fibres, or increase in optical loss.

2.3.2 *Water immersion/moisture permeation*

During their operational life, cable joints may be immersed in water or exposed to very high humidity for long periods of time. Fibres exposed to very high humidity and/or liquid water, may deteriorate in strength and have a reduced time to failure under static fatigue. A desiccative material may also be used to reduce the humidity within the closure.

The closure shall prevent entry of liquid water. Liquid water in a cable joint may freeze and, under some conditions, can cause fibre crushing or breaks. A water sensor may be installed in the closure to detect the presence of water.

Fibres shall be arranged within the closure so that their stress levels are sufficiently limited to ensure a satisfactory lifetime taking into account the expected relative humidity within the closure. Various materials, such as continuous metallic barrier, can be used to reduce the rate of moisture permeation.

2.3.3 *Lightning*

Fibre cables containing metallic elements such as moisture or rodent barrier, metallic strength member, or copper pair, are subject to lightning damage.

To prevent or minimize lightning damage the closure shall be capable of passing the resulting high current through the joint without damaging the fibre joints.

2.3.4 *Vibration*

Optical fibre cable joints may be located on aerial messenger strands, underground in manholes, directly buried, on bridges and other structures; as a result of their location, they may be subject to vibrations from wind, traffic, railways, pile-driving and blasting operations. The cable joints shall be able to withstand these vibrations without loss of function, damage to the fibres, or increase in optical loss.

2.3.5 *UV (solar) radiation*

Cable joints placed in aerial plant will be subject to UV radiation from sunlight. The material of the closure shall be resistant to UV radiation. Any surface degradation shall not result in product(s) that may be harmful to persons handling the closures upon subsequent reentry or reduce the performance level of the closure.

2.3.6 *Snow and ice*

In some aerial and duct applications, the closure will be exposed to and coated with snow and/or ice. The performance of the closure shall not be degraded by the snow or ice.

3 Fibre organizers

Fibre organizers are an integral part of an optical fibre cable joint. The organizers are comprised of one or more sheets or trays that have means for holding fibre joints and fibre in an orderly manner, and shall minimize fibre strain.

3.1 *Characteristics of fibre organizers*

The function of an optical fibre organizer is:

1) to provide means for storing and protecting fibre joints in a predetermined order and in relation to the sub units of an optical fibre cable; the number of fibre joints in one organizer may vary according to the size and shape of the fibre joint and the number of fibres in a cable sub-unit;

2) to ensure a minimum fibre bend radius of 30 millimetres so that the residual strain is $\leq$ 0.2%. The actual bend radius may be larger for some fibre designs in specific transmission systems to maintain a low loss;

3) to provide easy identification and access to any stored fibre joint for re-jointing without causing damage to any other jointed fibres or interruption of traffic;

4) to provide means for storing the slack fibre required for jointing and for possible rejointing in the future.

The materials used for making the organizer shall be compatible with the other materials in the cable joint.

3.2 *Configurations of optical fibre organizers*

The trays or sheets of an organizer may be configured in one of the following ways:

1) lateral sliding from a frame — similar to removing a book from a shelf;

2) rotation about a hinge — similar to turning a page in a book;

3) lifting from a stack — similar to lifting a book from a stack; or

4) unroll — similar to locating a page on a scroll.

3.3 *Mechanical and environmental characteristics*

The fibre organizer shall protect the fibre and shall continue to function without mechanical damage to the fibres or fibre joints or without degradation to signals carried by the fibres, when the cable joint is subjected to the mechanical and environmental conditions discussed above in §§ 2.2 and 2.3.