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

ALUMINIUM CABLE SHEATHS

ITU-T Recommendation L.4

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation L.4 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.4

ALUMINIUM CABLE SHEATHS

(Geneva, 1972; modified at Geneva, 1976, Malaga-Torremolinos, 1984 and Melbourne, 1988)

1 General

Because of the technological progress made in the use of aluminium, aluminium cable sheaths are being used on an increasing scale and their favourable characteristics can now be fully exploited.

These characteristics include:

– low density (almost a quarter that of lead);

– much higher mechanical strength than lead, so that the sheath is lighter not only because aluminium is lighter than lead, but because the thickness may be less than for lead;

– very high resistance to vibration;

– high conductivity, so that a better screening factor and more effective protection from overvoltages of atmospheric origin can be obtained.

It is now found that the stiffness of an aluminium sheath does not give rise to any additional serious problems during laying.

However, because aluminium is more vulnerable than lead to electrochemical and electrolytic corrosive action, aluminium cable sheaths and the joints between individual factory lengths (jointing sleeves and adjacent sections of cable) require a Class II (see [1]) outer protective covering of plastic material.

As can be seen from the foregoing, an aluminium sheath has many advantages over a lead sheath. The generalized use of aluminium for sheathing cables is therefore desirable, at least whenever cable costs would not be increased compared with the use of lead, and also whenever aluminium sheaths satisfy the technical requirements to a greater extent. The use of cables with aluminium sheaths is particularly interesting in the case of trunk cables.

2 Types of aluminium sheath

2.1 *Extruded sheaths*

This type of sheath is obtained by extruding the aluminium directly around the cable core. The press may be of the *continuous* type or not. If it is not continuous, care must be taken to ensure that no problems are caused in the zones affected by the intermittent nature of the process.

2.2 *Welded sheaths*

This type of sheath is made by applying around the cable core an aluminium strip which is longitudinally welded.

2.3 *Quality of sheath material*

In order to make the means of protection against corrosion effective, great care has to be taken concerning the quality of the sheath. In case pure aluminium is used, the purity of aluminium for the sheath should not be lower than 99.5% grade, for both the extruded sheath or the welded sheath.

2.4 *Choice of sheath shape and thickness*

After the sheath has been extruded or welded it may either be shrunk on to the cable core (noncorrugated sheath) or corrugated by a variety of methods (corrugated sheath).

The sheath may be corrugated or noncorrugated, depending on the diameter of the cable core, the minimum radius of curvature during laying and on the mechanical characteristics of the aluminium used (see [2]). As a rough guide it can be stated that the sheath should be corrugated in the case of cables of more than 40-mm core diameter.

As stated in § 1 above the thickness of the metal used for aluminium sheaths is usually less than for lead sheaths.

The thicknesses given in Table 1/L.4 are suggested although the values given in this table apply to both extruded and welded sheaths; however, extruded sheaths may not be less than 0.9 mm and welded sheaths may not be more than 1.4 mm, that being the maximum thickness which can be welded by existing methods.

The use of lesser thicknesses than those indicated in Table 1/L.4 is not excluded and, conversely, in the case of coaxial cables without armouring, the thickness of metal for all sheaths may have to be increased to improve mechanical protection. The increase in the thickness may be as much as approximately 0.3 mm.

Values different from those given in Table 1/L.4 may, of course, be adopted in certain cases (for example, if extremely favourable screening factors are required).

3 Protective coverings

As stated above, since aluminium used in an underground environment is more liable to corrosion than lead, an impermeable (Class II) covering should be provided in accordance with reference [1] to ensure the protection of the cable sheath and the jointing sections of individual factory lengths of cable (jointing sleeves and adjacent sections of cable).

Two types of plastic material can be used at present for protective coverings:

a) polyvinylchloride (PVC);

b) polyethylene.

Polyethylene is preferable since its general characteristics and its low permeability for water vapour give better protection to the aluminium.

To ensure that moisture which may have penetrated the protective covering (for example, because of a defect in the covering) does not spread along the surface of the sheath, extending the areas of corrosion, it is essential to apply a leakproof layer consisting of an adhesive tape or a suitable mixture.

The leakproof layer must adhere well to the aluminium, especially when PVC is used for the covering, since this material, unlike polyethylene, does not cling tightly to the sheath after extrusion.

The protective covering on the aluminium sheath should be sound. One form of test with the cable on the drum is to measure the insulation resistance of the covering.

TABLE 1/L.4

Suggested thickness

Core diameter (mm)		Metal thickness (mm)	
Minimum	Maximum	Noncorrugated sheaths	Corrugated sheaths [a)]
–	10	0.7 to 1.0	0.5 to 0.9
10	15	0.7 to 1.0	0.6 to 0.9
15	20	0.9 to 1.0	0.7 to 0.9
20	25	1.1	0.8 to 0.9
25	30	1.1 to 1.2	0.9
30	35	1.1 to 1.3	0.9 to 1.0
35	40	1.1 to 1.4	1.1
40	45	1.5	1.1 to 1.2
45	50	1.6	1.1 to 1.2
50	60		1.1 to 1.3
60	70		1.1 to 1.4
70	80		1.3 to 1.5

[a] If it is intended to obtain approximately the same screening factor with a corrugated sheath as with a noncorrugated one, the thickness should be the same as with a noncorrugated sheath.

In the case of corrugated sheaths, the bituminous mixture must fill the corrugations sufficiently to allow complete contact with the outer covering.

Special tests should be made of the efficiency of the leakproof layer. A common test consists in removing a part of the protective covering from a sample of the aluminium sheath and submitting it to electrolytic attack using an outside source of e.m.f. After some time, a check must be made to see whether the corrosion is confined to the place from which the protective covering was removed. The effectiveness of the protective covering can be assessed by means of a test to check the adhesion of the bituminous compound to both the aluminium sheath and the plastic covering.

To ensure the permanent effectiveness of the protective covering when cables are laid in areas exposed to lightning discharges (in particular as concerns avoiding perforations due to lightning discharges) the indications given in the manual cited in [3] should be taken into account.

If a test of the protective covering is necessary in the manufacturing process, an electric spark detect method or a voltage resistance test method with the cable submerged in water is effective. In the process of installation and operation, if the factors that might cause damage to the protective covering or decrease the protective covering's insulation resistance are to be found, the test should be carried out and the faults should be eliminated.

4 Jointing of aluminium sheaths

Jointing is undoubtedly a more difficult operation for aluminium than for lead sheaths, although these difficulties have been minimized by improved techniques.

There are several methods of jointing aluminium sheaths:

- jointing by means of lead sleeves;
- jointing by means of lead rings or cones which are plumbed using a normal method or fixed with special glue to the aluminium sheath to permit subsequent soldering to lead sleeves;
- jointing by means of aluminium sleeves joined to the aluminium sheath by pressure welding (explosion, pressure or cold welding);
- other methods including the use of adhesive tapes and epoxy pastes.

The methods used for the jointing of aluminium sheaths must meet the conditions recommended in the booklet cited in [4].

For an aluminium-sheathed cable subjected to significant temperature variations, tensions due to cable contraction should not be borne by the joints as this can lead to joint failure, particularly with noncorrugated sheaths.

5 Cathodic protection

The corrosion protection of aluminium sheaths depends mainly on a high quality anti-corrosion protective cover. However, if there is serious risk of damage to the protective cover, and particularly if it is not possible to re-establish the protective cover to its original specifications after repair, the cover should be protected with special measures such as sacrifice anode electrical chemical protection. Aluminium alloy sacrifice anode, which has the advantage of a higher current capacity per unit weight, an appropriate protective potential, an abundant raw material resource base, and ease of manufacture, is an effective measure to protect aluminium sheathed cables. Tests show that good results can be obtained if the protected aluminium sheath potential value with respect to ground is limited within the range of –0.85 to 1.20 V (relative to a $Cu/CuSO_4$ electrode).

6 If there are no special requirements in using aluminium sheaths for optical fibre cables, the same sheath material and manufacturing process may be used as for metallic conductor cables.

References

[1] CCITT manual *Outside plant technologies for public networks*, Part IV-A, Chapter III, § 1.2.2, ITU, Geneva 1988.

[2] *Ibid.*, Part I, Chapter III, § 6.2.2.

[3] CCITT manual *The protection of telecommunication lines and equipment against lightning discharges*, ITU, Geneva, 1974, 1978.

[4] CCITT manual *Jointing of plastic-sheathed cables*, ITU, Geneva, 1978.