

PATENT SPECIFICATION

(11) 1 411 023

1 411 023

- (21) Application No. 22697/73 (22) Filed 11 May 1973
 (31) Convention Application No. 47332/72 (32) Filed 13 May 1972 (19)
 (31) Convention Application Nos. 52603/72 and 52604/72
 (32) Filed 27 May 1972 in
 (33) Japan (JA)
 (44) Complete Specification published 22 Oct. 1975
 (51) INT CL² C08J 5/00
 (52) Index at acceptance

C3P 102 11D2A2A 11K4 11K6 11K7 11K8 4D3B1 4K11
 4K6 4K7 4K8 6D3 6K11 6K4 6K7 6K8 7D1A
 7K11 7K4 7K6 7K8 8D2A 8D2B2 8K11 8K4 8K6
 8K7 8K8 F PC18 PC20B PC20D2
 H1A 1C 3E



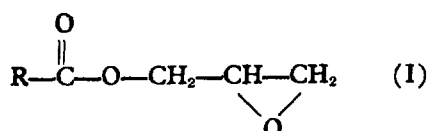
(54) LAMINATED TAPE FOR SHEATHING CABLE

- (71), We, SUMITOMO ELECTRIC INDUSTRIES LTD., a Japanese Company, of No. 15, 5-Ghome, Kitahama, Higashi-Ku, Osaka, Japan, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention relates to laminated sheathing tape for forming the shielding layer of a laminate sheathed cable and comprising a metal tape and a resin laminated to one or both surfaces of the metal tape; and to a laminate sheathed cable comprising a cable core, such laminated tape positioned longitudinally or wound helically around the cable core, and a jacket of a plastics material coated on said laminated tape.
- A resin to be laminated on the tape during the the production of the laminate sheathed cable is required to have adhesive properties whereby it adheres both to the metal tape and to a plastics jacketing material such as polyethylene. The resin is also required to exhibit good processing properties during production of the cable, for example, good abrasion-resistance in a tape-forming apparatus.
- Aluminium is usually used for the metallic component of such a metallic tape, and the reasons why the laminate resin is required to have good adhesion for the metallic tape and the polyethylene which is usually used for the jacketing layer are to improve the moisture-resistance of the cable, that is the laminate resin must serve to prevent moisture permeation, to improve the mechanical strength such as the bending property of a unitized sheath (jacketing layer) by strongly laminating the metallic tape to the polyethylene jacketing layer, and to assist the function of the metallic tape to control the shrinkage of the sheath. It should be explained that a plastics sheath has stresses formed therein during extrusion and thus shrinks due to the heat cycle upon exposure to the open air.
- As may be seen from British Patent Specification No. 886,417, polyethylene has long been used as the laminating resin, but it suffers from the defect of weak adhesive strength to aluminium tape.
- United States Patent Specification No. 3,233,036 discloses a technique which remedies this defect by using a carboxyl-containing resin so as to improve its adhesion with the aluminium tape. It, suffers however, from the defect that sufficient bond strength in the sheath cannot be obtained because of the greatly different polarity of such a resin from polyethylene used in the outer protective layer.
- United States Patent Specification No. 3,586,756 (corresponding to Japanese Patent Publication No. 23257/70) discloses an attempt to eliminate both the above-mentioned defects. A laminated tape is there disclosed comprising an aluminium tape having a polyethylene layer on each face thereof, the inner surface of each polyethylene layer being modified with carboxyl groups capable of chemically bonding with the aluminium of the tape. The outer surface of each layer is accordingly formed of ethylene homopolymer which, although it does not have the ability to adhere to the tape as effectively as the carboxyl-containing ethylene copolymer, does adhere more strongly to the jacketing layer.
- When this kind of laminated tape is used, although the mechanical property of the resulting cable is excellent, various defects occur in the preparation of laminated tapes such as that the manufacturing steps are complicated; that the manufacturing cost is high; and the consequently the cost of the resulting cables is also high, since the laminated tapes thus prepared are composed of two or more layers.
- The object of the present invention is to provide economically a laminate sheathed cable

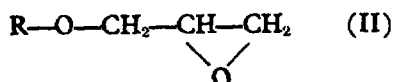
of improved mechanical strength by using a resin composition which adheres sufficiently to a metal layer and to a polyethylene protective jacketing layer. The use of the said resin composition results in the elimination of complicated steps in the manufacture of a laminated tape.

The present invention is therefore characterized by the use of a copolymer consisting of an ethylene component which is compatible with the protective polyethylene of the cable and other components containing reactive groups having good adhesiveness to metal.

According to the present invention there is provided a laminated tape for forming the shielding layer of a laminate sheathed cable and comprising a metal tape and a resin coated to one or both surfaces thereof, the resin being a terpolymer of (a) at least about 75% by weight ethylene, (b) unsaturated glycidyl ester of the following general formula (I):



wherein R represents a hydrocarbon residue containing an ethylenically unsaturated bond or, an unsaturated glycidyl ether of the following general formula (II):



wherein R has the previous significance, and (c) an alkyl acrylate, an alkyl methacrylate or vinyl acetate, and having a melt index of not more than about 15.

According to another aspect of the present invention there is provided a laminated tape and a laminate sheathed cable which utilizes a resin having improved heat stability, being the above-described terpolymer component containing 100 to 10,000 ppm of an anti-oxidant.

The terpolymer used in the present invention may be prepared according to various methods. One method of preparation is to polymerize a mixture of ethylene and other comonomers in the presence of a free-radical forming catalyst under the polymerization conditions of a pressure of from 40 to 5,000 kg/cm² and a temperature of from 40 to 300°C. Another method is to add, in the polymerization step, a chain-transfer agent such as ethane, propane, propylene or the like, to prepare the copolymer.

When the resin is used for coating a metal tape, the adhesiveness thereof to the metal tape and subsequently to the protective polyethylene and the mechanical strength thereof are good; and accordingly not only is the adhesive strength of the resulting tape improved, but the workability of the laminated tape in the manufacture of a cable is also improved.

Figure 1 of the accompanying drawings is a cross-section of a conventional laminate sheathed cable; and,

Figure 2 is a series of three schematic views illustrating bonding strength test methods referred to in Table 3 for laminate tapes.

As shown in Figure 1, a laminate sheathed cable is composed of a cable core 1, a laminated tape layer 2 consisting of a metallic tape 3 having laminated thereon a resin layer 4 and a jacketing layer 5 composed of a synthetic resin.

The merits of the resin compositions used in this invention will now be illustrated in detail and compared with the use of resins not in accordance with the invention. Since aluminium tape is ordinarily used as the metallic layer in laminate sheathed cables, an aluminium tape was likewise used as the metallic layer to which the compositions were applied.

The basic characteristics of the following resins are shown in Table 1; the compositions of the terpolymers are shown in Table 2 (% by weight); and their adhesive and other properties in Table 3.

TABLE 1

Basic characteristics of resins

Resin	melt index (g/10 min) ASTM 1238	Tensile strength (kg/cm ²) JISK-6760	Elongation (%) JISK-6760	Coefficient of static friction (against surface of copper)
E ₁	12.4	1.48	550	0.50
E ₂	2.8	1.80	614	0.45
A ₁	5.7	1.62	768	0.70
A ₂	1.7	2.59	763	0.68
S	3.5	2.92	478	0.56
P	7.2	1.27	512	0.40
G ₁	2.0	1.69	610	0.45
G ₂	2.0	1.72	605	0.48
G ₃	12.0	1.55	572	0.56
G ₄	8.0	1.62	598	0.50
G ₅	2.0	1.73	635	0.48
G ₆	2.0	1.70	645	0.48
G ₇	5.0	1.58	602	0.51
G ₈	3.0	1.68	612	0.49
G ₉	2.0	1.74	659	0.46
G ₁₀	2.0	1.68	630	0.48
G ₁₁	3.0	1.58	610	0.50
G ₁₂	2.0	1.65	597	0.50
V ₁	2.0	1.69	610	0.48
V ₂	2.0	1.74	642	0.46
V ₃	2.0	1.70	624	0.45
V ₄	5.0	1.61	587	0.51
V ₅	2.0	1.75	619	0.46
V ₆	3.0	1.67	621	0.45
V ₇	3.0	1.59	574	0.47
V ₈	6.0	1.59	577	0.48

TABLE 1 (Continued)

E ₁ - E ₂ :	ethylene-vinyl acetate copolymer
A ₁ - A ₂ :	ethylene-acrylate copolymer
S:	copolymer of ethylene and comonomer containing carboxyl group
P:	polyethylene
G ₁ - G ₃ :	ethylene-glycidyl methacrylate-methyl acrylate terpolymer
G ₄ :	ethylene-glycidyl methacrylate-methyl methacrylate terpolymer
G ₅ - G ₇ :	ethylene-glycidyl acrylate-ethyl acrylate terpolymer
G ₈ :	ethylene-glycidyl acrylate-ethyl methacrylate terpolymer
G ₉ - G ₁₁ :	ethylene-allyl glycidyl ether-methyl acrylate terpolymer
G ₁₂ :	ethylene-allyl glycidyl ether-methyl methacrylate terpolymer
V ₁ - V ₄ :	ethylene-glycidyl acrylate-vinyl acetate terpolymer
V ₅ - V ₈ :	ethylene-allyl glycidyl ether-vinyl acetate terpolymer

TABLE 2

Grade	GMA	GA	AGE	MA	EA	MMA	EMA	ethylene	VA
G ₁	2.4	—	—	8	—	—	—	balance	—
G ₂	6.0	—	—	6	—	—	—	„	—
G ₃	12.0	—	—	4	—	—	—	„	—
G ₄	6.0	—	—	—	—	8	—	„	—
G ₅	—	2.5	—	—	10	—	—	„	—
G ₆	—	6.0	—	—	6	—	—	„	—
G ₇	—	10.0	—	—	4	—	—	„	—
G ₈	—	6.5	—	—	—	—	5	„	—
G ₉	—	—	3.5	10	—	—	—	„	—
G ₁₀	—	—	6.5	3	—	—	—	„	—
G ₁₁	—	—	12.0	2	—	—	—	„	—
G ₁₂	—	—	5.0	—	—	6	—	„	—
V ₁	—	2.5	—	—	—	—	—	„	8
V ₂	—	2.5	—	—	—	—	—	„	6

TABLE 2 (Continued)

Grade	GMA	GA	AGE	MA	EA	MMA	EMA	ethylene	VA
V ₃	—	6.0	—	—	—	—	—	„	4
V ₄	—	12.0	—	—	—	—	—	„	2
V ₅	—	—	2.0	—	—	—	—	„	8
V ₆	—	—	6.0	—	—	—	—	„	8
V ₇	—	—	10.0	—	—	—	—	„	4
V ₈	—	—	12.5	—	—	—	—	„	2

GMA: glycidyl methacrylate

GA: glycidyl acrylate

AGE: allyl glycidyl ether

MA: methyl acrylate

EA: ethyl acrylate

MMA: methyl methacrylate

EMA: ethyl methacrylate

VA: vinyl acetate

TABLE 3

Resin	Adhesive strength between aluminium tape and laminating resin (g/cm)		Adhesive strength between laminating resin and polyethylene (kg/cm)		Workability of cable (*4)	Blocking of laminate tape (*5)	Adhesive strength between aluminium tape and laminating resin (g/cm)
	sheet method (*1)	laminating method (*2)	sheet method (*3)				high-temp-erature laminating method (*6)
E ₁	341	341	4 or more		bad	Yes	—
E ₂	394	320	„		good	No	—
A ₁	1613	433	„		bad	Yes	—
A ₂	1068	421	„		bad	Yes	—
S	1559	1055	o		good	No	—
P	159	50	5.5		good	No	—
G ₁	2000 or more	600 or more	4 or more	good		No	419
G ₂	„	„	„	good		No	423

TABLE 3 (Continued)

Resin	Adhesive strength between aluminium tape and laminating resin (g/cm)		Adhesive strength between laminating resin and polyethylene (kg/cm)		Blocking of laminate tape (*5)	Adhesive strength between aluminium tape and laminating resin (g/cm)
	sheet method (*1)	laminating method (*2)	sheet method (*3)	Workability of cable (*4)		high-temp-erature laminating method (*6)
G ₃	2000 or more	600 or more		good	No	339
G ₄	"	"	"	"	"	411
G ₅	"	"	"	"	"	429
G ₆	"	"	"	"	"	441
G ₇	"	"	"	"	"	402
G ₈	"	"	"	"	"	452
G ₉	"	"	"	"	"	433
G ₁₀	"	"	"	"	"	408
G ₁₁	"	"	"	"	"	394
G ₁₂	"	"	"	"	"	447
V ₁	"	"	"	"	"	421
V ₂	"	"	"	"	"	438
V ₃	"	"	"	"	"	437
V ₄	"	"	"	"	"	445
V ₅	"	"	"	"	"	430
V ₆	"	"	"	"	"	427
V ₇	"	"	"	"	"	440
V ₈	"	"	"	"	"	444
two-layer type tape *(7)	—	520	—	"	"	—

Footnotes to Table 3

— not tested

- *(1) Method wherein soft aluminium (thickness 0.2 mm) was heat bonded at 180°C to a resin sheet (thickness 1.0 mm), followed by cooling to room temperature.
(For the measurement of the adhesive strength, see Fig. 2 (a)).
- *(2) Method wherein a layer of resin (0.05 mm) was laminated to soft aluminium (thickness 0.2 mm) using an extruder.
(For the measurement of the adhesive strength, see Fig. 2 (b)).
The extrusion temperature was 230°C, and the speed of lamination was 10 metres/min.
- *(3) Method wherein jacketing polyethylene (low density polyethylene, thickness 1.0 mm) was heat bonded at 160°C to a resin sheet (thickness 1.00 mm), followed by cooling to room temperature. (For the measurement of the adhesive strength, see Fig. 2 (c)).
- *(4) In the manufacture of cables, the surface of a resin film undergoes wear or splitting in, for example, a laminated tape-forming apparatus. This wear or splitting depends upon the mechanical properties of the resin, and also on the type of the comonomers and their contents.
- *(5) The laminated tape wound in coil form underwent blocking during storage. The blocking depends upon the types of the comonomers, their contents and the melt index of the copolymer.
- *(6) Method wherein a resin layer (thickness 0.05 mm) was laminated on soft aluminium (thickness 0.2 mm) using an extruder. (For the measurement of the adhesive strength, see Fig. 2(c)). The extrusion temperature was higher than 265°C, and the speed of lamination is 10 metres/min.
- *(7) This is a laminated tape manufactured by the method as described in Japanese Patent Publication No. 23257/70.

As apparent in the above Tables 1 and 2, the adhesive strength of the ethylene-vinyl acetate copolymer (E_1 , E_2) is weak, particularly to the aluminium tape. With respect to the ethylene - acrylate copolymer (A_1 , A_2) the adhesive strength thereof is strong, but the workability in cable manufacture and the blocking property of the laminated tape are poor.

When polyethylene (P) is used as the laminating resin, the adhesive strength to the aluminium tape is weak; and when the resin containing carboxyl group (S) is used, the adhesive strength to the polyethylene used as the jacket layer is weak.

Accordingly, these resins (E_1 , E_2 , A_1 , A_2 , P, S) are unsuitable in using as materials for laminates.

In the above examples and comparative examples, it is substantiated that the terpolymers of the present invention consisting of (a) ethylene, (b) an unsaturated glycidyl ester or an unsaturated glycidyl ether and (c) an alkyl acrylate, an alkyl methacrylate or vinyl acetate are excellent in every respect; thus is in adhesiveness to the aluminium tape and to the polyethylene of the jacket layer

and in workability in the manufacture of cables, the ternary copolymers of the invention are far superior to the conventional resins heretofore known and used.

The above examples show some embodiments of the present invention. According to our studies, it has further been found that when the total concentration of the comonomer components except ethylene exceeds about 25% by weight and when the melt index exceeds about 15, it becomes difficult to form a laminated tape around a cable core. As shown in Table 3, the terpolymers of the present invention are excellent in adhesive strength to the aluminium tape when the laminated tapes are formed by means of a press-sheet method —*(1)— or by means of an extrusion laminating method —*(2)— under the laminating conditions of 230°C and 10 m/min. However, the properties of the laminated tapes of the present invention prepared by means of a high-temperature extrusion-laminating method —*(6)— wherein an extruder is used under the extrusion-laminating conditions of a higher temperature of 265°C or more are not so different from those of the conventional laminated tapes, and in

30

35

40

45

50

55

particular, the adhesive strength of the said high-temperature extrusion laminated tapes is inferior to that of the laminated tapes prepared under a temperature of 230°C. By observing the thickness of the laminated resin layer, we found that there was at most 10% thickness fluctuation in the tapes prepared by extrusion at 230°C and that there was about 28% thickness fluctuation in those prepared at 265°C.

We have prepared various extrusion-laminated tapes at a high extrusion temperature to try to improve the adhesive strength between the aluminium tape and the resin layer, to increase the lamination speed, and to make uniform the thickness of the resin layer; and we have succeeded in the preparation of such improved laminated tapes under high-temperature extrusion-laminating conditions.

In detail, the preparation of the said improved laminated tapes was attained by adding from 100 to 10,000 ppm of an antioxidant to the above-mentioned terpolymers. The results obtained by this addition are shown in the following Table 4; the effects are excellent and may not be attained with the conventional laminating materials, as is shown in Table 4.

The various kinds of antioxidants that we actually tested are shown in Table 5. In general, any antioxidants have the same effects as those shown in Table 4. In addition, the workability in cable manufacture and the blocking property of laminated tape were also tested for the combination of the terpolymer and the antioxidant, and it has been substantiated that these properties are as good as in the cases when the antioxidant is not contained.

With respect to the content of the antioxidant, the heat stability effect may be attained in the resulting tape by the addition of 100 ppm or more, but the effect is more remarkable with 300 ppm or more. The related tests were conducted with addition of up to 10,000 ppm of the antioxidant, and the same effects were confirmed. However, it has been found that if the content of the antioxidant is increased too much, the antioxidant migrates to the surface of the tape, which is undesirable. Accordingly, the preferred range of antioxidant is from 300 to 5,000 ppm.

Due to the addition of the antioxidant, the laminating speed is greatly increased, and the fluctuation of thickness of the formed resin layer decreased to about 10%.

TABLE 4

Adhesive strength of resin containing antioxidant

Resin	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminium tape and resin (g/cm) laminating method *(2)
E ₁	Antigen WX	1000	355
E ₂	"	"	334
A ₁	"	"	460
A ₂	"	"	430
S	"	"	1026
P	"	"	55
G ₁	"	100	499
"	"	300	578
"	"	1000	700 or more
"	"	5000	"
"	"	10000	"
"	Irganox 1010	100	522
"	"	300	592

TABLE 4 (Continued)

Adhesive strength of resin containing antioxidant

Resin	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminium tape and resin (g/cm) laminating method *(2)
G ₁	Irganox 1010	1000	700 or more
"	"	5000	"
"	"	10000	"
G ₄	Antigen WX	300	576
"	"	1000	700 or more
"	"	5000	"
"	Irganox 1010	300	580
"	"	1000	700 or more
"	"	5000	"
G ₅	Antigen WX	300	610
"	"	1000	700 or more
"	"	5000	"
"	Irganox 1010	300	545
"	"	1000	700 or more
"	"	5000	"
G ₆	Antigen WX	300	583
"	"	1000	700 or more
"	"	5000	"
"	Irganox 1010	300	565
"	"	1000	698
"	"	5000	700 or more
G ₉	Antigen WX	300	551
"	"	1000	700 or more
"	"	5000	"
"	Irganox 1010	300	573
"	"	1000	682
"	"	5000	700 or more

TABLE 4 (Continued)

Antioxidant strength of resin containing antioxidant

Resin	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminium tape and resin (g/cm) laminating method *(2)
G ₁₂	Antigen WX	300	584
"	"	1000	700 or more
"	"	5000	"
"	Irganox 1010	300	549
"	"	1000	700 or more
"	"	5000	"
V ₁	Antigen WX	100	489
"	"	300	578
"	"	1000	600 or more
"	"	5000	"
"	"	10000	"
"	Irganox 1010	100	502
"	"	300	595
"	"	1000	600 or more
"	"	5000	"
"	"	10000	"
V ₃	Antigen WX	300	573
"	"	1000	600 or more
"	"	5000	"
"	Irganox 1010	300	556
"	"	1000	600 or more
"	"	5000	"
V ₅	Antigen WX	100	481
"	"	300	543
"	"	1000	594
"	"	5000	600 or more
"	Irganox 1010	100	479
"	"	300	567

TABLE 4 (Continued)

Antioxidant strength of resin containing antioxidant

Resin	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminium tape and resin (g./cm) laminating method *(2)
V ₅	Irganox 1010	1000	600 or more
"	"	5000	"
V ₇	Antigen WX	300	532
"	"	1000	600 or more
"	"	5000	"
"	Irganox 1010	300	552
"	"	1000	600 or more
"	"	5000	"

TABLE 5
Antioxidant

Trade name	Chemical name
Antigen WX	4,4'-thiobis-(-tert.butyl-3-methylphenol)
Semilizer BBM	4,4'-butylidene-bis-(6-tert.butyl-3-cresol)
Topanol* CA	high molecular weight phenol type
Antigen MB	mercapto-benzimidazole
Soxinol MZ	zinc salt of 2-mercapto-benzthiazole
Soxinol SE	selenium-diethyl-dithiocarbamate
Antigen RD	polymer of 2,2,4-trimethyl-1,2-dihydro-quinoline
Antigen WA	reaction product of 1,1-bis(4-hydroxy-phenyl)-cyclohexane and organic amine
Antigen F	N,N'-di-β-naphthyl-p-phenylenediamine
Antigen PA	phenyl-β-naphthylamine
Antigen D	phenyl-β-naphthylamine
Irganox* 565	triazine derivative
Irganox* 858	triazine derivative
Irganox* 1010	high molecular weight hindered phenol
Irganox* 1076	high molecular weight hindered phenol

* Registered Trade Marks.

- 5 The bending strength of cable and the adhesive strength between the aluminium tape and the polyethylene jacketing layer via the laminating resin are shown in the following Tables 6 and 7. Some typical resins as shown in Table 1 were used as the laminating resin; 10
- Table 6 shows embodiments containing antioxidant and Table 7 embodiments not containing antioxidant. The cable used for this experiment had a structure as shown in Figure 1 (No. 26 AWG, 100 pairs, aerial cable of 0.4 mm diameter).

TABLE 6

Properties of cable (resin with antioxidant)

Resin	Amount of antioxidant (ppm)	Adhesive strength between aluminium tape and jacketing layer (kg/cm)	Number of bends required for cracks to appear in aluminium tape.
P	Antigen WX 3000	0.95	10-15
S	„ „	1.55	20-25
E ₁	„ „	1.65	20-25
G ₁	„ „	3.24	35-40
„	Irganox 1010 „	3.52	35-40
G ₄	Antigen WX „	3.19	35-40
„	Irganox 1010 „	3.42	35-40
G ₅	Antigen WX „	3.33	30-35
„	Irganox 1010 „	2.97	30-35
G ₆	Antigen WX „	3.46	30-35
„	Irganox 1010 „	3.09	30-35
G ₉	Antigen WX „	3.14	35-40
„	Irganox 1010 „	3.38	35-40
V ₁	Antigen WX 3000	3.42	35-40
„	Irganox 1010 „	3.35	35-40
V ₇	Antigen WX „	3.29	35-40
„	Irganox 1010 „	3.32	35-40
Two layer	—	3.05	
type tape			30-35

TABLE 7

Resin	Adhesive strength between aluminium tape and jacketing layer (kg/cm)	Number of bends required for cracks to appear in aluminium tape.
P	0.98	10-15
S	1.66	20-25
E ₁	1.73	20-25
G ₁	1.54	20-25
G ₄	1.68	20-25
G ₅	1.83	20-25
G ₈	1.72	20-25
G ₉	1.70	20-25
G ₁₂	1.59	20-25
V ₁	1.62	20-25
V ₃	1.71	20-25
V ₅	1.58	20-25
V ₇	1.78	20-25

Remarks:

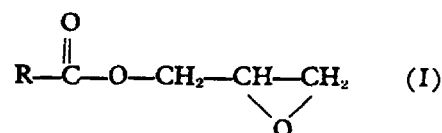
1) The resin used and the method of testing adhesive strength were the same as described with respect to Table 2.

2) Bending test: The sample was bent reciprocally at an angle of 180°C over a mandrel having a diameter twelve times that of the cable. One reciprocal bending motion was counted as one bend.

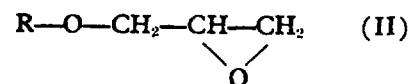
As may be seen from Tables 6 and 7, cables incorporating laminated tape according to the present invention have excellent properties similar to those of cable incorporating a two-layer type tape. From these results, it is apparent that the cables of the present invention are excellent from the view-point both of mechanical strength and economy of production.

WHAT WE CLAIM IS:—

1. A laminated tape for forming the shielding layer of a laminate sheathed cable and comprising a metal tape and a resin coated to one or both surfaces thereof, the resin being a terpolymer of (a) at least about 75% by weight ethylene, (b) an unsaturated glycidyl ester of the following general formula (I):



wherein R represents a hydrocarbon residue containing an ethylenically unsaturated bond or, an unsaturated glycidyl ether of the following general formula (II):



wherein R has the previous significance, and (c) an alkyl acrylate, an alkyl methacrylate or vinyl acetate, and having a melt index of not more than about 15.



TABLE 7

Resin	Adhesive strength between aluminium tape and jacketing layer (kg/cm)	Number of bends required for cracks to appear in aluminium tape.
P	0.98	10-15
S	1.66	20-25
E ₁	1.73	20-25
G ₁	1.54	20-25
G ₄	1.68	20-25
G ₅	1.83	20-25
G ₆	1.72	20-25
G ₉	1.70	20-25
G ₁₂	1.59	20-25
V ₁	1.62	20-25
V ₃	1.71	20-25
V ₅	1.58	20-25
V ₇	1.78	20-25

Remarks:

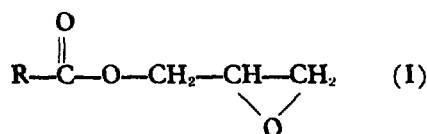
1) The resin used and the method of testing adhesive strength were the same as described with respect to Table 2.

2) Bending test: The sample was bent reciprocally at an angle of 180°C over a mandrel having a diameter twelve times that of the cable. One reciprocal bending motion was counted as one bend.

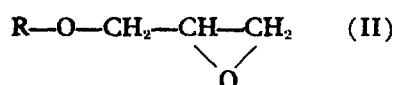
As may be seen from Tables 6 and 7, cables incorporating laminated tape according to the present invention have excellent properties similar to those of cable incorporating a two-layer type tape. From these results, it is apparent that the cables of the present invention are excellent from the view-point both of mechanical strength and economy of production.

WHAT WE CLAIM IS:—

1. A laminated tape for forming the shielding layer of a laminate sheathed cable and comprising a metal tape and a resin coated to one or both surfaces thereof, the resin being a terpolymer of (a) at least about 75% by weight ethylene, (b) an unsaturated glycidyl ester of the following general formula (I):



wherein R represents a hydrocarbon residue containing an ethylenically unsaturated bond or, an unsaturated glycidyl ether of the following general formula (II):



wherein R has the previous significance, and (c) an alkyl acrylate, an alkyl methacrylate or vinyl acetate, and having a melt index of not more than about 15.

2. A tape as claimed in Claim 1, wherein said resin contains an antioxidant in an amount of from 100 to 10,000 ppm.
3. A tape as claimed in Claim 2, wherein said resin contains an antioxidant in an amount of from 300 to 5,000 ppm.
4. A tape as claimed in Claim 2 or 3, wherein the antioxidant is any one of those listed in Table 5 herein.
5. A tape as claimed in any preceding Claim, wherein R is a vinyl, α -methyl-vinyl or allyl.
6. A tape as claimed in any one of Claims 1 to 4, wherein the resin is any terpolymer of those designated as G₁ to G₁₂ or V₁ to V₈ in Table 2 herein or any composition of those designated as G₁ to G₁₂ or V₁ to V₈ listed in Table 4 herein.
7. A laminated tape as claimed in Claim 1 and substantially as herein described.
8. A laminate sheathed cable including a cable core and a sheath formed by wrapping around the core a tape as claimed in any preceding Claim.
- 20

GEE & CO.,
Chartered Patent Agents,
Chancery House, Chancery Lane,
London, WC2A 1QU, and
39, Epsom Road,
Guildford, Surrey.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1975.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

