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(54) LAMINATED TAPE FOR SHEATHING CABLE

(71) We, SUMITOMO ELECTRIC INDUSTRIES LTD., a Japanese Company of No. 15, 5-Chome, 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 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 to 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 on each face thereof, an inner polyethylene layer being modified with carboxyl groups capable of chemically bonding with the aluminium of the tape and an outer layer 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.

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

Figure 2 is a series of two schematic views illustrating bonding strength test methods referred to in Tables 1 and 3 for laminated 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

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3 having laminated thereon a resin layer 4 and a jacketing layer 5 composed of a synthetic resin.

5 To evaluate the three above-mentioned kinds of laminated tapes, some properties of a known laminate sheathed cables having the structure

shown in Fig. 1 were observed and the results are shown in the following Table 1.

The laminated tape used in the laminate sheathed cable whose properties were tested consisted of a soft aluminium tape 0.2 mm thick and a laminated resin layer 0.05 mm thick.

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TABLE 1

Resin No.	Adhesive strength between the aluminium tape and the polyethylene jacket**	Number of bends required for cracks to appear in the aluminium tape ***	Remarks
P	0.95 Kg/cm (a)	10 - 15	(a) Peel-off occurred between the aluminium and the laminated resin
S	1.55 (b)	20 - 25	(b) Peel-off occurred between the polyethylene jacket and the laminated resin
E-S	3.05 (c)	30 - 35	(c) Cohesive destruction between the aluminium and the polyethylene jacket occurred

* P: Laminating polyethylene (Sumikathene[†] F-701)

† Registered Trade Mark

S: Metal salt of a copolymer of ethylene and acrylic acid (Surlyn[†] A)

E-S: A two-layered laminate in which S was laminated to the aluminium surface and a copolymer of ethylene and vinyl acetate (Evatate D-2011) was laminated to the S-layer

** A rectangular sample with a width of 10 mm was taken from the cable sheath, and a peeling test was conducted as shown in Fig. 2 (a) by peeling the aluminium sheet from the resin layer at an angle of 180° and a separating speed of 100 mm/min.

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

15 As may be seen from Table 1, the laminated sheathed cable incorporating the two-layered laminated tape exhibited very superior properties. On the other hand, however, because of its multi-layered structure, the production of this kind of laminated tape involves complicated manufacturing steps and a high production cost, which in turn results in an increase in the cost of the cable.

20 U.S. Patent Specification No. 3,586,756 also discloses a method whereby the properties

of the two-layered laminate tape are imparted to a mono-layered laminate tape. According to this method, reactive groups are concentrated in the vicinity of the metal tape in a resin layer laminated to the metal tape, and the concentration of the reactive groups is decreased progressively with distance from the metal surface so that at the other surface of the laminate layer it adheres to the jacketing polyethylene but would not be capable of adhering to the metal. This laminate tape is

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produced, for example, by first preparing a polyethylene tape, chemically treating one surface only of the polyethylene tape to form a layer containing reactive groups on said surface, bonding the chemically-treated surface to the surface of a metal tape, and then heat-sealing. This method suffers however from manufacturing difficulties, and is not economical.

- 10 We have discovered a method of economically preparing a laminate sheathed cable having excellent mechanical properties by using a laminated tape composed of one layer of a resin composition which adheres both to a metal layer and to a protective polyethylene layer, which tape does not necessitate any complicated steps for its manufacture.

15 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 coated on one or both surfaces with a resin being a copolymer of ethylene and a comonomer selected from glycidyl methacrylate, glycidyl acrylate and allyl-glycidyl ether, the copolymer having a melt index of 16 g/10 min or less measured at a temperature of 190° C and under a load of 2160 g.

- 20 According to another aspect of the present invention there is used as the laminating material a mixed composition consisting of (1) one or more binary copolymers of ethylene and glycidyl methacrylate, ethylene and glycidyl acrylate and ethylene and allyl glycidyl ether, the copolymers having a melt index of 16 g/10 min or less at a temperature of 190° C and under a load of 2160g, and (2) one or more copolymers of ethylene and alkyl acrylates, ethylene and alkyl methacrylates and ethylene and vinyl acetate.

40 An improved heat stability may be imparted to the resin if from 100 to 10,000 ppm of an antioxidant are added thereto.

- 45 The reason why the properties of the resulting laminate sheathed cable of the present invention as mentioned above are improved by using a mixture of the components (1) and (2) is that the adhesive strength between the laminating resin layer and the metal may be improved due to the high adhesiveness resulting from the reaction of the epoxy groups in the first component and the metal, and to the

close contact between the resin layer and the surface of the metal resulting from the existence of the second component; and that the adhesiveness between the polyethylene of the protective jacket of the laminate sheathed cable and the laminating resin layer is improved due to the existence of the second component which is sufficiently compatible with the polyethylene.

The above-mentioned copolymers of the first component may be prepared by various methods. One method is to polymerize a mixture of ethylene and the other component in the presence of a catalyst for forming free-radicals under 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 copolymers.

The reason why the antioxidant is added is to improve the workability of the resins in high-temperature and high-speed extrusion at an extrusion temperature of 265° C or more to improve the adhesive strength between the resin layer and the surface of a metal tape and to obtain a resin layer of uniform thickness.

The present invention will now be explained in more detail by the following Examples.

EXAMPLE 1.

Various specimens of laminated tapes were prepared by means of a lamination method where the binary copolymers mentioned above and the mixture of components (1) and (2) were used without any antioxidant. The adhesive strength between the metal and the laminated resin and that between the resin and the protective plastic layer were tested in each specimen and the results are shown in Table 2. For reference, some conventional laminating resins were also similarly tested and the results are shown in Table 2.

In Table 3, the components constituting the respective resins used in these experiments and the characteristics thereof (melt index) are given.

As aluminium is the most generally used material for metallic tape it was used in these experiments; polyethylene was used as the plastics material of the protective outer layer.

TABLE 2

Adhesiveness of resin (without antioxidant)

Resins	Adhesive strength between metal and laminating resin of laminate tape * (1) (g/cm) low-temperature lamination	Adhesive strength between polyethylene and metal via laminating resin * (2) (g/cm)	Adhesive strength between metal and laminating resin of laminate tape * (3) (g/cm) high-temperature lamination
Reference P	50	320	—
S	1055	0	—
E-S * (4)	520	2500	—
Single component			
E ₁	430	2420	411
E ₂	490	2540	408
E ₃	465	2600	422
E ₄	460	2610	415
E ₅	475	2700	414
E ₆	530	2450	427
F ₁	505	2800	401
G ₁	440	2750	405
G ₂	470	2700	398
Mixture			
E ₁ /A ₁ * (5)			
= 50/50	454	3000 or more	400
= 95/5	480	"	432
E ₁ /B ₁			
= 30/70	448	"	399
= 60/40	475	"	419
E ₂ /A ₁			
= 10/90	493	2870	445
E ₂ /A ₂			
= 20/80	495	2900	442
E ₂ /A ₃			
= 50/50	510	3000 or more	426

TABLE 2 (Continued)

Adhesiveness of resin (without antioxidant)			
Resins	Adhesive strength between metal and laminating resin of lamine tape * (1) (g/cm) low-tempera- ture lamination	Adhesive strength between poly- ethylene and metal via laminating resin * (2) (g/cm)	Adhesive strength between metal and laminating resin of lamine tape * (3) (g/cm) high-tempera- ture lamination
E_2/A_4			
= 90/10	550	3000 or more	451
E_2/B_1			
= 80/20	551	„	438
E_2/B_1			
= 50/50	535	„	412
E_2/B_3			
= 5/95	505	2800	462
E_3/A_2			
= 5/95	470	2710	421
= 10/90	472	2705	418
= 50/50	486	3000 or more	410
= 80/20	498	„	426
= 90/10	496	„	420
E_3/A_3			
= 5/95	472	2650	431
= 15/85	480	2770	427
= 20/80	477	2760	427
= 70/30	494	3000 or more	419
E_3/B_1			
= 20/80	470	„	424
= 50/50	498	„	422
= 80/20	525	„	429
E_3/B_1			
= 50/50	510	„	437

TABLE 2 (Continued)

Adhesiveness of resin (without antioxidant)

Resins	Adhesive strength between metal and laminating resin of laminate tape * (1) (g/cm) low-tempera- ture lamination	Adhesive strength between poly- ethylene and metal via laminating resin * (2) (g/cm)	Adhesive strength between metal and laminating resin of laminate tape * (3) (g/cm) high-tempera- ture lamination
E_4/A_1			
= 30/70	468	2800	392
= 80/20	480	3000 or more	407
E_4/A_4			
= 50/50	484	„	410
E_4/B_1			
= 80/20	508	„	428
E_4/B_2			
= 50/50	500	„	414
E_5/A_2			
= 10/90	490	2860	422
= 40/60	495	3000 or more	420
E_5/B_2			
= 20/80	520	2920	436
= 40/60	540	3000 or more	438
E_6/A_2			
= 3/97	538	2470	467
= 15/85	550	2510	443
= 50/50	561	2840	438
= 70/30	580	3000 or more	450
E_6/A_4			
= 50/50	550	„	436
= 80/20	584	„	452
E_6/B_2			
= 20/80	545	2500	434
= 40/60	565	2910	428

TABLE 2 (Continued)

Adhesiveness of resin (without antioxidant)

Resins	Adhesive strength between metal and laminating resin of laminating tape * (1) (g/cm) low-tempera- ture lamination	Adhesive strength between poly- ethylene and metal via laminating resin * (2) (g/cm)	Adhesive strength between metal and laminating resin of laminating tape * (3) (g/cm) high-tempera- ture lamination
E_6/B_2			
= 60/40	569	3000 or more	440
= 95/5	580	„	457
F_1/A_1			
= 10/19	505	„	418
= 80/20	560	„	433
F_1/A_2			
= 20/80	512	2820	422
= 90/10	564	3000 or more	439
F_1/A_3			
= 30/70	524	2860	417
= 70/30	555	3000 or more	440
F_1/A_4			
= 50/50	530	„	428
F_2/B_1			
= 20/80	534	„	435
= 30/70	538	„	430
F_1/B_2			
= 50/50	560	„	442
= 70/30	582	„	438
G_1/A_2			
= 20/80	451	2790	380
= 50/50	462	3000 or more	392
= 80/20	469	„	408
G_1/B_1			
= 10/90	443	2810	396
= 30/70	450	2840	373

TABLE 2 (Continued)

Adhesiveness of resin (without antioxidant)

Resins	Adhesive strength between metal and laminating resin of laminate tape * (1) (g/cm) low-temperature lamination	Adhesive strength between polyethylene and metal via laminating resin * (2) (g/cm)	Adhesive strength between metal and laminating resin of laminate tape * (3) (g/cm) high-temperature lamination
G_2/A_1			
= 10/90	473	2720	410
= 40/60	490	2840	404
= 70/30	520	2960	421
G_2/B_1			
= 10/90	494	3000 or more	422
= 40/60	530	„	427
= 70/30	560	„	438

* (1) A resin of 0.05 mm thickness was laminated on an aluminium tape of 0.2 mm thickness, by means of a T-die method wherein an extruder (cylinder diameter: 50 mm) was used and the resin temperature was 230°C. The adhesive strength was measured, according to the method shown in Fig. 2 (a) by peeling off the resin film parallel to the surface of the tape at a speed of 100 mm/min.

* (2) The laminated tape prepared in the above method * (1) was placed on a polyethylene sheet of 2 mm thickness via the laminating resin, and afterwards they were bonded together under the conditions of a temperature of 200°C and a pressure of 60 kg/cm² for 15 minutes. The adhesive strength was measured according to the method shown in Fig. 2 (b).

* (3) Laminated type was prepared analogously to the above method * (1) except that the resin temperature was 260°C. The method of testing the adhesive strength was the same as in the above method * (1).

* (4) Equal to the E-S of Table 1.

* (5) Ratio of the respective components (% by weight).

TABLE 3

Component	Resin	Melt index *(5) (g/10 min)	Ratio of Composition (wt. %)			
Single component	P	7.2				
	S	3.5				
	E-S	—				
Second component of mixture	A ₁	11	ethylene-vinyl acetate copolymer			
	A ₂	5	„			
	A ₃	2	„			
	A ₄	3	„			
	B ₁	6	ethylene-ethylacrylate copolymer			
	B ₂	2	„			
	B ₃	1	„			
Single component and first component of mixture	E ₁	0.6	EMA *(6)	GA *(7)	AGE *(8)	ethylene balance
	E ₂	1	12	0	0	„
	E ₃	3	6.5	0	0	„
	E ₄	6	6.5	0	0	„
	E ₅	9	6.5	0	0	„
	E ₆	12	16	0	0	„
	F ₁	14	0	6.0	0	„
	G ₁	2	0	0	3.5	„
	G ₂	6	0	0	7.8	„

*(5) ASTM-1238, temperature 190°C, load 2160g

*(6) glycidyl methacrylate

*(7) glycidyl acrylate

*(8) allyl glycidyl ether

5 From the results of Table 2, it is clear that the laminated tapes prepared by using laminating resins of binary copolymers of ethylene-glycidyl acrylate, ethylene-glycidyl methacrylate or ethylene-allyl glycidyl ether have better properties than those of the conventional

laminated tapes. In addition, it also is clear that the use of a mixture of copolymers results in advantageous synergistic effects, the properties of the mixed compositions being superior to those of the first component only. It also was confirmed that other combinations,

besides those illustrated in the Table 2, have analogous excellent properties.

As shown in the Table 2, the binary copolymers have excellent adhesive strength to the aluminium tape when the laminated tapes are formed by means of an extrusion-lamination method *(1) 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-lamination method *(3) where an extruder is used under the extrusion-lamination conditions of a higher temperature of 260° C or more are not very different from those of the conventional laminated tapes, and, in particular, the adhesive strength of said high-temperature extrusion-laminated tapes is inferior to that of the laminated tapes prepared at a temperature of 230° C. By observing the thickness of the laminated resin layer, we have found that there was at most 10% thickness fluctuation in the tapes prepared by extrusion at 230° C and that there was about 26% thickness fluctuation in those prepared at 260° C.

EXAMPLE 2.

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

More precisely, the preparation of the said improved laminated tapes was attained by adding from 100 to 10,000 ppm of an antioxidant the binary copolymers or the mixtures thereof. The results due to this addition are shown in the Table 4. The excellent effects there shown may not be attained with conventional laminating materials.

We tested the various antioxidants shown in Table 5, and in Table 4 the results of using some typical ones are shown. In general, any other antioxidants have effects similar to those shown in Table 4. In addition, the workability into cable and the blocking property of laminated tape were also tested with respect to the binary copolymers and the mixtures thereof containing antioxidant, and it was substantiated that the other properties were as good as when no antioxidant was used.

With respect to the content of the antioxidant, the heat stability effect may be attained in the resulting tape by using an amount of 100 ppm or more, but the effect is more remarkable by using an amount of 300 ppm or more. The tests were conducted with contents 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 increases too much, the antioxidant migrates to the surface of the tape, which is undesirable. Accordingly, the preferred range of the antioxidant content is from 300 to 5,000 ppm.

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

TABLE 4

Adhesiveness of resin containing antioxidant

Resin (ratio given by weight)	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminum tape and resin (g/cm) laminated method * (9)
P	Antigen WX	1000	55
S	"	1000	1026
E ₃	"	100	435
"	"	300	452
"	"	1000	470
"	"	5000	463
"	"	10000	469
"	Irganox 1010	100	437
"	"	300	458
"	"	1000	469
"	"	5000	477
"	"	10000	472
E ₅	Antigen WX	100	436
"	"	300	456
"	"	1000	480
"	"	5000	487
"	"	10000	479
"	Irganox 1010	100	429
"	"	300	460
"	"	1000	479
"	"	5000	486
"	"	10000	477
E ₃ /A ₂ = 50/50	Antigen WX	100	439
"	"	300	462
"	"	1000	489
"	"	5000	491
"	"	10000	482

TABLE 4 (Continued)

Adhesiveness of resin containing antioxidant

Resin (ratios given by weight)	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminum tape and resin (g/cm) laminated method * (9)
$E_3/A_2 = 50/50$	Irganox 1010	100	440
"	"	300	458
"	"	1000	484
"	"	5000	485
"	"	10000	483
$E_3/B_2 = 40/60$	Antigen WX	100	461
"	"	300	498
"	"	1000	547
"	"	5000	555
"	"	10000	550
"	Irganox 1010	100	466
"	"	300	501
"	"	1000	552
"	"	5000	548
"	"	10000	544
$F_1/A_4 = 50/50$	Antigen WX	100	450
"	"	300	489
"	"	1000	537
"	"	5000	543
"	"	10000	535
"	Irganox 1010	100	457
"	"	300	496
"	"	1000	459
"	"	3000	540
"	"	10000	543
$G_2/B_3 = 40/60$	Antigen WX	100	448
"	"	300	482
"	"	1000	529

TABLE 4 (Continued)

Adhesiveness of resin containing antioxidant

Resin (ratios given by weight)	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminum tape and resin (g/cm) laminated method * (9)
G ₂ /B ₃ = 40/60	Antigen WX	5000	533
"	"	10000	527
"	Irganox 1010	100	450
"	"	300	491
"	"	1000	521
"	"	5000	532
"	"	10000	528

* (9) extrusion temperature, 260°C; lamination speed 30 m/min.

TABLE 5
Antioxidant

Trade Name	Chemical Name
Antigen WX	4,4'-thiobis-(-tert.butyl-3-methylphenol)
Samilizer 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-dihydroquinoline
Antigen WA	reaction product of 1,1-bis(4-hydroxyphenyl)-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.

Various kinds of laminated tapes were prepared by using various kinds of resins (single component) and resin mixtures (of the first component and the second component), and then laminate sheathed cables were prepared by using the said laminated tapes. The properties of the thus prepared laminate sheathed cables are shown in Tables 6 and 7.

The laminate tapes were prepared by means of a T-die method using an extruder (cylinder diameter: 50 mm), at a resin temperature of

265° C (for the resins containing antioxidant).

The laminated tapes thus prepared consisted of a soft aluminium tape of a thickness of 0.2 mm and a resin layer a thickness of 0.05 mm.

The cable used for this experiment had a structure as shown in Fig. 1 (26 AWG, 100 pairs, aerial cable of 0.4 mm diameter).

The jacketing layer of the cable was made of polyethylene, and the processing temperature was 220—230° C.

TABLE 6

Component	Resin	Adhesive strength between aluminium tape and polyethylene jacket (kg/cm) * (2)	Number of bends required for cracks to form in aluminium tape * (3)
First component	E ₁	2.76	32—36
	E ₂	2.50	27—30
	E ₃	2.84	30—35
	E ₄	2.52	28—33
	E ₅	2.43	28—30
	E ₆	2.80	29—37
	F ₁	2.50	28—31
	G ₁	2.84	30—34
	G ₂	2.96	31—39
Mixture of first component and second component (ratios given by weight)	E ₁ /A ₁ = 95/5	3.04	30—35
	E ₁ /B ₁ = 60/40	3.12	34—38
	E ₂ /A ₁ = 10/90	2.78	29—35
	E ₂ /A ₃ = 50/50	3.02	31—35
	E ₂ /A ₄ = 90/10	3.41	40 or more
	E ₂ /B ₁ = 80/20	3.50	„
	E ₂ /B ₃ = 5/95	2.83	29—34
	E ₃ /A ₂ = 10/90	2.81	30—35
	„ = 50/50	2.99	34—36
	„ = 90/10	3.11	31—35
	E ₃ /A ₃ = 5/95	2.86	30—35
	„ = 70/30	3.14	35—40

TABLE 6 (Continued)

Component	Resin	Adhesive strength between aluminium tape and polyethylene jacket (kg/cm) * (2)	Number of bends required for cracks to form in aluminium tape * (3)
Mixture of first component and second component (ratios given by weight)	$E_3/B_1 = 50/50$	3.40	40 or more
	„ = 80/20	3.56	„
	$E_3/B_2 = 50/50$	3.52	„
	$E_4/A_1 = 30/70$	2.88	29-35
	„ = 80/20	3.40	40 or more
	$E_4/A_4 = 50/50$	3.00	30-35
	$E_4/B_1 = 80-20$	3.90	40 or more
	$E_4/B_3 = 50/50$	3.25	„
	$E_5/A_2 = 40/60$	2.76	26-34
	$E_5/B_2 = 40/60$	3.14	33-36
	$E_6/A_2 = 3/97$	2.81	30-38
	$E_6/A_2 = 70/30$	3.42	40 or more
	$E_6/B_2 = 95/5$	3.94	„
	$F_1/A_1 = 10/90$	2.70	29-35
	$E_1/A_2 = 50/50$	2.96	32-37
	$F_1/B_1 = 30/70$	2.88	35-38
	$G_1/A_3 = 50/50$	3.30	40 or more
	$G_1/B_1 = 30/70$	3.40	„
	$G_2/A_1 = 40/60$	3.14	30-35
	$G_2/B_3 = 40/60$	3.02	„

* (2)
same as in Table 1

* (3)

TABLE 7 (containing antioxidant)

Resin (ratios given by weight)	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminium tape and poly- ethylene jacket (kg/cm) * (2)	Number of bends required for cracks to form in aluminium tape * (3)
E ₃	Irganox 1010	1000	2.80	30-35
E ₃	Irganox 1010	5000	2.87	30-35
E ₃	Irganox 1010	1000	2.58	28-33
E ₃	Irganox 1010	5000	2.72	30-35
E ₃ /A ₂ = 50/50	Irganox 1010	1000	2.95	33-38
E ₃ /A ₂ = 50/50	Irganox 1010	5000	3.10	34-36
F ₁ /A ₄ = 50/50	Irganox 1010	1000	2.93	32-35
F ₁ /A ₄ = 50/50	Irganox 1010	5000	3.02	34-38
G ₂ /B ₃ = 40/60	Irganox 1010	1000	3.10	32-37
G ₂ /B ₃ = 40/60	Irganox 1010	5000	3.16	33-36

* (2)

same as in the Table 1.

* (3)

As may be seen from Tables 6 and 7, the laminate sheathed cables of the present invention prepared by using the laminated tapes of the present invention incorporating the above mentioned binary copolymer resins or the mixtures thereof have excellent properties which are far superior to those of the conventional cables shown in Table 1.

After various experiments, it was confirmed that the laminate sheathed cables prepared by using mixed resin compositions containing 5-95% by weight, preferably 5-75% by weight, of the second component had the most superior properties.

WHAT WE CLAIM IS:—

1. A laminated tape for forming the shielding layer of a laminate sheathed cable and comprising a metal tape coated on one or both surfaces with a resin being a copolymer of ethylene and a comonomer selected from glycidyl methacrylate, glycidyl acrylate and allyl-glycidyl ether, the copolymer having a melt index of 16 g/10 min or less measured at a temperature of 190° C and under a load of 2160 g.

2. A laminated tape for forming the shielding layer of a laminate sheathed cable and comprising a metal tape coated on one or both surfaces with a resin being a mixture of (1)

one or more copolymers as defined in Claim 1 and (2) one or more other copolymers of ethylene and a comonomer selected from alkyl acrylates, alkyl methacrylates and vinyl acetate.

3. A tape as claimed in Claim 1 or 2, wherein the resin contains an antioxidant in an amount of from 100 to 10,000 ppm.

4. A tape as claimed in Claim 3, wherein the resin contains an antioxidant in an amount of from 300 to 5,000 ppm.

5. A tape as claimed in Claim 4, wherein the antioxidant is any one of those listed in Table 5.

6. A tape as claimed in Claim 2, or Claim 3, 4 or 5, when dependent thereon, wherein the proportion of said other copolymer is from 5 to 95% by weight of the total resin.

7. A tape as claimed in Claim 6, wherein the proportion of said other resin is from 5 to 75% of the total resin.

8. A laminated tape for sheathing cable as claimed in Claim 1 or 2, and substantially as herein described.

9. A laminated tape for sheathing cable as claimed in Claim 1 or 2 and substantially as herein described in Example 1 or 2.

10. 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.

TABLE 7 (containing antioxidant)

Resin (ratios given by weight)	Antioxidant	Amount of antioxidant (ppm)	Adhesive strength between aluminium tape and poly- ethylene jacket (kg/cm) * (2)	Number of bends required for cracks to form in aluminium tape * (3)
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5. A tape as claimed in Claim 4, wherein the antioxidant is any one of those listed in Table 5.

6. A tape as claimed in Claim 2, or Claim 3, 4 or 5, when dependent thereon, wherein the proportion of said other copolymer is from 5 to 95% by weight of the total resin.

7. A tape as claimed in Claim 6, wherein the proportion of said other resin is from 5 to 75% of the total resin.

8. A laminated tape for sheathing cable as claimed in Claim 1 or 2, and substantially as herein described.

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