

PACKAGING TUBES FOR ELECTRONIC COMPONENTS

This invention relates to packaging tubes used for holding electronic components in transit and to a method of producing such tubes. In particular, although not exclusively, the invention is concerned with carrier
5 tubes for components in dual-in-line (DIL) encapsulation.

In the electronics industry it is often necessary to pack and transport large numbers of components encapsulated in the so-called DIL encapsulation, the majority being integrated circuits (I.C.'s). The DIL
10 encapsulation consists of a fairly flat rectangular body in which the I.C. or other component(s) is encapsulated, with short connecting leading pins descending from the two longer sides of the encapsulation.

To pack and transport these DIL encapsulated
15 components there are currently provided hollow elongate carrier tubes which generally have a cross section which is substantially trapezoidal with an inward projection from the longer parallel side of the trapezium. The components are slid into the tube straddling this
20 projection. Normally such packaging tubes fully encircle the electronic components. The tubes may be required to have an antistatic property to protect the electronic components from possible damage by static electricity building up on the tube. This antistatic action can
25 be providing by the use of carbon black, usually with either polystyrene or polypropylene as tube material.



The carbon black leads to a tube having antistatic properties, but which is also opaque, making it impossible to see how many electronic components are contained in the carrier tube.

5 UK Patent Specification 1593760 discloses the use of a tube in which a top portion is transparent. The remainder of the tube contains carbon particles so as to be conductive. The tube is made from PVC (polyvinylchloride). This tube thus has an electrically
10 conductive opaque portion and a transparent portion providing a window along the length of the tube. This window however is not electrically conductive, so that the components can contact both conductive and non-conductive tube regions.

15 Broadly in this invention we provide a tube in which a window of light transmitting material is provided, but the components are prevented from touching the non-conductive areas represented by such windows of light transmitting material.

20 One proposal for achieving this result appears in US 4327832, but this employs inward projections, giving a greater thickness of material, at either side of the window. Another proposal appears in GB-A-2119755, which however employs an overlap of transparent and
25 opaque plastic materials.

 This invention provides a packaging tube suitable for electronic components of predetermined form, the tube comprising walls which are of opaque antistatic material, and include side walls connected by a top
30 wall to face and extend over a confronting top surface of the components, with light transmitting material forming at least one transparent window through the said top wall to provide along the length of the tube means for seeing the said surface of components therein;
35 the said top wall being shaped such that the window is disposed outwardly of opaque wall regions of the

said top wall at either side of the window, which wall regions are oriented such that in use of the tube with components having a flat top surface, both wall regions confront and extend over part of the said top surface of components in the tube, the said wall regions acting to prevent contact between the components and the light transmitting material of the window, with uniformity of thickness of material across each transition from a said opaque wall region to the transparent window.

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10 Preferably, the tube has an indentation i.e. an inward projection extending along the length of the tube, to be straddled within the tube by the said components.

In the tubes of this invention it is preferred that there is a continuous window extending along the tube, but it would be possible to employ a succession of windows along the length of the tube.

15 The invention embraces a method of making such a tube, comprising the steps of forming streams of molten opaque antistatic material and light transmitting material, and advancing these streams by means of respective feed screws, feeding the streams to different parts of a passage leading to an extrusion orifice, letting them merge in the passage and extruding them together as a hollow tube with a window, which tube can be shaped further while it is still soft.

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25 We prefer to use PVC as the tube material, incorporating carbon black to provide the antistatic property, because of the greater rigidity of PVC which enables the thickness of the tube body to be reduced as compared with the thickness necessary when polystyrene or polypropylene is used.

30 The packaging tube of this invention may in particular be an extruded packaging tube for integrated circuits in dual-in-line encapsulation, the tube being hollow, elongate and of a uniform cross-section which includes an indentation or internal projection to be straddled by the components. The preferred cross-section for such a tube has a pair of spaced apart substantially



parallel edges, namely the top wall and a bottom wall,
and a pair of mutually diverging edges extending between
them to define substantially a trapezium, the aforesaid
projection to be straddled by the components being
5 substantially rectangular in section and extending
inwardly from the bottom wall, which is the longer
parallel edge of the trapezium.

The said top wall may then comprise or contain
an outward projection, within which the window is confined,
10 with the said indentation and projection dimensioned
so that the projection of one tube can engage into
the indentation of a like tube so as to locate the
tubes when one tube is stacked lengthwise upon another.
In one preferred arrangement such a said projection
15 containing a window is provided, and stands proud of
all the rest of the top wall of the tube from which
it projects.

In another form of the invention a window lies
between two projections into the interior of the tube.
20 It is possible to provide more than one window.
In particular, a first window can be provided extending
along the length of the shorter parallel side of the
trapezium and a second window can be provided extending
along the length of the top surface of the projection
25 from the longer parallel side, the tube being shaped
to prevent components from touching either window.
One advantage of two windows is that it strengthens
the tube, because conductive PVC is not as strong as
transparent PVC.

Embodiments of the present invention, given by way of example, will now be described with reference to the accompanying drawings in which:-

Figure 1 is a perspective view of one end portion
5 of a packaging tube;

Figure 2 is a somewhat diagrammatic cross-section of the tube of Figure 1;

Figure 3 to 7 show further possible cross-sections for tubes embodying the present invention and each
10 having a single longitudinal window;

Figures 8 to 13 show possible cross-sections for tubes embodying the present invention and each having two longitudinal windows;

Figure 14 is a sectional view of an extruder head
15 for producing packaging tubes formed from opaque antistatic plastic and from transparent plastic, having a single longitudinal window;

Figure 15 is a sectional view along the line XV-XV of the extruder head shown in Figure 14;

Figure 16 is an end view of the extruder head die
20 shown in Figure 14 looking in the direction of arrow XVI;

Figures 17 to 19 correspond to Figures 14 to 16 respectively for an extruder head for producing packaging
25 tubes having two longitudinal windows;

Figure 20 shows a die for producing packaging tubes in association with the extruder head shown in Figure 14;

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Figure 21 is a sectional view on line XXI-XXI of the die shown in Figure 20.

Referring first to Figure 1 of the drawings the packaging tube shown is an elongate tube formed by
5 extrusion of the plastics material from which it is made. The tube has a uniform cross-section and as can be seen from Figure 2 this cross-section comprises a top wall, mutually inclined side walls 4, 6, a bottom
8 parallel to the top wall 2, but longer, and an inward
10 projection 10 of rectangular section which extends into the tube from the longer parallel wall i.e. the bottom 8. The sides 2, 4, 6, 8 define substantially a trapezium shape. The tube is used to carry integrated circuits 12 (Figure 2) in dual-in-line encapsulation.
15 These are packed into the tubes straddling the inward projection 10 so that the body 14 of the encapsulation rests on the projection 10 and the connecting pins 16 lie at each side of it. The integrated circuits are retained in the packaging tubes by pins 20 inserted
20 through holes punched at each end of the tube.

The tube shown in Figures 1 and 2 is primarily formed from rigid PVC which incorporates carbon black thus giving the tube an antistatic property but at the same time rendering it opaque. This opaque PVC
25 is shown shaded in Figure 2 and forms the margins 31 of the top wall, the base 8, the inward projection 10 and the walls 6, 4. Thus they are a single-wall,

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conductive, carbonized part.

The central portion of the top 2 is formed of PVC from which the carbon black is absent, so that the PVC material is clear. This shows without shading in Figure 2. It provides a transparent, non-conductive window 32 through which integrated circuits in the packaging tube can be seen. The window 32 joins the top margins 31 through shoulders 33. These merge tangentially into the margins 31 but meet the flat window 32 at right angle corners. Accordingly, the antistatic margins 31 stand proud, within the tube, from the internal surface of the window 32, which is confined within an outward projection.

Therefore the encapsulated components in the tube cannot touch the window but are held in a position spaced from it. A further feature of this tube cross section is that the tubes will stack with the outward projection including the window 32 of one fitting into the area 9 (at the base of the inward projection 10) of another.

This packaging tube can be extruded from PVC with carbon black as the anti-static material, or it can be made from the conventional materials polystyrene or polypropylene as alternatives to PVC.

Figures 3 to 13 show further possible cross sections. In each case anti-static material is shown shaded while window material is shown without shading. The antistatic material can in each case be rigid PVC incorporating carbon black.

The cross sections shown in Figures 4, 8 and 10 are based on a trapezoidal shape similar to that of Figures 1 and 2. The cross sections shown in Figures 5 to 7 and 11 to 13 are based on a rectangular shape, i.e. both pairs of sides are parallel. In the case of Figure 3 there are sloping side walls connected by a top wall which is made up from angled walls 34 and a window 32.

The angled walls 34 prevent the body of the component from reaching the window 32.

Figure 4 shows a cross section in which the window 32 is in the plane of the top wall 2, but longitudinal inwardly directed ridges 36 either side of the window prevent the body of the component from reaching the window.

Figures 5, 6 and 7 show cross sections in which the basic shape is rectangular instead of trapezoid. The cross section of Figure 5 is analogous to that of Figure 2 in that the window 32 is recessed and shoulders 33 prevent the body of the component from reaching the window. The embodiment shown in Figure 6 has angled walls 34, analogous to those shown in Figure 3. These prevent the component body 14 from reaching the flat central section which includes the window 32 without twisting. The central section is considerably wider than the window 32 in the embodiment of Figure 3, and if the component twists (shown in phantom on Figure 6) its body 14 can touch the top wall 2. However, the window 32 is only in the central portion of the central flat section whereas the component body can only touch the margins 31 of the flat section. Therefore the component body is still prevented from touching the window. Figure 7 is analogous to Figure 4.

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Figures 8 to 13 show cross-sections of tubes which are analogous to Figures 2 to 7 respectively, except that the tubes of Figures 8 to 13 have a second window 32a in the internal projection 10. This second window 32a extends longitudinally along the end face of the projection 10, and is recessed so that it cannot come into contact with the body 14 of a component in the tube. The component body will be held away from the window 32a by the side margins 40 of the end face of the projection 10.

One advantage of the constructions of Figures 8 to 13 is that the transparent PVC of the windows 32, 32a is stronger than the opaque conductive PVC of the rest of the tube. Consequently the second window 32a adds to the strength of the tube.

Figures 14 to 16 show apparatus for forming tubes such as those of Figures 2 to 7 having a single window.

A distinguishing feature of this apparatus is that it has two main screws for extruding plastics material. The screw 41 is for clear PVC, the screw 42 for opaque PVC incorporating carbon black as conductive antistatic material.

The two different plastics materials are advanced along respective tubes 43, 44 within which the screws 41, 42 operate. The tube 44 delivers directly into a prolongation of it 46 of the same diameter.

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Within this prolongation there is a central mandrel 48 supported on a web 50, while on the opposite side of the mandrel to this web there is a tube 52 which is connected to the tube 43 by a duct 54 as shown. The
5 mandrel incorporates an air vent 56.

The downstream part of the mandrel 48 is surrounded by an extrusion die 58, held in place by a large forged nut 60. The die and mandrel together define an annular extrusion orifice. The die may be heated.

10 Molten opaque plastic is driven forward by the screw 42 from the tube 44 into the prolongation 46. Molten clear plastic is driven by the screw 41 through the duct 54 and out of the tube 52 to form a clear stream within the stream of opaque plastic. The streams
15 of molten plastic merge without mixing and are extruded together through the orifice as a circular tube with a transparent sector 61 and a much larger opaque sector 62 as shown by Figure 10. The size of the tube 52 and the feed rates of the two screws 41, 42 are arranged
20 so as to give sectors 61, 62 of the desired size.

Figures 17 to 19 show a variant form of the apparatus of Figures 14 to 16. This variant form is suitable for forming tubes with two windows as shown in Figures 8 to 13.

25 The variant form has a second tube 43_a for clear plastics material, with a screw 41_a, a leading via a second duct 54_a to a second tube 52_a at the mandrel 48.

Its structure and operation are as those of the apparatus of Figures 14 to 16, except that since there are two tubes 52, 52a either side of the mandrel 48, the web 50 is displaced as shown in Figure 18. The extruded tube of plastic obviously has two clear sectors 61, 61a and two opaque sectors 62.

The circular tube 64 produced by the apparatus of Figures 14 to 16 or of 17 to 19 is then formed to the shape required by a die. Figures 20 and 21 show the die 70 for the tube of Figures 1 and 2. Dies for other tube cross-sections would be analogous.

— The tubular extrusion is fed into the die 70 while it is still hot enough to be soft, and within the die is formed to the tube shape 66. The die 70 is cooled with water which passes through tubes 72. Preferably the water is supplied at a temperature of from 3° to 7°C. A vacuum or partial vacuum is connected to tubes 74 to assist in forming the plastic tube shape 66.

As shown by the cross-sectional view in Figure 12, the subatmospheric pressure applied via tubes 74 is used to suck the tube against the sides and particularly the edges of the die 70. The tubes 74 are connected to the die cavity 75 by narrow passages 76 which enter the die cavity particularly at positions along the edges of the die cavity.

The die cavity 75 should of course have a shape appropriate to the tube being made. The shape shown is that of the tube of Figures 1 and 2.

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For all of the tubes described above the antistatic PVC containing carbon black can for example be formed by compounding the following materials in the proportions by weight stated:

5	PVC powder	67%
	carbon black	30%
	stabilizer	1.5%
	lubricant	0.5%
	processing aid	1%

10 The carbon black used must of course be conductive so that no static electricity can accumulate on the parts of the surface of the tube formed from it.

 The thickness of the tube walls, preferably lies between 0.014 and 0.060 inches. (Wall

15 thicknesses are somewhat exaggerated in the drawings).



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CLAIMS:

1. A packaging tube suitable for electronic components of predetermined form, the tube comprising walls which are of opaque antistatic material, and include side walls connected by a top wall to face and extend over
5 a confronting top surface of the components, with light transmitting material forming at least one transparent window through the said top wall to provide along the length of the tube means for seeing the said surface of components therein; the said top wall being shaped
10 such that the window is disposed outwardly of opaque wall regions of the said top wall at either side of the window, which wall regions are oriented such that in use of the tube with components having a flat top surface, both wall regions confront and extend over
15 part of the said top surface of components in the tube, the said wall regions acting to prevent contact between the components and the light transmitting material of the window, with uniformity of thickness of material across each transition from a said opaque wall region
20 to the transparent window.

2. A packaging tube according to claim 1 having a window of light transmitting material extending continuously along the length of the tube.



3. A packaging tube according to claim 1 or claim
2 which is of substantially quadrilateral overall
cross section, with the said top wall and a bottom
wall being disposed parallel there being an indentation
5 along the length of the bottom wall to provide an
inward projection to be straddled by electronic components
in the tube.
4. A packaging tube according to claim 3 in which
the said overall cross-section is trapezoid, the bottom
10 wall being wider than the top wall.
5. A packaging tube according to claim 3 or claim
4 wherein the said top wall comprises or contains
an outward projection, within which the window is
confined, and the said indentation and projection
15 are dimensioned so that the projection of one tube
can engage into the indentation of a like tube so
as to locate the tubes when one tube is stacked lengthwise
upon another.
6. A packaging tube according to claim 1 which is
20 a hollow elongate tube of substantially rectangular
overall cross-section.
7. A packaging tube according to any one of the preceding
claims which has at least one additional window with
which the material of the components of predetermined
25 shape cannot come into contact, spaced around the cross-
section of the tube from the first window(s).



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3. A packaging tube according to any one of claims 3 to 5 which additionally has at least one additional window with which the material of the components of predetermined shape cannot come into contact, the said additional window(s) being located in the face of said indentation nearest to the said second parallel side of the tube.
9. A packaging tube according to claim 7 or claim 8 wherein a said additional window extends continuously along the length of the tube.
- 10 10. A packaging tube according to claim 1 in which the or a said window lies between two projections of the top wall into the interior of the tube.
11. A packaging tube according to claim 2 or any claim appendant thereto which is an extruded tube whose formation includes extrusion together of streams of light-transmitting thermoplastic material and opaque antistatic thermoplastic material.
12. A packaging tube according to any one of the preceding claims wherein said opaque antistatic material comprises 20 polyvinylchloride incorporating carbon black.

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13. A method of making a packaging tube according to claim 2 or any claim appendant thereto comprising the steps of

- 5 a) forming and advancing a stream of molten light-transmitting thermoplastic material by means of a first feed screw;
- b) forming and advancing a stream of molten opaque antistatic material by means of a second feed screw;
- 10 c) feeding both said streams to respective separate portions of a tubular passage, which passage terminates in an extrusion orifice;
- d) allowing said streams to merge in said passage and extruding them together through said orifice to form a hollow tube with a light transmitting window
- 15 therein.

14. A method of making a packaging tube according to claim 9 which comprises the steps of

- 20 a) forming and advancing two streams of molten light-transmitting thermoplastic material by means of respective feed screws,
- b) forming and advancing two streams of molten light-transmitting thermoplastic material by means of respective feed screws,
- 25 c) feeding all three said streams to respective separate portions of a tubular passage, which passage terminates in an extrusion orifice,
- d) allowing the said streams to merge in the said passage and extruding them together through the orifice



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to form a hollow tube with two light transmitting windows therein.

15. A method according to claim 13 or claim 14
in which the tube is subsequently shaped further
5 while still soft.

16 A packaging tube substantially as herein described
with reference to and as illustrated in any figures
of the accompanying drawings.
