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**D E C I S I O N**  
**of 30 May 2001**

**Case Number:** T 0671/99 - 3.3.3

**Application Number:** 90905900.8

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**IPC:** H05K 1/03

**Language of the proceedings:** EN

**Title of invention:**  
High capacitance laminates

**Patentee:**  
W. L. Gore & Associates, Inc.

**Opponent:**  
Rogers Corporation

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 56, 123(2)

**Keyword:**  
"Implicit disclosure (yes)"  
"Inventive step (yes)"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 0671/99 - 3.3.3

**D E C I S I O N**  
**of the Technical Board of Appeal 3.3.3**  
**of 30 May 2001**

**Appellant:** Rogers Corporation  
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**Representative:** McCallum, William Potter  
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**Decision under appeal:** Interlocutory decision of the Opposition Division  
of the European Patent Office posted 3 May 1999  
concerning maintenance of European patent  
No. 0 463 105 in amended form.

**Composition of the Board:**

**Chairman:** R. Young  
**Members:** C. Idez  
J. De Preter

## Summary of Facts and Submissions

- I. The grant of European patent No. 0 463 105 in respect of European patent application No. 90 905 900.8, based on International patent application No. PCT/US90/01247, filed on 7 March 1990, and claiming priority of the earlier US patent application No. 324 832 of 16 March 1989, was announced on 16 February 1994 (Bulletin 94/07) on the basis of 9 claims.

Claim 1 as granted read as follows:

"A laminate comprising a film (1) of filled expanded polytetrafluoroethylene and a layer (2) of electrically conductive metal attached to at least one side thereof characterised in that the film (1) contains 25-85 volume percent particulate filler having a high dielectric constant; the film (1) has a thickness of between 0.0025 and 0.0127 mm (0.0001 and 0.005 inches); the film (1) is densified to form a film which is substantially free of visual pinholes; and the film (1) has a matrix tensile strength of at least 183 kg/cm<sup>2</sup> (2600 psi)."

Dependent Claims 2 to 6 referred to preferred embodiments of the laminate according to Claim 1.

Independent Claim 7 read as follows:

"A printed circuit board comprising at least one layer of a laminate as claimed in any preceding claim."

Independent Claim 8 read as follows:

"A method of forming a laminate comprising a film (1)

of filled expanded polytetrafluoroethylene and having a matrix tensile strength of at least 183 kg/cm<sup>2</sup> (2600 psi) and a film (2) of electrically conductive metal, characterised in that the method comprises the steps of:

(a) mixing 25-85 volume percent particulate filler with polytetrafluoroethylene in aqueous dispersion.

(b) co-coagulating the filler and polytetrafluoroethylene;

(c) lubricating the filled polytetrafluoroethylene with lubricant and paste extruding the lubricated material to form a film;

(d) calendaring the lubricated film;

(e) expanding said film by stretching it to form a porous polytetrafluoroethylene having said filler distributed therein;

(f) densifying the stretched material by compressing it until the film has a thickness of between 0.0025 to 0.127 mm (0.0001 and 0.005 inches) and is substantially free of visual pinholes;

(g) laminating a layer of electrically conductive metal to the film before or after said densification."

Dependent Claim 9 dealt with a preferred feature of the filler used in the method according to Claim 8.

II. On 14 November 1994 a Notice of Opposition was lodged in which revocation of the patent in its entirety was requested on the grounds set out in Article 100(a) EPC, the argumentation provided being, however, only directed to inventive step. In the course of the opposition procedure, the Opponent further raised an objection of public prior use. The opposition was supported, inter alia, by the following documents:

D1: EP-A-0 279 769;

D2: EP-A-0 013 379;

D3: EP-A-0 160 418;

D4: US-A-3 953 566; and

D5: EP-A-0 160 439;

as well as the later filed, but admitted

E1': Affidavit of Dr. Allen F. Horn III dated  
3 February 1999, referring to the products RO  
2800, RO 2810 and RT Duroid 6010; and

E13: Certified copy of material data sheet of RT Duroid  
6010 dated December 1988.

III. By an interlocutory decision announced orally on  
15 April 1999 and issued in writing on 3 May 1999, the  
Opposition Division held that the grounds of opposition  
did not prejudice the maintenance of the patent in  
amended form on the basis of the set of Claims 1 to 7  
of the main request submitted during the oral  
proceedings. This set of claims differed from the set  
of claims as granted in that the expression "said  
laminate having a capacitance of greater than 100.75  
picofarads/cm<sup>2</sup> (650 picofarads per square inch)" had  
been introduced at the end of Claim 1 as granted, in  
that the feature "having a capacitance of greater than  
100.75 picofarads/cm<sup>2</sup> (650 picofarads per square inch)"  
had been incorporated between "laminate" and  
"comprising a film (1)" in the first sentence of the  
independent method Claim as granted, and in that,

granted Claims 4 and 6 having been deleted, the further claims had been accordingly renumbered.

The decision explicitly mentioned that the Opponent had admitted during the written procedure that the documents cited as support for an alleged prior use were not novelty destroying since the product RO 2800 did not exhibit the required capacitance and since the product RT Duroid 6010 did not have the required thickness, and that novelty had not been disputed by the Opponent during the oral proceedings. The Opposition Division, as well as the Opponent, regarded D1 as the closest prior art, since it related to laminates comprising a highly filled thin polytetrafluoroethylene (PTFE) film with a metallic layer. It stated that the PTFE film comprised in the laminate of D1 differed from the film required in Claim 1 of the opposed patent in capacitance and in matrix tensile strength (MTS). The objective technical problem was to provide laminates similar to those disclosed in D1 (i.e. comprising a highly filled thin PTFE film with a metallic layer and being substantially free of visual pinholes) having a high capacitance and a high MTS. Even if the solution to the first aspect of the technical problem could be regarded as obvious in view of D2 referred at page 4, lines 55 to 56 of D1 in form of its corresponding US patent 4 335 180 (D2'), the solution to the second aspect of this problem could not be derived in an obvious manner from D4. The Opposition Division took the view that Example 4 of D4, where an asbestos filled PTFE film had been stretched, and Example 16 of D4, where an unfilled PTFE film had been stretched and densified, related to individual teachings and that there was no incentive to combine these two examples. Furthermore, the film of Example 4

of D4 had a thickness well above that required in the patent in suit, and also contained a fibrous material (i.e. asbestos), the use thereof, according to D1, resulting in the presence of pinholes in the film. Concerning independent process Claim 6, the Opposition Division considered that this Claim was in fact directed to a method for producing a laminate according to the main claim, the novelty and inventive step of which had been acknowledged, and met therefore the requirements of Articles 54 and 56 EPC.

- IV. On 2 July 1999 a Notice of Appeal was lodged by the Opponent against this decision with simultaneous payment of the prescribed fee.

With the Statement of Grounds of Appeal filed on 13 September 1999, the Appellant submitted two new documents:

D4': US-A-4 096 227 which was a divisional application of D4; and

D6: US-A-4 732 629.

With its letter dated 30 April 2001, the Appellant further submitted an Affidavit of Dr. Allen F. Horn III dated 27 April 2000 and an Affidavit of Mr. John Brookes dated 22 March 2000.

- V. The arguments presented by the Appellant in the Statement of Grounds of Appeal and its further submission of 30 April 2001 could be summarized as follows:

(i) Concerning the product claims :

(i.1) Provided the term "expanded" used in Claim 1 were to be ignored, and it were considered that MTS values greater than 2600 psi were implicitly disclosed in D1, the technical problem would be to give a high capacitance to the closest prior art laminates of D1. The solution to this problem would be obvious in view of D2'.

(i.2) Provided the term "expanded" used in Claim 1 were to be ignored, the material RO 2800 manufactured and sold by the Appellant prior to the 16 March 1989 should be considered as the closest prior art. This material met the requirements set out in Claim 1 for the filler content, the thickness, the MTS, and the absence of pinholes of the film (cf. E1'). The technical problem would be to give a high capacitance to this prior art laminate and it would have been obvious to replace the silica filler contained in the RO 2800 by the titania filler used in the prior art product RT Duroid 6010.

(i.3) Provided the minimum MTS of 2600 psi would be considered as a structural characteristic due to the expansion step, D1 or D5 would be regarded as the closest prior art.

(i.3.1) Starting from D1 the technical problem could be split into two partial problems, i.e. improving the strength and the capacitance of the laminates of D1. The first partial problem would be solved in an obvious manner by following the teaching of D4' or D6 by



expanding the filled extruded PTFE before calendering it. Concerning the solution of the capacitance problem, the same conclusions as mentioned hereinbefore in view of D2' would apply.

(i.3.2) Starting from D5, the technical problem would be to transform the laminates of D5 into high capacitance laminates while maintaining their MTS. It would have been obvious for the person skilled in the art to increase the titanium oxide content of the laminates of D5 and to subject them to a compression step as taught in D4' in order to reduce their porosity and thickness.

(ii) Concerning the method claims:

(ii.1) D1 read in combination with D2' already disclosed the steps (a), (b), (c), (d), (f) of the claimed process according to the patent in suit. The residual difference was the expansion step.

(ii.2) It was known from D1 to produce laminates with thin, highly filled films of PTFE without pinholes, wherein a high capacitance could be achieved by appropriate selection of the filler in view of D2' referred to in D1.

(ii.3) The residual problem of further increasing the MTS of the film was to be solved in an obvious manner by combining the teaching of D1 either with D4' or D6, which both taught to expand a filled PTFE in order to increase its MTS.

- (ii.4) The Affidavit of Mr. William P. Mortimer Jr. filed on January 2000 by the Patentee should be disregarded as not relevant since it merely referred to the production of films as claimed in EP-B-0 463 106 and not to laminates.

VI. The arguments submitted by the Respondent in its letter dated 20 January 2000 could be summarized as follows:

- (i) The photograph (C) annexed to the Affidavit of Mr. William P. Mortimer Jr. submitted with letter of 20 January 2000 clearly showed the presence of nodes interconnected by fibrils in the PTFE film used in the manufacture of the laminate according to the patent in suit, this structure indicating that expanded PTFE had been used for the film. The photograph (D) which referred to prior art (i.e. D1) finished film of unexpanded PTFE, showed a non-fibrillar structure and the presence of pinholes. Thus, any attempt to reduce the thickness of the film disclosed in D1 below 1.5 mil with similar filler loading resulted in a film which contained pinholes.

- (ii) D1 did not disclose the following features of the claimed laminates:

- (ii.1) the filled PTFE was not expanded PTFE;
- (ii.2) the filler used did not have a high dielectric constant;
- (ii.3) there was no reference to the matrix tensile strength; and

- (ii.4) there was no reference to capacitance.
  
- (iii) In only one Example did D4 make reference to the use of a filler (asbestos). This kind of filler was known to result in the formation of pinholes. Thus, the skilled person, seeking to produce films free of pinholes, would not combine the teachings of D1 and D4.
  
- (iv) The prior art product RO 2800 had been produced according to D1. Thus, the combination with D4 would not render the claimed subject-matter obvious.
  
- (v) The aim of D4' was to produce a porous article, which would be unsuitable in the laminate of the patent in suit. Even if it would be accepted, that D4' implied that other fillers than asbestos could be used, there was no suggestion in D4' of the other necessary parameters of the product according to Claim 1 of the patent in suit such as quantity of filler, matrix tensile strength and capacitance.
  
- (vi) There was only one sentence in D6 which referred to the use of a filler, but there was no suggestion as to the thinness of filled films, the amount and size of filler and the influence thereof on the presence of pinholes.
  
- (vii) Starting from D5 the skilled person would not be aware of how much he should increase the amount of titanium dioxide and how he should do so without producing tears and pinholes in the

finished products. The combination of D5 with both D1 and D4 made by the Appellant was based on an ex post facto analysis.

(viii) The claimed products being inventive, the subject matter of the method claims would similarly not be obvious.

VII. With letter dated 18 May 2001, the Respondent submitted a set of 7 claims as new main request. With a fax dated 25 May 2001, the Respondent requested a further amendment of Claim 1 then on file so that Claim 1 of the main request of the Respondent read as follows:

"A laminate comprising a film (1) of filled expanded polytetrafluoroethylene and a layer (2) of electrically conductive metal attached to at least one side thereof characterised in that the film (1) contains 25-85 volume percent particulate filler having a high dielectric constant; the film (1) has a thickness of between 0.0025 and 0.127 mm (0.0001 and 0.005 inches); the film (1) is densified to form a film which is substantially free of visual pinholes and has a structure comprising nodes interconnected by fibrils; the film (1) has a matrix tensile strength of at least 183 kg/cm<sup>2</sup> (2600 psi); said laminate having a capacitance of greater than 100.75 picofarads/cm<sup>2</sup> (650 picofarads per square inch)."

Dependent claims 2 to 4 and independent Claim 5 respectively corresponded to Claims 2, 3, 5 and 7 as granted. Independent method Claim 6 differed from method Claim 8 as granted only in that the expression "having a structure comprising nodes interconnected by fibrils and" had been incorporated between the term

"polytetrafluoroethylene" and "having said filler distributed therein" in step (e) of the claimed method.

Dependent method Claim 7 corresponded to Claim 9 as granted.

- VIII. With a fax dated 25 May 2001, the Appellant indicated that it had no objection to the grant of a patent on the basis of the main request of the Respondent (i.e. Claim 1 as submitted on 25 May 2001 and Claims 2 to 7 as submitted on 18 May 2001) and that it would not attend the oral proceedings scheduled for 30 May 2001.
- IX. At the oral proceedings held on 30 May 2001, which were not attended by the Appellant, the Respondent submitted a set of 7 claims as new main request and made the request submitted with letter of 18 May 2001 its first auxiliary request.

Claim 1 of the main request reads as follows:

"A laminate comprising a film (1) of filled expanded polytetrafluoroethylene having a structure comprising nodes interconnected by fibrils; and a layer (2) of electrically conductive metal attached to at least one side thereof characterised in that the film (1) contains 25-85 volume percent particulate filler having a high dielectric constant; the film (1) has a thickness of between 0.0025 and 0.127 mm (0.0001 and 0.005 inches); the film (1) is densified to form a film which is substantially free of visual pinholes and has a structure comprising nodes interconnected by fibrils; the film (1) has a matrix tensile strength of at least 183 kg/cm<sup>2</sup> (2600 psi); said laminate having a capacitance of greater than 100.75 picofarads/cm<sup>2</sup> (650

picofarads per square inch)."

Dependent claims 2 to 4 and independent Claim 5 respectively corresponded to Claims 2, 3, 5 and 7 as granted.

Independent method Claim 6 reads as follows:

"A method of forming a laminate having a capacitance of greater than 100.75 picofarads/cm<sup>2</sup> (650 picofarads per square inch) comprising a film (1) of filled expanded polytetrafluoroethylene and having a matrix tensile strength of at least 183 kg/cm<sup>2</sup> (2600 psi) and a film (2) of electrically conductive metal, characterised in that the method comprises the steps of:

(a) mixing 25-85 volume percent particulate filler with polytetrafluoroethylene in aqueous dispersion.

(b) co-coagulating the filler and polytetrafluoroethylene;

(c) lubricating the filled polytetrafluoroethylene with lubricant and paste extruding the lubricated material to form a film;

(d) calendaring the lubricated film;

(e) expanding said film by stretching it to form a porous polytetrafluoroethylene having a structure comprising nodes interconnected by fibrils and having said filler distributed therein;

(f) densifying the stretched material by compressing it until the film has a thickness of between 0.0025 to 0.127 mm (0.0001 and 0.005 inches) and is substantially free of visual pinholes;

(g) laminating a layer of electrically conductive metal to the film before or after said densification."

Dependent method Claim 7 corresponds to Claim 9 as

granted.

Concerning the patentability of this main request the Respondent essentially referred to the arguments presented in its letter dated 20 January 2000.

The Respondent requested that the decision be set aside and the patent be maintained on the basis of Claims 1 to 7 submitted during the oral proceedings or auxiliarily on the basis of Claims 1 to 7 submitted by letter of 18 May 2001.

### **Reasons for the Decision**

1. The appeal is admissible.
2. *Procedural Matters*
  - 2.1 As mentioned above, the Appellant indicated in his fax dated 25 May 2001 that he would not be represented at the oral proceedings. In accordance with Rule 71(2) EPC, the proceedings therefore continued without the Appellant.
  - 2.2 The second point concerns the late filed documents i.e. D4' and D6 both submitted with the Statement of Grounds of Appeal by the Appellant, the Affidavit of Mr. William P. Mortimer Jr. and photographs (A), (B),

(C) and (D) annexed thereto submitted with letter of 20 January 2000 of the Respondent, and the Affidavits of Dr. Allen F. Horn III and of Mr. John Brookes both submitted with letter of 30 April 2001 of the Appellant.

- 2.3 Although the Board was of the preliminary opinion that only the Affidavit of Mr. Mortimer and the photographs (A), (B), (C) and (D) annexed thereto, and the Affidavits of Dr. Horn and Mr. Brookes might be sufficiently relevant to be admitted in the procedure, this point turned out not to be decisive for the outcome of the appeal for the following reasons.
- 2.3.1 The Respondent had submitted the Affidavit of Mr. P. Mortimer and photographs (A), (B), (C) and (D) annexed thereof, in order to show that the expansion step led to a structure comprising nodes interconnected by fibrils in the densified film.
- 2.3.2 Since this feature has been incorporated in Claim 1 of the main request submitted during the oral proceedings, and since the presence of this structure in the densified product is no longer contested by the Appellant (cf. fax dated 25 May 2001 of the Appellant), there was no need to discuss this Affidavit and the photographs nor, consequently, the Affidavits of Dr. Horn and Mr. Brookes both filed by the Appellant in reaction to the Affidavit of Mr. Mortimer.
- 2.3.3 Consequently, none of the late-filed documents was admitted to the proceedings (Article 114(2) EPC).



*Main Request*

3. *Admissibility of amendments*

3.1 The Opposition Division has stated that the set of Claims 1 to 7 of the main request on which its decision was based met the requirements of Article 123(2) and (3) EPC and the Board sees no reasons to depart from that view.

3.2 Claim 1 differs from Claim 1 of this set of claims by (a) the insertion of the expression "having a structure comprising nodes interconnected by fibrils" between "expanded polytetrafluoroethylene" and "and a layer (2)" and (b) by the incorporation of the expression "has a structure comprising nodes interconnected by fibrils" between "substantially free of visual pinholes;" and "the film (1) has a matrix tensile strength of at least 183 kg/cm<sup>2</sup> (2600 psi)".

3.3 Support for the amendment (a) is to be found on page 4, lines 7 to 9 of the application as originally filed. Amendment (a) meets therefore the requirements of Article 123(2) EPC.

3.4 There is, however, no explicit support in the application as originally filed for the amendment (b) since it is not explicitly stated in the patent in suit itself that the structure of nodes interconnected by fibrils which results from the expansion step is retained after the densification step.

- 3.5 Thus, the question to be considered is whether the overall change in the patent originating from this amendment is directly and unambiguously derivable from the information presented by the content of the application as originally filed, when account is taken of matter which is implicit to a person skilled in the art in what has been expressly mentioned.
- 3.6 The passage on page 4, lines 7 to 9 of the application as originally filed refers to the US-A-3 953 566 (i.e. D4) for the preparation of the expanded PTFE. In view of this document and as pointed out by the Respondent during the oral proceedings, it is evident that it is the specific structure comprising nodes interconnected by fibrils, which is responsible for the high strength of the PTFE products both in porous (expanded) and dense (expanded and densified) forms (cf. D4 column 1, lines 25 to 31; column 2, line 52 to column 3, line 3; column 21, lines 30 to 48). Since the aim of the application as originally filed (cf. page 2, lines 27 to 28) was the use of materials having high tensile strength, this being reflected in Claim 1 as originally filed by the indication of the matrix tensile strength of the PTFE film contained in the claimed laminate, and since, as evidenced in D4, this property is unequivocally related to the presence of the specific structure comprising nodes interconnected by fibrils in the PTFE product, the amendment (b) is directly and unambiguously derivable from the information contained in the application as originally filed, and does not contravene Article 123(2) EPC.
- 3.7 No objection under Article 123(2) EPC arises against dependent Claims 2 to 4 and independent Claim 5 which respectively correspond to dependent Claims 2 to 4 and

- independent Claim 5 of the set of claims on which the decision under appeal was based (cf. paragraph 3.1 above).
- 3.8 Method Claim 6 differs from method Claim 6 of the set of claims on which the decision under appeal was based, by the incorporation of the feature "having a structure comprising nodes interconnected by fibrils and" between the expressions "porous polytetrafluoroethylene" and "having said filler distributed therein" in step (e) of the claimed method.
- 3.9 This amendment is supported by the application documents as originally filed (cf. page 4, lines 7 to 9) and is therefore allowable under Article 123(2) EPC.
- 3.10 No objection under Article 123(2) EPC arises in respect of dependent Claim 7, which corresponds to dependent Claim 7 of the set of claims on which the decision under appeal was based.
- 3.11 The amendments carried out in independent Claims 1 and 6, which merely specify the structure of the polytetrafluoroethylene, do not extend the scope of protection, so that Article 123(3) EPC is also complied with.
- 3.12 The amendments to the claims do not introduce any unclarities. Accordingly, the requirements of Article 84 EPC are complied with.
4. *State of the art*
- 4.1 The documents considered in the opposition procedure can be summarized as follows.

4.1.1 D1 discloses an electrical substrate material comprising fluoropolymeric material and a ceramic filler having a low dielectric constant, low loss and low coefficient of thermal expansion, the ceramic filler being in an amount of at least 55 weight percent of the total substrate material, and the ceramic filler being coated with a silane coating. At least one layer of conductive material may be disposed on at least a portion of the electrical substrate material (cf. D1, Claims 1, 12). Table 4 of D1 discloses PTFE films having a thickness of 0.038 mm (0.0015 inch) and comprising 62 % of a ceramic filler. This table shows that only the sample comprising a ceramic filler from which all particles equal or greater than 30  $\mu\text{m}$  have been removed, and containing no glass fiber is free of pinholes. The process for making these electrical substrate materials is essentially the same as the manufacturing process disclosed in D2' (cf. D1, page 4, lines 55 to 59).

4.1.2 D2 relates to microwave circuit boards comprising a sheet of dielectric material having conductive foil clad to one and usually both sides of the sheet. In the process for making the dielectric material, a dielectric filler (e.g. titania) is added to an aqueous polymer dispersion. The dielectric filler preferably comprises from 10 to 65% by weight of the dielectric material and PTFE is one the preferred polymers used. Microfibers are then added to the polymer and filler slurry. Once the slurry is mixed in any conventional manner to a point where the polymer, the filler and the fibers are intimately mixed, the materials are agglomerated to provide a dough-like product. The water is removed and a lubricant is mixed with the dried dough. The obtained material is formed by conventional

methods such as paste extrusion and/or calendering into the desired shape (e.g. sheet). Subsequent to the formation of the dielectric material, conductive plates are adhered to the dielectric material. The formed sheets and the conductive plates are laminated to cause densification of the sheets and adhesion of the sheets to each other and to the conductive plates (cf. D2, page 3, line 23 to page 4, line 37; page 5, lines 24 to 38; page 6, line 37 to page 8, line 13). In particular, Example 3 of D2 discloses laminates including two 34  $\mu\text{m}$  thick copper foils and having a total thickness between 0.68 and 0.75 mm. These laminates have a dielectric constant between 9.00 and 10.88 (i.e. a high capacitance) and comprise a film of PTFE filled with 63 to 65% by weight of titanium dioxide and 3.4 % by weight of fibers.

- 4.1.3 D3 deals with printed circuit boards comprising at least one layer of metal firmly bonded in laminar contact with at least one layer of solid, sintered PTFE. This layer may contain a filler such as titanium dioxide or aluminum oxide. In one Example (cf. D3, page 8, lines 1 to 7; Figure 3) D3 discloses a printed circuit board in which the solid PTFE layer comprises 15% by weight of titanium dioxide.
- 4.1.4 D4 relates to a process for the production of porous products of tetrafluoroethylene polymers, which process comprises expanding a shaped article consisting essentially of highly crystalline PTFE made by paste forming extrusion technique, after removal of lubricant by stretching the unsintered shaped article at a rate exceeding about 10% per second and maintaining the shaped article at a temperature between about 35°C and the crystalline melting point of the

tetrafluoroethylenepolymer during the stretching. The porous articles obtained exhibit a specific structure consisting of nodes interconnected by fibrils and due to this specific structure possess high strength. In its Example 4, D4 discloses the manufacture of an expanded filled film by expanding in the longitudinal direction a calendered film having a thickness of 0.203 mm (0.008 inch) and comprising asbestos powder in proportion of four parts by weight resin to one part asbestos. D4 also teaches that it is possible to produce high strength and high density products by compressing the expanded material (cf D4. Claim 1; column 1, lines 21 to 41; column 2, line 50 to column 3, line 8; Example 4; Example 16).

4.1.5 D5 discloses printed circuit boards comprising a layer of expanded porous PTFE firmly bonded to and in laminar contact with at least one layer of electrically conducting materials. The layer of porous expanded PTFE may comprise a filler such as titanium dioxide or aluminium oxide in an amount of 10 % by weight (cf. D5, Claims 1, 6, 7; page 8, lines 2 to 9).

4.2 There is no need further to deal with the products RO 2800, RO 2810 and RT Duroid 6010 since it has not been contested that these products have respectively been obtained according to D1 (cf. D1, page 13, lines 2 to 3; and E1') and to D2' (cf. E.13).

## 5. *Novelty*

The subject-matter of Claims 1 to 7 of the set of Claims on which the decision under appeal was held to be novel by the Opposition Division. This was not contested by the Appellant.

In the light of the cited documents, the Board also takes the same view for the subject-matter of Claims 1 to 7 of the main request, the subject-matter of which has been further limited compared with that of the request on which the decision under appeal was based.

6. *Closest prior art, technical problem and its solution*

6.1 The patent in suit concerns high capacitance laminates made from thin film of PTFE in which the films are plated or clad with copper or conductive foils and sheets.

6.2 Such products are known from D2 (D2'), in particular Example 3 thereof (cf. paragraph 4.1.2 above). This Example qualifies, in the Board's view, as the closest prior art.

6.3 As indicated in the introduction of the patent in suit for many digital printed circuit applications, thinner high dielectric laminates would be desirable but very thin PTFE films with high dielectric constant are difficult to obtain since surface discontinuities in the films such as pinholes, causing electrical problems (i.e. impairment of the dielectric properties of the films), occur during the calendaring of the films.

6.4 Thus, starting from Example 3 of D2, the technical problem underlying the patent in suit may be seen in the provision of laminates having a high capacitance and comprising a very thin film of filled polytetrafluoroethylene being free of surface discontinuities such as pinholes and having a high strength.

- 6.5 The solution proposed in the patent in suit is to expand the highly filled PTFE film to give it a specific structure comprising nodes interconnected by fibrils, this resulting in a high MTS.
- 6.6 The effectiveness of the proposed solution, as illustrated, for instance, in Example 1 of the patent in suit, which shows the manufacture of a laminate containing a very thin film of filled PTFE (0.0635 mm) having a matrix tensile strength of 246 kg/cm<sup>2</sup>, and having a high capacitance, has not been put in question by the Appellant, and the Board sees no reason to take a different view.
7. *Inventive step*
- 7.1 It remains to be decided whether this solution was obvious to a person skilled in the art having regard to the cited prior art.
- 7.2 An essential feature of the claimed laminates is the requirement that the filled PTFE film has been expanded prior to being densified and that it therefore exhibits a structure comprising nodes interconnected by fibrils.
- 7.3 D2 neither mentions the use of expanded PTFE nor refers to very thin highly filled PTFE films and cannot itself suggest the solution of the technical problem.
- 7.4 D5 relates to laminates comprising an expanded porous PTFE film which may merely comprise 10 % by weight of titanium dioxide or aluminum oxide. D5 is totally silent on the use of larger amounts of fillers and on the specific purpose of the expansion step. There is no hint that this step would allow the manufacture of very



thin, more highly filled (i.e. 25 to 85 % in volume) PTFE films free of pinholes leading to laminates of high capacitance. Consequently, there is no guidance to the solution of the technical problem in the disclosure of D5.

7.5 D4 relates to the manufacture of expanded articles of PTFE. These articles may contain fillers and may be densified. Nevertheless, there is no hint in D4 to use an expansion step in order to provide a thin and highly filled PTFE film free of pinholes. Furthermore, it could not have been foreseen that this step would not deteriorate the surface of a highly filled PTFE film, since the expansion would inevitably modify the filler distribution in the film. Thus, D4 does not provide any assistance in the solution of technical problem.

7.6 D1 refers to laminates having a low capacitance and, at least for this reason, the person skilled in the art would not search a solution of the technical problem of providing high capacitance laminates comprising very thin films of PTFE in this document. Furthermore, D1 makes no mention of expanded PTFE, let alone of a structure comprising nodes interconnected by fibrils. Indeed, D1 solves the problem of the absence of pinholes (cf. table 4 of D1) by the use of a filler having a specific particle size distribution (no particles equal or greater than 30  $\mu\text{m}$ ) and will therefore lead away from the solution proposed in the patent in suit.

7.7 D3 does not add anything to the information disclosed in D2, since it merely refers to laminates comprising a solid (i.e. non expanded) layer of PTFE which may comprise only up to 15% by weight of titanium dioxide

or aluminum oxide.

7.8 It follows that the solution of the technical problem does not arise in an obvious way from the cited state of the art. Consequently, the subject-matter of Claim 1 involves an inventive step.

7.9 Dependent Claims 2 to 4, which relate to preferred embodiments of the laminate of Claim 1 are supported by the patentability of the main claim and are thus also allowable.

The same considerations apply for independent Claim 5 which relate to a printed circuit board comprising at least one layer of the laminate according to Claim 1 and for Claims 6 and 7 which refer to methods for making a laminate within the ambit of Claim 1.

7.10 Since the main request is allowable, there is no need to consider the auxiliary request.

## **Order**

### **For these reasons it is decided that:**

1. The decision under appeal is set aside.
2. The case is remitted to the Opposition Division with the order to maintain the patent on the basis of Claims 1 to 7 forming the main request submitted during the oral proceedings and after any necessary consequential amendment of the description.

The Registrar:

The Chairman:

E. Görgmaier

R. Young